Appendix V6-1A

Back River Project: 2011 Hydrology Baseline Report

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Sabina Gold & Silver Corp.

BACK RIVER PROJECT
2011 Hydrology Baseline Report







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BACK RIVER PROJECT
2011 HYDROLOGY BASELINE REPORT

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Executive Summary

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Executive Summary

The Back River Project lies in the southwestern portion of the Ellice River Watershed, in the West Kitikmeot region of Nunavut and is situated within the continuous permafrost zone of the continental Canadian Arctic.

The Back River Project consists of several property areas, and baseline work in 2011 focused on the Goose property area. This report presents the results of the 2011 hydrology baseline program conducted within the Goose property area.

A network of nine hydrometric monitoring stations was operated in 2011. The network monitored the runoff from a total watershed area of 209.8 km^2. Two existing stations were remobilized and seven new stations established in early-June of 2011. The monitoring stations were mostly established at locations within the Goose property area within watersheds containing known deposits. One monitoring station situated outside of the Project area and watershed boundary was established as a reference location.

The hydrometric network was operated through the open water season from June 10, 2011 to September 17, 2011. During this period, continuous time series stage data were collected at each station and a total of 41 manual discharge measurements were completed. Based on the stage and discharge data collected, stage-discharge rating equations were determined and annual hydrographs generated.

The annual hydrographs clearly show that the Project lies in an Arctic-nival flow regime with snowmelt driven peak flows and no flow during the winter. Generally, peak flows were observed during freshet in early to mid-June followed by a second rainfall induced peak in early July. The early timing of the rainfall, occurring before the freshet had receded to summer low flows led to hydrographs with bimodal peaks. Peak flows in the region typically occur during the spring freshet and are driven by snowmelt. In 2011, rainfall events that occurred in July, halfway throughout the spring freshet, generated secondary peaks in the hydrographs. After the July storms, discharge decreased through the summer reaching a minimum in mid-August. Late summer rainfall in the region lead to increased flow through the beginning of September for the Project area.

Peak flows varied substantially among gauged streams. Instantaneous peak flows ranged from 0.10 m^3/s at the EL-H1 hydrometric station, which monitors a drainage area of 1.4 km^2, to 8.44 m^3/s at the PL-H1 station, which monitors the entire Propellor Lake drainage area of 204.4 km^2.

Volumetric outflows from each of the monitored drainages were generally found to be a function of drainage area. The minimum volumetric outflows were observed at EL-H1 (Echo Drainage outflow; drainage area = 1.4 km^2) which had a total annual water output of 0.11 million cubic meters. The maximum annual volumetric output was 25.31 million cubic meters at PL-H1 (Propellor Drainage outflow; drainage area = 204.4 km^2).

Average annual runoff from all gauged drainages in the monitored area was 170 mm. Approximately 75% of the annual runoff occurred in June and July and as little as 3% in August. All monitored streams can be classified as either intermittent or ephemeral. The majority are intermittent with zero flow in the winter due to ice conditions. Three of the smaller streams were found to be ephemeral, only carrying water immediately after snowmelt or rainfall events. It was determined that on average the monitored streams flowed for 30% of the year while for the remaining 70% they were either frozen or dried up.

Acknowledgements

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Acknowledgements

This Report was prepared by Rescan Environmental Services Ltd. (Rescan) for Sabina Gold and Silver Corporation. Field data collection was conducted by Coby Hall (B.Sc.), and Xavier Pinto (M.Sc.). The report was prepared and written by Coby Hall, Xavier Pinto, David Luzi (M.Sc.), and technically reviewed by R.W. (Bob) Askin (M.Sc., MCSCE, P.Geo., P.Eng.). The project was managed by Deborah Muggli (Ph.D., M.Sc., R.P.Bio.).

Rescan staff were assisted in the field by Justin Porter, Robbie Eleehetook and Vernon Harper.

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ADCP	Acoustic Doppler current profiler.
Annual runoff	Annual runoff is a measure of the hydrologic response of a watershed. It is often presented as a depth of water, in mm, over an entire watershed allowing direct comparison with precipitation totals.
Arctic nival	Hydrological regime defined by Church (1974). In this regime snow melt is the major hydrological event producing runoff and continuous permafrost impedes deep infiltration reducing base flow and winter flow.
Baseflow	The groundwater component of flow discharge that is attributed to soil moisture and groundwater drainage into a channel.
Break-up	The melting and dissipation of this ice cover on a water body.
Canadian Shield	A vast geologic area of exposed Precambrian crystalline igneous and high-grade metamorphic rocks that form tectonically stable areas covered by a thin layer of soil. It has a deep, common, joined bedrock region in eastern and central Canada and stretches North from the Great Lakes to the Arctic Ocean, covering over half of Canada.
Drainage Basin	The zone or portion of land that contributes water to the surface water runoff that flows past a given point along a stream channel.
Ephemeral	A stream which flows only during or after rain or snow-melt and has no baseflow component.
Freeze-up	The formation of an ice cover on a water body.
Freshet	In channels, the relatively high annual peak water discharge period resulting from spring/summer meltwater runoff of the snowpack accumulated over the winter.
Hydrograph	A graphical plot of water discharge versus time.
Intermittent	A stream which flows only part of the year.
ISO	International Organization for Standardization
MAD	The mean annual discharge (MAD), computed as an average discharge over the year.
NAD 83	North American Datum 1983. A datum is a reference system for computing or correlating the results of a survey. The NAD83 datum is based on the spheroid (GRS80).
Permafrost	Bedrock, organic or earth material that has temperatures below 0°C persisting over at least two consecutive years.
Stage	The depth of water in a water course or channel.

Stage-Discharge Curve	A curve derived from concurrently measured stage and discharge data that is used to estimate the discharge for any given observed stage. Often referred to as a rating curve for a hydrometric station.
Talik	An unfrozen section of ground within a layer of discontinuous permafrost. Taliks can also be found underneath water bodies in a layer of continuous permafrost.
Unit Yield	It is a ratio of water discharges normalized to the drainage area for a basin. This parameter allows for direct comparison of the hydrological response of basins with different size drainage areas.
WSC	Water Survey of Canada.
UTM	Universal Transverse Mercator. A mathematical transformation (map projection) of the earth's surface to create a flat map sheet.

1. Introduction

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1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold & Silver Corporation (Sabina) located in the West Kitikmeot region on Nunavut. The Project consists of several properties, one of which is the Goose property (Figure 1-1). An exploration camp is located beside Goose Lake (Goose Camp), and Sabina conducted a drilling program out of this camp during 2011.

Several exploration targets exist in the Goose property area, including the Llama, Umwelt, Echo and Goose deposits. For 2011, select baseline studies were conducted in the areas that could be influenced by the future development of these deposits. Rescan Environmental Services (Rescan) was contracted by Sabina, to conduct the following baseline studies in 2011:

- Dustfall and Air Quality;
- Surface Hydrology;
- ML/ARD;
- Lake and Pond Bathymetry;
- Freshwater Water Quality, Sediment Quality and Aquatic Biology;
- Freshwater Fish and Fish Habitat;
- Wildlife; and
- Archaeology.

In addition, Sabina continued the on-site meteorology and hydrogeology monitoring programs. Data from these programs will also be included in 2011 baseline reports to be prepared by Rescan.

This report presents the results from the Hydrology Baseline Program that was carried out in 2011. The Hydrology Baseline Program included the collection of site-specific data from streams and rivers in the Goose property area. Monitoring was focussed on drainages that contain known deposits, the farthest downstream river associated with the property and all the main inflows and outflows of Goose Lake which is central to the property. Additionally, a monitoring site was established in a reference drainage located approximately 14 km away from existing deposits.

The objectives of the 2011 study were:

- the continued operation of the two hydrometric monitoring stations established in 2010;
- the expansion of the existing 2010 hydrometric monitoring network with the installation and operation of six additional hydrometric monitoring stations in the Project area and a reference station adjacent to the Project area;
- the development of stage-discharge relationships for each of the monitored drainage basins;
- the calculation of water discharges and production of annual hydrographs for each of the monitored drainage basins; and
- the calculation of hydrologic indices including: annual runoff, seasonal runoff distribution, peak flows, and low flows.

A description of the hydrological setting, overall sampling design, and the methods used for data collection is provided in Chapter 2 of this report. Results of the 2011 monitoring program are provided in Chapter 3. All raw data collected in 2011 are provided as appendices to this report.



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Back River Project Location

Figure 1-1

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2. Hydrological Setting

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2. Hydrological Setting

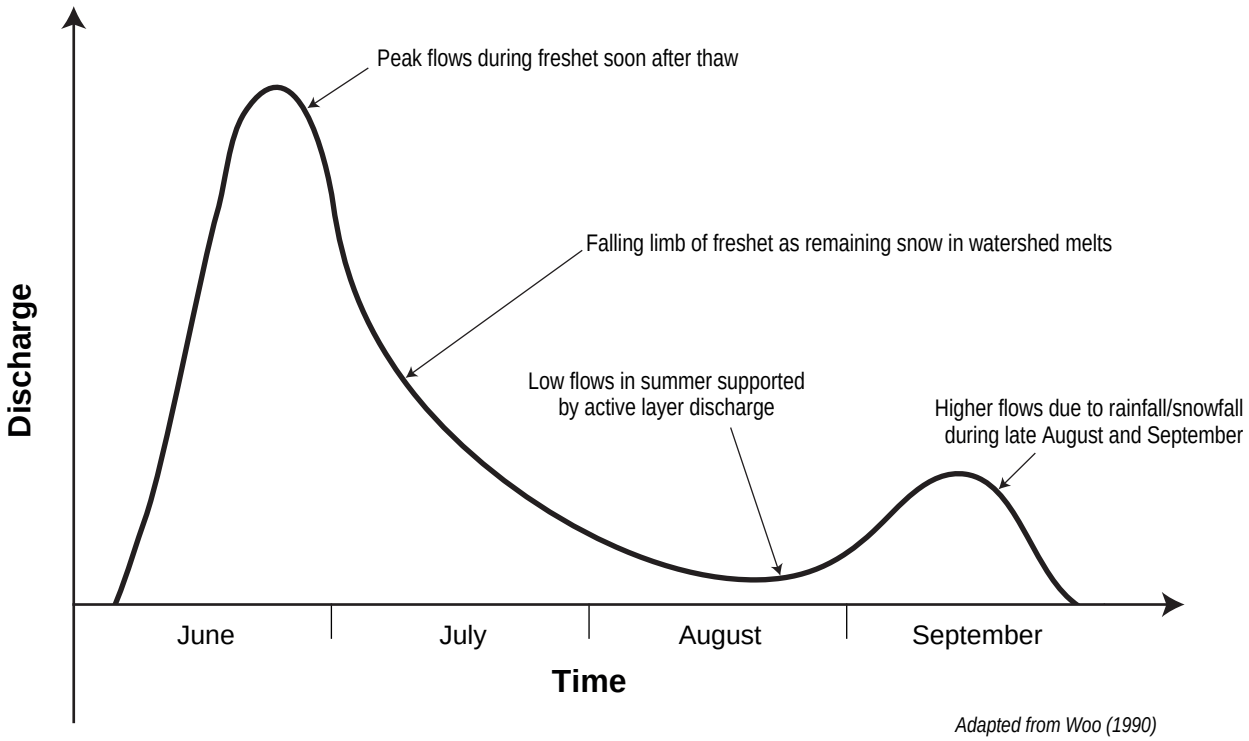
2.1 ARCTIC HYDROLOGY

The Project area lies within the continuous permafrost zone of the continental Canadian Arctic. The presence of permafrost is hydrologically significant as it has a very low hydraulic conductivity and thus acts as a barrier to deep groundwater recharge. This process increases surface runoff and decreases sub-surface flow. Compared to nonpermafrost regions, permafrost watersheds tend to have higher peak flow and lower base flow (Kane 1997). Hydrologic processes in permafrost watersheds are generally dominated by snow accumulation and melt, surface runoff, and runoff routed through lakes. The annual flow hydrograph is defined by the long cold winters and the short summers. Most of the annual runoff occurs during spring freshet and is derived from the melting snow pack. Additionally, summer frontal systems may generate precipitation events that produce moderate runoff late in the season. Following freshet, a low flow period typically develops through July and August. Due to the presence of permafrost, there is limited groundwater support for smaller streams; however, there may be interaction between groundwater systems and larger rivers and/or lakes through taliks or openings in the permafrost. As a result of the permafrost, baseflow in streams is supported only by flow through the shallow upper active layer of the soil and release from storage features including lakes and wetlands. Overall, surface runoff in Arctic basins is largely controlled by snowmelt and the presence of permafrost, which accentuates runoff peaks while reducing base flow conditions (Woo 1990).

The hydrologic year for the region is defined by break-up and freeze-up. According to regional data from the Water Survey of Canada (WSC), break-up typically occurs in early-June and freeze-up in early-October. Water is stored in the snowpack during winter and is released as temperatures increase during the spring freshet. Small to medium sized streams typically freeze dry during the winter, due to the limited storage capacity of the surrounding landscape. Even some large rivers in the continuous permafrost region cease to flow after freeze-up (Woo 1990).

A conceptual hydrograph showing typical annual discharge patterns for small watersheds is shown in Figure 2.1-1. The hydrograph is characterized by a steep rising limb leading to a peak during the freshet period and a second rainfall-generated peak that can be observed in certain years in late August or early to mid-September. Generally, within the continuous permafrost region discharge is dominated by snowmelt floods, referred to as a nival regime. Church (1974) distinguished between a Subarctic and an Arctic Nival regime. The Subarctic regime experiences limited winter low flow sustained by the discharge of intrapermafrost and subpermafrost groundwater, and a spring freshet associated with ice jams. During summer low flow conditions predominate, but large flood peaks can be generated by frontal precipitation systems in zones of discontinuous permafrost. The Arctic Nival regime has one major flood period in the spring, followed by a rapid recession to base flow, with the occasional peak related to rainstorm events. Winter flow is absent because the suprapermafrost groundwater reservoir is too limited to maintain flow.

In very small basins the freshet can be as short as a few days and will often occur immediately after ice break-up in the lakes, if lakes are present in the basin. Stream flow in these basins may cease after freshet and streams remain dry until the late summer rains begin. In contrast to smaller basins, in rivers draining larger watersheds the freshet peak may be delayed after ice break-up. The delay occurs as snowmelt from upper portions of the larger watershed is routed through the system. Smaller basins can also have more dramatic responses to precipitation than larger watersheds. In larger watersheds the presence of lakes creates significant flow attenuation, which may diminish the magnitude of peak flows.



Adapted from Woo (1990)

Note: Approximate scale only

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Theoretical Typical Annual Flow Hydrograph for a Small Arctic Watershed

Figure 2.1-1

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The amount of runoff during summer and fall is controlled by rainfall and evaporation. Open-water evaporation rates in summer often exceed total rainfall such that soil moisture deficits build up in the shallow active layer of the soil. Studies of hillslope processes in northern watersheds (e.g., Quinton and Marsh 1998) have shown that summer rainfall may produce little or no runoff from hillslopes in the permafrost zone. In this case, stream flow increases only due to rain falling directly onto lake surfaces or when there is high intensity or lower intensity/higher duration rainfall.

A number of factors influence the volume of freshet runoff in Arctic watersheds, these factors include:

- *Amount of snowpack available to be melted in spring.* Snowpack depth is dependent on the amount of snowfall during the previous winter and the amount of snow remaining in each watershed in May or June. Snow can be lost or redistributed due to sublimation, melting, or wind;
- *Rate of temperature rise in spring.* This can greatly affect peak flow rates as a rapid increase in temperature after the snowpack is already saturated can produce high melt rates. Differential melt rates on north and south facing slopes can also occur which may affect the size of the area contributing to the melt;
- *Timing of opening of stream channels linking lakes.* Snowmelt from hillslopes surrounding lakes can occur before the stream channels draining the lakes become ice free. In this case, meltwater can be stored in the lake and then released once the channels are open to flow; and
- *Soil moisture conditions and lake levels at the end of the previous summer*. If there was a dry summer during the previous year, lake levels could have been lowered and a soil moisture deficit could have developed within the hillslopes surrounding the lakes. As a result, a portion of the annual runoff will recharge the lakes and soil moisture and not be transmitted from the watershed as stream flow.

2.2 AVAILABLE REGIONAL HYDROLOGIC DATA

Regional data are available from hydrometric stations operated by WSC (Table 2.2-1 and Figure 2.2-1). Data from the five stations with the closest proximity to the Project area were analyzed to provide background information on the regional surface water hydrology.

Table 2.2-1. Regional Water Survey of Canada (WSC) Stations Relevant to the Study Area

Station Name	Station Number	Geographic Location		Drainage Area (km^2)	Period of Record
Back River below Beechy Lake	10RA001	65°11’14”N	106°5’9”W	19,600	1978 - present
Baily River near the mouth	10RA002	65°0’38”N	104°29’26”W	14,500	1978 - present
Burnside River near the mouth	10QC001	66°43’34”N	108°48’47”W	16,800	1976 - present
Gordon River near the mouth	10QC002	66°48’36”N	107°6’4”W	1,530	1977 - 1994
Ellice River near the mouth	10QD001	67°42’30”N	104°8’21”W	16,900	1971 - present

Analysis of historical data revealed the break-up in these rivers has typically occurred in early-June and freeze-up in early-October. Peak flows generally were observed in early to mid-June during freshet and some stations recorded a second substantial peak in late summer or early autumn. The Gordon River and Ellice River hydrometric stations frequently report zero flow throughout the winter.

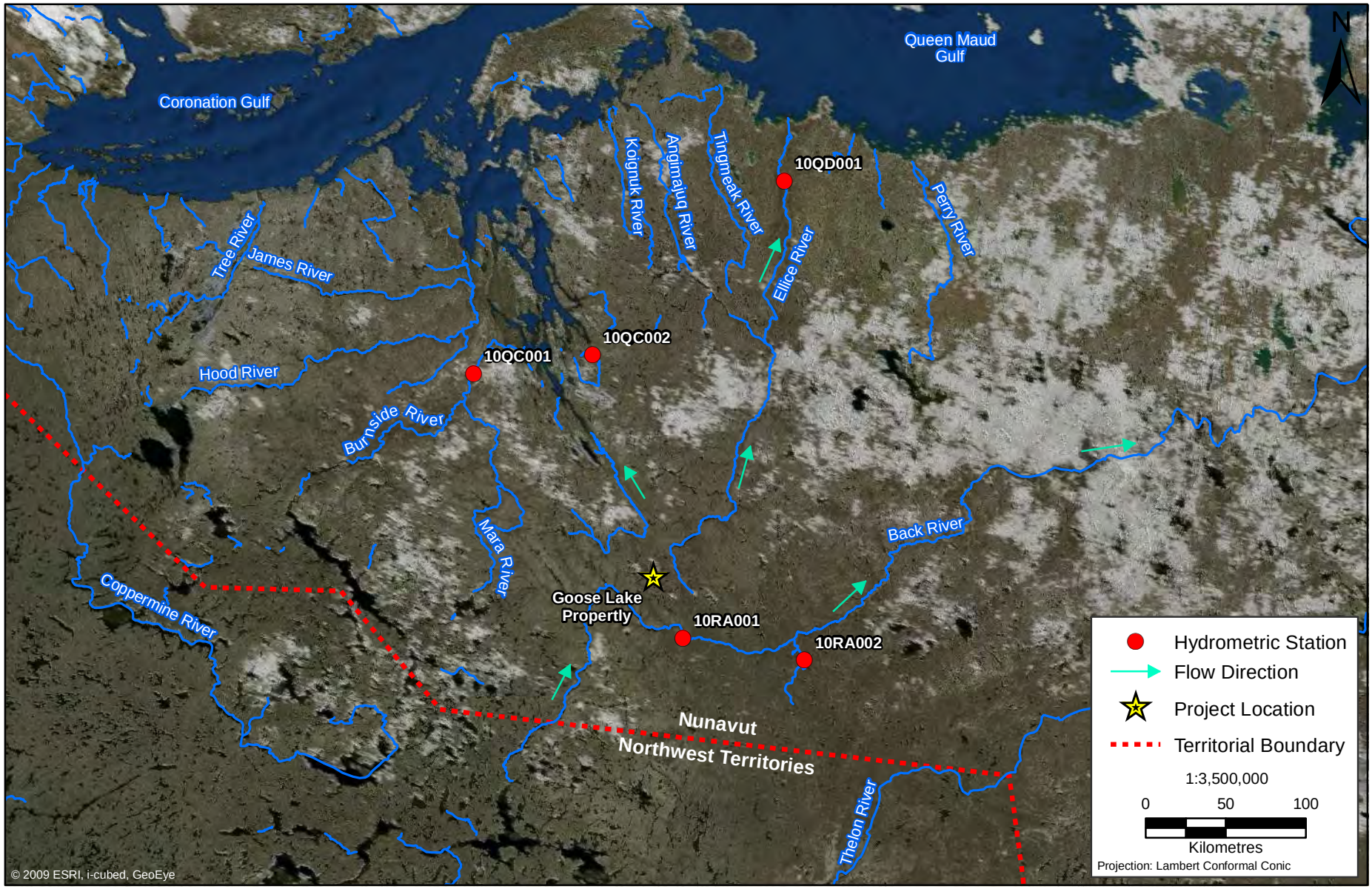


Figure 2.2-1

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Water Survey of Canada (WSC) Hydrometric Stations Relevant to the Study Area

Figure 2.2-1

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2.3 STUDY AREA

The study area is located in the southwestern portion of the Ellice River Watershed (16,900 km^2) near the watershed boundaries of the Back River Watershed and the Western River Watershed (Figure 2.3-1). The Ellice River discharges north to the Arctic Ocean in the Queen Maud Gulf approximately 300 km from the project area.

The 2011 study area comprised a total drainage area of 209.8 km^2. The study was designed monitor a 203.3 km^2 area encompassing the proposed Project development within the Ellice River watershed. An additional reference station was located in a 5.3 km^2 drainage basin within the Back River watershed approximately 14 km to the south of the proposed development (Figure 2.3-2). The basins within the Project area are characterized by extensive networks of lakes, low relief hummocky topography, and exposed bedrock uplands (Plates 2.3-1 and 2.3-2).



Plate 2.3-1. High angle oblique view showing the extensive lake coverage and low relief hummocky topography typical of the Goose property area. This photograph was taken from the Reference drainage basin looking north towards the watershed boundary of the Ellice River and Back River regional watersheds. Photograph taken on August 15, 2011.

The study area has approximately 17% lake coverage, an average slope of 2.4%, and a total relief of 83 m. The gauged streams within the study area range from small ephemeral channels, less than 1 m in width, to larger streams with widths exceeding 50 m. Larger streams are located at the outlets of the larger lakes. Although some large rivers in the region may still have flow during the winter, it is likely that most stream channels around the Project area freeze to their bed and have zero flow during the winter months. Based on available data from WSC, the Ellice River near its mouth typically stops flowing over the winter period.



Plate 2.3-2. Looking north along one of the inflows into Goose Lake which is central to the Goose property. Note the relatively low relief topography, bedrock outcrops and low tundra vegetation typical of the region.



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Figure 2.3-1

Regional Watersheds of the Back River Project

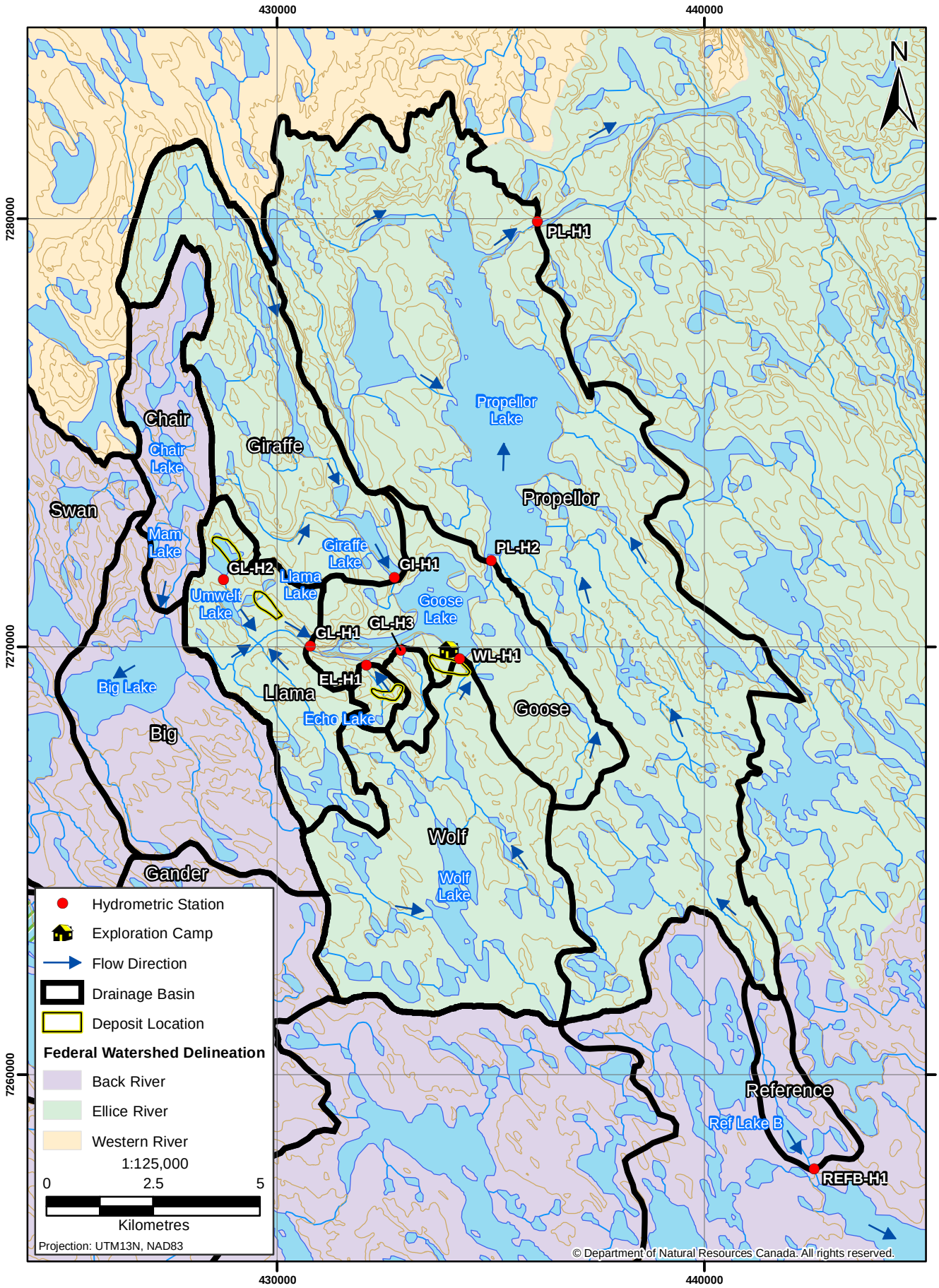


Figure 2.3-2

2011 Study Area Drainage Basins within the Back River Project

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3. Methodology

3. Methodology

3.1 HYDROMETRIC MONITORING NETWORK

A network of hydrometric monitoring stations was established to collect continuous water level data at selected locations within the Project area. The automated stations recorded stream water level data at ten minute intervals during the open water season.

3.1.1 2010 Network

In 2010 a small network of two hydrometric monitoring stations was operated from July 3 to September 13, 2010 (Table 3.1-1).

Table 3.1-1. 2010 Hydrometric Monitoring Stations

Hydro-metric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	Monitoring Type
		Easting	Northing			
GL-H1	Goose Lake inflow	430,772	7,270,016	14.0	July 3 to September 13	stream water level
GL-H2	Llama Lake outflow	428,746	7,271,567	1.7	July 3 to September 13	stream water level

** UTM, Datum NAD 83, Zone 13 W*

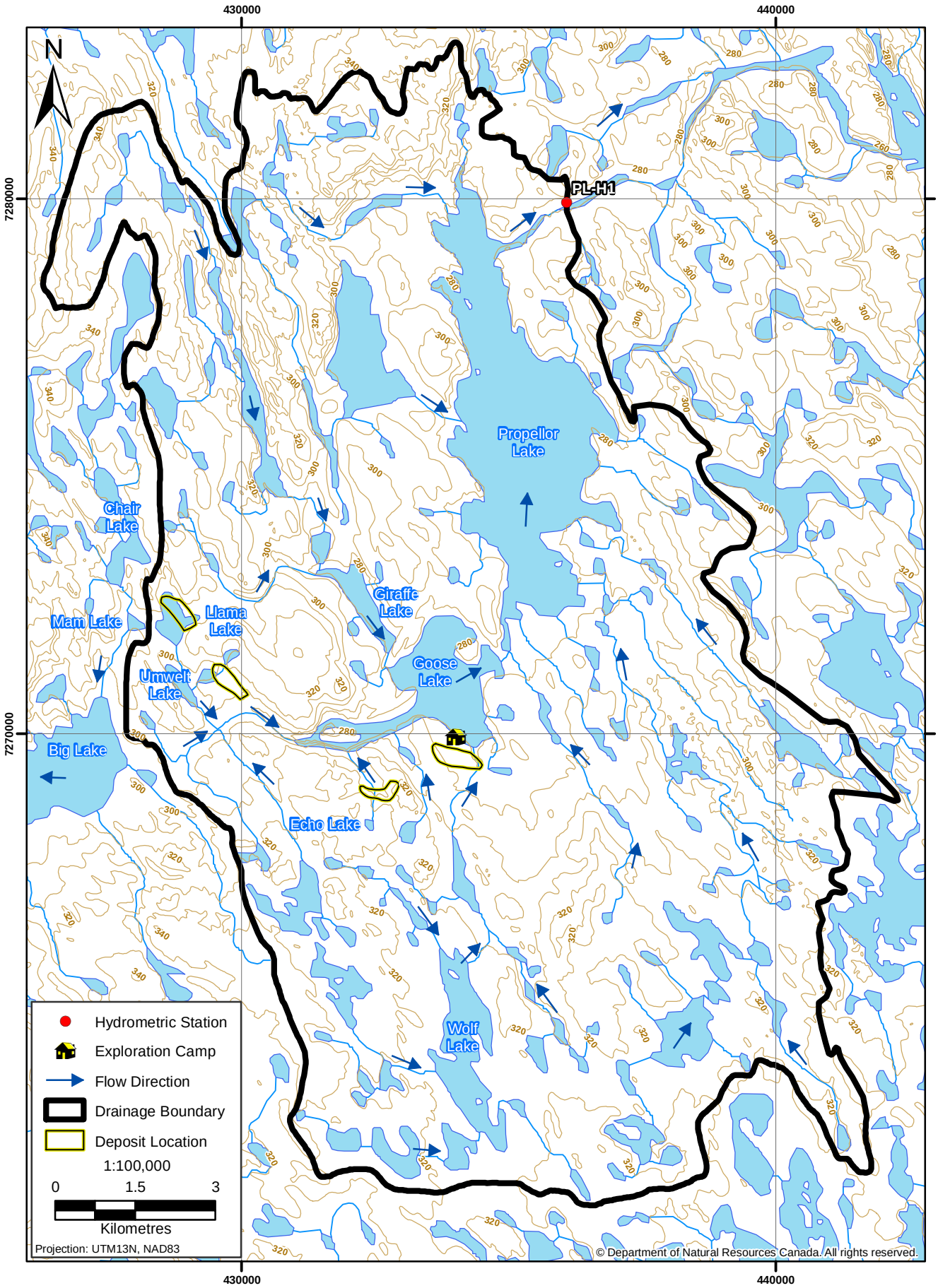
3.1.2 2011 Network

In 2011 a network of nine hydrometric monitoring stations was operated from June 10 to September 17. The 2011 network included the remobilization of the two stations established in 2010, plus the installation of six new stations within the Project area and one reference station south of the Project drainage boundary. The 2011 network focused on monitoring basins and sub-basins around the known deposits in the Project area, and the furthest downstream river associated with the property at Propellor Lake outflow. Location, drainage area and period of operation for each station in the 2011 network are provided in Table 3.1-2 and Figures 3.1-1 through 3.1-6. Station information sheets are provided in Appendix 1.

Table 3.1-2. 2011 Hydrometric Monitoring Stations

Hydro-metric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	Monitoring Type
		Easting	Northing			
GL-H1	Goose Lake inflow	430,772	7,270,016	14.0	June 10 to September 16	stream water level
GL-H2	Llama Lake outflow	428,746	7,271,567	1.7	June 10 to September 16	stream water level
GL-H3	Goose Lake inflow	432,891	7,269,919	1.8	June 14 to September 16	stream water level
PL-H1	Propellor Lake outflow	436,094	7,279,939	204.4	June 14 to September 17	stream water level
PL-H2	Propellor Lake inflow	435,007	7,272,014	101.5	June 11 to September 17	stream water level
GI-H1	Giraffe Lake outflow	432,744	7,271,610	27.4	June 11 to September 16	stream water level
EL-H1	Echo Drainage outflow	432,091	7,269,573	1.4	June 13 to September 16	stream water level
WL-H1	Wolf Drainage outflow	434,269	7,269,719	35.1	June 10 to September 17	stream water level
REFB-H1	Reference B Lake outflow	442,573	7,257,794	5.3	June 13 to September 17	stream water level

** UTM, Datum NAD 83, Zone 13 W.*

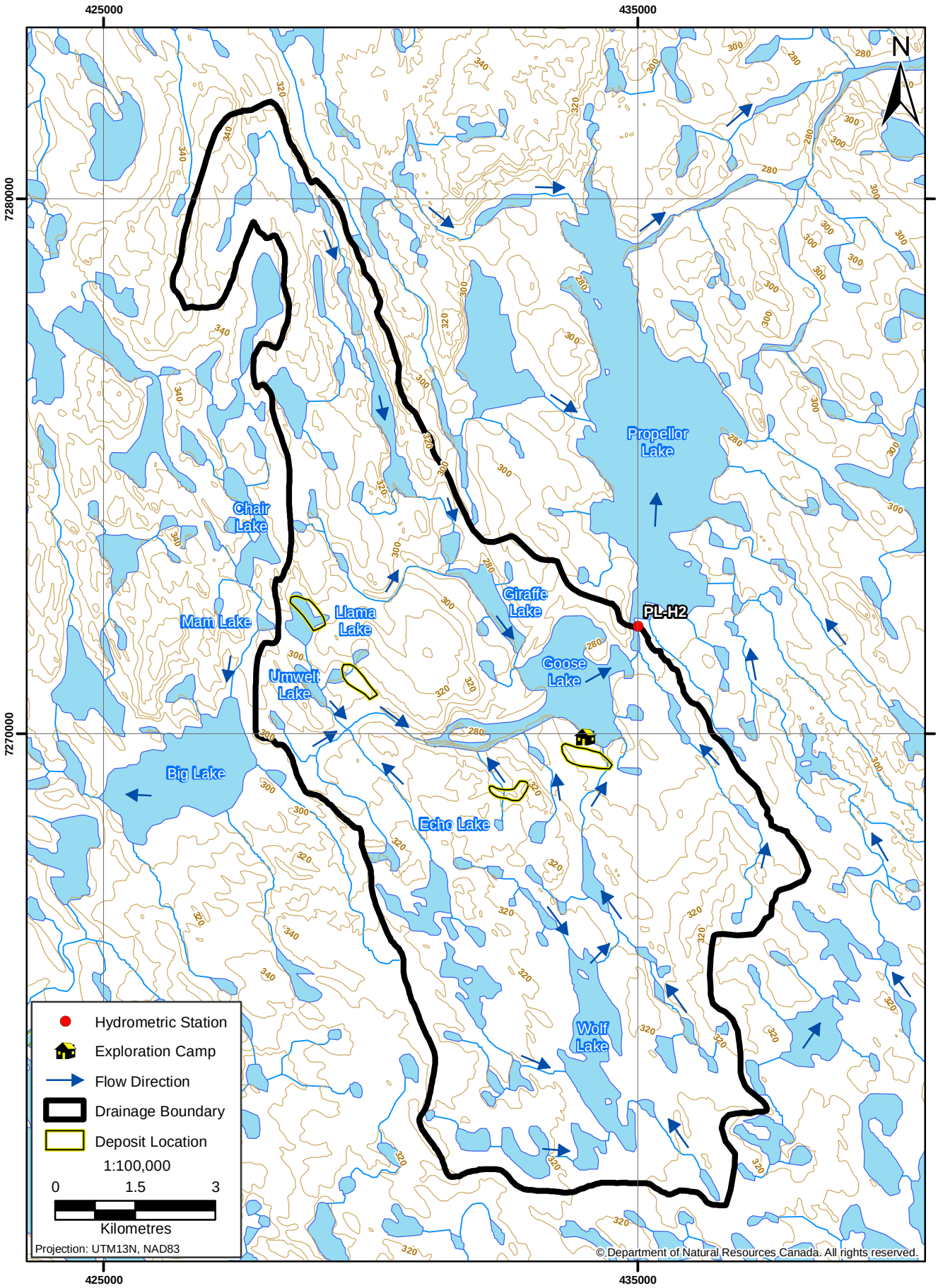


Sabina GOLD & SILVER CORP.

Drainage Boundary for Propellor Lake Hydrometric Monitoring Station PL-H1

Figure 3.1-1

Rescan™ Engineers & Scientists

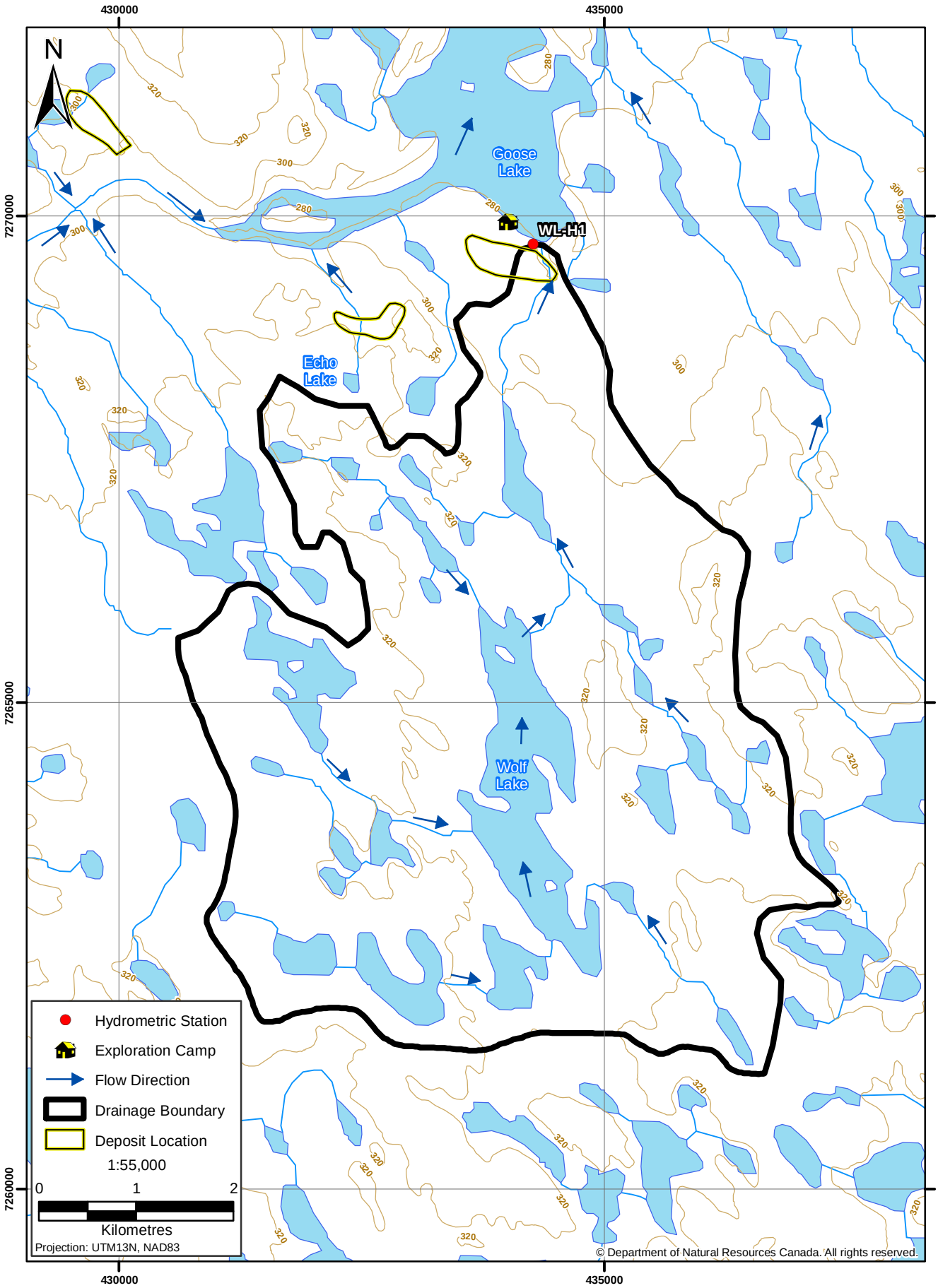


Sabina GOLD & SILVER CORP

Drainage Boundary for Propellor Lake Hydrometric Monitoring Station PL-H2

Figure 3.1-2

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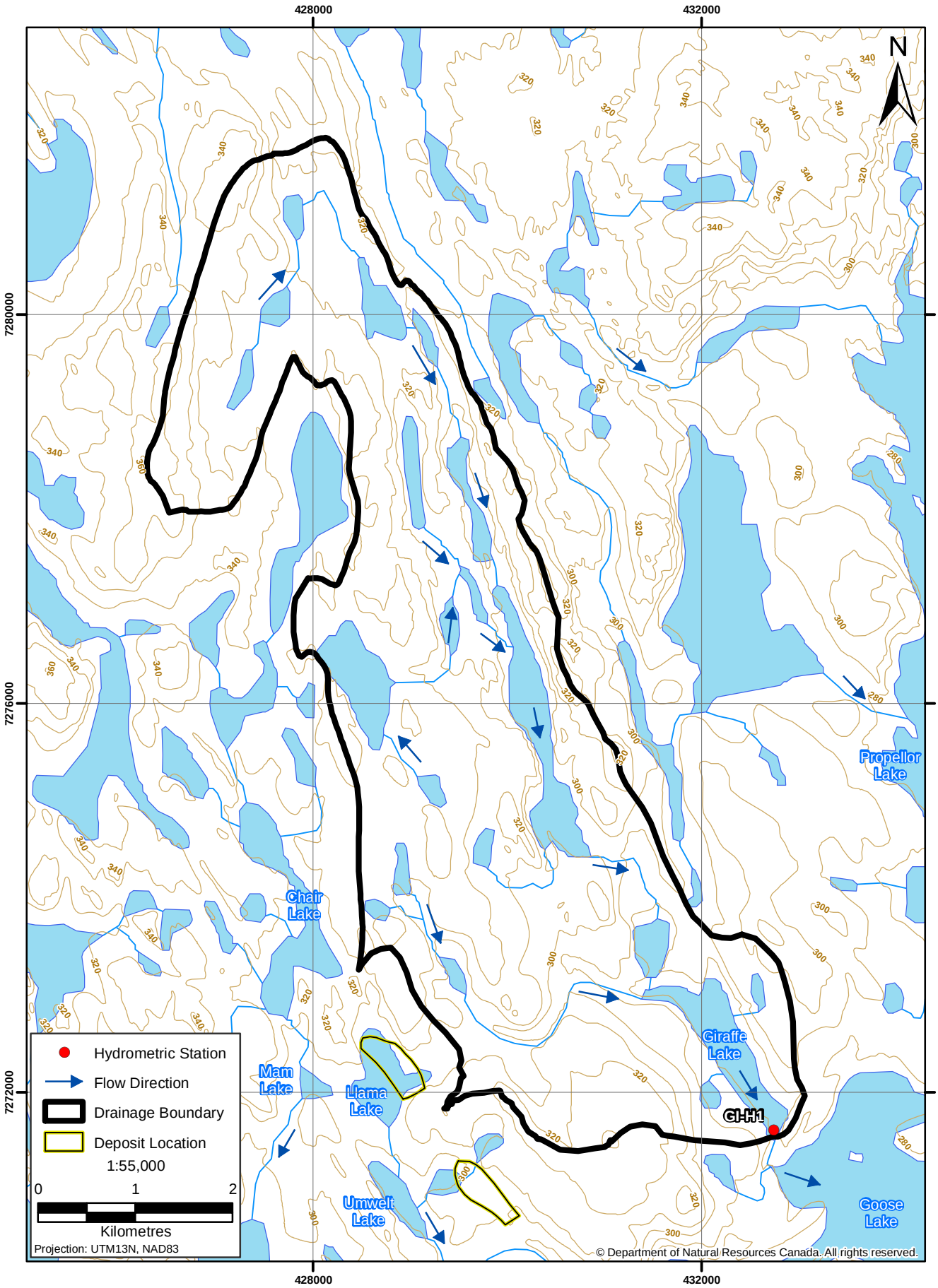


Sabina GOLD & SILVER CORP.

Drainage Boundary for Goose Lake Hydrometric Monitoring Station WL-H1

Figure 3.1-3

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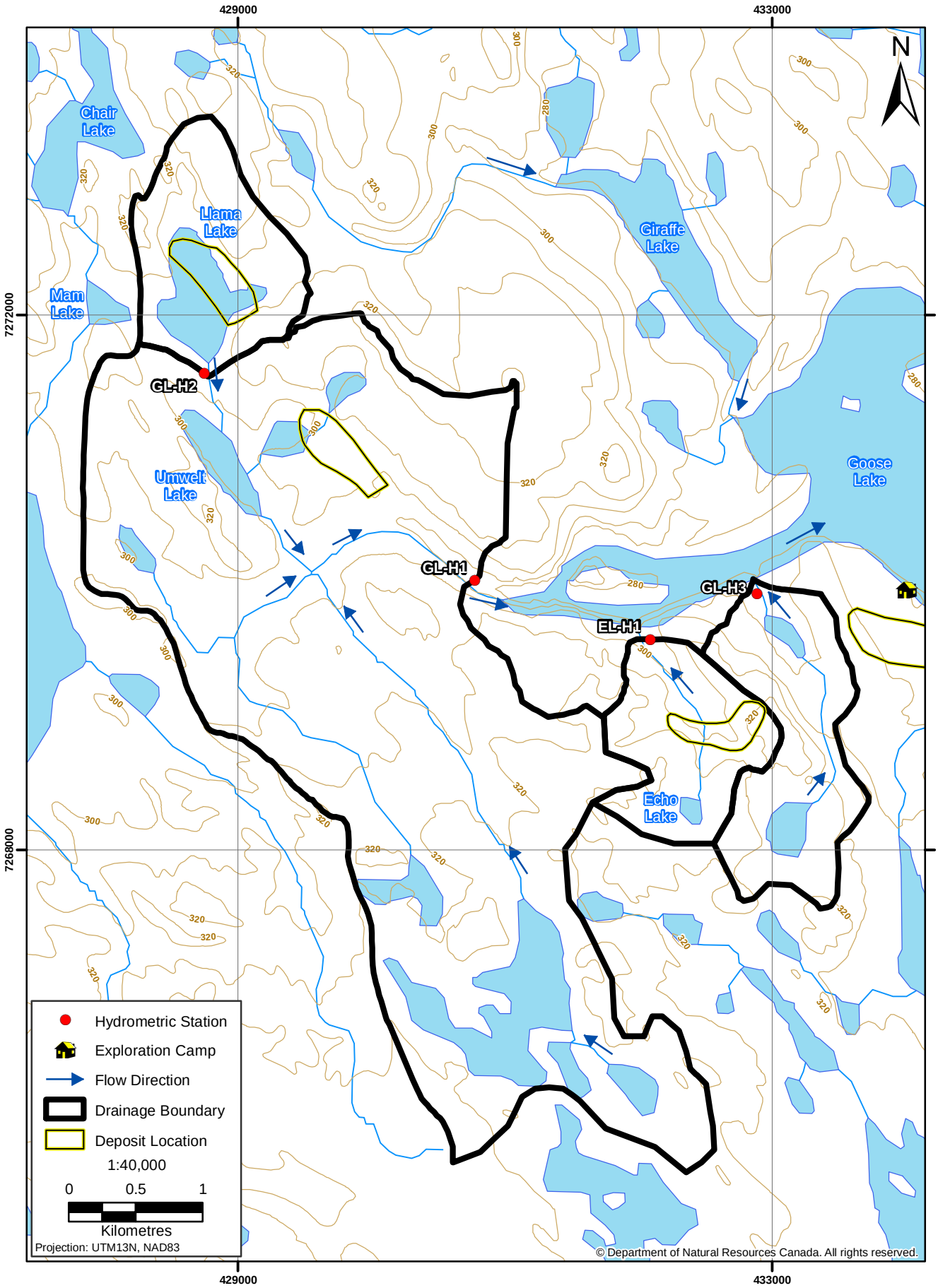


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Drainage Boundary for Giraffe Lake Hydrometric Monitoring Station GI-H1

Figure 3.1-4

Rescan™ Engineers & Scientists

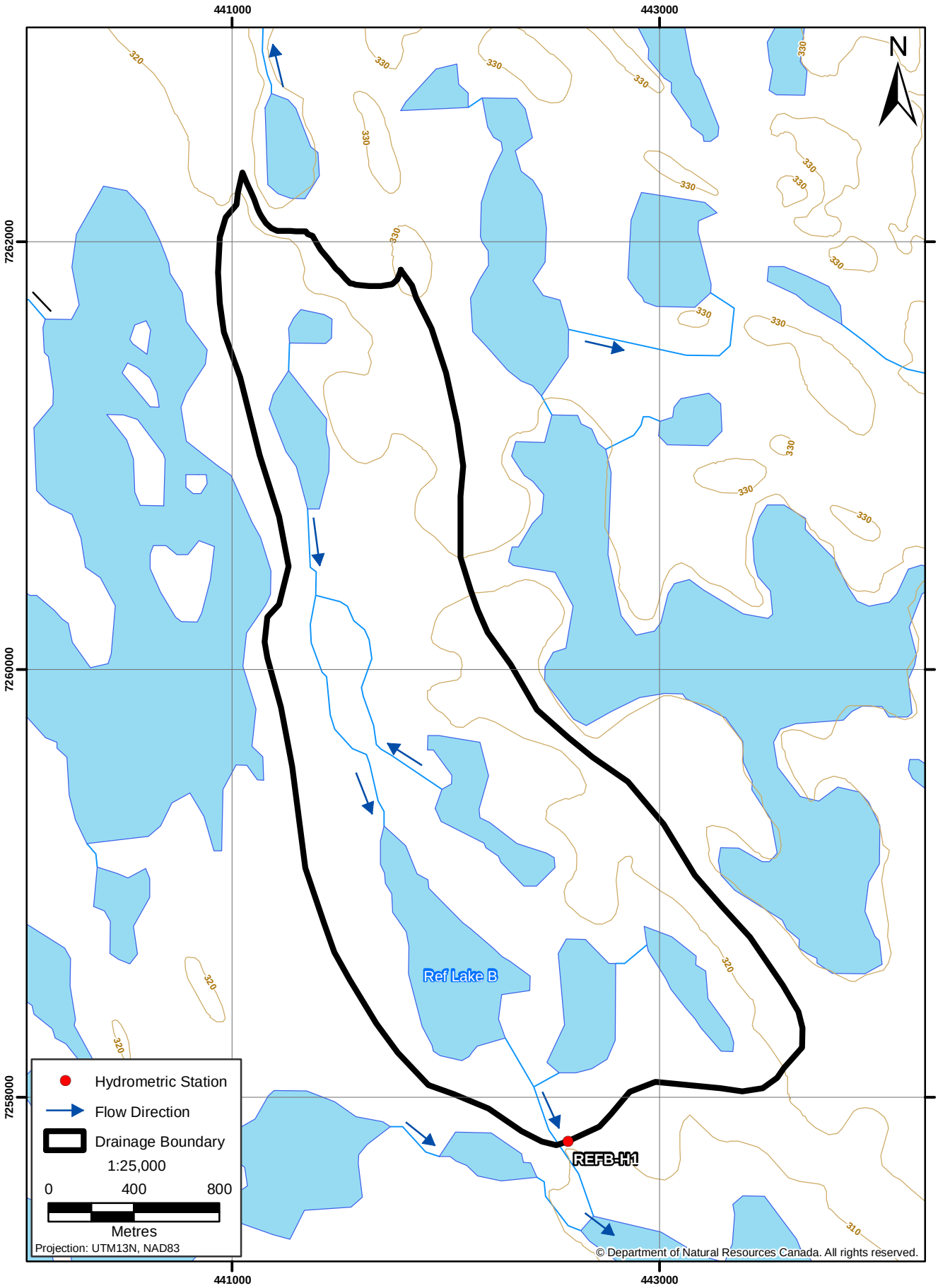


Sabina GOLD & SILVER CORP.

Drainage Boundaries for GL-H1, GL-H2, GL-H3 and EL-H1 Hydrometric Monitoring Stations

Figure 3.1-5

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Drainage Boundary for Reference Lake Hydrometric Monitoring Station REFB-H1

Figure 3.1-6

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3.2 HYDROMETRIC MONITORING STATION SETUPS

Hydrometric monitoring stations were setup within the Project area to obtain water level data at selected stream and lake sites. Automated stations were programmed to record continuous data at 10 minute intervals.

Several factors influenced the selection of the location for the monitoring sites in 2011: the monitored watershed contained known mineral deposits; the location was either a main inflow or outflow of Goose Lake (located at the centre of the deposit area); and the location was at the drainage outlet of the watershed associated with the property. Specific station locations were determined during the initial field reconnaissance conducted in June of 2011. Further, sites were selected to best meet the basic criteria required for desirable gauging locations. Such criteria include: the ability to obtain accurate water level data and to measure discharge at all stages; a stable natural control of water elevation at the site; and accessibility during the entire operational period.

Each hydrometric monitoring station, including the two established in 2010, consisted of a PS-98i® 0-5 PSI vented pressure transducer (Instrumentation Northwest Inc.) paired with an ELF-2 data logger (Terrascience Ltd.). The instrumentation measured and recorded water levels at 10 minute intervals. Pressure transducers were encased within an aluminum flex conduit which was secured to angle iron (1.5 m lengths by 50 mm width and 6 mm thickness) and laid flat on the stream/lake bed in order to keep the transducer weighted in place. The flex conduit housing the transducer cable was routed to a steel weather proof enclosure containing the data logger. The box was securely installed above the high water mark. An example of a typical station set-up is shown in Plate 3.2-1.

3.3 DISCHARGE MEASUREMENTS

At each hydrometric station, current velocity measurements were performed so that discharges could be determined. Measurements were taken throughout the open water season in order to obtain a wide range of discharges under different flow conditions. Four site visits were conducted during mid-June, mid-July, mid-August, and mid-September time periods.

Manual flow measurements were carried out at each site using two different methods depending on the flow conditions and morphology of the stream. At eight of the sites, where the stream channels could be safely waded, a handheld current velocity meter was used. At one site where the channel was too deep to wade, an acoustic Doppler current profiler (ADCP) was used to determine discharge.

3.3.1 Current Velocity Measurements

The location of the metered section at each site was determined based on channel geometry and flow conditions at time of measurement. Generally, the stream was measured along a straight reach near the station where the bed was as uniform as possible. Areas with submerged vegetation and/or immovable rocks were avoided where possible.

Current velocities were measured using either a mechanical current meter (Swoffer 2100™) fitted with a 75 mm diameter propeller or an electromagnetic current meter (Marsh-McBirney Flo-mate™). A fixed sampling interval of 40 seconds was selected for each velocity measurement, during which an average velocity was determined.



Plate 3.2-1. Photographs illustrating the hydrometric monitoring station design.

During each hydrometric station visit, measurements of water current velocity, depth of flow and distance across the channel were obtained. Typically, a minimum of 20 current velocity measurements are taken across the width of a channel, with the aim of having each vertical or observation interval accounting for less than 10% of the total discharge (Plate 3.3-1). This method assumes that the velocity measured at each vertical represents the mean velocity in a segment. At each observation point across the channel, if the observed water depth was less than 0.75 m, current water velocities were measured at 60% of the flow depth of water. The measurement at 60% of the flow depth is generally accepted as representing the mean velocity of the vertical water section (Herschy 2009). When water depths were greater than 0.75 m, current velocities were measured at 20% and 80% of the water depth, with the average of the two readings taken to represent the mean velocity for the vertical. In all cases, the adopted methods followed standard WSC operating procedures (Terzi 1981).

3.3.2 ADCP Measurements

At one hydrometric station, water depth was too high during the open water season to allow field personnel to safely wade and measure discharge with a handheld current velocity meter. Therefore, discharge was measured at this site by means of a StreamPro® (Teledyne RD Instruments) acoustic Doppler current profiler (ADCP). All measurements were conducted according to standard operating procedures (Rehmel et al. 2003, WSC 2004).



Plate 3.3-1. Velocity-area discharge measurements at hydrometric station GL-H1 using a handheld current velocity meter. Photograph taken on June 10, 2011.

The location of the ADCP measurements was selected following the same general principles as with the handheld current velocity meter. In addition, the section was chosen where the channel was relatively narrow to allow for better instrument control during the ADCP measurements.

At the selected location a boat was used to ferry personnel and a rope system across the channel. A cableway was used to manoeuvre the ADCP in controlled transects perpendicular to the direction of flow (Plate 3.3-2). Multiple transects were conducted until a minimum of four transects recorded discharges that were all within 5% of the measured mean discharge. The total discharge measurement was computed by taking the average of the four valid transects.

3.4 HYDROMETRIC STATION SURVEYS

3.4.1 Levelling Surveys

At stations where water surface elevation or stage is measured it is common practice to determine the stage above a specified reference surface or gauge datum. In order to check for the accuracy and consistency of the recorded data, it is necessary to periodically verify the elevation of the gauge in relation to the established station datum. To check and ensure that the gauge is properly set to the station datum, differential levelling techniques are used.

To establish and maintain vertical elevation control at the Project hydrometric monitoring locations, three local benchmarks were installed at each station. Benchmarks consisted of 76 mm concrete expansion bolts secured in bedrock or large stable boulders found in the vicinity of the stations. One benchmark at each station was assigned to be the primary reference point, and assigned an arbitrary local elevation of 100.000 m. All recorded water levels were then referenced to this primary benchmark.

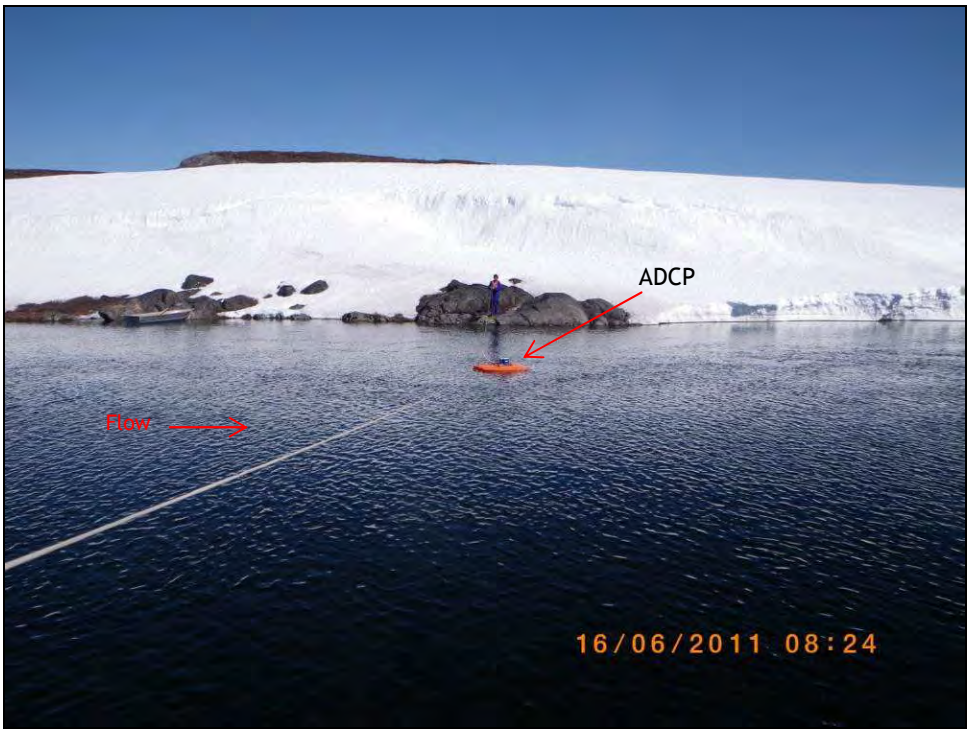


Plate 3.3-2. Discharge measurements at hydrometric station PL-H1 using an acoustic Doppler current profiler (ADCP). Photograph taken on June 16, 2011.

Throughout the 2011 monitoring period, hydrometric levelling surveys were conducted during site visits in early June, mid-July, etc. Each survey was completed using an engineer's level and a calibrated levelling rod.

3.4.2 Channel Geometry Surveys

Surveys were completed at each monitored hydrometric station in order to define channel-geometry of the gauged stream section. At the majority of hydrometric stations, a suitable channel reach with a total length of approximately three to six channel widths was selected, using the hydrometric station as the midpoint of the surveyed section. Three evenly spaced cross-sections, perpendicular to the channel reach, were surveyed using a compass and chain technique.

For the station located at the outflow of Giraffe Lake (GI-H1) a near-shore longitudinal profile was measured at the station. Two additional channel cross-sections were measured downstream from this station. At the outflow of Propellor Lake (PL-H1) only one cross-section was measured. Information of the channel bed topography, obtained from the ADCP measurement, was merged with topographic information of the adjacent banks surveyed using compass and chain. At each station, all surveyed cross-sections were referenced to the established arbitrary local datum. Upon completion of field surveying, data were input into RoadEng® software (Softree Technical Systems Inc.), to produce the representative channel cross-sections.

3.5 STAGE – DISCHARGE RELATIONS

In 2011, stage-discharge relations were developed for each hydrometric station. For the two stations operated in 2010 and 2011, data for those two years were combined in the development of the stage-discharge relations. Stage-discharge relations were expressed as rating curves. Rating curves are used to convert water level data (stage) recorded by the hydrometric monitoring stations into a continuous

discharge time-series or hydrograph. The quality of a rating curve depends on the number and accuracy of the individual data points used to generate the curve as well as the hydraulic characteristics of the monitoring location. To develop a robust stage-discharge relationship 10 to 15 manual stream flow measurements are recommended. These need to be representative of a wide range of flow conditions (ISO 2010). Typically, these measurements are distributed over a minimum two-year period, with approximately 6 measurements collected each year. Each additional point increases the range and robustness of the rating curve at varying discharge levels. Discharge measurements at the higher end of the discharge range are especially important as they help to define the high end of the rating curve. This is important as high flows often require extrapolation beyond the range of the observed data used to generate the rating curve and the rating relationship can change from low flow periods to high flow periods, depending on channel geometry.

In the absence of a stage–discharge measurement corresponding to high flow conditions, the rating curve is often extrapolated to a high flow value that is beyond the range of the observed data used to generate the curve. Most stage-discharge relationships in this study were extrapolated to values less than or equal to 1.5 times the greatest measured discharge. Any discharge extrapolation beyond that limit is not recommended as the resulting value will have a high uncertainty associated with it (ISO 2010). The stage-discharge relation for the hydrometric station EL-H1 was extended beyond 1.5 times the highest measured discharge to account for the range of measured stages, therefore there is greater uncertainty in the high discharges calculated at this station.

Rating curves were developed using Aquarius™ Time Series Hydrologic Software (Aquatics Informatics Inc.). The software uses standard methods outlined by the United States Geological Survey and the International Organization for Standardization (Kennedy 1984, ISO 2010). Plotted on a logarithmic scale, a least-squares regression procedure was used to produce a line of best fit and logarithmic equation for the concurrently measured water level (stage) and discharge data. Taking the antilogarithmic transformation, discharge was determined by a power function of the form:

$$Q = C\ (\mathrm{h} - a)^{b}$$

where Q is the discharge [m^3/s], C and b are regression coefficients, h is the stage (water level) [m], and a is the stage at zero flow (datum correction) [m].

3.6 DAILY DISCHARGE HYDROGRAPHS

Annual hydrographs, presented as mean daily discharge, were generated for each of the hydrometric monitoring stations operated in 2011. Daily discharge is the average discharge calculated over a 24 hour period.

For the operational period at each station, discharges were calculated by applying the developed rating curves to the recorded stage data. Prior to recorded stage data, rising limbs of the hydrographs were estimated assuming a logarithmic growth function. The onset of the spring freshet was determined using available meteorological data from the Project area along with observed site conditions during the initial site visit in early June 2011. The recession limb of each hydrograph was extended down to a zero flow date based on a linear decay function. This function is an extrapolation of the initial recession of the hydrograph that was captured in the data record.

3.7 MONTHLY VOLUMETRIC OUTFLOW

At each hydrometric station, the monthly and annual volumetric water outflows were determined. Volumetric outflows are expressed in millions of cubic meters per month for each of the monitored basins.

3.8 FLOW DURATION ANALYSIS

Flow duration analysis considers the percent of time that a specific discharge level has been exceeded or equalled during a period of record. A flow duration curve is the relation between the magnitudes of stream flow at a point and the frequency (probability) with which those magnitudes are exceeded over an extended period of time (Dingman 2002).

For each monitored basin within the Project area, a flow duration curve was generated. The curve shows the percent of time that a discharge in a stream channel is likely to be equalled or exceeded, and is used to show the range of discharge levels that occurs along a monitored stream course. The flow duration curve is a useful planning tool in evaluating water discharge, as a function of basin characteristics.

A flow duration curve is constructed by ranking discharge values over a period of record, and then calculating their associated probabilities of exceedance using the following equation:

$$P = 100 \times [M/(n+1)] \qquad (2)$$

Where P is the probability that a given flow will be equalled or exceed, M is the ranked position on the listing, and n is the number of events for the period of record (OSU 2005).

3.9 HYDROLOGIC INDICES

Calculated annual runoff, seasonal runoff distribution, mean annual discharge (MAD), peak flow, and low flow are important hydrologic indices that provide useful information when undertaking a hydrologic assessment for design of mine Project infrastructure as well as when managing the water resources once a mine has entered operations.

3.9.1 Annual Runoff

Calculated annual runoff (expressed as a depth) represents the difference between annual precipitation, snowmelt, and evaporation. It is a valuable metric for obtaining gross estimates of the water available from a basin. Because it is standardized by watershed area it is also a useful index for comparing the hydrologic response of basins of different sizes. Annual runoff was expressed as observed annual runoff and as estimated annual runoff. Observed annual runoff only included runoff values for the period of record at each hydrometric station. Estimated annual runoff was the total runoff for the entire open water season, which includes both estimated and observed values.

3.9.2 Seasonal Runoff Distribution

Seasonal runoff distribution was determined by summing the daily runoff by month for each basin. Monthly runoff as a depth and as a percent of the total annual runoff was calculated and presented to illustrate the spatial and temporal distribution of runoff in the Project area.

3.9.3 Mean Annual Discharge

The mean annual discharge (MAD), computed as an average discharge over the year, is an additional variable that gives an indication of the potential amount of water a basin can provide as a function of drainage area, geology, and climate.

3.9.4 Annual Peak and Low Flow

Peak flows represent the maximum flow rate of a catchment during a year in response to precipitation events or snowmelt. Peak flows are used in combination with flood frequency analysis techniques in order to estimate design flows used in the sizing of ditches, diversion channels, or stream crossings. Conversely, low flows provide an estimate of the normal baseflow conditions during the open water season, which is important to the sustained health of a stream's aquatic community.

4. Results

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4. Results

Results from the 2011 Hydrology Monitoring Program are presented as follows: (1) completed discharge measurements, (2) hydrometric surveys, (3) determined stage-discharge relationships, (4) daily discharge hydrographs, (5) volumetric outflows, (6) flow duration analysis, and (7) hydrologic indices for the area.

4.1 DISCHARGE MEASUREMENT SUMMARY

Discharge measurements were taken during the June freshet period at each hydrometric station with additional measurements conducted in July, August, and September 2011, for a total of 41 measurements. The measurements were collected through the open water season in order to obtain a range of discharges at different flow conditions (Table 4.1-1 and Appendix 2).

Two discharge measurements were taken during the freshet period at most of the hydrometric stations to capture the range of flow conditions observed, the exception was the hydrometric station REFB-H1 where stream flows remained constant during the site visit. During the August visit, discharge measurements were not conducted at the hydrometric stations GL-H3, EL-H1, and REFB-H1, as these streams were dry.

Table 4.1-1. Summary of Completed Discharge Measurements in the Goose Property Area in 2011

Hydrometric Station	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
GL-H1	June 10	99.638	0.439	Velocity-Area (Swoffer current meter)
	June 15	99.699	0.615	Velocity-Area (Swoffer current meter)
	July 8	99.522	0.247	Velocity-Area (FlowMate current meter)
	August 14	98.837	0.007	Velocity-Area (FlowMate current meter)
	September 16	99.566	0.270	Velocity-Area (FlowMate current meter)
GL-H2	June 10	99.833	0.075	Velocity-Area (Swoffer current meter)
	June 15	99.879	0.121	Velocity-Area (Swoffer current meter)
	July 8	99.821	0.063	Velocity-Area (FlowMate current meter)
	August 12	99.713	<0.001	Velocity-Area (FlowMate current meter)
	September 16	99.813	0.046	Velocity-Area (FlowMate current meter)
GL-H3	June 14	99.934	0.648	Velocity-Area (Swoffer current meter)
	June 15	99.916	0.478	Velocity-Area (Swoffer current meter)
	July 9	99.806	0.075	Velocity-Area (FlowMate current meter)
	September 16	99.816	0.172	Velocity-Area (FlowMate current meter)
PL-H1	June 14	99.190	7.338	Velocity-Area (ADCP)†
	June 16	99.202	8.079	Velocity-Area (ADCP)
	July 10	99.063	4.575	Velocity-Area (ADCP)
	August 12	98.644	0.116	Velocity-Area (ADCP)
	September 17	99.021	3.925	Velocity-Area (ADCP)

(continued)

Table 4.1-1. Summary of Completed Discharge Measurements in the Goose Property Area in 2011 (completed)

Hydrometric Station	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
PL-H2	June 11	99.730	1.813	Velocity-Area (Swoffer current meter)
	June 16	99.810	3.332	Velocity-Area (Swoffer current meter)
	July 8	99.691	1.780	Velocity-Area (FlowMate current meter)
	August 14	99.482	0.055	Velocity-Area (FlowMate current meter)
	September 17	99.720	1.646	Velocity-Area (FlowMate current meter)
GI-H1	June 11	99.660	0.587	Velocity-Area (Swoffer current meter)
	June 15	99.722	0.965	Velocity-Area (Swoffer current meter)
	July 8	99.733	0.523	Velocity-Area (FlowMate current meter)
	August 13	99.541	0.041	Velocity-Area (FlowMate current meter)
	September 16	99.735	0.403	Velocity-Area (FlowMate current meter)
EL-H1	June 13	99.375	0.037	Velocity-Area (Swoffer current meter)
	June 15	99.361	0.023	Velocity-Area (Swoffer current meter)
	July 9	99.259	0.002	Velocity-Area (FlowMate current meter)
	September 16	99.304	0.013	Velocity-Area (FlowMate current meter)
WL-H1	June 13	98.704	1.973	Velocity-Area (Swoffer current meter)
	June 17	98.648	0.840	Velocity-Area (Swoffer current meter)
	July 9	98.522	0.370	Velocity-Area (FlowMate current meter)
	August 15	98.229	0.003	Velocity-Area (FlowMate current meter)
	September 17	98.525	0.371	Velocity-Area (FlowMate current meter)
REFB-H1	June 12	99.633	0.206	Velocity-Area (Swoffer current meter)
	July 9	99.540	0.031	Velocity-Area (FlowMate current meter)
	September 17	99.513	0.023	Velocity-Area (FlowMate current meter)

† - Discharge measured by means of an acoustic Doppler current profiler
** - Pressure transducer stage referenced to site-specific arbitrary datum*

4.2 HYDROMETRIC STATION SURVEYS

4.2.1 Levelling Surveys

Levelling surveys were completed during each flow measurement during the 2011 field season. A summary of the survey control points at each station are provided in the station information sheets (Appendix 1). Survey data from the re-established GL-H1 and GL-H2 stations were used to reference the 2011 stage data to existing benchmarks installed in 2010.

At the majority of new stations the surveys confirmed that the pressure transducers measuring water level remained stationary and properly calibrated during the monitoring period. At the station GL-H3 the transducer was shifted vertically during field work and the survey data were used to confirm the change in elevation of the pressure transducer and to correct for this error in the stage time series. At the reference station, REFB-H1 survey data were used to correct for a drift in the stage time series. The drift was caused by a gradual sinking of the transducer as the stream bed thawed over the period of record (Plate 4.2-1).

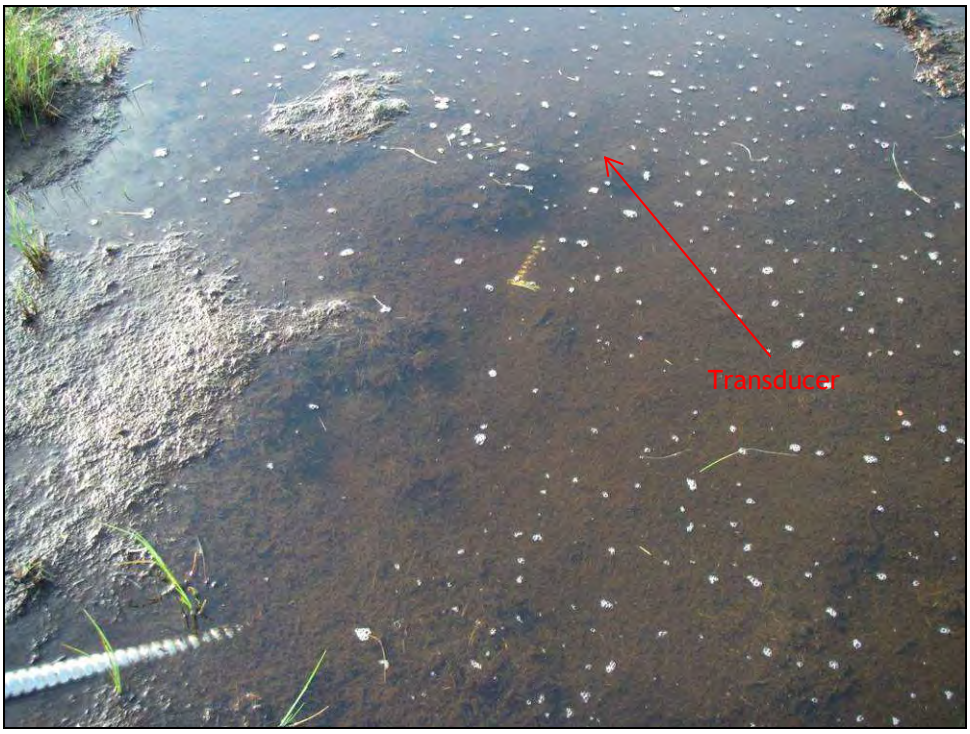


Plate 4.2-1. Close up view showing the transducer submerged in the thawed stream bed late in the summer at the hydrometric monitoring station REFB-H1. Data recorded in the levelling surveys conducted over the field season were used to correct for the change in elevation of the transducer. Photograph taken on August 15, 2011.

4.2.2 Channel Geometry Surveys

Channel geometry surveys conducted at each hydrometric monitoring location are provided in Appendix 6. Surveys of the monitored reaches provide a physical representation of the channel geometry. These data will be used to determine channel stability and shifts on an annual basis. Cross-sections of the channels at the installed pressure transducers also show the 2011 minimum, mean, and maximum observed water level elevations.

4.3 STAGE-DISCHARGE RATING CURVES

At the two hydrometric stations established in 2010, the data collected in 2011 were combined with the data collected in 2010 to increase the range and the robustness of the rating curves. A wider range of flows were measured in 2011. This helped to better define the upper and lower ends of the preliminary rating curves that were developed in 2010. At the seven new stations installed in 2011, between three and five discharge measurements were conducted during the open water season. These measurements were used in the development of preliminary rating equations. Additional discharge measurements are required in order to increase the range and robustness of the stage-discharge relationships.

At most stations a single rating curve was fit to the full range of flows measured, as no substantial break points were observed. The exception was at hydrometric station WL-H1 where a two stage (Low/High) rating curve was developed. At this site, the monitored reach was confined to a fairly deep channel with steep banks during low to medium flow conditions; however, during high flow conditions the banks were overtopped and the stream was able to flood the flat tundra adjacent to the channel. Rating equations are summarized in Table 4.3-1 and rating curves are provided in Appendix 3.

Table 4.3-1. Summary of 2011 Rating Equations for the Hydrometric Monitoring Stations in the Goose Property Area

Hydrometric Station		Rating Equation $Q = C (h-a)^b$	Root Mean Square
GL-H1		$Q = 0.26 (h-98.32)^{4.82}$	18.6
GL-H2		$Q = 5.55 (h-99.52)^{2.21}$	18.0
GL-H3		$Q = 12.30 (h-99.71)^{2.01}$	21.8
PL-H1		$Q = 21.25 (h-98.52)^{2.50}$	3.3
PL-H2		$Q = 26.42 (h-99.30)^{3.09}$	12.8
GI-H1		$Q = 9.55 (h-99.48)^{1.91}$	41.0
EL-H1		$Q = 5.63 (h-99.20)^{2.88}$	30.0
WL-H1	Low Stage	$Q = 4.35 (h-98.19)^{2.30}$	15.7
	High Stage	$Q = 22.97 (h-98.28)^{2.96}$	15.7
REFB-H1		$Q = 29.21 (h-99.35)^{3.98}$	13.5

Q= discharge [m^3/s]; C= y intercept; h= recorded stage [m]; a= stage at zero flow (datum correction) [m]; b= slope

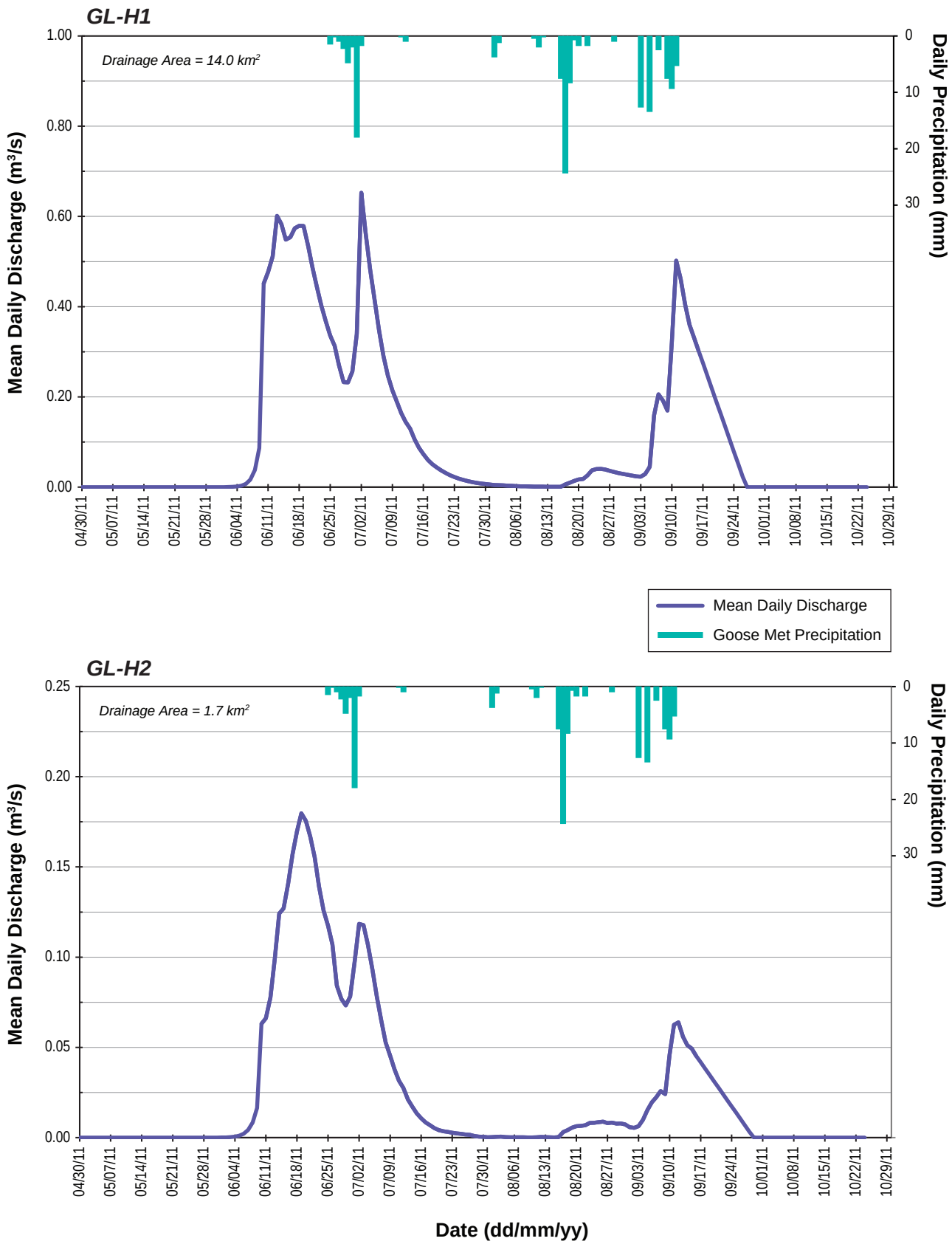
Also included in the table is the Root Mean Square (RMS) which is used by the Aquarius® software as an overall measure of error of the stage-discharge relation. The RMS is a statistical parameter that describes how well the values predicted by the stage-discharge relation fit or represent the observed data. The departure from true values computed by this statistic combines both bias and lack of precision. The lower the RMS, the better the estimated values provided by the rating relationship.

4.4 ANNUAL HYDROGRAPHS

The 2011 annual mean daily discharge hydrographs presented in Figures 4.4-1 through 4.4-5 show similar trends over the year at each monitored location in the Back River Project area. Mean daily discharge tables are provided in Appendix 4 and individual hydrographs in Appendix 5.

Break-up was estimated to occur in early-June when mean daily air temperatures were consistently above freezing in the Project area (Figure 4.4-6). Three prominent peaks were observed in each of the hydrographs. The largest peak flows were driven by snowmelt and occurred during the freshet period in early to mid-June in most basins. A second peak was observed in all basins approximately 19 days after the freshet peak and was the result of precipitation events that occurred in late June and early July. This was the maximum event for stations GL-H2 and GI-H1. After the July elevated flows, discharge steadily decreased throughout the Project area until mid-August. After this date daily discharges were augmented by rainfall events occurring throughout the second half of August and carrying on through September leading to a third peak evident in most of the hydrographs. After the September precipitation event, flows continued to recede until end of the monitoring period, which coincided with mean daily air temperatures dropping below the freezing level.

It is important to note there is a degree of uncertainty in the estimated freshet peak flows for hydrometric stations GL-H3, WL-H1, REFB-H1 and EL-H1. Based on the continuous time series recorded at these sites, it is unclear whether the maximum freshet peak was recorded or it occurred prior to station installation. To estimate the spring freshet peak a correlation analysis between the observed discharge time series at these sites and the time series recorded at GL-H1 (where the peak was observed) was performed. Results from the analysis were used to estimate discharges prior to June 10 when data collection began at the station GL-H1. A strong correlation was observed between discharge values at GL-H1 and GL-H3, WL-H1, and REFB-H1 (Table 4.4-1). The correlation analysis between discharge values at GL-H1 and EL-H1 did not yield good results and therefore was not used in further analysis.

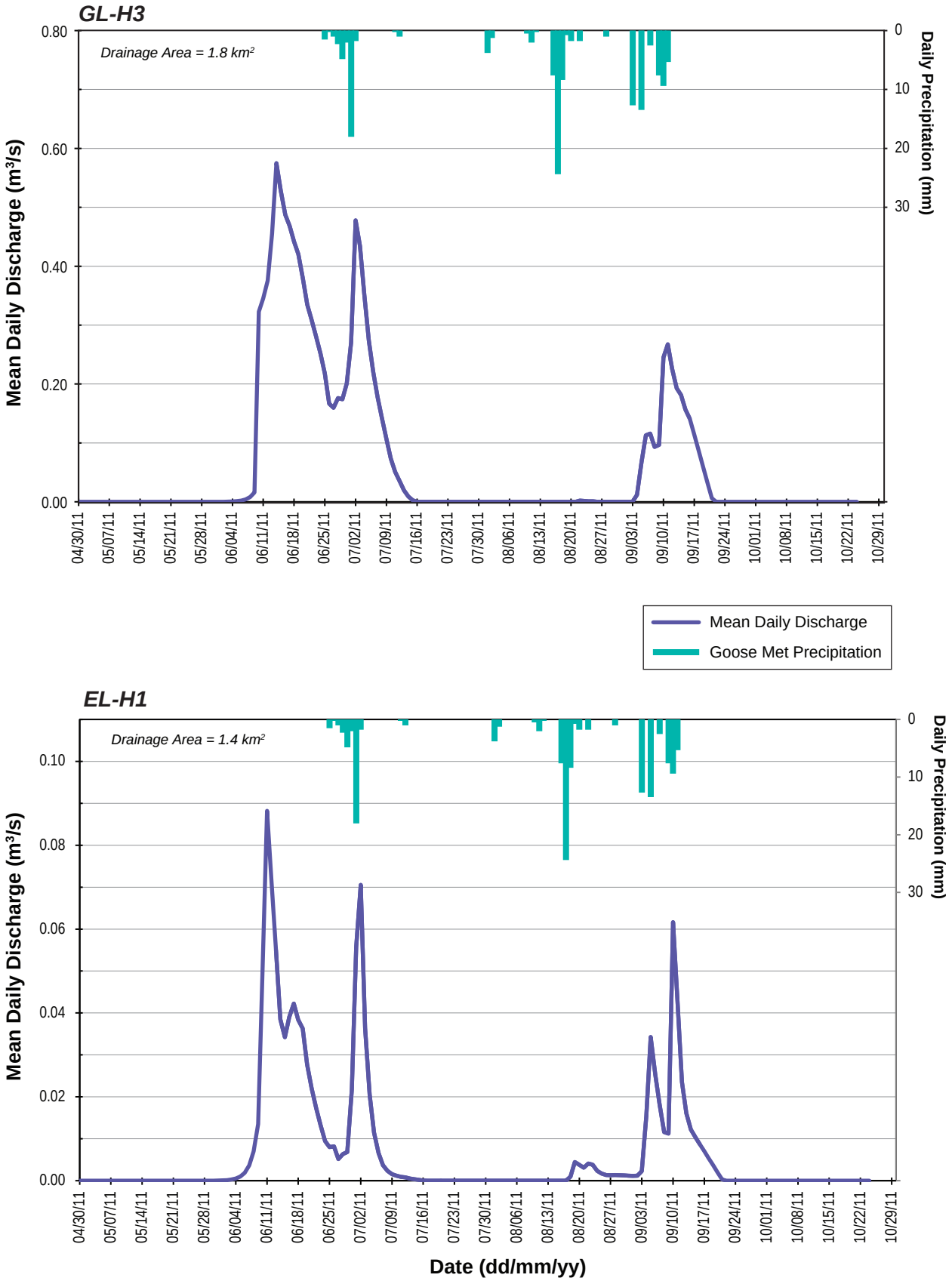


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Annual Hydrograph at GL-*H1* and GL-*H2* Hydrometric Monitoring Stations, 2011

Figure 4.4-1

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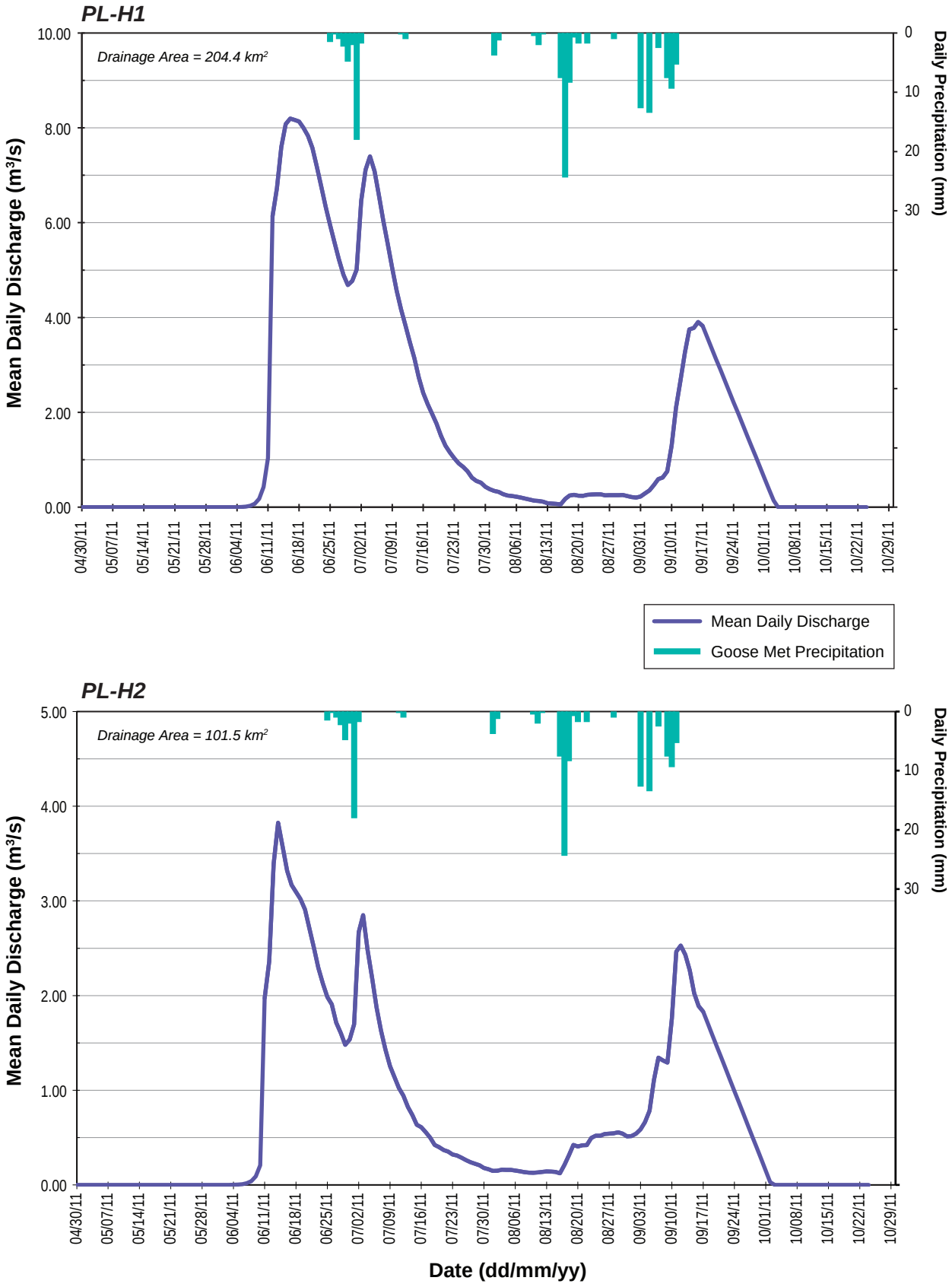


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Annual Hydrograph at GL-*H3* and EL-*H1* Hydrometric Monitoring Stations, 2011

Figure 4.4-2

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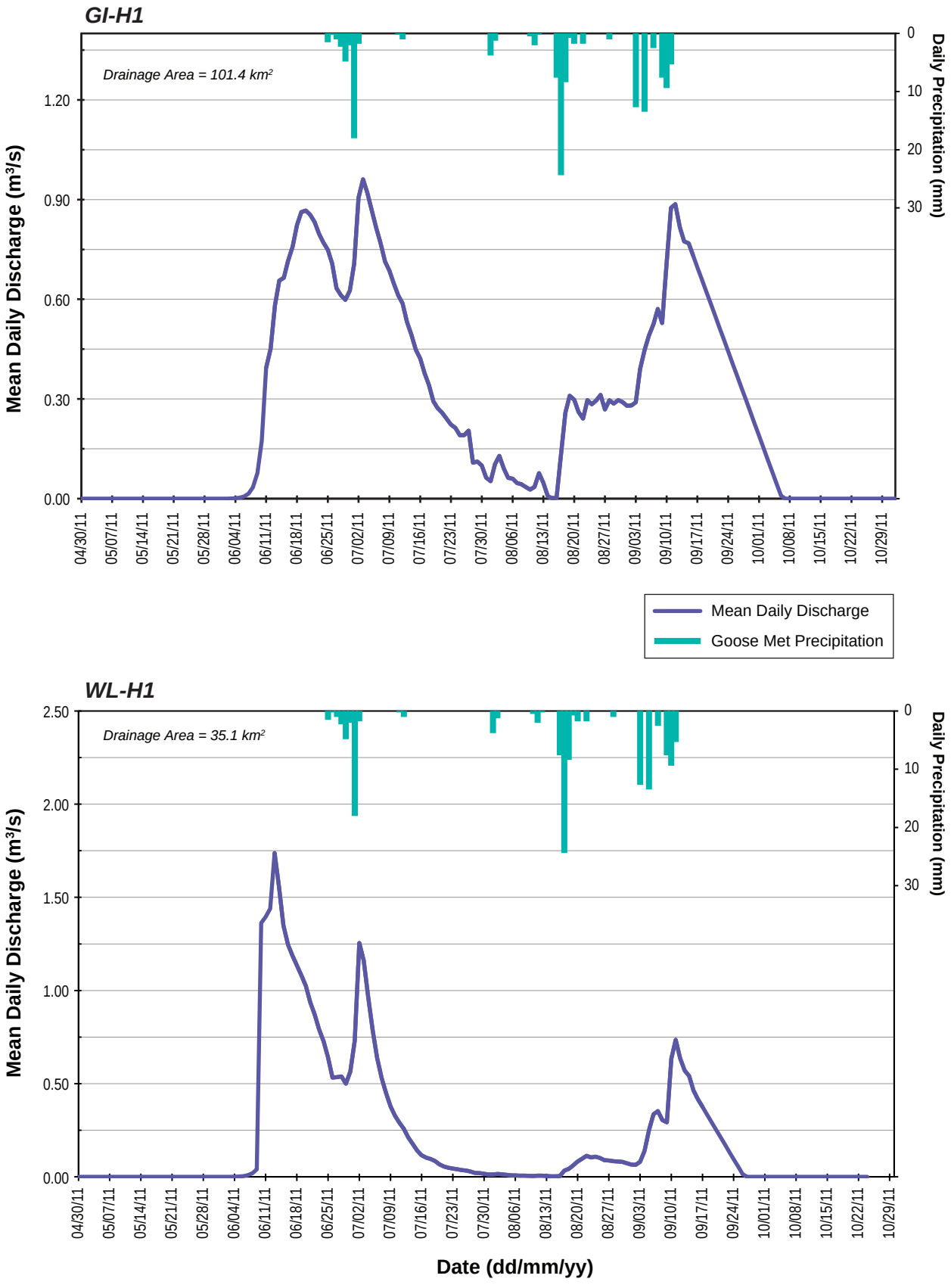


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Annual Hydrograph at PL-*H1* and PL-*H2* Hydrometric Monitoring Stations, 2011

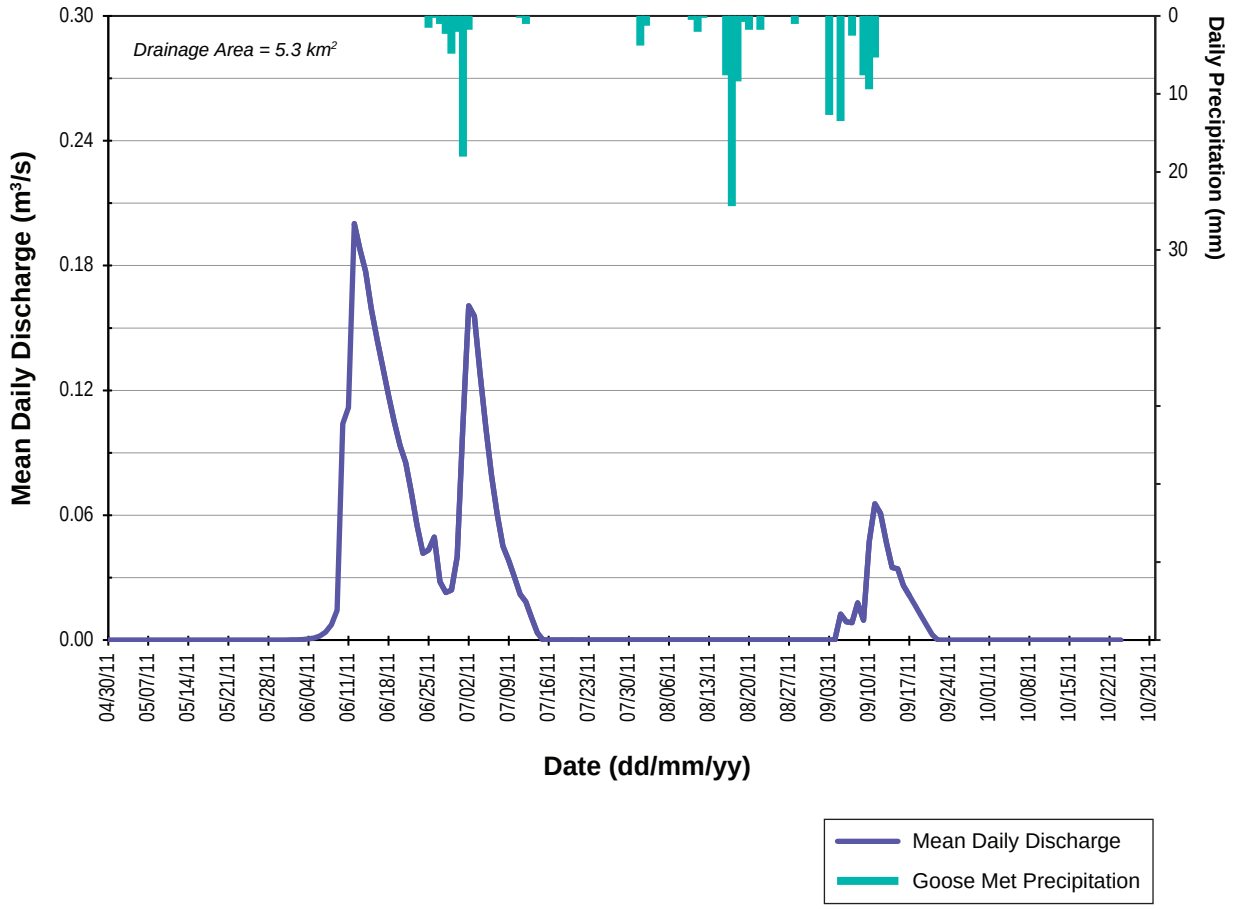
Figure 4.4-3

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Annual Hydrograph at GI-*H1* and WL-*H1* Hydrometric Monitoring Stations, 2011

Figure 4.4-4

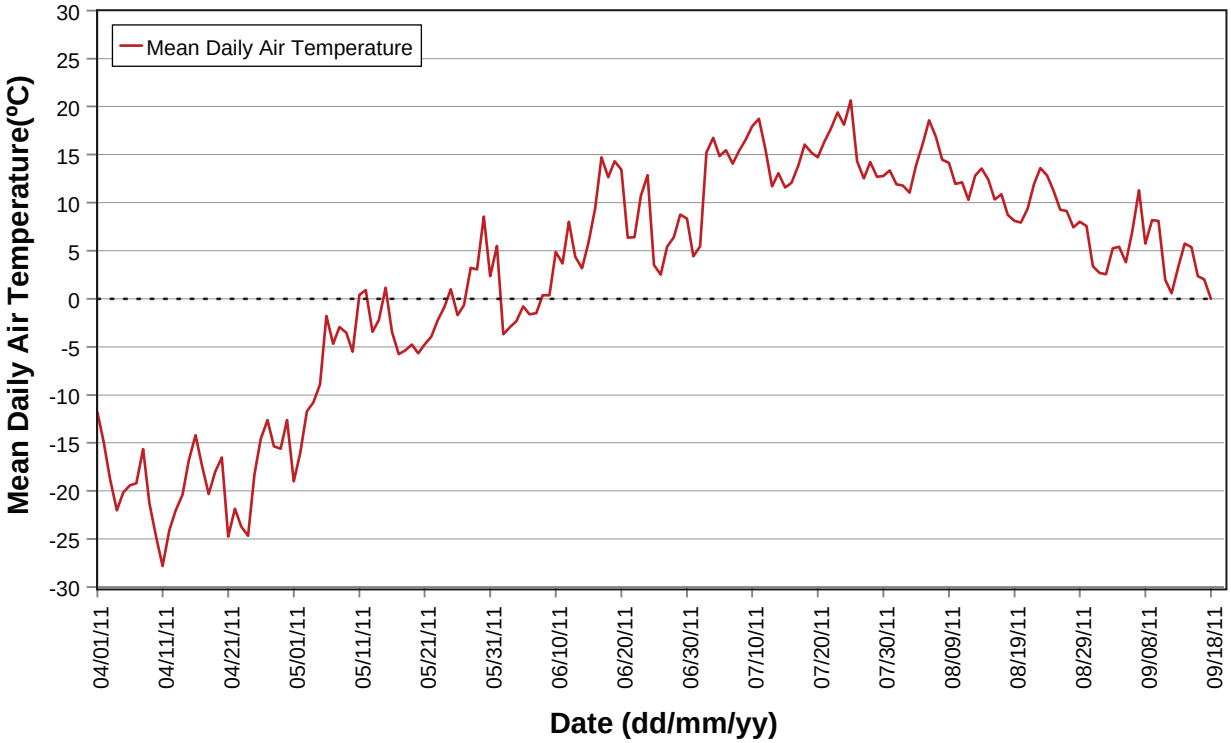


Annual Hydrograph at REFB-*H1* Hydrometric Monitoring Station, 2011

Figure 4.4-5



High angle oblique view of Propellor Lake outflow during spring freshet. Note the lakes remain ice covered for a period after break-up occurs in the streams thus delaying or extending the freshet period in the region.



Mean Daily Air Temperature Recorded During the Break-up Period and Through The Open Water Season at Goose Lake Meteorological Station in 2011

Figure 4.4-6

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Table 4.4-1. Correlation Analysis between the Observed Discharge Time Series at Station GL-H1 and Stations GL-H3, WL-H1, and REFB-H1

Station	Sample Size (Days)	R2
GL-H3	33	0.97
WL-H1	33	0.97
REFB-H1	34	0.91

The freshet peak at EL-H1 was estimated using a different approach. The annual hydrograph for this station shows a flashier response in the drainage compared to the larger drainages. Runoff response to precipitation inputs was observed to occur one to two days earlier than at other drainages. Therefore, it was assumed that the freshet peak also occurred slightly earlier than the peaks at the surrounding stations. Linear extrapolation was used to extend the recession limb of the recorded freshet data back two days prior to the start of the monitoring period for this station.

4.4.1 Volumetric Outflow

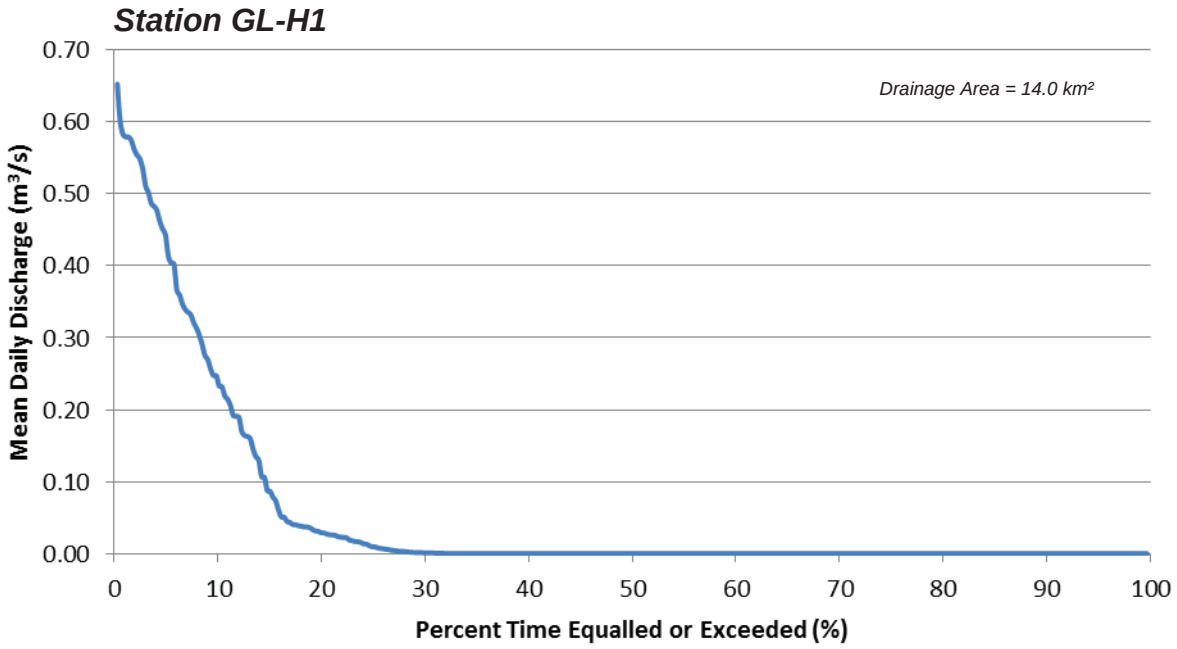
The total monthly and annual volumetric water outflows for each of the drainages are presented in Table 4.4-2. Outflows from each of the monitored drainages were generally found to be a function of drainage area. The minimum volumetric outflows were observed at EL-H1 (drainage area = 1.4 km^2) which had a total annual water output of 0.11 million cubic meters. The maximum annual volumetric output was 25.13 million cubic meters at PL-H1 (drainage area = 204.4 km^2).

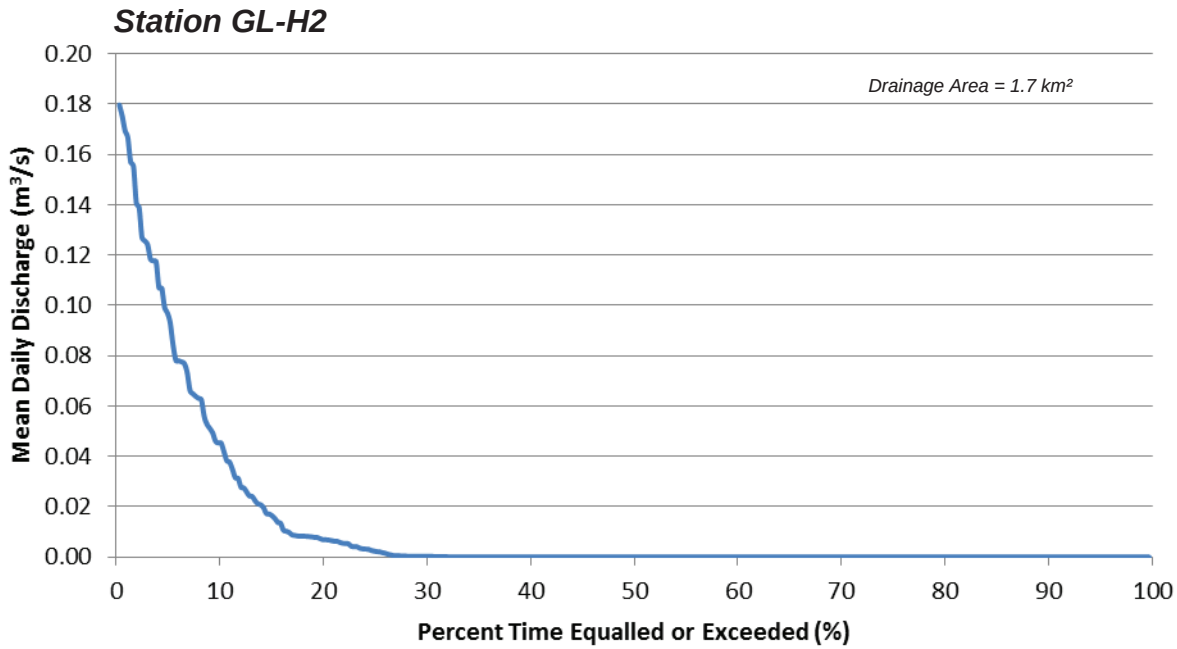
Table 4.4-2. 2011 Volumetric Water Yield in Millions of Cubic Meters (million m^3) for Hydrometric Stations in the Goose Property Area

Hydrometric Station	Jan-May	June	July	August	September	October	Nov-Dec	Total Annual
GL-H1	0.00	0.82	0.42	0.04	0.44	0.00	0.00	1.71
GL-H2	0.00	0.22	0.08	0.01	0.07	0.00	0.00	0.38
GL-H3	0.00	0.61	0.23	<0.01	0.19	0.00	0.00	1.03
PL-H1	0.00	11.20	8.34	0.57	4.93	0.10	0.00	25.13
PL-H2	0.00	4.40	2.49	0.80	3.30	0.02	0.00	11.00
GI-H1	0.00	1.23	1.23	0.43	1.37	0.05	0.00	4.31
EL-H1	0.00	0.06	0.02	<0.01	0.03	0.00	0.00	0.11
WL-H1	0.00	1.83	0.79	0.12	0.68	0.00	0.00	3.42
REFB-H1	0.00	0.17	0.08	0.00	0.04	0.00	0.00	0.29

4.5 FLOW DURATION ANALYSIS

Annual flow duration curves (FDC) were produced for each of the monitored streams in 2011 (Figures 4.5-1 through 4.5-5). The trends in the FDC clearly demonstrate the seasonality of these small Arctic streams. A range of exceedance values and a percentage of time in the open water season during which streams were flowing are presented in Table 4.5-1. The flow duration analysis of all drainages in the Project area reveals that on average there was stream flow during 30% of the year with a maximum of 36% observed at GL-H1 and a minimum of 17% at REFB-H1. The shape of the FDC describes the runoff response of each drainage to precipitation or snow melt events. The smaller (e.g., EL-H1) basins typically produced a steeper FDC as they responded quicker to hydrological inputs.



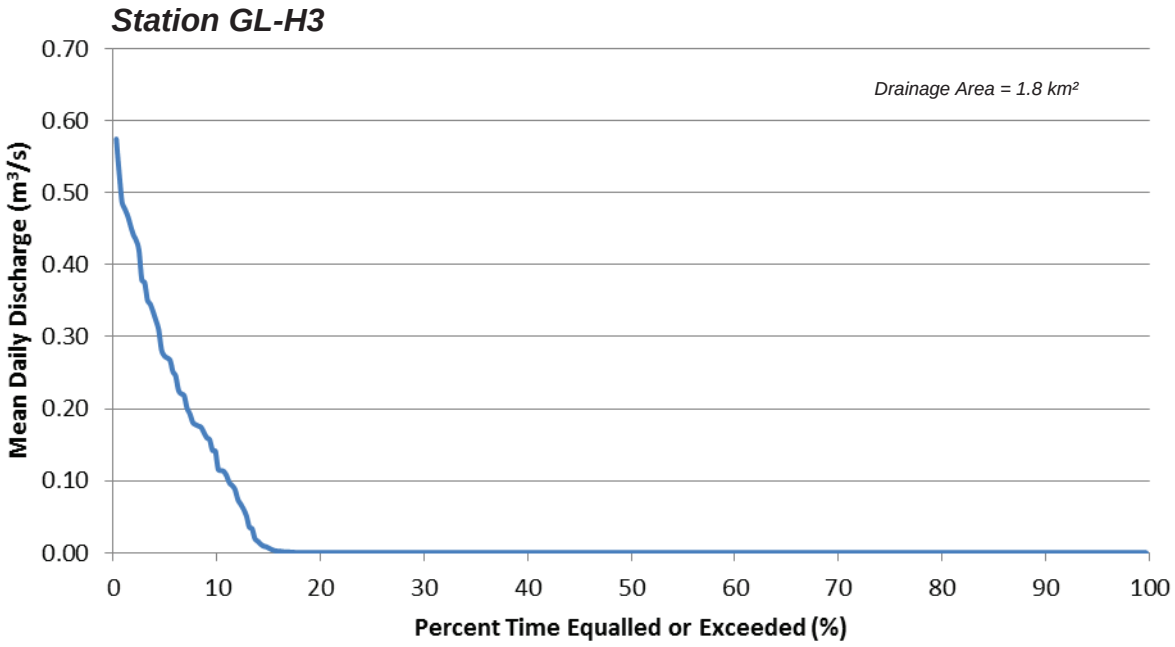


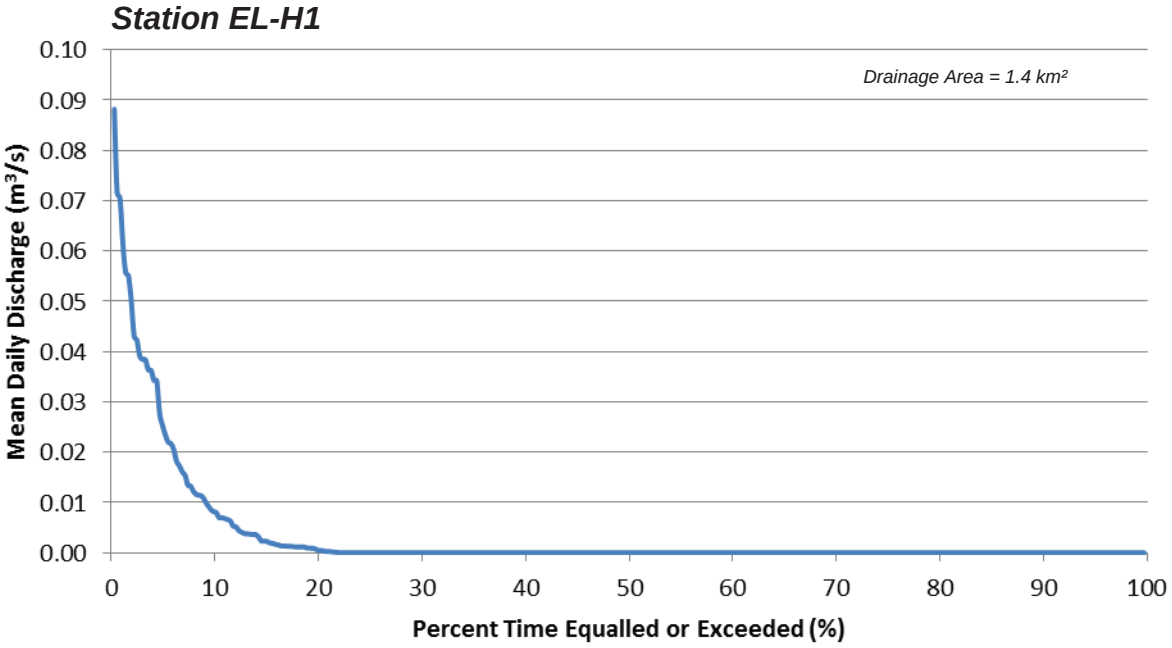
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2011 Flow Duration Curves for Hydrometric Monitoring Stations GL-H1 and GL-H2

Figure 4.5-1

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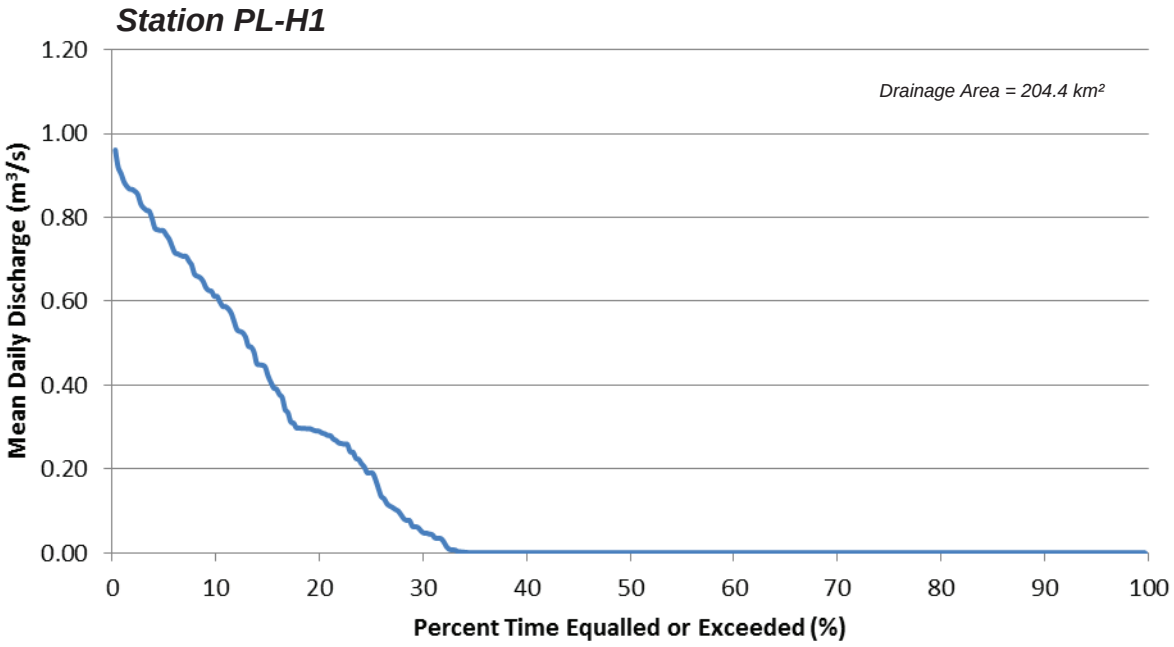


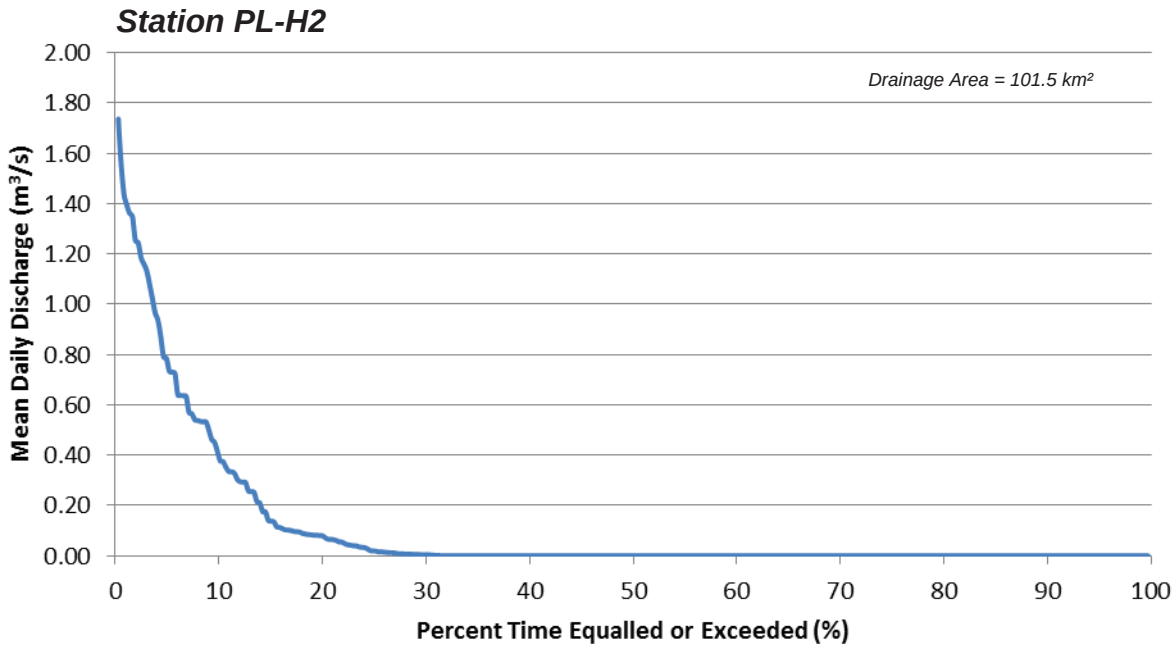
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2011 Flow Duration Curves for Hydrometric Monitoring Stations GL-H3 and EL-H1

Figure 4.5-2

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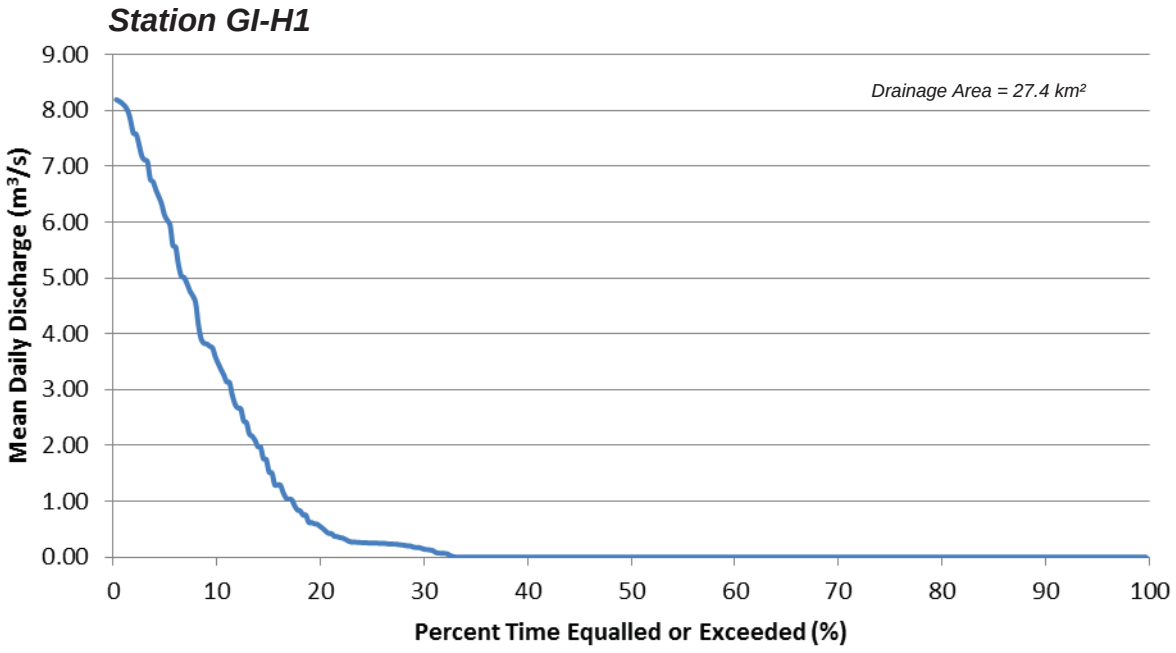


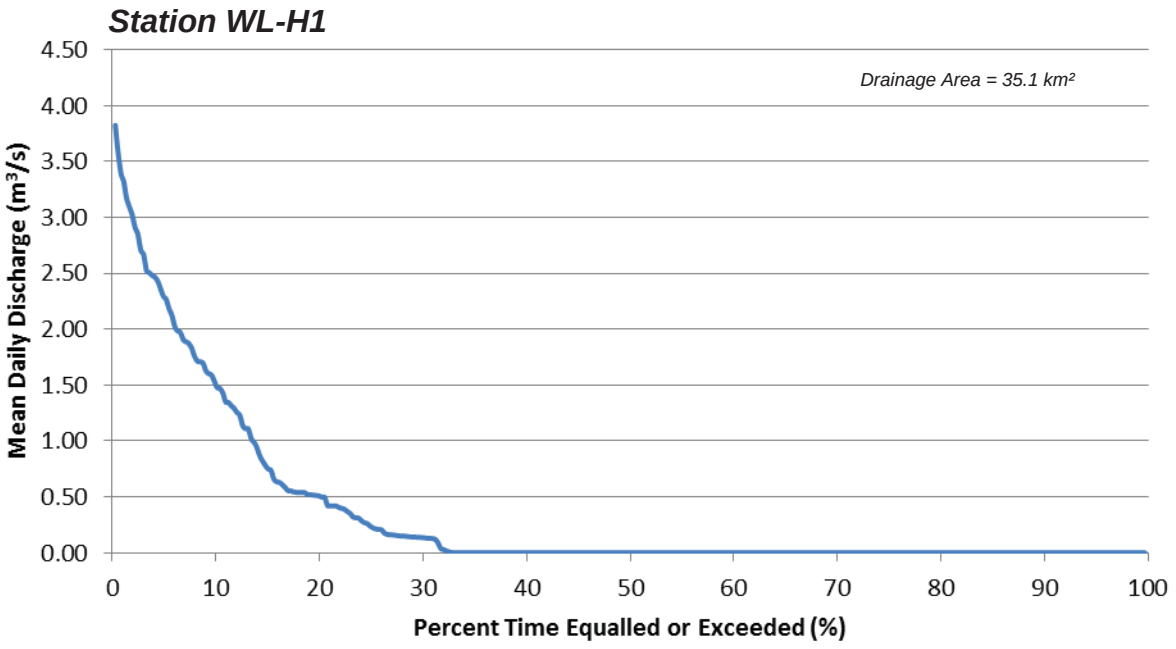
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2011 Flow Duration Curves for Hydrometric Monitoring Stations PL-H1 and PL-H2

Figure 4.5-3

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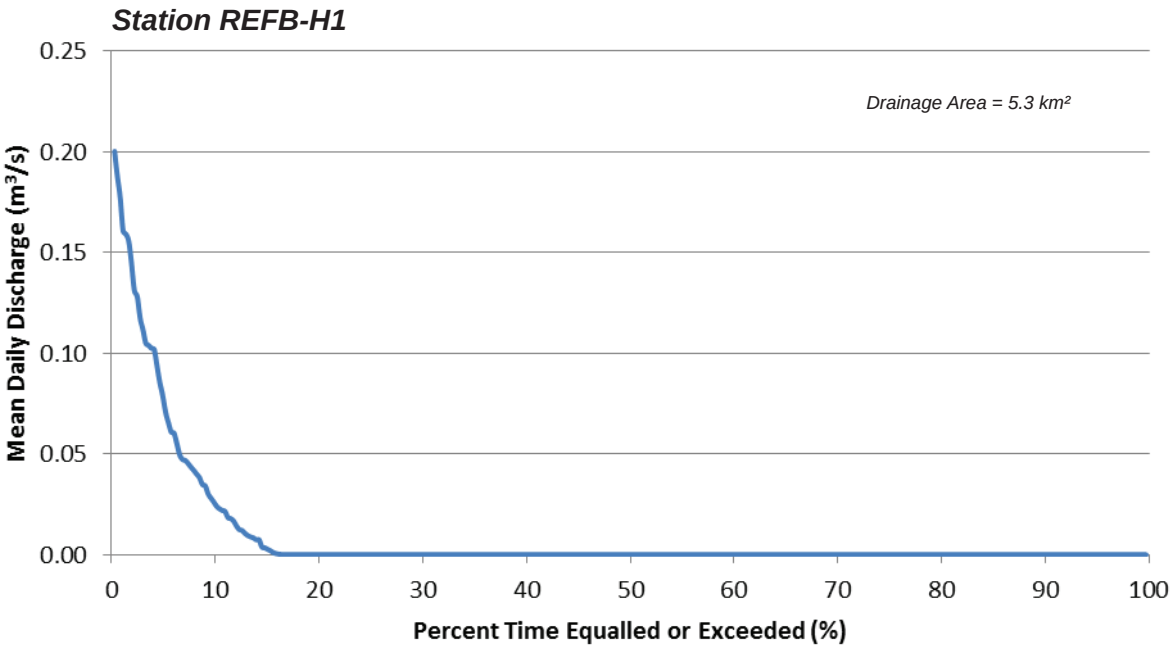


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2011 Flow Duration Curves for Hydrometric Monitoring Stations GI-H1 and WL-H1

Figure 4.5-4

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2011 Flow Duration Curve for Hydrometric Monitoring Station REFB-H1

Figure 4.5-5

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Table 4.5-1. Flow Duration Analysis Exceedance Values and Annual Flow Duration for Stations Located in the Project Area

Hydrometric Station	Drainage Area (km^2)	Flow (m^3/s) Equalled or Exceeded 5% of the Time	Flow (m^3/s) Equalled or Exceeded 10% of the Time	Flow (m^3/s) Equalled or Exceeded 20% of the Time	% of Year with Flow
GL-H1	14.0	0.414(m^3/s)	0.230(m^3/s)	0.027(m^3/s)	33%
GL-H2	1.7	0.093(m^3/s)	0.045(m^3/s)	0.007(m^3/s)	34%
GL-H3	1.8	0.271(m^3/s)	0.116(m^3/s)	<0.001(m^3/s)	21%
PL-H1	204.4	6.036(m^3/s)	3.470(m^3/s)	0.515(m^3/s)	35%
PL-H2	101.5	2.267(m^3/s)	1.479(m^3/s)	0.497(m^3/s)	34%
GI-H1	27.4	0.758(m^3/s)	0.612(m^3/s)	0.280(m^3/s)	36%
EL-H1	1.4	0.024(m^3/s)	0.008(m^3/s)	0.001(m^3/s)	24%
WL-H1	35.1	0.735(m3/s)	0.378(m3/s)	0.073(m3/s)	33%
REFB-H1	5.3	0.071(m3/s)	0.024(m3/s)	0.000(m3/s)	17%

Conversely, larger drainage basins showed a flatter FDC. This reflects a more attenuated response as water was routed through the system (e.g., station PL-H1).

4.6 HYDROLOGIC INDICIES

4.6.1 Annual Runoff

In 2011 the estimated average annual runoff from the gauged drainages in the Goose property area and the adjacent reference drainage was 170 mm, ranging from 56 mm at REFB-H1 to 564 mm at GL-H3. The estimated runoff was generally only slightly higher than the observed runoff for the period of record which ranged from 51 to 477 mm with an average of 144 mm (Table 4.6-1). The differences in observed runoff is likely due to the physical characteristics of the individual drainages including, drainage area, topography (slope and aspect), lake and wetland coverage, amount of exposed bedrock and the depth of the active layer.

The low runoff at REFB-H1 is likely related to the percent of lake coverage in the basin (16.6%), which acts as a storage reservoir. The relative large storage in the watershed coupled to the low relief topography limit drainage and promotes local ponding of runoff. The potential for hydrological losses through evaporation from this drainage basin is great due to the inputs (snowmelt or rainfall) slowly moving through the system and collecting in lakes or other depressions of the flat topography.

In contrast, the highest runoff values observed at GL-H3 may be a result of the low percent of lake coverage (7.5%) and uncharacteristically steep terrain for the Project area. The steeper topography may generate greater runoff by increasing overland flow during snowmelt or rain events. Further, with fewer lakes available for storage this surface runoff directly generates stream flow. Finally, the steep topography will affect snow accumulation and melt rates in the drainage. In order to fully understand the runoff production from individual basins, further work would need to be conducted to characterize the physiography of each basin.

4.6.2 Mean Annual Discharge

Mean annual discharge (MAD) was calculated as an average of the mean daily discharges for the open water period from the beginning of June through September and for the total year (January to December). MAD during the open water season was lowest at EL-H1 (0.010 m^3/s) and highest at PL-H1

(2.387 m^3/s), with an average of 0.501 m^3/s for all the gauged drainages in the project area. MAD calculated for the entire year was much lower due to the large portion of the year with zero flow conditions. On average MAD for the full year was 0.167 m^3/s with a minimum of 0.003 m^3/s at EL-H1 and a maximum of 0.799 m^3/s at PL-H1 (Table 4.6-1).

Table 4.6-1. 2011 Annual Runoff and Mean Annual Discharge for the Goose Property Area

Hydro-metric Station	Drainage Area (km^2)	Observed Runoff (mm)	Period of Record (observed)	Estimated Annual Runoff (mm)	MAD (m^3/s)		% Lake Coverage in Drainage Area
					Open Water	Total	
GL-H1	14.0	112	June 10 to September 16	122	0.163	0.054	10.56
GL-H2	1.7	212	June 10 to September 16	227	0.036	0.012	23.05
GL-H3	1.8	477	June 14 to September 16	564	0.099	0.033	7.51
PL-H1	204.4	110	June 14 to September 17	123	2.387	0.799	18.92
PL-H2	101.5	97	June 11 to September 17	108	1.049	0.350	15.06
GI-H1	27.4	134	June 11 to September 16	157	0.406	0.137	13.28
EL-H1	1.4	61	June 13 to September 16	77	0.010	0.003	2.23
WL-H1	35.1	83	June 10 to September 17	97	0.327	0.109	16.59
REFB-H1	5.3	51	June 13 to September 17	56	0.028	0.009	19.13

4.6.3 Seasonal Runoff Distribution

The seasonal runoff distribution was similar for all the gauged drainages in the Project area (Table 4.6-2, Figure 4.6-1). On average, approximately 75% of runoff occurred in the months of June and July and 22% in September. Only 3% of runoff occurred in August and negligible amounts through the remainder of the year. In most drainages the maximum monthly runoff occurred in June, with exception of GI-H1 where there was slightly more runoff in September and equal runoff amounts during June and July.

Table 4.6-2. 2011 Monthly Runoff Distribution (mm) in the Goose Property Area

Hydrometric Station	Jan-May	June	July	August	September	October	Nov-Dec
GL-H1	0	59	30	3	31	0	0
GL-H2	0	131	50	6	40	0	0
GL-H3	0	335	125	0	104	0	0
PL-H1	0	55	41	3	24	0	0
PL-H2	0	43	24	8	33	0	0
GI-H1	0	45	45	16	50	2	0
EL-H1	0	42	13	2	20	0	0
WL-H1	0	52	22	3	19	0	0
REFB-H1	0	33	16	0	7	0	0

4.6.4 Annual Peak and Low Flow

Observed peak flows for most basins in the Project area occurred in mid-June. Instantaneous peak flows ranged from 0.13 m^3/s at EL-H1 to 8.44 m^3/s, at PL-H1, while daily peak flows ranged from 0.09 to 8.19 m^3/s at the same stations respectively. At EL-H1 the reported instantaneous and daily peak flows occurred on different days because daily peak flow was determined using the estimated freshet daily discharges that were not recorded in the 10 minute (instantaneous) data.

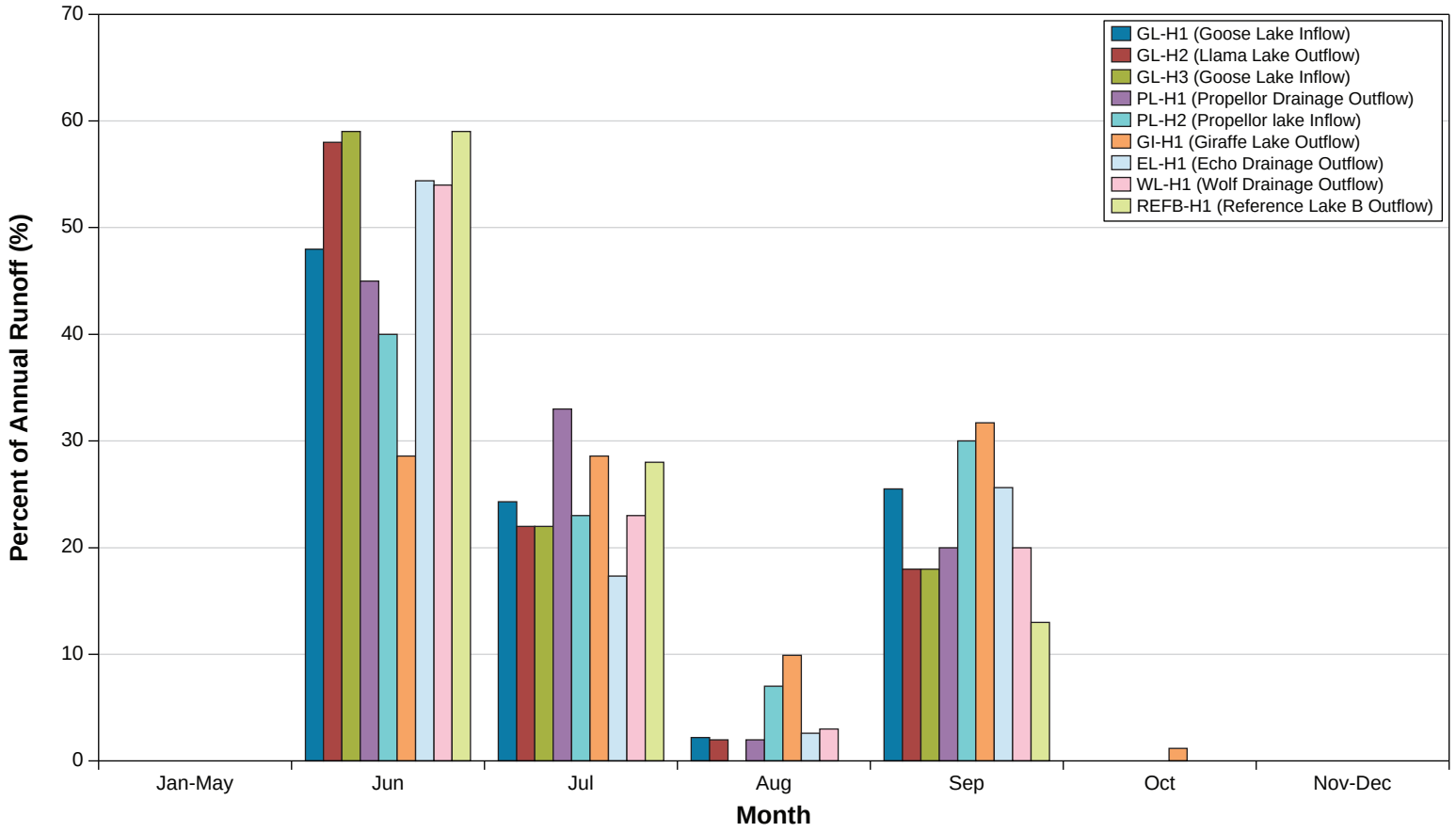


Figure 4.6-1

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Monthly Runoff Distribution for the Goose Property Area

Figure 4.6-1

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Peak unit yields were at a minimum of 35.73 L/s/km^2 at GI-H1 and reached a maximum of 355.16 L/s/km^2 at GL-H3 (Table 4.6-3). This wide range of peak flows was due to the locations of the stations and the size of the drainages being monitored. The general trend observed agreed with previous work that reports that smaller drainage basins typically exhibit higher discharge per unit area than larger ones (Linsley et al. 1982; Eaton et al. 2007). As drainage area increases the potential for hydrological losses increases proportionally, since larger catchments tend to have a larger number of land depressions where water is stored compared to smaller ones. Additionally, it takes longer for water to be routed through a larger watershed, thus runoff becomes attenuated. The largest peak unit yields were observed at the station GL-H3. This is likely due to a combination of the small drainage size and basin characteristics that increase direct runoff by reducing the storage capacity and therefore the potential for losses.

Table 4.6-3. 2011 Peak Flows and Peak Unit Yields

Hydrometric Station	Drainage Area (km^2)	Peak Flow (m^3/s)			Peak Unit Yield (L/s/km^2)	
		Instantaneous	Daily	Date	Instantaneous	Daily
GL-H1	14.0	0.70	0.65	Jul 2	50.14	46.68
GL-H2	1.7	0.19	0.18	Jun 19	114.58	107.43
GL-H3	1.8	0.65	0.57	Jun 14	355.16	313.44
PL-H1	204.4	8.44	8.19	Jun 18 / 16	41.27	40.08
PL-H2	101.5	3.88	3.83	Jun 14	38.23	37.68
GI-H1	27.4	0.98	0.96	Jul 3	35.73	35.07
EL-H1	1.4	0.13 E	0.09	*Jul 1 / Jun 11	62.38	64.31
WL-H1	35.1	1.83	1.74	Jun 13	52.19	49.55
REFB-H1	5.3	0.21	0.20	Jun 12	39.49	37.72

**-Instantaneous and daily peak flow occurred on separate days.*
E- Discharge estimate is greater than 1.5 x the maximum measured discharge.

Annual low flows are expected to reach zero in all the basins once freeze-up occurs, and zero flow conditions will last throughout the winter months (approximately October to May). The observed low flows are those that occurred during the 2011 period of record from early-June the mid-September. Observed low flows for the majority of basins in the Project area occurred in mid-August. The three streams monitored by the hydrometric stations GL-H3, EL-H1 and REFB-H1 experienced zero flow conditions during the open water period starting as early as July 15 and continuing up until September 4 at the reference station REFB-H1 (Table 4.6-4).

Table 4.6-4. 2011 Observed Daily Minimum Flows (June through September)

Hydrometric Station	Drainage Area (km^2)	Daily minimum Flow (m^3/s)	Date
GL-H1	14.0	0.001	August 17
GL-H2	1.7	< 0.001	August 10
GL-H3	1.8	0*	July 17 – August 20
PL-H1	204.4	0.060	August 16
PL-H2	101.5	0.122	August 16
GI-H1	27.4	0.002	August 15
EL-H1	1.4	0*	July 17 – August 16
WL-H1	35.1	0.002	August 15
REFB-H1	5.3	0*	July 15 – September 4

** Dry channel conditions between the indicated dates.*

5. Summary

5. Summary

5.1 SUMMARY

The 2011 hydrology baseline program expanded on baseline data collected in 2010. A monitoring network established in 2010 included two hydrometric stations that collectively monitored a drainage area of 15.7 km^2. In 2011 the existing monitoring network was expanded and included nine hydrometric stations that monitored a total drainage area of 209.8 km^2. The 2011 hydrometric monitoring network focussed on basins around the Goose property area with known deposits located within them. Included in the network was one monitoring station located outside the Project watershed area which was established as a reference monitoring site.

The hydrometric network was operated through the open water season from June 10, 2011 to September 17, 2011. During this time period, continuous time series water level (stage) data were collected at each station and a total of 41 manual discharge measurements were completed. Based on the stage and discharge data collected, stage-discharge rating equations were determined and annual hydrographs produced.

The annual hydrographs show that basins within the Project area have a hydrologic regime characterized by snowmelt driven peak flows during the spring freshet and no flows during the winter. Three prominent peaks were observed in each of the hydrographs. The largest peak flows were driven by snowmelt and occurred during the freshet period in early to mid-June in most basins. A second peak was observed in all basins approximately 19 days after the freshet peak and was the result of precipitation events that occurred in late June and early July. After the July elevated flows, discharge steadily decreased throughout the Project area until mid-August. After this date daily discharges were augmented by rainfall events occurring throughout the second half of August and carrying on through September leading to a third peak evident in most of the hydrographs. After the September precipitation event, flows continued to recede until the end of the monitoring period. Peak flows varied substantially between gauged streams. Instantaneous peak flows ranged from 0.13 m^3/s at the hydrometric station EL-H1 (Echo Drainage outflow) to 8.44 m^3/s at the station PL-H1 (Propellor Drainage outflow).

Volumetric outflows from each of the monitored drainages were generally found to be a function of drainage area. The minimum volumetric outflows were observed at EL-H1 (Echo Drainage outflow; drainage area = 1.4 km^2) which had a total annual water output of 0.11 million cubic meters. The maximum annual volumetric output was 25.31 million cubic meters at PL-H1 (Propellor Drainage outflow; drainage area = 204.4 km^2). The calculated peak unit yields varied among the monitored drainages, generally increasing as drainage area decreased. Peak unit yields were at a minimum of 35.73 $L/s/km^2$ at GI-H1 (Giraffe Lake outflow) and reached a maximum of 355.16 $L/s/km^2$ at GL-H3 (Goose Lake inflow).

Average annual runoff from the monitored region was 170 mm. Runoff varied between drainages from a minimum of 51 mm at REFB-H1 to a maximum of 477 mm at GL-H3 (Goose Lake inflow). Approximately 75% of the annual runoff occurred in June and July, 22% in September, as little as 3% in August and negligible amounts for the remainder of the year. All monitored streams can be considered either intermittent or ephemeral. The majority are considered intermittent (seasonal) with zero flow in the winter when they freeze to their bed. Three of the smaller streams were found to be ephemeral, only carrying water immediately after snowmelt or rainfall events. On average the monitored streams flowed for 30% of the year, and they were either frozen or dry for the remainder of the year.

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Appendix 1

Hydrometric Monitoring Station Information

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Appendix 1.1. Station Information Sheet for Hydrometric Station GL-H1

Site ID:	GL-H1	Drainage Area (km^2):	14.0
Site Location:	Near the mouth of the southwestern inflow to Goose Lake		
UTM:	NAD 83, Zone 13W	430,772 E	7,270,016 N

Benchmarks	Elevation	Description
BM3	100.000	Bolt on left bank upstream of the station
BM4	100.218	Rebar on left bank downstream of the station
BM5	100.527	Rebar on left bank at the data logger box

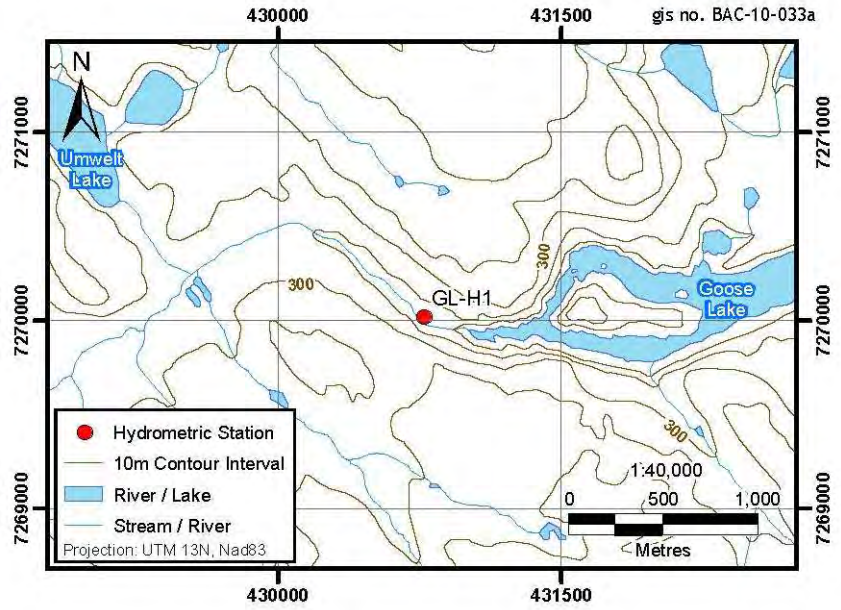
Transducer:	PS-98i	Logger:	ELF-2

Operating Periods:		
2010	June 10- Sep 16	Established June 16, 2010
2011	June 10- Sep 16	

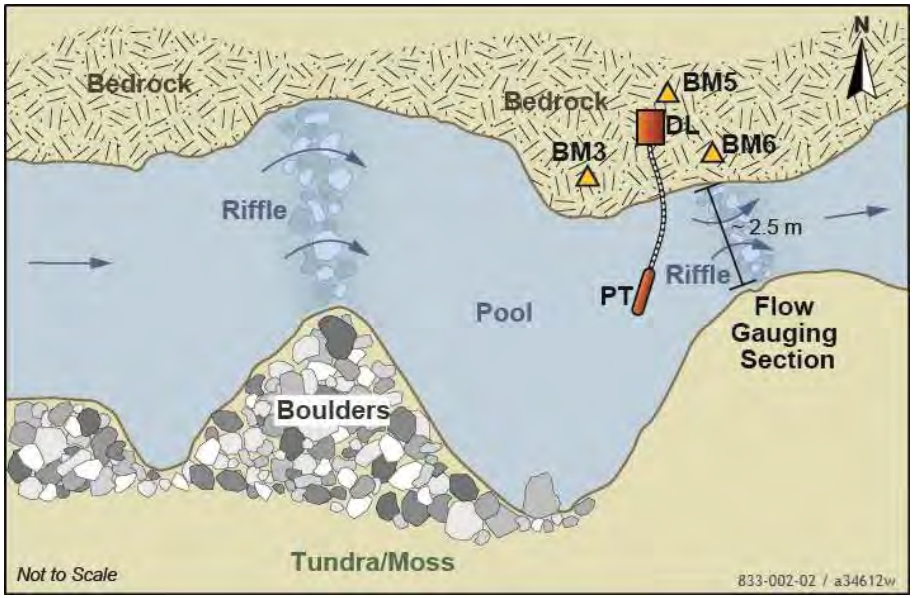
General Comments:

- Location previously established and monitored from 2007 to 2009 as D32 by Gartner Lee.
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station GL-H1



Low angle view looking upstream towards the monitored stream reach. The enclosure for the data logger can be seen on the left bank. September 16, 2011.

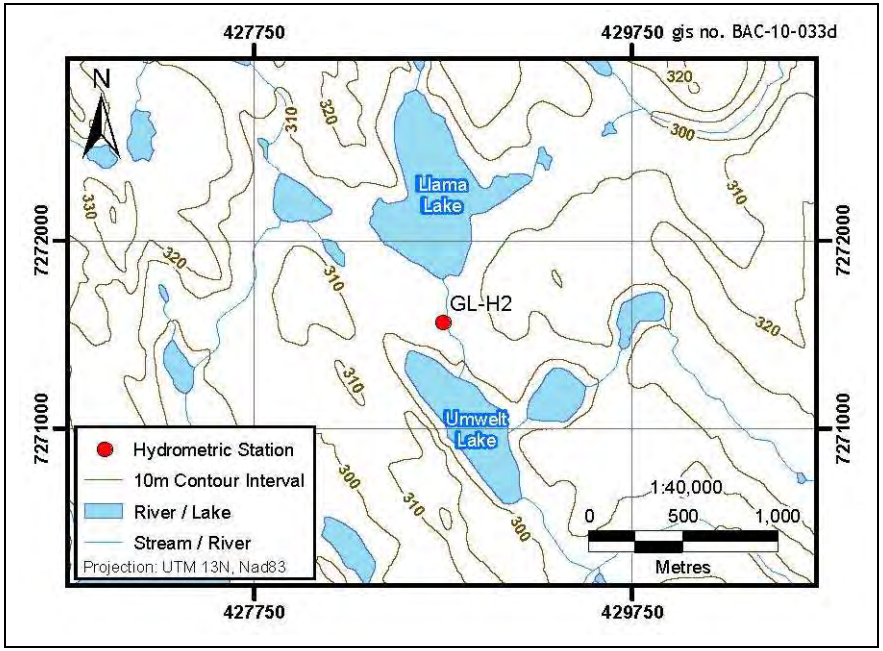
Site Photo

Appendix 1.2. Station Information Sheet for Hydrometric Station GL-H2

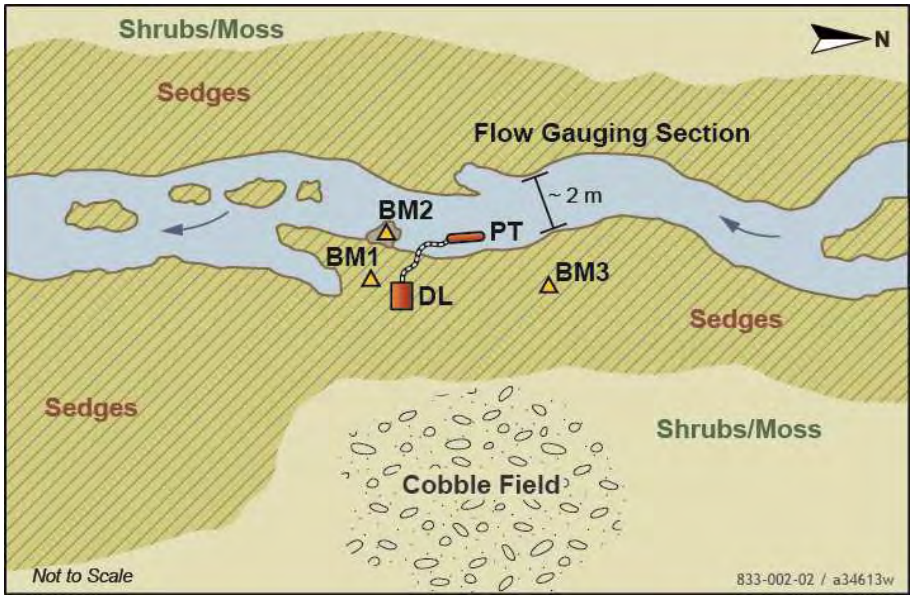
Site ID:	GL-H2	Drainage Area (km^2):	1.7
Site Location:	Llama Lake outflow		
UTM:	NAD 83, Zone 13W	428,746 E	7,271,567 N
Benchmarks	**Elevation**	**Description**	
BM1	100.000	Bolt at base of DL enclosure box	
BM2	99.746	Bolt in boulder embedded in LB	
BM3	99.792	Bolt in buried boulder ~5m upstream of station	
Transducer:	PS-98i	Logger:	ELF-2
Operating Periods:			
2010	July 06- Sept 29	Established June 16, 2010	
2011	June 10 – Sept 16		
General Comments:			

- Relatively low flow
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station GL-H2



Low angle view looking upstream to the north along the monitored stream reach. September 16, 2011.

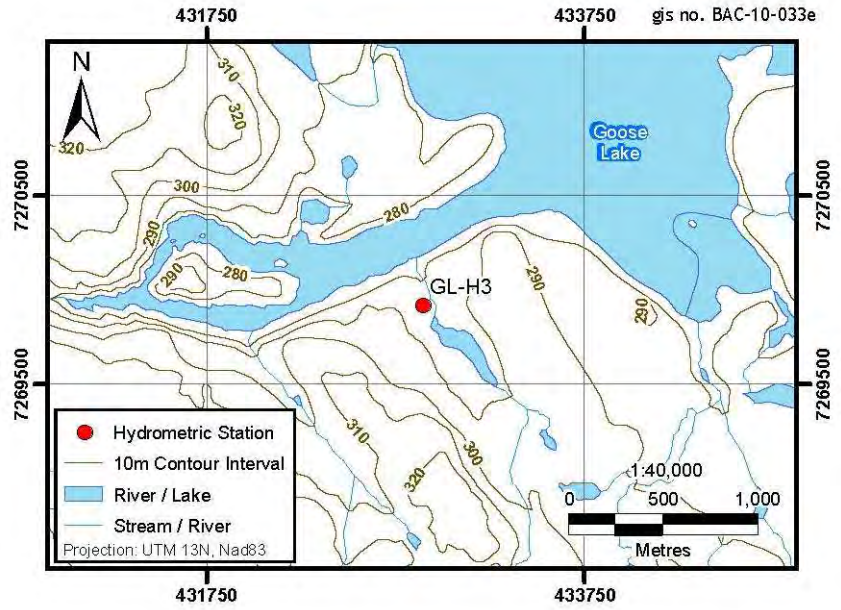
Site Photo

Appendix 1.3. Station Information Sheet for Hydrometric Station GL-H3

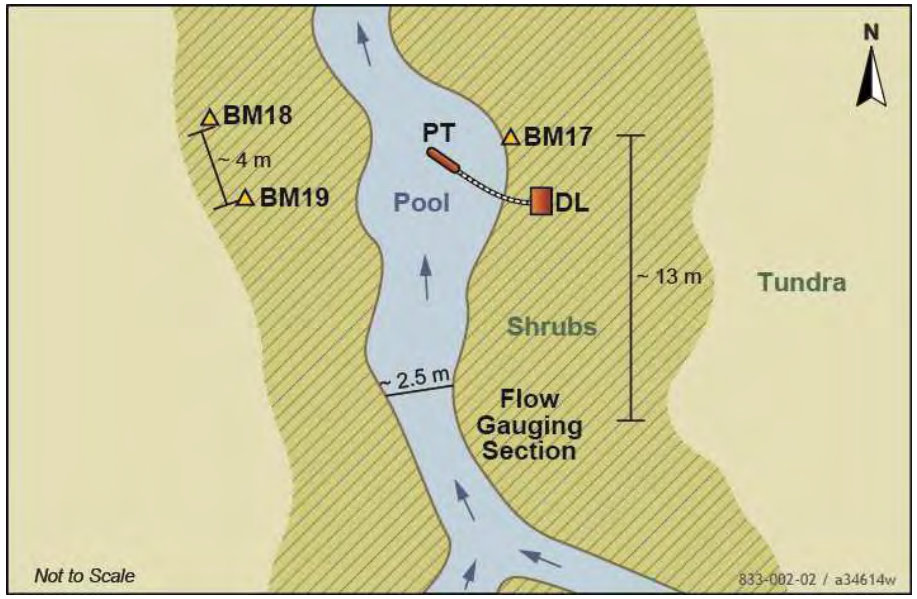
Site ID:	GL-H3	Drainage Area (km^2):	1.8
Site Location:	Near the mouth of a small inflow to the west arm of Goose Lake		
UTM:	NAD 83, Zone 13W	432,891 E	7,269,919 N
Benchmarks	**Elevation**	**Description**	
BM17	100.00	Bolt on right bank downstream of the station	
BM18	100.137	Bolt on left bank downstream of the station	
BM19	100.042	Bolt on left bank even with the station	
Transducer:	PS-98i	Logger:	ELF-2
Operating Periods:			
2011	June 14 - Sep 16	Established June 16, 2011	
General Comments:			

- Zero flow during summer low flow period
- Wadeable under all conditions
- Bench marks marked with rebar stakes for locating
- Access by helicopter or on foot from camp

General Site Information



Site Map



Plan View of Hydrometric Station GL-H3



Low angle view looking downstream along the monitored reach towards Goose Lake's west arm. June 14, 2011.

Site Photo

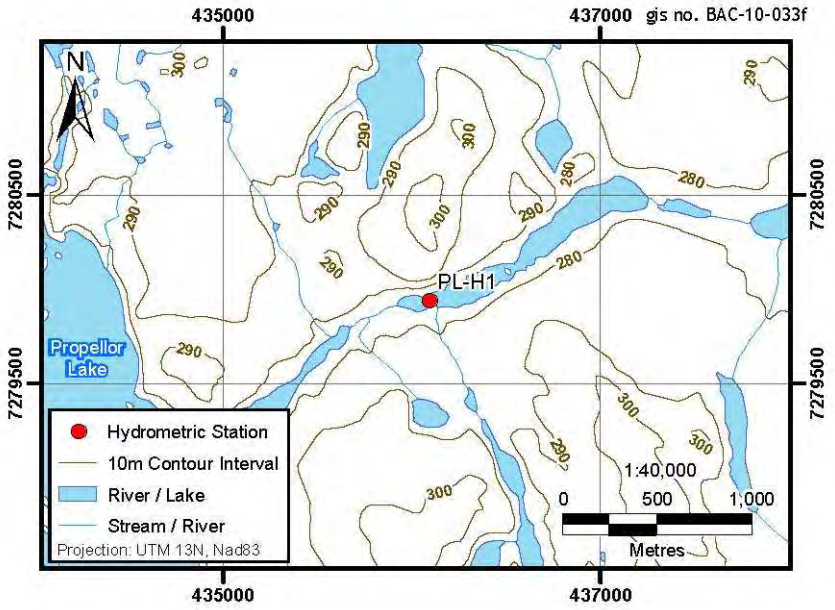
Appendix 1.4. Station Information Sheet for Hydrometric Station PL-H1

Site ID:	PL-H1	Drainage Area (km^2):	204.4
Site Location:	Downstream from Propellor Lake outflow		
UTM:	NAD 83, Zone 13W	436,094 E	7,279,939 W
Benchmarks	**Elevation**	**Description**	
BM8	100.00	Bolt upstream from station	
BM7	99.603	Bolt near station	
BM6	99.539	Bolt sownstream from station	
Transducer:	PS-98i	Logger:	ELF-2
Operating Periods:			
2011	June14 - Sep 17	Established June 14, 2011	

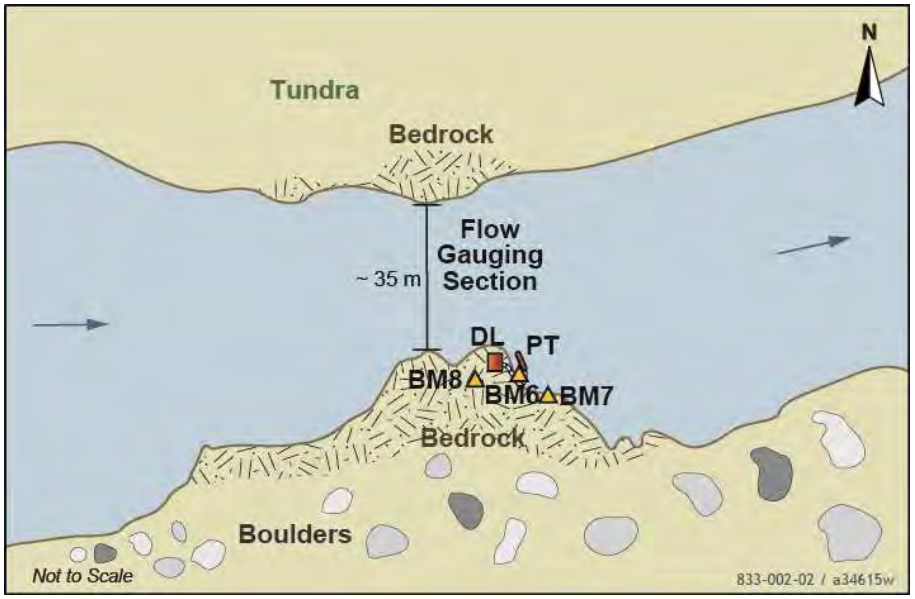
General Comments:

- Boat required to cross channel
- Deep but relatively low velocity reach
- Not wadeable under any conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station PL-H1



Low angle view looking across the channel and slightly upstream towards station PL-H1 and the monitored reach. July 10, 2011.

Site Photo

Appendix 1.5. Station Information Sheet for Hydrometric Station

Site ID:	PL-H2	Drainage Area (km^2):	101.5
Site Location:	Between the outflow of Goose Lake and the inflow of Propellor Lake		
UTM:	NAD 83, Zone 13 W	435,007 E	7,272,014 N

Benchmarks	Elevation	Description
BM4	100.000	Bolt on in-stream boulder near the station
BM45	99.869	Bolt on in-stream boulder near the station
BM46	100.177	Bolt on in-stream boulder near the station

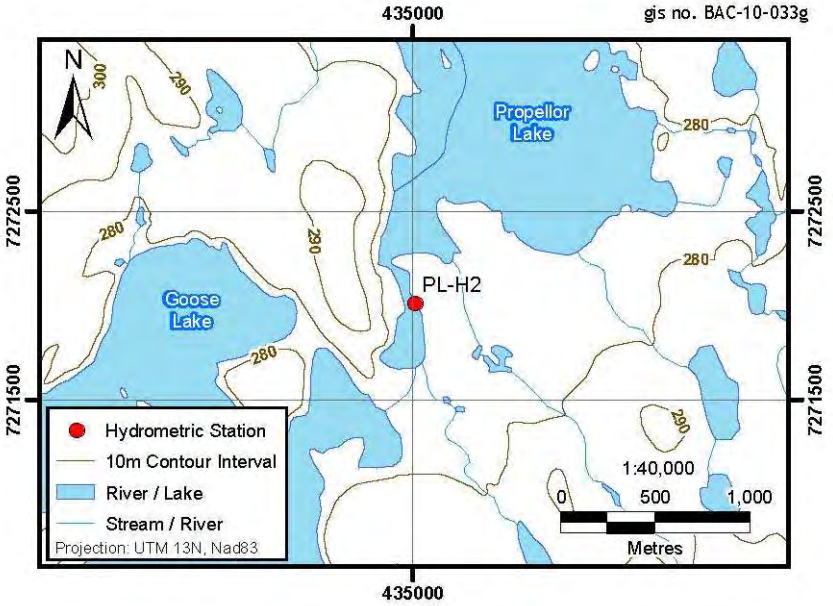
Transducer:	PS-98i	Logger:	ELF-2

Operating Periods:		
2011	June 11 – Sep 17	Established June 11, 2011

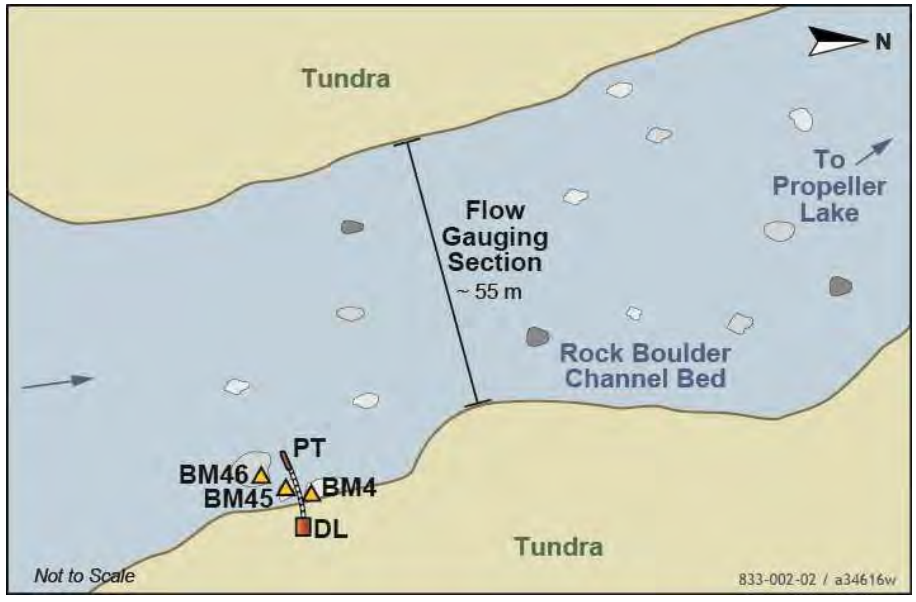
General Comments:

- Wide boulder strewn channel
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station PL-H2



Low angle view looking downstream from the right bank along the monitored stream reach. June 11, 2011.

Site Photo

Appendix 1.6. Station Information Sheet for Hydrometric Station GI-H1

Site ID:	GI-H1	Drainage Area (km^2):	27.4
Site Location:	Outflow of Giraffe Lake		
UTM:	NAD 83, Zone 13W	432,744 E	7,271,610 N

Benchmarks	Elevation	Description
BM5	100.000	Bolt near station
BM47	99.925	Bolt downstream from station
Bm49	100.038	Bolt downstream from station

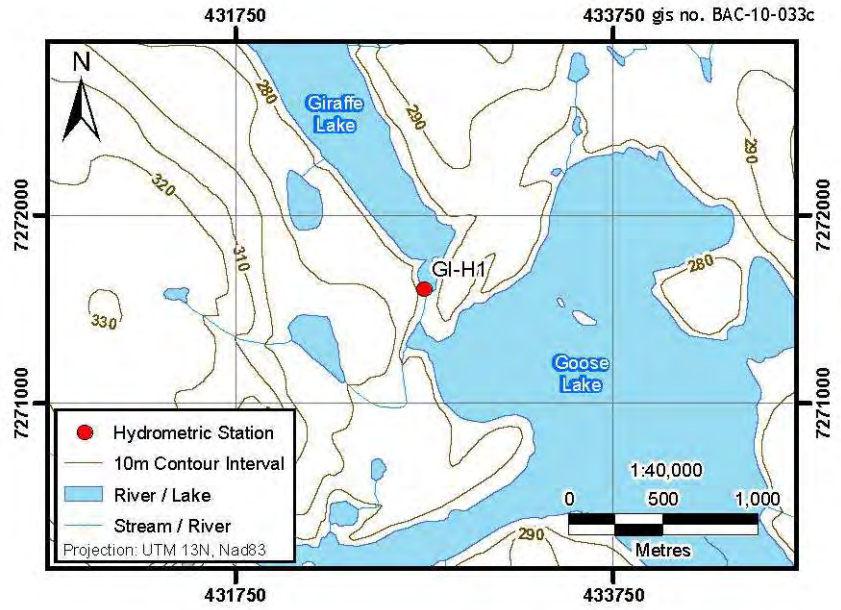
Transducer:	PS-98i	Logger:	ELF2

Operating Periods:		
2011	June 11 - Sep 16	Established June 16, 2011

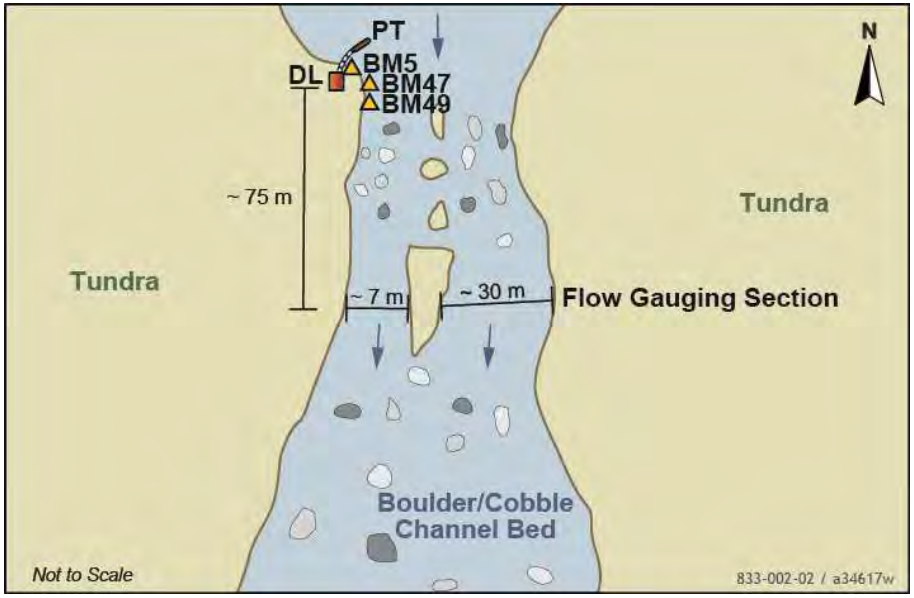
General Comments:

- Wide boulder strewn channel
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station GI-H1



High angle oblique view of Giraffe Lake outflow. Photograph was taken during very low flow conditions. August 13, 2011.

Site Photo

Appendix 1.7. Station Information Sheet for Hydrometric Station EL-H1

Site ID:	EL-H1	Drainage Area (km^2):	1.4
Site Location:	Near the inflow to Goose Lakes west arm		
UTM:	NAD 83, Zone 13W	432,091 E	7,269,573 N

Benchmarks	Elevation	Description
BM14	100.000	Bolt near the station
BM15	99.915	Bolt downstream from the station
BM16	99.984	Bolt upstream from the station

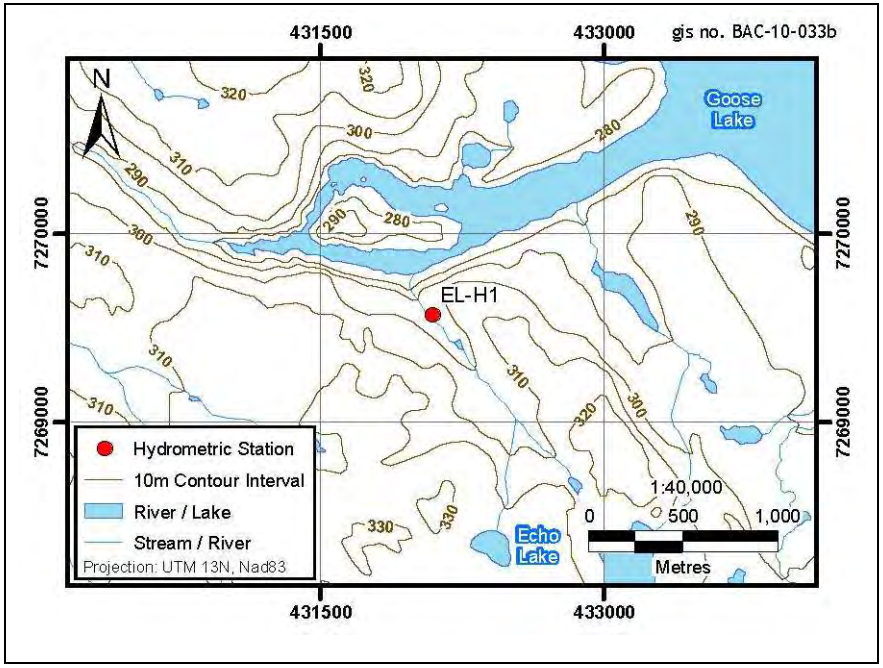
Transducer:	PS-98i	Logger:	ELF-2

Operating Periods:		
2011	June 13 - Sep 16	Established June 13, 2011

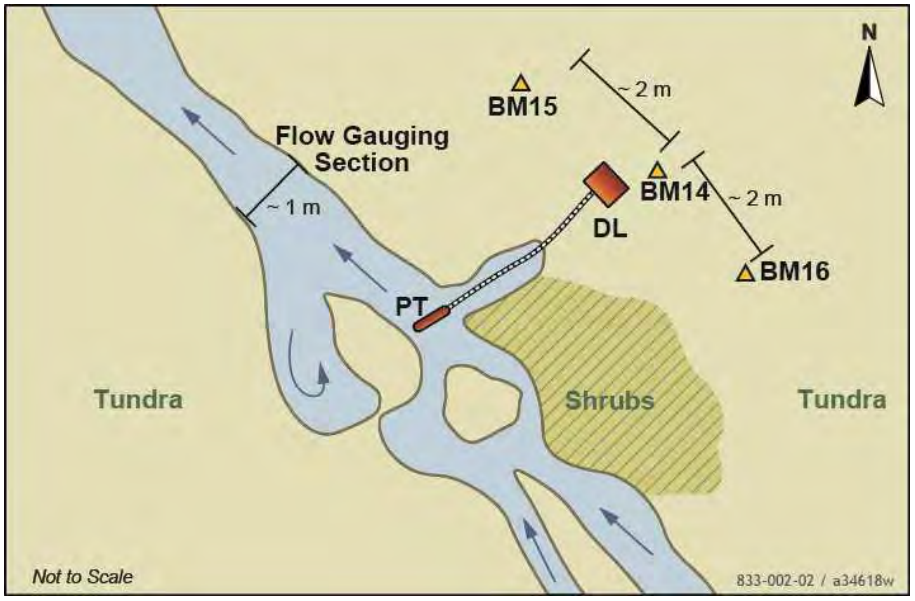
General Comments:

- Ephemeral channel prone to flooding
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station EL-H1



Low angle view looking downstream along the monitored reach. Note the water flowing through the tundra vegetation of this small ephemeral channel. Due to the ephemeral nature of the stream, the channel is lined with grasses. June 13, 2011.

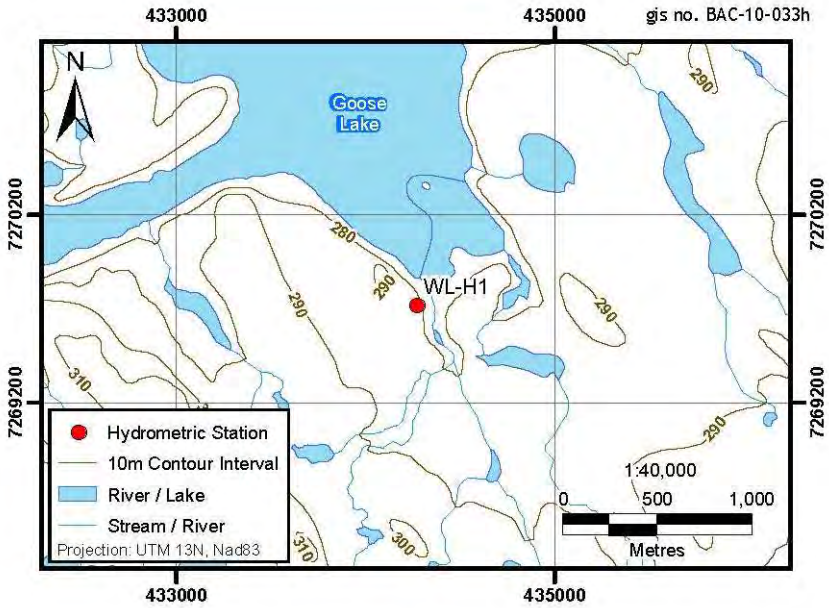
Site Photo

Appendix 1.8. Station Information Sheet for Hydrometric Station WL-H1

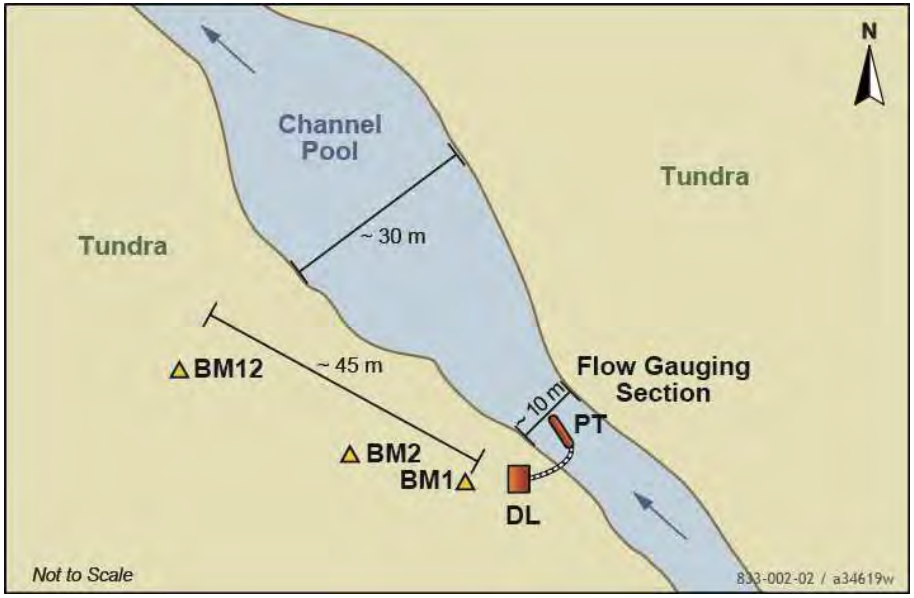
Site ID:	WL-H1	Drainage Area (km^2):	35.1
Site Location:	Near the southern most inflow to Goose Lake		
UTM:	NAD 83, Zone 13W	434,269 E	7,269,719 N
Benchmarks	**Elevation**	**Description**	
BM12	100.00	Bolt ~65m northwest of the station	
BM1	99.207	Tip of drill casing near station	
BM2	99.917	Tip of drill casing between station and BM12	
Transducer:	PS-98i	Logger:	ELF-2
Operating Periods:			
2011	June 10 - Sep 17	Established June 10, 2011	
General Comments:			

- Relatively deep channel
- Relatively low velocity
- Wadeable under most conditions
- Access by helicopter

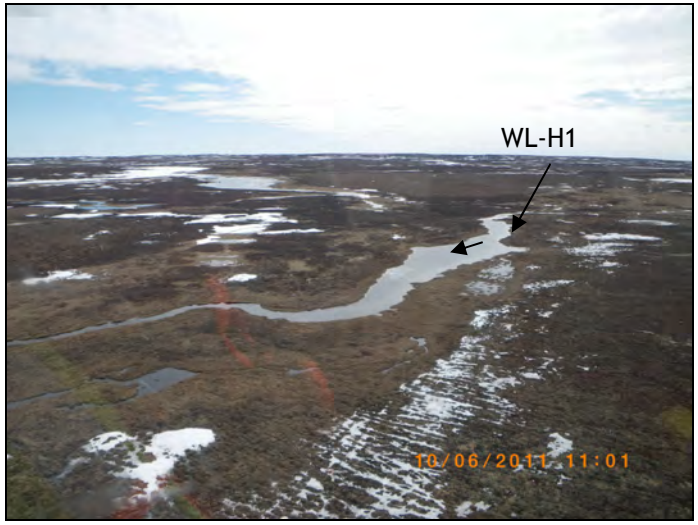
General Site Information



Site Map



Plan View of Hydrometric Station WL-H1



High angle oblique view looking upstream along the monitored reach. The location of the station is indicated in the Photograph. June 10, 2011

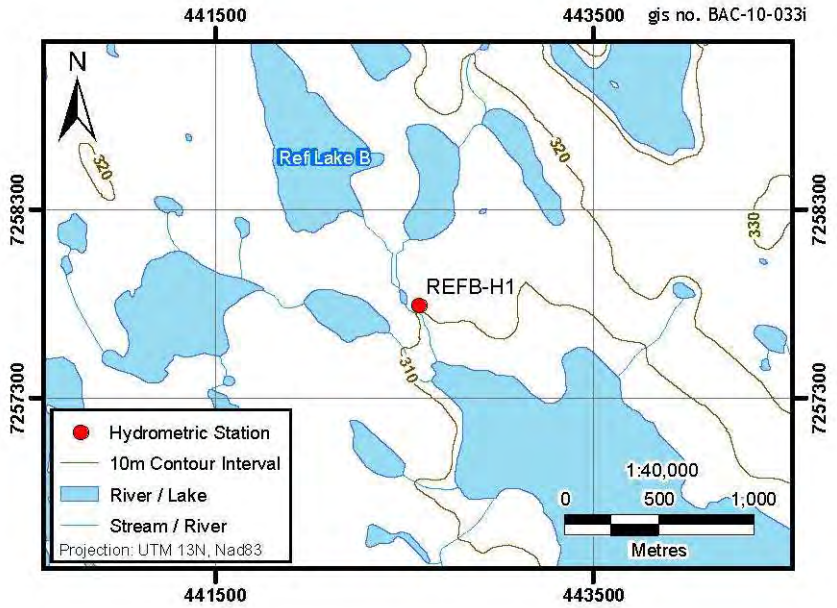
Site Photo

Appendix 1.9. Station Information Sheet for Hydrometric Station REFB-H1

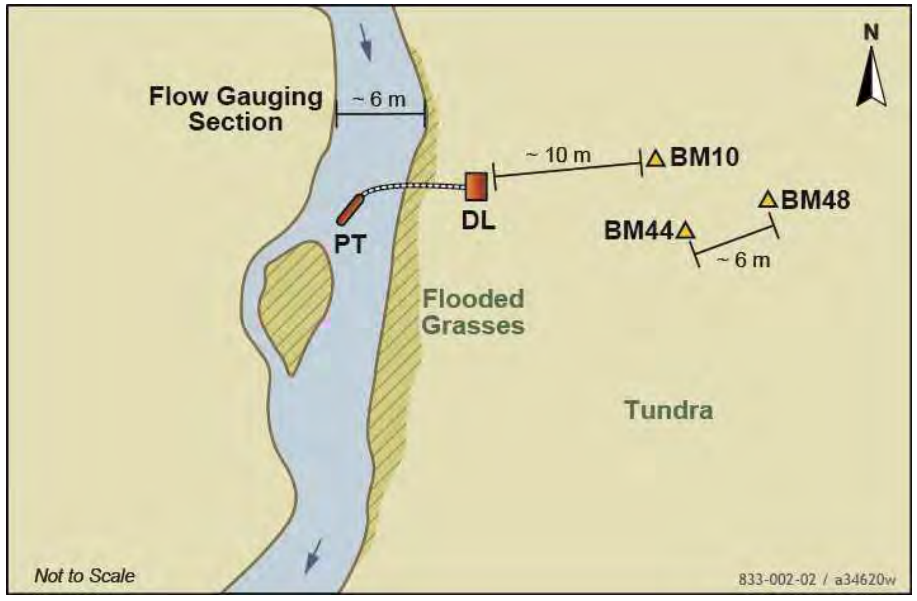
Site ID:	REFB-H1	Drainage Area (km^2):	5.3
Site Location:	Near the outflow of Reference Lake B		
UTM:	NAD 83, Zone 13W	442,573 E	7,257,794 N
Benchmarks	**Elevation**	**Description**	
BM10	100.000	Bolt ~10m west of the data logger	
BM44	99.962	Bolt ~5m south of BM10	
BM48	100.118	Bolt ~ 6m west of BM44	
Transducer:	PS-98i	Logger:	ELF-2
Operating Periods:			
2011	June 13 - Sep 17	Established June 13, 2011	
General Comments:			

- Ephemeral stream
- Soft bed (transducer sinks over the summer)
- Wadeable under all conditions
- Access by helicopter

General Site Information



Site Map



Plan View of Hydrometric Station REFB-H1



High angle oblique view looking east across the monitored reach. The transducer was placed in the pool cantered in the photograph. August 15, 2011.

Site Photo

Appendix 2
Discharge Measurements

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Appendix 2.1. Manual Discharge Measurements at GL-H1 in 2011

Date Monitored:	10-Jun-11	**Pressure Transducer (m):**	0.881
Time (24 hr):	15:40	**Discharge Q (m^3/s):**	0.439
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
left bank	2.00	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.20	0.01	0.00			0.03	0.0010	0.0000	0.01
	2.40	0.21	0.06			0.08	0.0420	0.0033	0.75
	2.60	0.34	0.01			0.03	0.0680	0.0023	0.53
	2.80	0.28	0.07			0.09	0.0560	0.0049	1.12
	3.00	0.25	0.12			0.13	0.0500	0.0066	1.51
	3.20	0.41	0.07			0.09	0.0820	0.0072	1.64
	3.40	0.36	0.12			0.13	0.0720	0.0096	2.18
	3.60	0.38	0.10			0.11	0.0760	0.0087	1.99
	3.80	0.38	0.25			0.25	0.0760	0.0190	4.31
	4.00	0.32	0.26			0.26	0.0640	0.0165	3.76
	4.20	0.39	0.35			0.34	0.0780	0.0265	6.02
	4.40	0.44	0.36			0.35	0.0880	0.0307	6.99
	4.60	0.46	0.39			0.38	0.0920	0.0347	7.91
	4.80	0.38	0.39			0.38	0.0760	0.0287	6.53
	5.00	0.63	0.33			0.32	0.1260	0.0405	9.21
	5.20	0.61	0.40			0.39	0.1220	0.0472	10.75
	5.40	0.66	0.42			0.41	0.1320	0.0536	12.21
	5.60	0.68	0.46			0.44	0.1360	0.0605	13.76
	5.80	0.15	0.28			0.28	0.0300	0.0083	1.89
	6.00	0.15	0.28			0.28	0.0300	0.0083	1.89
	6.20	0.11	0.29			0.29	0.0220	0.0063	1.43
	6.40	0.12	0.27			0.27	0.0240	0.0064	1.46
	6.60	0.14	0.15			0.16	0.0280	0.0045	1.02
	6.80	0.15	0.16			0.17	0.0300	0.0051	1.15
right bank	7.00	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.439**	

Appendix 2.1. Manual Discharge Measurements at GL-H1 in 2011

Date Monitored:	15-Jun-11	**Pressure Transducer (m):**	0.948
Time (24 hr):	13:50	**Mean Discharge Q (m^3/s):**	0.615
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s) 60%	20%	80%	Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
right bank	7.40	0.00	0.00			0.03	0.0000	0.0000	0.00
	7.30	0.26	0.31			0.30	0.0390	0.0118	1.92
	7.10	0.35	0.11			0.12	0.0700	0.0087	1.41
	6.90	0.22	0.41			0.40	0.0440	0.0175	2.84
	6.70	0.14	0.38			0.37	0.0280	0.0103	1.68
	6.50	0.19	0.44			0.43	0.0380	0.0162	2.63
	6.30	0.85	0.28	0.46	0.10	0.28	0.1700	0.0470	7.64
	6.10	0.77	0.45	0.47	0.42	0.43	0.1540	0.0663	10.77
	5.90	0.69	0.43			0.42	0.1380	0.0574	9.33
rock in 80% reading	5.70	0.79	0.26	0.46	0.06	0.26	0.1580	0.0408	6.64
	5.50	0.62	0.38			0.37	0.1230	0.0453	7.36
	5.30	0.71	0.40			0.39	0.1420	0.0550	8.94
	5.10	0.55	0.41			0.40	0.1100	0.0437	7.10
	4.90	0.56	0.38			0.37	0.1120	0.0412	6.70
	4.70	0.43	0.38			0.37	0.0860	0.0317	5.15
	4.50	0.44	0.34			0.33	0.0880	0.0291	4.72
	4.30	0.44	0.15			0.16	0.0870	0.0139	2.26
	4.10	0.40	0.23			0.23	0.0800	0.0185	3.01
	3.90	0.44	0.18			0.19	0.0880	0.0164	2.67
	3.70	0.50	0.13			0.14	0.1000	0.0142	2.30
	3.50	0.42	0.14			0.15	0.0840	0.0127	2.06
	3.30	0.40	0.12			0.13	0.0800	0.0106	1.73
	3.10	0.27	0.08			0.10	0.0472	0.0046	0.74
	2.95	0.38	0.03			0.05	0.0494	0.0026	0.42
left bank	2.84	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.615**	

Note: if taking velocity readings at 20% and 80% of water depth then the 60% velocity value will be calculated as follows.

V60% = (V20% +V80%)/2

Appendix 2.1. Manual Discharge Measurements at GL-H1 in 2011

Date Monitored:	8-Jul-11	**Pressure Transducer (m):**	0.772
Time (24 hr):	16:00	**Mean Discharge Q (m^3/s):**	0.247
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

			Velocity (m/s)			Cross Sectional		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
RB	1.05	0.00	0.00			0.0000	0.0000	0.00
	1.10	0.07	0.10			0.0088	0.0009	0.35
	1.30	0.17	0.08			0.0340	0.0027	1.10
	1.50	0.16	0.14			0.0320	0.0045	1.81
	1.70	0.26	0.12			0.0520	0.0062	2.52
	1.90	0.25	0.14			0.0500	0.0070	2.83
	2.10	0.46	0.09			0.0920	0.0083	3.35
	2.30	0.47	0.08			0.0940	0.0075	3.04
	2.50	0.66	0.24			0.0990	0.0238	9.61
	2.60	0.65	0.19			0.0650	0.0124	4.99
	2.70	0.50	0.36			0.0500	0.0180	7.28
	2.80	0.40	0.43			0.0400	0.0172	6.96
	2.90	0.35	0.48			0.0350	0.0168	6.79
	3.00	0.32	0.44			0.0480	0.0211	8.54
	3.20	0.25	0.43			0.0500	0.0215	8.69
	3.40	0.20	0.43			0.0400	0.0172	6.96
	3.60	0.21	0.37			0.0420	0.0155	6.28
	3.80	0.22	0.33			0.0440	0.0145	5.87
	4.00	0.18	0.36			0.0360	0.0130	5.24
	4.20	0.14	0.37			0.0280	0.0104	4.19
	4.40	0.10	0.34			0.0200	0.0068	2.75
	4.60	0.04	0.23			0.0090	0.0021	0.84
	4.85	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.247**	

Appendix 2.1. Manual Discharge Measurements at GL-H1 in 2011

Date Monitored:	14-Aug-11	**Pressure Transducer (m):**	0.087
Time (24 hr):	11:50	**Mean Discharge Q (m^3/s):**	0.007
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.80	0.00	0.00			0.0000	0.0000	0.00
	1.85	0.09	0.02			0.0068	0.0001	1.96
	1.95	0.10	0.00			0.0100	0.0000	0.00
	2.05	0.11	0.00			0.0110	0.0000	0.00
	2.15	0.10	-0.01			0.0100	-0.0001	-1.45
	2.25	0.10	-0.01			0.0100	-0.0001	-1.45
	2.35	0.12	0.01			0.0120	0.0001	1.74
	2.45	0.10	0.03			0.0075	0.0002	3.26
	2.50	0.09	0.02			0.0045	0.0001	1.30
	2.55	0.08	0.01			0.0040	0.0000	0.58
	2.60	0.11	0.03			0.0055	0.0002	2.39
	2.65	0.20	0.09			0.0100	0.0009	13.03
	2.70	0.19	0.12			0.0095	0.0011	16.51
	2.75	0.17	0.14			0.0085	0.0012	17.23
	2.80	0.16	0.13			0.0080	0.0010	15.06
	2.85	0.13	0.11			0.0065	0.0007	10.35
	2.90	0.12	0.11			0.0060	0.0007	9.56
	2.95	0.11	0.08			0.0055	0.0004	6.37
	3.00	0.10	0.03			0.0075	0.0002	3.26
	3.10	0.02	0.01			0.0020	0.0000	0.29
	3.20	0.06	0.00			0.0105	0.0000	0.00
left bank	3.45	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.007**	

Appendix 2.1. Manual Discharge Measurements at GL-H1 in 2011

Date Monitored:	16-Sep-11	**Pressure Transducer (m):**	0.814
Time (24 hr):	13:08	**Mean Discharge Q (m^3/s):**	0.270
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

			Velocity (m/s)			Cross Sectional		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
right bank	0.35	0.00	0.00			0.0000	0.0000	0.00
	0.40	0.08	0.16			0.0060	0.0010	0.36
	0.50	0.04	0.16			0.0040	0.0006	0.24
	0.60	0.18	0.32			0.0180	0.0058	2.13
	0.70	0.22	0.32			0.0220	0.0070	2.60
	0.80	0.44	0.38			0.0440	0.0167	6.18
	0.90	0.44	0.46			0.0440	0.0202	7.49
	1.00	0.41	0.54			0.0410	0.0221	8.19
	1.10	0.51	0.49			0.0510	0.0250	9.24
	1.20	0.36	0.55			0.0360	0.0198	7.32
	1.30	0.34	0.55			0.0340	0.0187	6.92
	1.40	0.33	0.61			0.0330	0.0201	7.45
	1.50	0.26	0.56			0.0260	0.0146	5.39
	1.60	0.24	0.61			0.0240	0.0146	5.41
	1.70	0.20	0.60			0.0200	0.0120	4.44
	1.80	0.18	0.59			0.0180	0.0106	3.93
	1.90	0.17	0.61			0.0170	0.0104	3.84
	2.00	0.17	0.52			0.0170	0.0088	3.27
	2.10	0.24	0.45			0.0240	0.0108	3.99
	2.20	0.28	0.39			0.0280	0.0109	4.04
	2.30	0.26	0.33			0.0260	0.0086	3.17
	2.40	0.25	0.21			0.0250	0.0053	1.94
	2.50	0.28	0.00			0.0280	0.0000	0.00
	2.60	0.17	0.25			0.0170	0.0043	1.57
	2.70	0.13	0.14			0.0130	0.0018	0.67
	2.80	0.11	0.04			0.0110	0.0004	0.16
	2.90	0.08	0.02			0.0080	0.0002	0.06
	3.00	0.08	0.00			0.0080	0.0000	0.00
left bank	3.10	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.270**	

Appendix 2.2. Manual Discharge Measurements at GL-H2 in 2011

Date Monitored:	10-Jun-11	**Pressure Transducer (m):**	0.297
Time (24 hr):	18:00	**Discharge Q (m^3/s):**	0.075
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
left bank	3.30	0.00	0.00			0.03	0.0000	0.0000	0.00
	3.15	0.14	0.16			0.17	0.0175	0.0030	3.92
	3.05	0.17	0.23			0.23	0.0170	0.0039	5.22
	2.95	0.19	0.25			0.25	0.0190	0.0047	6.29
	2.85	0.19	0.22			0.22	0.0190	0.0042	5.61
	2.75	0.20	0.22			0.22	0.0200	0.0045	5.91
	2.65	0.20	0.18			0.19	0.0200	0.0037	4.95
	2.55	0.19	0.22			0.22	0.0190	0.0042	5.61
behind rock	2.45	0.15	0.01			0.03	0.0150	0.0005	0.68
behind rock	2.35	0.15	0.04			0.06	0.0150	0.0009	1.21
	2.25	0.21	0.16			0.17	0.0210	0.0035	4.70
	2.15	0.21	0.12			0.13	0.0210	0.0028	3.70
	2.05	0.22	0.12			0.13	0.0220	0.0029	3.88
	1.95	0.21	0.07			0.09	0.0210	0.0018	2.45
	1.85	0.22	0.08			0.10	0.0220	0.0021	2.83
	1.75	0.24	0.13			0.14	0.0240	0.0034	4.51
	1.65	0.24	0.08			0.10	0.0240	0.0023	3.09
	1.55	0.20	0.25			0.25	0.0200	0.0050	6.62
	1.45	0.18	0.30			0.29	0.0180	0.0053	7.03
	1.35	0.18	0.29			0.29	0.0180	0.0051	6.82
	1.25	0.18	0.24			0.24	0.0180	0.0043	5.74
	1.15	0.21	0.17			0.18	0.0210	0.0037	4.95
	1.05	0.17	0.13			0.14	0.0145	0.0020	2.72
	0.98	0.15	0.06			0.08	0.0150	0.0012	1.57
right bank	0.85	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.075**	

Appendix 2.2. Manual Discharge Measurements at GL-H2 in 2011

Date Monitored:	15-Jun-11	**Pressure Transducer (m):**	0.342
Time (24 hr):	8:20	**Discharge Q (m^3/s):**	0.121
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
right bank	1.50	0.00	0.00			0.03	0.0000	0.0000	0.00
	1.60	0.16	0.08			0.10	0.0160	0.0016	1.28
	1.70	0.16	0.25			0.25	0.0160	0.0040	3.28
	1.80	0.15	0.26			0.26	0.0150	0.0039	3.19
	1.90	0.20	0.28			0.28	0.0200	0.0055	4.55
	2.00	0.21	0.36			0.35	0.0210	0.0073	6.03
	2.10	0.22	0.38			0.37	0.0220	0.0081	6.66
	2.20	0.24	0.32			0.31	0.0240	0.0075	6.17
rock ~1m upstream	2.30	0.27	0.15			0.16	0.0270	0.0043	3.55
rock ~1m upstream	2.40	0.28	0.14			0.15	0.0280	0.0042	3.47
rock ~1m upstream	2.50	0.25	0.21			0.21	0.0250	0.0053	4.39
rock ~1m upstream	2.60	0.24	0.16			0.17	0.0240	0.0040	3.33
rock ~1m upstream	2.70	0.25	0.18			0.19	0.0250	0.0047	3.84
rock ~1m upstream	2.80	0.23	0.20			0.20	0.0230	0.0047	3.87
	2.90	0.24	0.29			0.29	0.0240	0.0068	5.64
rock upstream	3.00	0.26	0.07			0.09	0.0260	0.0023	1.88
rock upstream	3.10	0.16	0.06			0.08	0.0160	0.0013	1.04
	3.20	0.20	0.27			0.27	0.0200	0.0053	4.40
	3.30	0.20	0.36			0.35	0.0200	0.0070	5.74
	3.40	0.20	0.32			0.31	0.0200	0.0062	5.14
	3.50	0.23	0.35			0.34	0.0225	0.0076	6.28
	3.60	0.21	0.37			0.36	0.0210	0.0075	6.20
	3.70	0.20	0.31			0.30	0.0200	0.0061	4.99
	3.80	0.19	0.24			0.24	0.0161	0.0039	3.20
	3.87	0.20	0.13			0.14	0.0160	0.0023	1.87
left bank	3.96	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.121**	

Appendix 2.2. Manual Discharge Measurements at GL-H2 in 2011

Date Monitored:	8-Jul-11	**Pressure Transducer (m):**	0.284
Time (24 hr):	14:50	**Discharge Q (m^3/s):**	0.063
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
left bank	0.80	0.00	0.00			0.0000	0.0000	0.00
grass	1.00	0.06	0.00			0.0120	0.0000	0.00
	1.20	0.10	0.02			0.0150	0.0003	0.48
	1.30	0.11	0.14			0.0110	0.0015	2.45
	1.40	0.18	0.22			0.0180	0.0040	6.30
	1.50	0.18	0.21			0.0180	0.0038	6.02
	1.60	0.18	0.29			0.0180	0.0052	8.31
	1.70	0.22	0.29			0.0220	0.0064	10.16
	1.80	0.22	0.27			0.0220	0.0059	9.46
	1.90	0.22	0.31			0.0220	0.0068	10.86
	2.00	0.22	0.17			0.0220	0.0037	5.95
	2.10	0.22	0.13			0.0220	0.0029	4.55
	2.20	0.22	0.04			0.0220	0.0009	1.40
	2.30	0.20	0.27			0.0200	0.0054	8.60
	2.40	0.16	0.20			0.0160	0.0032	5.09
	2.50	0.16	0.16			0.0160	0.0026	4.08
	2.60	0.14	0.28			0.0140	0.0039	6.24
	2.70	0.14	0.15			0.0140	0.0021	3.34
	2.80	0.21	0.10			0.0210	0.0021	3.34
	2.90	0.26	0.07			0.0260	0.0018	2.90
	3.00	0.24	0.01			0.0300	0.0003	0.48
right bank	3.15	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.063**	

Appendix 2.2. Manual Discharge Measurements at GL-H2 in 2011

Date Monitored:	12-Aug-11	**Pressure Transducer (m):**	0.177
Time (24 hr):	14:40	**Discharge Q (m^3/s):**	0.000
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
left bank	1.95	0.00	0.00			0.0000	0.0000	0.00
	2.05	0.09	-0.01			0.0068	-0.0001	-23.08
	2.10	0.12	0.00			0.0090	0.0000	0.00
	2.20	0.15	0.01			0.0150	0.0002	51.28
	2.30	0.21	0.00			0.0210	0.0000	0.00
	2.40	0.22	-0.01			0.0220	-0.0002	-75.21
	2.50	0.23	0.00			0.0230	0.0000	0.00
	2.60	0.22	0.01			0.0220	0.0002	75.21
	2.70	0.20	-0.01			0.0200	-0.0002	-68.38
	2.80	0.21	-0.01			0.0210	-0.0002	-71.79
	2.90	0.14	0.01			0.0140	0.0001	47.86
	3.00	0.17	0.01			0.0170	0.0002	58.12
	3.10	0.13	0.01			0.0130	0.0001	44.44
	3.20	0.17	-0.01			0.0170	-0.0002	-58.12
	3.30	0.16	0.00			0.0160	0.0000	0.00
	3.40	0.16	0.00			0.0160	0.0000	0.00
	3.50	0.14	0.01			0.0105	0.0001	35.90
	3.55	0.11	0.02			0.0055	0.0001	37.61
	3.60	0.11	0.01			0.0055	0.0001	18.80
	3.65	0.16	0.01			0.0080	0.0001	27.35
	3.70	0.12	0.00			0.0090	0.0000	0.00
	3.80	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.000**	

Appendix 2.2. Manual Discharge Measurements at GL-H2 in 2011

Date Monitored:	16-Sep-11	**Pressure Transducer (m):**	0.275
Time (24 hr):	11:00	**Discharge Q (m^3/s):**	0.046
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	0.50	0.00	0.00			0.0000	0.0000	0.00
	0.60	0.08	-0.02			0.0080	-0.0002	-0.35
	0.70	0.18	0.13			0.0180	0.0023	5.07
	0.80	0.16	0.22			0.0160	0.0035	7.62
	0.90	0.21	0.06			0.0210	0.0013	2.73
	1.00	0.18	0.23			0.0180	0.0041	8.96
	1.10	0.22	0.17			0.0220	0.0037	8.10
	1.20	0.16	0.26			0.0160	0.0042	9.01
	1.30	0.15	0.18			0.0150	0.0027	5.85
	1.40	0.20	0.02			0.0200	0.0004	0.87
	1.50	0.20	0.21			0.0200	0.0042	9.09
	1.60	0.20	0.22			0.0200	0.0044	9.53
	1.70	0.19	0.21			0.0190	0.0040	8.64
	1.80	0.20	0.19			0.0200	0.0038	8.23
	1.90	0.18	0.12			0.0180	0.0022	4.68
	2.00	0.19	0.10			0.0190	0.0019	4.11
	2.10	0.16	0.17			0.0160	0.0027	5.89
	2.20	0.12	0.06			0.0120	0.0007	1.56
	2.30	0.10	0.02			0.0100	0.0002	0.43
	2.40	0.06	0.00			0.0045	0.0000	0.00
	2.45	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.046**	

Appendix 2.3. Manual Discharge Measurements at GL-H3 in 2011

Date Monitored:	14-Jun-11	**Pressure Transducer (m):**	0.962
Time (24 hr):	11:00	**Discharge Q (m^3/s):**	0.648
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
right bank	2.60	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.90	0.17	0.03			0.05	0.0340	0.0018	0.27
	3.00	0.21	0.31			0.30	0.0210	0.0064	0.98
	3.10	0.29	0.60			0.58	0.0290	0.0168	2.59
	3.20	0.30	0.65			0.63	0.0300	0.0188	2.90
	3.30	0.35	0.69			0.67	0.0350	0.0233	3.59
	3.40	0.34	0.61			0.59	0.0340	0.0200	3.09
	3.50	0.36	0.59			0.57	0.0360	0.0205	3.16
	3.60	0.37	0.96			0.92	0.0370	0.0342	5.27
	3.70	0.38	1.16			1.12	0.0380	0.0424	6.54
	3.80	0.44	1.15			1.11	0.0440	0.0487	7.51
	3.90	0.48	1.13			1.09	0.0480	0.0522	8.05
	4.00	0.50	1.19			1.14	0.0500	0.0572	8.83
	4.10	0.47	1.26			1.21	0.0470	0.0569	8.78
	4.20	0.43	1.31			1.26	0.0425	0.0535	8.26
	4.30	0.41	1.33			1.28	0.0410	0.0524	8.09
	4.40	0.40	1.37			1.32	0.0400	0.0527	8.13
	4.50	0.35	0.94			0.90	0.0350	0.0317	4.89
	4.60	0.30	0.79			0.76	0.0300	0.0228	3.52
	4.70	0.24	0.52			0.50	0.0240	0.0121	1.86
	4.80	0.18	0.67			0.65	0.0180	0.0116	1.79
	4.90	0.14	0.52			0.50	0.0245	0.0123	1.90
left bank	5.15	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.648**	

Appendix 2.3. Manual Discharge Measurements at GL-H3 in 2011

Date Monitored:	15-Jun-11	**Pressure Transducer (m):**	0.943
Time (24 hr):	17:00	**Discharge Q (m^3/s):**	0.478
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
right bank	2.60	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.80	0.08	0.00			0.03	0.0120	0.0003	0.06
	2.90	0.18	0.00			0.03	0.0180	0.0005	0.09
	3.00	0.20	0.19			0.20	0.0200	0.0039	0.82
	3.10	0.26	0.24			0.24	0.0260	0.0063	1.31
	3.20	0.29	0.75			0.72	0.0290	0.0210	4.38
	3.30	0.32	0.60			0.58	0.0320	0.0185	3.87
	3.40	0.37	0.50			0.48	0.0370	0.0179	3.74
	3.50	0.38	0.51			0.49	0.0380	0.0187	3.91
	3.60	0.36	0.97			0.93	0.0360	0.0336	7.03
	3.70	0.38	1.00			0.96	0.0380	0.0366	7.64
	3.80	0.41	0.95			0.91	0.0410	0.0375	7.84
	3.90	0.45	0.97			0.93	0.0450	0.0420	8.78
	4.00	0.44	0.96			0.92	0.0440	0.0406	8.50
	4.10	0.42	1.05			1.01	0.0420	0.0424	8.87
	4.20	0.39	1.12			1.08	0.0390	0.0420	8.78
	4.30	0.38	1.16			1.12	0.0380	0.0424	8.86
	4.40	0.34	1.09			1.05	0.0340	0.0356	7.45
	4.50	0.31	0.50			0.48	0.0310	0.0150	3.13
	4.60	0.27	0.28			0.28	0.0265	0.0073	1.53
	4.70	0.23	0.36			0.35	0.0225	0.0079	1.64
	4.80	0.16	0.35			0.34	0.0160	0.0054	1.14
	4.90	0.10	0.19			0.20	0.0150	0.0029	0.61
left bank	5.10	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.478**	

Appendix 2.3. Manual Discharge Measurements at GL-H3 in 2011

Date Monitored:	9-Jul-11	**Pressure Transducer (m):**	0.902
Time (24 hr):	12:22	**Discharge Q (m^3/s):**	0.075
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
	1.60	0.00	0.00			0.0000	0.0000	0.00
	1.70	0.02	0.00			0.0020	0.0000	0.00
	1.80	0.08	0.00			0.0080	0.0000	0.00
	1.90	0.19	0.00			0.0190	0.0000	0.00
	2.00	0.21	0.00			0.0210	0.0000	0.00
	2.10	0.20	0.01			0.0200	0.0002	0.27
	2.20	0.20	0.02			0.0200	0.0004	0.54
	2.30	0.21	0.03			0.0210	0.0006	0.84
	2.40	0.28	0.02			0.0280	0.0006	0.75
	2.50	0.24	0.08			0.0240	0.0019	2.57
	2.60	0.24	0.26			0.0240	0.0062	8.36
	2.70	0.27	0.30			0.0270	0.0081	10.85
	2.80	0.29	0.30			0.0290	0.0087	11.66
	2.90	0.30	0.32			0.0300	0.0096	12.87
	3.00	0.30	0.33			0.0300	0.0099	13.27
	3.10	0.30	0.34			0.0300	0.0102	13.67
	3.20	0.28	0.34			0.0280	0.0095	12.76
	3.30	0.25	0.31			0.0250	0.0078	10.39
	3.40	0.18	0.05			0.0180	0.0009	1.21
	3.50	0.16	0.00			0.0480	0.0000	0.00
	4.00	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.075**	

Appendix 2.3. Manual Discharge Measurements at GL-H3 in 2011

Date Monitored:	16-Sep-11	**Pressure Transducer (m):**	0.910
Time (24 hr):	16:20	**Discharge Q (m^3/s):**	0.172
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	0.80	0.00	0.00			0.0000	0.0000	0.00
	0.90	0.09	-0.04			0.0090	-0.0004	-0.21
	1.00	0.12	-0.03			0.0120	-0.0004	-0.21
	1.10	0.17	0.04			0.0170	0.0007	0.39
	1.20	0.20	0.12			0.0200	0.0024	1.39
	1.30	0.24	0.17			0.0240	0.0041	2.37
	1.40	0.27	0.13			0.0270	0.0035	2.04
	1.50	0.31	0.11			0.0310	0.0034	1.98
	1.60	0.38	0.41			0.0380	0.0156	9.05
	1.70	0.40	0.31			0.0400	0.0124	7.20
	1.80	0.42	0.34			0.0420	0.0143	8.29
	1.90	0.40	0.41			0.0400	0.0164	9.52
	2.00	0.40	0.44			0.0400	0.0176	10.22
	2.10	0.43	0.44			0.0430	0.0189	10.99
	2.20	0.44	0.44			0.0440	0.0194	11.24
	2.30	0.42	0.43			0.0420	0.0181	10.49
	2.40	0.42	0.42			0.0420	0.0176	10.24
	2.50	0.35	0.17			0.0350	0.0060	3.46
	2.60	0.27	0.05			0.0270	0.0014	0.78
	2.70	0.20	0.01			0.0300	0.0003	0.17
	2.90	0.10	0.05			0.0200	0.0010	0.58
	3.10	0.12	0.00			0.0180	0.0000	0.00
left bank	3.20	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.172**	

Appendix 2.4. Manual Discharge Measurements at PL-H1 in 2011

Date Monitored:	14-Jun-11	**Pressure Transducer (m):**	0.768
Time (24 hr):	17:00	**Water Temperature-ADCP(°C):**	4
Personnel:	C.Hall, X.Pinto	**Water Temperature-Thermometer(°C):**	n/a
Method:	Velocity - area with ADCP	**Mean Discharge Q (m^3/s):**	7.34
Instrument Model:	Teledyne/RDI StreamPro	**Error (Std dev m^3/s)**	0.15
Instrument Serial#:	947	**Mean % Q Measured**	77.4

	Discharge Q (m^3/s)							% Bad	
Transect #	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**% Q Measured**	**Ensembles**	**Bins**
1	0.739	5.664	0.826	0.069	0.074	7.372	76.8	8	5
2	0.719	5.544	0.718	0.06	0.08	7.121	77.9	12	4
3	0.733	5.732	0.755	0.084	0.083	7.387	77.6	10	3
4	0.757	5.763	0.806	0.079	0.065	7.470	77.1	11	5
Mean	**0.737**	**5.676**	**0.776**	**0.073**	**0.076**	**7.34**	**77.36**	**10.25**	**4.25**

Date Monitored:	16-Jun-11	**Pressure Transducer (m):**	0.779
Time (24 hr):	9:00	**Water Temperature-ADCP(°C):**	4.3
Personnel:	C.Hall, X.Pinto	**Water Temperature-Thermometer(°C):**	n/a
Method:	Velocity - area with ADCP	**Mean Discharge Q (m^3/s):**	9.08
Instrument Model:	Teledyne/RDI StreamPro	**Error (Std dev m^3/s)**	0.12
Instrument Serial#:	947	**Mean % Q Measured**	76.9

	Discharge Q (m^3/s)							% Bad	
Transect #	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**% Q Measured**	**Ensembles**	**Bins**
1	0.778	6.27	0.868	0.097	0.076	8.089	77.5	7	7
2	0.767	6.11	0.851	0.093	0.123	7.944	76.9	12	6
3	0.784	6.14	0.928	0.084	0.106	8.042	76.3	20	6
4	0.797	6.34	0.876	0.091	0.135	8.239	77.0	14	5
Mean	**0.782**	**6.215**	**0.881**	**0.091**	**0.110**	**8.08**	**76.93**	**13.25**	**6.00**

Date Monitored:	10-Jul-11	**Pressure Transducer (m):**	0.642
Time (24 hr):	9:30	**Water Temperature-ADCP(°C):**	11.8
Personnel:	C.Hall	**Water Temperature-Thermometer(°C):**	n/a
Method:	Velocity - area with ADCP	**Mean Discharge Q (m^3/s):**	4.57
Instrument Model:	Teledyne/RDI StreamPro	**Error (Std dev m^3/s)**	0.17
Instrument Serial#:	947	**Mean % Q Measured**	61.2

	Discharge Q (m^3/s)							% Bad	
Transect #	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**% Q Measured**	**Ensembles**	**Bins**
1	0.598	2.64	1.08	0.013	0.06	4.391	60.1	14	4
2	0.637	2.87	1.04	0.028	0.061	4.636	61.9	13	3
3	0.604	2.8	0.999	0.032	0.062	4.497	62.3	12	3
4	0.654	2.89	1.14	0.021	0.07	4.775	60.5	11	5
Mean	**0.623**	**2.800**	**1.065**	**0.024**	**0.063**	**4.57**	**61.20**	**12.50**	**3.75**

Date Monitored:	12-Aug-11	**Pressure Transducer (m):**	0.224
Time (24 hr):	11:00	**Water Temperature-ADCP(°C):**	13.3
Personnel:	C.Hall	**Water Temperature-Thermometer(°C):**	n/a
Method:	Velocity - area with ADCP	**Mean Discharge Q (m^3/s):**	0.12
Instrument Model:	Teledyne/RDI StreamPro	**Error (Std dev m^3/s)**	0.07
Instrument Serial#:	947	**Mean % Q Measured**	55.8

	Discharge Q (m^3/s)							% Bad	
Transect #	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**% Q Measured**	**Ensembles**	**Bins**
1	0.001	0.021	0.001	0.012	0.035	0.070	30.0	13	61
2	0.012	0.081	0.060	-0.046	-0.053	0.054	150.0	11	63
3	-0.023	0.047	0.000	0.085	0.023	0.132	35.6	12	63
4	0.025	0.016	0.239	-0.035	-0.038	0.207	7.7	16	65
Mean	**0.004**	**0.041**	**0.075**	**0.004**	**-0.008**	**0.12**	**55.83**	**13.00**	**63.00**

Appendix 2.4. Manual Discharge Measurements at PL-H1 in 2011

Date Monitored:	17-Sep-11	**Pressure Transducer (m):**	0.599
Time (24 hr):	8:40	**Water Temperature-ADCP(°C):**	
Personnel:	C.Hall	**Water Temperature-Thermometer(°C):**	
Method:	Velocity - area with ADCP	**Mean Discharge Q (m^3/s):**	3.93
Instrument Model:	Teledyne/RDI StreamPro	**Error (Std dev m^3/s)**	0.04
Instrument Serial#:	947	**Mean % Q Measured**	65.9

	Discharge Q (m^3/s)							% Bad	
Transect #	**Top**	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**	**% Q Measured**	**Ensembles**	**Bins**
1	0.435	2.560	0.776	0.059	0.070	3.900	65.6	11	8
2	0.452	2.600	0.804	0.062	0.068	3.986	65.2	9	9
3	0.448	2.570	0.806	0.040	0.048	3.912	65.7	15	9
4	0.446	2.570	0.794	0.044	0.048	3.902	65.9	8	10
Mean	**0.445**	**2.575**	**0.795**	**0.051**	**0.059**	**3.93**	**65.61**	**10.75**	**9.00**

Appendix 2.5. Manual Discharge Measurements at PL-H2 in 2011

Date Monitored:	11-Jun-11	**Pressure Transducer (m):**	0.503
Time (24 hr):	10:00	**Discharge Q (m^3/s):**	1.813
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
right bank	2.40	0.00	0.00			0.03	0.00	0.00	0.00
	3.00	0.28	0.00			0.03	0.11	0.00	0.16
	3.20	0.34	0.09			0.11	0.17	0.02	0.99
	4.00	0.25	0.05			0.07	0.35	0.02	1.35
	6.00	0.13	0.06			0.08	0.29	0.02	1.27
	8.50	0.23	0.10			0.11	0.46	0.05	2.91
	10.00	0.11	0.17			0.18	0.19	0.03	1.89
	12.00	0.12	0.18			0.19	0.24	0.04	2.47
	14.00	0.16	0.08			0.10	0.32	0.03	1.71
	16.00	0.26	0.16			0.17	0.52	0.09	4.84
	18.00	0.19	0.33			0.32	0.38	0.12	6.73
	20.00	0.28	0.29			0.29	0.56	0.16	8.81
	22.00	0.33	0.35			0.34	0.66	0.22	12.35
	24.00	0.20	0.41			0.40	0.40	0.16	8.76
	26.00	0.27	0.22			0.22	0.54	0.12	6.63
	28.00	0.18	0.25			0.25	0.36	0.09	4.95
	30.00	0.19	0.22			0.22	0.38	0.08	4.66
	32.00	0.19	0.21			0.21	0.38	0.08	4.48
	34.00	0.21	0.16			0.17	0.42	0.07	3.91
	36.00	0.34	0.08			0.10	0.68	0.07	3.63
	38.00	0.27	0.10			0.11	0.54	0.06	3.42
	40.00	0.20	0.08			0.10	0.40	0.04	2.14
	42.00	0.27	0.16			0.17	0.62	0.10	5.78
	44.60	0.19	0.13			0.14	0.38	0.05	2.97
	46.00	0.18	0.25			0.25	0.22	0.05	2.97
	47.00	0.18	0.01			0.03	0.12	0.00	0.21
left bank	47.30	0.00	0.00			0.03	0.00	0.00	0.00
Total Q								**1.813**	

Appendix 2.5. Manual Discharge Measurements at PL-H2 in 2011

Date Monitored:	16-Jun-11	**Pressure Transducer (m):**	0.582
Time (24 hr):	13:00	**Discharge Q (m^3/s):**	3.332
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
right bank	4.20	0.00	0.00			0.03	0.00	0.00	0.00
	7.40	0.35	0.04			0.06	0.67	0.04	1.22
	8.00	0.30	0.23			0.23	0.39	0.09	2.71
	10.00	0.20	0.06			0.08	0.40	0.03	0.95
	12.00	0.16	0.07			0.09	0.32	0.03	0.84
	14.00	0.25	0.21			0.21	0.50	0.11	3.20
	16.00	0.20	0.23			0.23	0.40	0.09	2.78
	18.00	0.31	0.11			0.12	0.62	0.08	2.30
	20.00	0.31	0.19			0.20	0.62	0.12	3.64
	22.00	0.27	0.43			0.42	0.54	0.22	6.74
	24.00	0.28	0.36			0.35	0.56	0.20	5.86
	26.00	0.38	0.20			0.20	0.76	0.16	4.67
	28.00	0.42	0.35			0.34	0.84	0.29	8.55
	30.00	0.39	0.22			0.22	0.78	0.17	5.21
	32.00	0.41	0.29			0.29	0.82	0.23	7.02
	34.00	0.31	0.22			0.22	0.62	0.14	4.14
	36.00	0.43	0.29			0.29	0.86	0.25	7.36
	38.00	0.41	0.12			0.13	0.82	0.11	3.27
	40.00	0.40	0.11			0.12	0.80	0.10	2.97
	42.00	0.27	0.26			0.26	0.54	0.14	4.19
	44.00	0.28	0.21			0.21	0.56	0.12	3.59
	46.00	0.30	0.23			0.23	0.60	0.14	4.17
	48.00	0.25	0.19			0.20	0.50	0.10	2.93
	50.00	0.20	0.22			0.22	0.40	0.09	2.67
	52.00	0.21	0.09			0.11	0.42	0.04	1.33
	54.00	0.21	0.17			0.18	0.42	0.07	2.24
	56.00	0.18	0.17			0.18	0.39	0.07	2.06
	58.30	0.30	0.26			0.26	0.44	0.11	3.37
left bank	58.90	0.00	0.00			0.03	0.00	0.00	0.00
Total Q								**3.332**	

Appendix 2.5. Manual Discharge Measurements at PL-H2 in 2011

Date Monitored:	8-Jul-11	**Pressure Transducer (m):**	0.465
Time (24 hr):	10:20	**Discharge Q (m^3/s):**	1.780
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.00	0.00	0.00			0.00	0.00	0.00
	3.00	0.15	0.05			0.30	0.02	0.84
	5.00	0.16	0.01			0.32	0.00	0.18
	7.00	0.13	0.04			0.26	0.01	0.58
	9.00	0.08	0.05			0.16	0.01	0.45
	11.00	0.14	0.10			0.28	0.03	1.57
	13.00	0.22	0.19			0.44	0.08	4.70
	15.00	0.18	0.09			0.36	0.03	1.82
	17.00	0.16	0.28			0.32	0.09	5.03
	19.00	0.25	0.26			0.50	0.13	7.30
	21.00	0.22	0.17			0.44	0.07	4.20
	23.00	0.26	0.20			0.52	0.10	5.84
	25.00	0.30	0.26			0.60	0.16	8.76
	27.00	0.32	0.28			0.64	0.18	10.07
	29.00	0.22	0.31			0.44	0.14	7.66
	31.00	0.36	0.14			0.72	0.10	5.66
	33.00	0.26	0.20			0.52	0.10	5.84
	35.00	0.22	0.25			0.44	0.11	6.18
	37.00	0.28	0.16			0.56	0.09	5.03
	39.00	0.18	0.19			0.36	0.07	3.84
	41.00	0.23	0.09			0.46	0.04	2.33
	43.00	0.21	0.17			0.42	0.07	4.01
	45.00	0.10	0.20			0.20	0.04	2.25
	47.00	0.14	0.03			0.28	0.01	0.47
	49.00	0.13	0.08			0.26	0.02	1.17
	51.00	0.08	0.15			0.16	0.02	1.35
	53.00	0.24	0.05			0.36	0.02	1.01
	54.00	0.31	0.15			0.22	0.03	1.83
left bank	54.40	0.00	0.00			0.00	0.00	0.00
Total Q							**1.780**	

Appendix 2.5. Manual Discharge Measurements at PL-H2 in 2011

Date Monitored:	14-Aug-11	**Pressure Transducer (m):**	0.253
Time (24 hr):	14;00	**Discharge Q (m^3/s):**	0.055
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.00	0.00	0.00			0.00	0.00	0.00
	2.00	0.05	0.00			0.05	0.00	0.00
	3.00	0.10	0.02			0.10	0.00	3.65
	4.00	0.00	0.00			0.00	0.00	0.00
	5.00	0.00	0.00			0.00	0.00	0.00
	6.00	0.04	0.00			0.04	0.00	0.00
	7.00	0.06	0.02			0.06	0.00	2.19
	8.00	0.07	0.01			0.07	0.00	1.28
	9.00	0.08	0.05			0.08	0.00	7.31
	10.00	0.10	0.06			0.10	0.01	10.96
	11.00	0.09	0.08			0.09	0.01	13.15
	12.00	0.10	0.01			0.10	0.00	1.83
	13.00	0.09	0.05			0.09	0.00	8.22
	14.00	0.10	0.03			0.10	0.00	5.48
	15.00	0.08	0.10			0.08	0.01	14.62
	16.00	0.07	0.07			0.07	0.00	8.95
	17.00	0.06	0.00			0.06	0.00	0.00
	18.00	0.00	0.00			0.00	0.00	0.00
	19.00	0.11	0.01			0.11	0.00	2.01
	20.00	0.19	0.03			0.19	0.01	10.41
	21.00	0.10	0.00			0.10	0.00	0.00
	22.00	0.00	0.00			0.00	0.00	0.00
	23.00	0.03	0.00			0.03	0.00	0.00
	24.00	0.15	0.00			0.15	0.00	0.00
	25.00	0.09	0.01			0.09	0.00	1.64
	26.00	0.00	0.00			0.00	0.00	0.00
	27.00	0.00	0.00			0.00	0.00	0.00
	28.00	0.08	0.01			0.08	0.00	1.46
	29.00	0.06	0.03			0.12	0.00	6.82
left bank	32.15	0	0			0.00	0.00	0.00
Total Q							**0.055**	

Appendix 2.5. Manual Discharge Measurements at PL-H2 in 2011

Date Monitored:	17-Sep-11	**Pressure Transducer (m):**	0.492
Time (24 hr):	11:41	**Discharge Q (m^3/s):**	1.646
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	2.10	0.00	0.00			0.00	0.00	0.00
	3.00	0.18	0.09			0.26	0.02	1.43
	5.00	0.11	0.09			0.22	0.02	1.20
	7.00	0.06	0.00			0.12	0.00	0.00
	9.00	0.13	0.06			0.26	0.02	0.95
	11.00	0.13	0.17			0.26	0.04	2.68
	13.00	0.17	0.17			0.34	0.06	3.51
	15.00	0.14	0.15			0.28	0.04	2.55
	17.00	0.18	0.26			0.36	0.09	5.68
	19.00	0.22	0.30			0.44	0.13	8.02
	21.00	0.20	0.29			0.40	0.12	7.05
	23.00	0.26	0.15			0.52	0.08	4.74
	25.00	0.27	0.22			0.54	0.12	7.22
	27.00	0.26	0.23			0.52	0.12	7.26
	29.00	0.23	0.09			0.46	0.04	2.51
	31.00	0.30	0.06			0.60	0.04	2.19
	33.00	0.25	0.17			0.50	0.09	5.16
	35.00	0.22	0.21			0.44	0.09	5.61
	37.00	0.27	0.13			0.54	0.07	4.26
	39.00	0.16	0.25			0.32	0.08	4.86
	41.00	0.20	0.25			0.40	0.10	6.07
	43.00	0.18	0.17			0.36	0.06	3.72
	45.00	0.15	0.19			0.30	0.06	3.46
	47.00	0.10	0.15			0.20	0.03	1.82
	49.00	0.22	0.11			0.44	0.05	2.94
	51.00	0.16	0.10			0.32	0.03	1.94
	53.00	0.20	0.09			0.30	0.03	1.64
	54.00	0.26	0.12			0.21	0.02	1.52
left bank	54.60	0.00	0.00			0.00	0.00	0.00
Total Q							**1.646**	

Appendix 2.6. Manual Discharge Measurements at GI-H1 in 2011

Date Monitored:	11-Jun-11	**Pressure Transducer (m):**	0.480
Time (24 hr):	15:00	**Total Discharge Q (m^3/s):**	0.587
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Right Channel			Velocity (m/s)			Calb. Velocity	Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	(m/S)	Area	Q (m^3/s)	% of Total Q
right bank	1.60	0.00	0.00			0.03	0.0000	0.0000	0.00
	1.80	0.18	0.36			0.35	0.0360	0.0126	4.82
	2.00	0.13	0.19			0.20	0.0390	0.0076	2.93
	2.40	0.09	0.19			0.20	0.0360	0.0070	2.70
	2.80	0.07	0.08			0.10	0.0280	0.0027	1.04
	3.20	0.20	0.06			0.08	0.0800	0.0063	2.43
	3.60	0.11	0.05			0.07	0.0440	0.0031	1.18
rock upstream	4.00	0.23	0.00			0.03	0.0920	0.0023	0.89
	4.40	0.29	0.12			0.13	0.1160	0.0154	5.91
	4.80	0.17	0.11			0.12	0.0680	0.0084	3.23
	5.20	0.31	0.05			0.07	0.1240	0.0087	3.33
	5.60	0.20	0.19			0.20	0.0600	0.0117	4.51
	5.80	0.29	0.20			0.20	0.0725	0.0148	5.70
	6.10	0.29	0.21			0.21	0.0870	0.0186	7.13
	6.40	0.29	0.27			0.27	0.0870	0.0233	8.93
	6.70	0.33	0.28			0.28	0.0990	0.0274	10.51
	7.00	0.14	0.26			0.26	0.0455	0.0118	4.51
	7.35	0.20	0.13			0.14	0.0700	0.0099	3.81
	7.70	0.25	0.32			0.31	0.0813	0.0254	9.74
	8.00	0.22	0.29			0.29	0.0660	0.0188	7.23
	8.30	0.22	0.19			0.20	0.0770	0.0151	5.78
	8.70	0.14	0.22			0.22	0.0385	0.0086	3.29
	8.85	0.11	0.03			0.05	0.0193	0.0010	0.38
left bank	9.05	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q (right channel)								**0.260**	

Left Channel			Velocity (m/s)			Calb. Velocity	Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	(m/S)	Area	Q (m^3/s)	% of Total Q
right bank	1.60	0.00	0.00			0.03	0.0000	0.0000	0.00
boulder field	2.75	0.17	0.02			0.04	0.1190	0.0051	1.57
boulder field	3.00	0.14	0.01			0.03	0.0735	0.0025	0.77
boulder field	3.80	0.08	0.04			0.06	0.0720	0.0044	1.34
boulder field	4.80	0.15	0.01			0.03	0.1650	0.0056	1.72
boulder field	6.00	0.15	0.07			0.09	0.1425	0.0125	3.83
boulder field	6.70	0.10	0.04			0.06	0.0750	0.0046	1.40
boulder field	7.50	0.06	0.05			0.07	0.0720	0.0050	1.54
boulder field	9.10	0.10	0.01			0.03	0.1000	0.0034	1.04
	9.50	0.07	0.10			0.11	0.0490	0.0056	1.72
	10.50	0.25	0.00			0.03	0.1875	0.0047	1.44
	11.00	0.40	0.07			0.09	0.3400	0.0299	9.14
	12.20	0.21	0.01			0.03	0.2100	0.0072	2.19
	13.00	0.19	0.10			0.11	0.1615	0.0185	5.67
	13.90	0.24	0.10			0.11	0.2400	0.0276	8.43
	15.00	0.22	0.10			0.11	0.2310	0.0265	8.11
	16.00	0.20	0.11			0.12	0.2000	0.0248	7.57
	17.00	0.20	0.18			0.19	0.1500	0.0280	8.56
	17.50	0.27	0.05			0.07	0.1350	0.0094	2.89
	18.00	0.29	0.06			0.08	0.2175	0.0172	5.25
	19.00	0.20	0.09			0.11	0.2000	0.0212	6.47
	20.00	0.23	0.09			0.11	0.2300	0.0243	7.45
	21.00	0.15	0.10			0.11	0.1500	0.0172	5.27
	22.00	0.15	0.09			0.11	0.1500	0.0159	4.86
	23.00	0.11	0.03			0.05	0.0715	0.0037	1.14
	23.30	0.18	0.03			0.05	0.0405	0.0021	0.64
left bank	23.45	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q (left channel)								**0.327**	

Appendix 2.6. Manual Discharge Measurements at GI-H1 in 2011

Date Monitored:	15-Jun-11	**Pressure Transducer (m):**	0.548
Time (24 hr):	11:00	**Total Discharge Q (m^3/s):**	0.965
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Right Channel			Velocity (m/s)			Calb. Velocity	Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	(m/S)	Area	Q (m^3/s)	% of Total Q
right bank	1.90	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.00	0.12	0.18			0.19	0.0120	0.0022	0.62
	2.10	0.14	0.17			0.18	0.0140	0.0025	0.69
	2.20	0.15	0.13			0.14	0.0150	0.0021	0.59
	2.30	0.14	0.17			0.18	0.0560	0.0099	2.77
	3.00	0.16	0.11			0.12	0.0880	0.0109	3.03
	3.40	0.10	0.18			0.19	0.0400	0.0075	2.08
	3.80	0.24	0.08			0.10	0.0960	0.0093	2.59
	4.20	0.21	0.13			0.14	0.0840	0.0119	3.32
	4.60	0.37	0.08			0.10	0.1480	0.0143	3.99
	5.00	0.35	0.20			0.20	0.1400	0.0286	7.98
	5.40	0.26	0.26			0.26	0.1040	0.0269	7.48
	5.80	0.44	0.26			0.26	0.1760	0.0455	12.67
	6.20	0.42	0.16			0.17	0.1680	0.0283	7.89
	6.60	0.27	0.31			0.30	0.1080	0.0328	9.12
	7.00	0.23	0.32			0.31	0.0920	0.0287	8.00
	7.40	0.23	0.30			0.29	0.0920	0.0271	7.54
	7.80	0.31	0.27			0.27	0.1240	0.0332	9.23
	8.20	0.19	0.43			0.42	0.0665	0.0277	7.70
	8.50	0.18	0.10			0.11	0.0720	0.0083	2.30
	9.00	0.10	0.00			0.03	0.0550	0.0014	0.38
left bank	9.60	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q (right channel)								**0.359**	

Left Channel			Velocity (m/s)			Calb. Velocity	Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	(m/S)	Area	Q (m^3/s)	% of Total Q
right bank	1.47	0.00	0.00			0.03	0.0000	0.0000	0.00
	1.70	0.17	0.22			0.22	0.0536	0.0119	1.96
	2.10	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.50	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.70	0.18	0.20			0.20	0.0540	0.0110	1.82
	3.10	0.00	0.00			0.03	0.0000	0.0000	0.00
	3.60	0.00	0.00			0.03	0.0000	0.0000	0.00
	4.00	0.17	0.22			0.22	0.1190	0.0265	4.37
	5.00	0.20	0.15			0.16	0.2000	0.0319	5.27
	6.00	0.14	0.00			0.03	0.1400	0.0035	0.58
	7.00	0.13	0.14			0.15	0.1300	0.0196	3.23
	8.00	0.09	0.06			0.08	0.0900	0.0071	1.17
	9.00	0.13	0.19			0.20	0.1300	0.0254	4.19
	10.00	0.16	0.05			0.07	0.1600	0.0112	1.85
	11.00	0.25	0.17			0.18	0.2500	0.0444	7.32
	12.00	0.25	0.11			0.12	0.2500	0.0310	5.10
	13.00	0.21	0.18			0.19	0.2100	0.0392	6.46
	14.00	0.21	0.21			0.21	0.2100	0.0448	7.39
	15.00	0.19	0.21			0.21	0.1900	0.0406	6.69
	16.00	0.19	0.21			0.21	0.1900	0.0406	6.69
	17.00	0.16	0.17			0.18	0.1600	0.0284	4.69
	18.00	0.17	0.13			0.14	0.1700	0.0241	3.97
	19.00	0.23	0.23			0.23	0.2300	0.0532	8.78
	20.00	0.24	0.16			0.17	0.2400	0.0405	6.68
	21.00	0.16	0.11			0.12	0.1600	0.0198	3.27
	22.00	0.13	0.09			0.11	0.1300	0.0138	2.27
	23.00	0.17	0.05			0.07	0.1700	0.0119	1.96
	24.00	0.10	0.09			0.11	0.1000	0.0106	1.75
	25.00	0.09	0.11			0.12	0.0900	0.0111	1.84
	26.00	0.10	0.01			0.03	0.1250	0.0043	0.70
left bank	27.50	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q (left channel)								**0.606**	

Appendix 2.6. Manual Discharge Measurements at GI-H1 in 2011

Date Monitored:	8-Jul-11	**Pressure Transducer (m):**	0.561
Time (24 hr):	13:05	**Total Discharge Q (m^3/s):**	0.523
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Right Channel			Velocity (m/s)			Cross Sectional		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
right bank	2.60	0.00	0.00			0.0000	0.0000	0.00
	3.00	0.22	0.13			0.0880	0.0114	4.81
	3.40	0.26	0.09			0.1040	0.0094	3.94
Rock upstream	3.80	0.33	0.00			0.1320	0.0000	0.00
	4.20	0.25	0.09			0.1000	0.0090	3.78
	4.60	0.37	0.06			0.1480	0.0089	3.73
	5.00	0.24	0.16			0.0960	0.0154	6.46
	5.40	0.18	0.08			0.0720	0.0058	2.42
	5.80	0.15	0.14			0.0600	0.0084	3.53
	6.20	0.36	0.15			0.1440	0.0216	9.08
	6.60	0.32	0.04			0.1280	0.0051	2.15
	7.00	0.27	0.12			0.1080	0.0130	5.45
	7.40	0.12	0.15			0.0480	0.0072	3.03
	7.80	0.11	0.12			0.0440	0.0053	2.22
	8.20	0.25	0.25			0.1000	0.0250	10.51
	8.60	0.32	0.03			0.1280	0.0038	1.61
Rock upstream	9.00	0.13	0.00			0.0520	0.0000	0.00
	9.40	0.28	0.33			0.1120	0.0370	15.54
	9.80	0.19	0.33			0.0760	0.0251	10.55
	10.20	0.32	0.03			0.1280	0.0038	1.61
	10.60	0.08	0.27			0.0320	0.0086	3.63
	11.00	0.22	0.16			0.0880	0.0141	5.92
left bank	11.40	0.00	0.00			0.0000	0.0000	0.00
Total Q (right channel)							**0.238**	

Left Channel			Velocity (m/s)			Cross Sectional		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
right bank	1.80	0.00	0.00			0.0000	0.0000	0.0
	2.00	0.14	0.16			0.0840	0.0134	4.7
	3.00	0.12	0.08			0.1200	0.0096	3.4
	4.00	0.06	0.06			0.0600	0.0036	1.3
	5.00	0.07	0.02			0.0700	0.0014	0.5
	6.00	0.18	0.02			0.1800	0.0036	1.3
	7.00	0.17	0.01			0.1700	0.0017	0.6
	8.00	0.15	0.06			0.1500	0.0090	3.2
	9.00	0.10	0.18			0.1000	0.0180	6.3
	10.00	0.17	0.00			0.1700	0.0000	0.0
	11.00	0.21	0.06			0.2100	0.0126	4.4
	12.00	0.20	0.11			0.2000	0.0220	7.7
	13.00	0.27	0.08			0.2700	0.0216	7.6
	14.00	0.21	0.10			0.2100	0.0210	7.4
	15.00	0.16	0.14			0.1600	0.0224	7.9
	16.00	0.23	0.08			0.2300	0.0184	6.5
	17.00	0.15	0.12			0.1500	0.0180	6.3
	18.00	0.14	0.10			0.1400	0.0140	4.9
	19.00	0.21	0.09			0.2100	0.0189	6.6
	20.00	0.21	0.09			0.2100	0.0189	6.6
	21.00	0.17	0.10			0.1700	0.0170	6.0
	22.00	0.16	0.05			0.1600	0.0080	2.8
	23.00	0.26	0.02			0.2600	0.0052	1.8
	24.00	0.23	0.02			0.2300	0.0046	1.6
	25.00	0.15	0.01			0.1500	0.0015	0.5
	26.00	0.06	0.00			0.0600	0.0000	0.0
	27.00	0.05	0.02			0.0375	0.0008	0.3
	27.50	0.05	0.00			0.1000	0.0000	0.0
left bank	31.00	0.00	0.00			0.0000	0.0000	0.0
Total Q (left channel)							**0.285**	

Appendix 2.6. Manual Discharge Measurements at GI-H1 in 2011

Date Monitored:	13-Aug-11	**Pressure Transducer (m):**	0.372
Time (24 hr):	9:30	**Total Discharge Q (m^3/s):**	0.041
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Right Channel			**Velocity (m/s)**			**Cross Sectional**		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
right bank	2.65	0.00	0.00			0.0000	0.0000	0.00
Rocks	3.75	0.00	0.00			0.0000	0.0000	0.00
Rocks	4.00	0.07	0.00			0.0210	0.0000	0.00
	4.35	0.18	0.01			0.0495	0.0005	2.58
	4.55	0.07	0.02			0.0158	0.0003	1.64
	4.80	0.14	0.01			0.0315	0.0003	1.64
	5.00	0.10	0.07			0.0200	0.0014	7.30
	5.20	0.11	0.05			0.0220	0.0011	5.74
	5.40	0.11	0.13			0.0220	0.0029	14.91
	5.60	0.21	0.01			0.0420	0.0004	2.19
	5.80	0.08	0.11			0.0160	0.0018	9.18
	6.00	0.13	0.13			0.0195	0.0025	13.22
	6.10	0.21	0.12			0.0210	0.0025	13.14
	6.20	0.16	0.13			0.0240	0.0031	16.27
	6.40	0.09	0.12			0.0180	0.0022	11.26
Rocks	6.60	0.00	0.00			0.0000	0.0000	0.00
Rocks	7.10	0.00	0.00			0.0000	0.0000	0.00
	7.20	0.07	0.01			0.0105	0.0001	0.55
	7.40	0.06	0.01			0.0075	0.0001	0.39
Rocks	7.45	0.00	0.00			0.0000	0.0000	0.00
left bank	9.50	0.00	0.00			0.0000	0.0000	0.00
Total Q (right channel)							**0.019**	

Left Channel			**Velocity (m/s)**			**Cross Sectional**		
Notes	**Station (m)**	**Depth (m)**	**60%**	**20%**	**80%**	**Area**	**Q (m^3/s)**	**% of Total Q**
	3.15	0.00	0.00			0.0000	0.0000	0.0
	3.25	0.14	0.04			0.0595	0.0024	10.9
	4.00	0.00	0.00			0.0000	0.0000	0.0
	4.90	0.27	0.02			0.2700	0.0054	24.6
	6.00	0.23	0.04			0.2415	0.0097	44.1
	7.00	0.00	0.00			0.0000	0.0000	0.0
	10.70	0.00	0.00			0.0000	0.0000	0.0
	11.20	0.15	0.00			0.0750	0.0000	0.0
	11.70	0.12	0.01			0.0780	0.0008	3.6
	12.50	0.07	-0.01			0.0455	-0.0005	-2.1
	13.00	0.00	0.00			0.0000	0.0000	0.0
	13.50	0.09	0.01			0.0450	0.0005	2.1
	14.00	0.08	0.02			0.0400	0.0008	3.7
	14.50	0.13	0.03			0.0650	0.0020	8.9
	15.00	0.11	0.01			0.0550	0.0006	2.5
	15.50	0.00	0.00			0.0000	0.0000	0.0
	16.00	0.08	0.01			0.0400	0.0004	1.8
	16.50	0.06	0.00			0.0450	0.0000	0.0
	17.50	0.08	0.00			0.0800	0.0000	0.0
	18.50	0.06	0.00			0.0600	0.0000	0.0
	19.50	0.08	0.00			0.0800	0.0000	0.0
	20.50	0.02	0.00			0.0130	0.0000	0.0
	20.80	0.14	0.00			0.1050	0.0000	0.0
	22.00	0.00	0.00			0.0000	0.0000	0.0
	23.00	0.08	0.00			0.0800	0.0000	0.0
	24.00	0.00	0.00			0.0000	0.0000	0.0
	25.00	0.09	0.00			0.2340	0.0000	0.0
left bank	29.20	0.00	0.00			0.0000	0.0000	0.0
Total Q (left channel)							**0.022**	

Appendix 2.6. Manual Discharge Measurements at GI-H1 in 2011

Date Monitored:	16-Sep-11	**Pressure Transducer (m):**	0.561
Time (24 hr):	8:00	**Total Discharge Q (m^3/s):**	0.403
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Right Channel			Velocity (m/s)			Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	Area	Q (m^3/s)	% of Total Q
right bank	0.00	0.00	0.00			0.0000	0.0000	0.00
	0.40	0.05	0.07			0.0200	0.0014	0.83
rock	0.80	0.28	0.04			0.1120	0.0045	2.67
	1.20	0.00	0.00			0.0000	0.0000	0.00
	1.60	0.08	0.01			0.0320	0.0003	0.19
	2.00	0.11	0.00			0.0440	0.0000	0.00
	2.40	0.14	0.05			0.0560	0.0028	1.67
	2.80	0.05	0.02			0.0200	0.0004	0.24
	3.20	0.17	0.03			0.0680	0.0020	1.21
	3.60	0.18	0.10			0.0720	0.0072	4.29
	4.00	0.18	0.00			0.0720	0.0000	0.00
	4.40	0.21	0.13			0.0840	0.0109	6.50
	4.80	0.23	0.08			0.0920	0.0074	4.38
	5.20	0.20	0.15			0.0800	0.0120	7.14
	5.60	0.38	0.14			0.1520	0.0213	12.67
	6.00	0.21	0.20			0.0840	0.0168	10.00
	6.40	0.09	0.32			0.0360	0.0115	6.86
	6.80	0.19	0.33			0.0760	0.0251	14.93
	7.20	0.25	0.28			0.1000	0.0280	16.67
	7.60	0.26	0.14			0.1040	0.0146	8.67
	8.00	0.12	0.05			0.0360	0.0018	1.07
left bank	8.20	0.00	0.00			0.0000	0.0000	0.00
Total Q (right channel)							**0.168**	

Left Channel			Velocity (m/s)			Cross Sectional		
Notes	Station (m)	Depth (m)	60%	20%	80%	Area	Q (m^3/s)	% of Total Q
right bank	0.00	0.00	0.00			0.0000	0.0000	0.0
	1.00	0.20	0.02			0.2000	0.0040	1.7
	2.00	0.24	0.06			0.2400	0.0144	6.1
	3.00	0.08	0.01			0.0800	0.0008	0.3
	4.00	0.23	0.04			0.2300	0.0092	3.9
rock	5.00	0.00	0.00			0.0000	0.0000	0.0
	6.00	0.09	0.00			0.0900	0.0000	0.0
	7.00	0.08	-0.07			0.0800	-0.0056	-2.4
	8.00	0.06	0.07			0.0600	0.0042	1.8
	9.00	0.32	0.04			0.3200	0.0128	5.5
	10.00	0.16	0.09			0.1600	0.0144	6.1
	11.00	0.11	0.08			0.1100	0.0088	3.8
	12.00	0.26	0.09			0.2600	0.0234	10.0
	13.00	0.08	0.06			0.0800	0.0048	2.0
	14.00	0.19	0.11			0.1900	0.0209	8.9
	15.00	0.23	0.05			0.2300	0.0115	4.9
	16.00	0.20	0.08			0.2000	0.0160	6.8
	17.00	0.26	0.09			0.2600	0.0234	10.0
	18.00	0.20	0.13			0.2000	0.0260	11.1
	19.00	0.12	0.12			0.1200	0.0144	6.1
	20.00	0.15	0.08			0.1500	0.0120	5.1
	21.00	0.26	0.05			0.2600	0.0130	5.5
	22.00	0.28	0.03			0.2800	0.0084	3.6
	23.00	0.14	0.03			0.1400	0.0042	1.8
	24.00	0.08	-0.08			0.0800	-0.0064	-2.7
	25.00	0.00	0.00			0.0000	0.0000	0.0
	26.00	0.00	0.00			0.0000	0.0000	0.0
left bank	27.80	0.00	0.00			0.0000	0.0000	0.0
Total Q (left channel)							**0.235**	

Appendix 2.7. Manual Discharge Measurements at EL-H1 in 2011

Date Monitored:	13-Jun-11	**Pressure Transducer (m):**	0.520
Time (24 hr):	14:30	**Discharge Q (m^3/s):**	0.037
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s) 60%	20%	80%	Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
right bank	3.60	0.00	0.00			0.03	0.0000	0.0000	0.00
	3.70	0.09	0.00			0.03	0.0090	0.0002	0.62
	3.80	0.09	0.00			0.03	0.0090	0.0002	0.62
	3.90	0.12	0.00			0.03	0.0120	0.0003	0.82
	4.00	0.14	0.05			0.07	0.0140	0.0010	2.67
	4.10	0.19	0.05			0.07	0.0190	0.0013	3.62
	4.20	0.22	0.09			0.11	0.0220	0.0023	6.34
	4.30	0.21	0.08			0.10	0.0210	0.0020	5.54
	4.40	0.24	0.05			0.07	0.0240	0.0017	4.57
	4.50	0.19	0.01			0.03	0.0190	0.0006	1.76
	4.60	0.16	0.00			0.03	0.0160	0.0004	1.09
	4.70	0.16	0.06			0.08	0.0160	0.0013	3.44
	4.80	0.16	0.08			0.10	0.0160	0.0016	4.22
	4.90	0.16	0.10			0.11	0.0160	0.0018	5.01
	5.00	0.17	0.10			0.11	0.0170	0.0020	5.32
	5.10	0.20	0.20			0.20	0.0200	0.0041	11.15
	5.20	0.22	0.32			0.31	0.0220	0.0069	18.71
	5.30	0.22	0.22			0.22	0.0220	0.0049	13.34
	5.40	0.22	0.17			0.18	0.0220	0.0039	10.65
left bank	5.50	0.15	0.00			0.03	0.0075	0.0002	0.51
Total Q								**0.037**	

Date Monitored:	15-Jun-11	**Pressure Transducer (m):**	0.506
Time (24 hr):	14:50	**Discharge Q (m^3/s):**	0.023
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s) 60%	20%	80%	Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
right bank	3.90	0.00	0.00			0.03	0.0000	0.0000	0.00
	4.10	0.08	0.07			0.09	0.0120	0.0011	4.53
	4.20	0.23	0.05			0.07	0.0230	0.0016	6.91
	4.30	0.19	0.10			0.11	0.0190	0.0022	9.37
	4.40	0.16	0.06			0.08	0.0160	0.0013	5.43
	4.50	0.14	0.02			0.04	0.0140	0.0006	2.59
	4.60	0.14	0.00			0.03	0.0140	0.0004	1.51
	4.70	0.14	0.00			0.03	0.0140	0.0004	1.51
	4.80	0.14	0.03			0.05	0.0140	0.0007	3.13
	4.90	0.12	0.12			0.13	0.0120	0.0016	6.85
	5.00	0.14	0.14			0.15	0.0140	0.0021	9.07
	5.10	0.16	0.10			0.11	0.0160	0.0018	7.89
	5.20	0.19	0.21			0.21	0.0190	0.0041	17.43
	5.30	0.19	0.23			0.23	0.0190	0.0044	18.90
	5.40	0.13	0.05			0.07	0.0163	0.0011	4.88
left bank	5.55	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.0233**	

Appendix 2.7. Manual Discharge Measurements at EL-H1 in 2011

Date Monitored:	9-Jul-11	**Pressure Transducer (m):**	0.405
Time (24 hr):	10:50	**Discharge Q (m^3/s):**	0.002
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
left bank	1.00	0.04	0.00			0.0010	0.0000	0.00
	1.05	0.04	0.00			0.0020	0.0000	0.00
	1.10	0.08	0.01			0.0040	0.0000	2.50
	1.15	0.12	0.04			0.0060	0.0002	15.00
	1.20	0.20	0.04			0.0100	0.0004	25.00
	1.25	0.26	0.03			0.0130	0.0004	24.38
	1.30	0.26	0.02			0.0130	0.0003	16.25
	1.35	0.25	0.00			0.0125	0.0000	0.00
	1.40	0.18	0.01			0.0090	0.0001	5.63
	1.45	0.17	0.01			0.0085	0.0001	5.31
	1.50	0.19	0.01			0.0095	0.0001	5.94
	1.55	0.17	0.00			0.0085	0.0000	0.00
	1.60	0.17	0.00			0.0085	0.0000	0.00
	1.65	0.15	0.00			0.0075	0.0000	0.00
	1.70	0.14	0.00			0.0070	0.0000	0.00
	1.75	0.14	0.00			0.0070	0.0000	0.00
	1.80	0.14	0.00			0.0070	0.0000	0.00
	1.85	0.14	0.00			0.0070	0.0000	0.00
	1.90	0.14	0.00			0.0175	0.0000	0.00
right bank	2.10	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.002**	

Appendix 2.7. Manual Discharge Measurements at EL-H1 in 2011

Date Monitored:	16-Sep-11	**Pressure Transducer (m):**	0.449
Time (24 hr):	14:43	**Discharge Q (m^3/s):**	0.013
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	0.40	0.00	0.00			0.0000	0.0000	0.00
	0.50	0.06	0.00			0.0060	0.0000	0.00
	0.60	0.09	0.00			0.0068	0.0000	0.00
	0.65	0.13	0.02			0.0065	0.0001	1.00
	0.70	0.20	0.05			0.0100	0.0005	3.84
	0.75	0.21	0.05			0.0105	0.0005	4.04
	0.80	0.20	0.06			0.0100	0.0006	4.61
	0.85	0.21	0.09			0.0105	0.0009	7.27
	0.90	0.20	0.12			0.0100	0.0012	9.23
	0.95	0.20	0.12			0.0100	0.0012	9.23
	1.00	0.20	0.09			0.0100	0.0009	6.92
	1.05	0.21	0.05			0.0105	0.0005	4.04
	1.10	0.12	0.13			0.0060	0.0008	6.00
	1.15	0.12	0.13			0.0060	0.0008	6.00
	1.20	0.13	0.18			0.0065	0.0012	9.00
	1.25	0.13	0.15			0.0065	0.0010	7.50
	1.30	0.12	0.14			0.0060	0.0008	6.46
	1.35	0.10	0.12			0.0050	0.0006	4.61
	1.40	0.10	0.09			0.0050	0.0005	3.46
	1.45	0.10	0.09			0.0050	0.0005	3.46
	1.50	0.09	0.07			0.0045	0.0003	2.42
	1.55	0.06	0.04			0.0030	0.0001	0.92
left bank	1.60	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.013**	

Appendix 2.8. Manual Discharge Measurements at WL-H1 in 2011

Date Monitored:	13-Jun-11	**Pressure Transducer (m):**	0.948
Time (24 hr):	9:30	**Discharge Q (m^3/s):**	1.973
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
left bank	1.85	0.00	0.00			0.03	0.0000	0.0000	0.00
	2.50	0.45	0.00			0.03	0.2138	0.0054	0.27
	2.80	0.65	0.07			0.09	0.1625	0.0143	0.72
	3.00	0.66	0.07			0.09	0.2310	0.0203	1.03
	3.50	0.77	0.13	0.15	0.10	0.14	0.3850	0.0528	2.68
	4.00	0.82	0.13	0.15	0.11	0.14	0.4100	0.0581	2.95
	4.50	0.96	0.14	0.16	0.11	0.15	0.4800	0.0702	3.56
	5.00	1.04	0.24	0.27	0.20	0.24	0.5200	0.1227	6.22
	5.50	1.08	0.27	0.32	0.22	0.27	0.5400	0.1444	7.32
	6.00	1.05	0.32	0.34	0.29	0.31	0.5250	0.1616	8.19
	6.50	1.03	0.32	0.33	0.31	0.31	0.5150	0.1608	8.15
	7.00	1.04	0.35	0.37	0.32	0.33	0.3640	0.1218	6.17
	7.20	1.00	0.35	0.38	0.31	0.33	0.2000	0.0669	3.39
	7.40	1.00	0.37	0.38	0.36	0.36	0.2000	0.0717	3.63
	7.60	1.00	0.37	0.40	0.33	0.35	0.2000	0.0707	3.59
	7.80	1.00	0.42	0.43	0.40	0.40	0.2000	0.0803	4.07
	8.00	1.00	0.38	0.41	0.35	0.37	0.2000	0.0736	3.73
	8.20	1.00	0.39	0.40	0.37	0.37	0.2000	0.0746	3.78
	8.40	1.00	0.41	0.43	0.39	0.40	0.2000	0.0794	4.02
	8.60	0.95	0.38	0.39	0.36	0.36	0.1900	0.0690	3.50
	8.80	0.95	0.38	0.40	0.35	0.36	0.1900	0.0690	3.50
	9.00	0.99	0.34	0.31	0.37	0.33	0.1980	0.0654	3.31
	9.20	1.00	0.37	0.36	0.38	0.36	0.2000	0.0717	3.63
	9.40	0.98	0.35	0.33	0.36	0.33	0.1960	0.0656	3.32
	9.60	0.96	0.32	0.28	0.36	0.31	0.2880	0.0899	4.56
	10.00	0.81	0.25	0.27	0.22	0.24	0.2430	0.0595	3.02
	10.20	0.68	0.14			0.15	0.2210	0.0333	1.69
	10.65	0.00	0.00			0.03	0.0000	0.0000	0.00
right bank	12.80	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**1.973**	

Note: if taking velocity readings at 20% and 80% of water depth then the 60% velocity value will be calculated as follows

V60% = (V20% +V80%)/2

Appendix 2.8. Manual Discharge Measurements at WL-H1 in 2011

Date Monitored:	17-Jun-11	**Pressure Transducer (m):**	0.893
Time (24 hr):	8:00	**Discharge Q (m^3/s):**	0.840
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s) 60%	20%	80%	Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
right bank	3.40	0.00	0.00			0.03	0.0000	0.0000	0.00
	4.20	0.54	0.00			0.03	0.2700	0.0068	0.81
	4.40	0.69	0.15			0.16	0.1380	0.0220	2.63
	4.60	0.74	0.16			0.17	0.1480	0.0250	2.97
	4.80	0.86	0.17	0.19	0.14	0.17	0.1720	0.0298	3.55
	5.00	0.91	0.16	0.18	0.14	0.17	0.1820	0.0307	3.66
	5.20	0.93	0.18	0.18	0.17	0.18	0.1860	0.0339	4.04
	5.40	0.91	0.19	0.20	0.18	0.20	0.1820	0.0356	4.24
	5.60	0.93	0.16	0.17	0.15	0.17	0.1860	0.0314	3.74
	5.80	0.91	0.19	0.20	0.18	0.20	0.1820	0.0356	4.24
	6.00	0.93	0.20	0.21	0.18	0.20	0.1860	0.0372	4.43
	6.20	0.95	0.20	0.21	0.18	0.20	0.1900	0.0380	4.53
	6.40	0.94	0.20	0.20	0.19	0.20	0.1880	0.0376	4.48
	6.60	0.93	0.18	0.18	0.17	0.18	0.1860	0.0339	4.04
	6.80	0.95	0.17	0.18	0.16	0.18	0.1900	0.0338	4.02
	7.00	0.94	0.19	0.18	0.19	0.19	0.1880	0.0359	4.28
	7.20	0.95	0.20	0.19	0.21	0.20	0.1900	0.0389	4.63
	7.40	0.96	0.19	0.19	0.19	0.20	0.1920	0.0376	4.47
	7.60	0.98	0.16	0.16	0.15	0.16	0.1960	0.0322	3.83
	7.80	0.97	0.15	0.16	0.14	0.16	0.1940	0.0310	3.69
	8.00	0.98	0.12	0.12	0.12	0.13	0.2205	0.0293	3.49
	8.25	0.99	0.11	0.08	0.13	0.12	0.2475	0.0295	3.52
	8.50	1.00	0.10	0.08	0.12	0.11	0.2500	0.0287	3.42
	8.75	1.00	0.11	0.11	0.11	0.12	0.2500	0.0310	3.69
	9.00	1.04	0.08	0.08	0.08	0.10	0.3380	0.0327	3.90
	9.40	0.97	0.05	0.01	0.08	0.07	0.3880	0.0254	3.03
	9.80	0.90	0.02	0.02	0.02	0.04	0.4950	0.0213	2.54
	10.50	0.79	0.01	0.01	0.00	0.03	0.6715	0.0199	2.37
	11.50	0.60	0.00			0.03	0.6000	0.0151	1.79
left bank	12.50	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.840**	

Note: if taking velocity readings at 20% and 80% of water depth then the 60% velocity value will be calculated as follows

V60% = (V20% +V80%)/2

Appendix 2.8. Manual Discharge Measurements at WL-H1 in 2011

Date Monitored:	9-Jul-11	**Pressure Transducer (m):**	0.768
Time (24 hr):	14:30	**Discharge Q (m^3/s):**	0.370
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
left bank	0.85	0.00	0.00			0.0000	0.0000	0.00
	1.00	0.09	0.00			0.0293	0.0000	0.00
	1.50	0.36	0.01			0.1800	0.0018	0.49
	2.00	0.50	0.03			0.2500	0.0075	2.02
	2.50	0.60	0.06			0.3000	0.0180	4.86
	3.00	0.70	0.06			0.3500	0.0210	5.67
	3.50	0.77	0.06	0.05	0.06	0.3850	0.0212	5.72
	4.00	0.88	0.07	0.08	0.05	0.4400	0.0286	7.72
	4.50	0.94	0.06	0.06	0.05	0.4700	0.0259	6.98
	5.00	0.96	0.07	0.07	0.07	0.4800	0.0336	9.07
	5.50	0.94	0.08	0.07	0.08	0.4700	0.0353	9.51
	6.00	0.92	0.08	0.08	0.07	0.4600	0.0345	9.31
	6.50	0.88	0.08	0.07	0.09	0.4400	0.0352	9.50
	7.00	0.86	0.07	0.07	0.06	0.4300	0.0280	7.54
	7.50	0.82	0.06	0.05	0.06	0.4100	0.0226	6.09
	8.00	0.73	0.07			0.3650	0.0256	6.90
	8.50	0.66	0.05			0.3300	0.0165	4.45
	9.00	0.45	0.05			0.2250	0.0113	3.04
	9.50	0.28	0.03			0.1400	0.0042	1.13
	10.00	0.12	0.00			0.0570	0.0000	0.00
right bank	10.45	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.370**	

Note: if taking velocity readings at 20% and 80% of water depth then the 60% velocity value will be calculated as follows.
V60% = (V20% +V80%)/2

Appendix 2.8. Manual Discharge Measurements at WL-H1 in 2011

Date Monitored:	15-Aug-11	**Pressure Transducer (m):**	0.474
Time (24 hr):	10:23	**Discharge Q (m^3/s):**	0.003
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
left bank	1.25	0.00	0.00			0.0000	0.0000	0.00
	1.30	0.04	0.00			0.0030	0.0000	0.00
	1.40	0.07	0.00			0.0070	0.0000	0.00
	1.50	0.06	0.01			0.0060	0.0001	2.29
	1.60	0.06	0.01			0.0060	0.0001	2.29
	1.70	0.10	0.00			0.0100	0.0000	0.00
	1.80	0.12	-0.01			0.0120	-0.0001	-4.57
	1.90	0.14	0.01			0.0140	0.0001	5.33
	2.00	0.12	0.00			0.0120	0.0000	0.00
	2.10	0.14	0.01			0.0140	0.0001	5.33
	2.20	0.12	0.02			0.0120	0.0002	9.14
	2.30	0.14	0.01			0.0140	0.0001	5.33
	2.40	0.14	-0.01			0.0140	-0.0001	-5.33
	2.50	0.12	-0.01			0.0120	-0.0001	-4.57
	2.60	0.12	0.01			0.0120	0.0001	4.57
	2.70	0.13	0.01			0.0130	0.0001	4.95
	2.80	0.11	0.01			0.0110	0.0001	4.19
	2.90	0.14	0.00			0.0140	0.0000	0.00
	3.00	0.10	0.00			0.0100	0.0000	0.00
	3.10	0.14	0.02			0.0140	0.0003	10.67
	3.20	0.12	0.04			0.0090	0.0004	13.71
	3.25	0.11	0.01			0.0055	0.0001	2.10
	3.30	0.10	0.05			0.0050	0.0003	9.52
	3.35	0.10	0.06			0.0050	0.0003	11.43
	3.40	0.09	0.08			0.0068	0.0005	20.57
	3.50	0.08	0.01			0.0080	0.0001	3.05
	3.60	0.10	0.00			0.0100	0.0000	0.00
right bank	3.70	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.003**	

Appendix 2.8. Manual Discharge Measurements at WL-H1 in 2011

Date Monitored:	17-Sep-11	**Pressure Transducer (m):**	0.774
Time (24 hr):	13:30	**Discharge Q (m^3/s):**	0.371
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.80	0.00	0.00			0.0000	0.0000	0.00
	2.30	0.25	-0.01			0.1500	-0.0015	-0.40
	3.00	0.50	-0.01			0.3000	-0.0030	-0.81
	3.50	0.79	-0.01	-0.01	-0.01	0.3950	-0.0040	-1.07
	4.00	0.89	0.03	0.02	0.03	0.4450	0.0111	3.00
	4.50	0.93	0.06	0.06	0.06	0.4650	0.0279	7.53
	5.00	0.90	0.08	0.08	0.07	0.4500	0.0338	9.11
	5.50	0.90	0.09	0.10	0.07	0.4500	0.0383	10.32
	6.00	0.82	0.08	0.09	0.06	0.4100	0.0308	8.30
	6.50	0.79	0.09	0.09	0.08	0.3950	0.0336	9.06
	7.00	0.75	0.09	0.10	0.07	0.3750	0.0319	8.60
	7.50	0.68	0.09			0.3400	0.0306	8.26
	8.00	0.64	0.08			0.3200	0.0256	6.91
	8.50	0.64	0.08			0.3200	0.0256	6.91
	9.00	0.63	0.07			0.3150	0.0221	5.95
	9.50	0.57	0.07			0.2850	0.0200	5.38
	10.00	0.48	0.07			0.2400	0.0168	4.53
	10.50	0.41	0.08			0.2050	0.0164	4.43
	11.00	0.35	0.06			0.1750	0.0105	2.83
	11.50	0.27	0.03			0.1418	0.0043	1.15
left bank	12.05	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.371**	

Note: if taking velocity readings at 20% and 80% of water depth then the 60% velocity value will be calculated as follows.
V60% = (V20% +V80%)/2

Appendix 2.9. Manual Discharge Measurements at REFB-H1 in 2011

Date Monitored:	12-Jun-11	**Pressure Transducer (m):**	0.345
Time (24 hr):	14:50	**Discharge Q (m^3/s):**	0.206
Personnel:	C.Hall, X.Pinto		
Method:	Velocity - area with Swoffer 2784	**Staff Gauge (m):**	n/a
Propeler	B2 (3")		
Calibration	426	**Indicator Eqn.**	
Instrument Zeroed	Y/N	n<0.35	V = X*0.8973 + 0.0251
FPA interval (seconds)	40.00	n>0.35	V = X*0.9581 + 0.0040

Notes	Station (m)	Depth (m)	Velocity (m/s)			Calb. Velocity (m/S)	Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%				
left bank	7.50	0.00	0.00			0.03	0.0000	0.0000	0.00
grass	8.00	0.14	0.00			0.03	0.0700	0.0018	0.85
grass	8.50	0.18	0.00			0.03	0.0900	0.0023	1.09
grass	9.00	0.19	0.00			0.03	0.0950	0.0024	1.16
grass	9.50	0.20	0.01			0.03	0.0800	0.0027	1.32
	9.80	0.25	0.18			0.19	0.0625	0.0117	5.65
	10.00	0.27	0.09			0.11	0.0540	0.0057	2.77
	10.20	0.25	0.27			0.27	0.0500	0.0134	6.48
	10.40	0.27	0.27			0.27	0.0540	0.0144	7.00
	10.60	0.29	0.27			0.27	0.0580	0.0155	7.51
	10.80	0.33	0.25			0.25	0.0660	0.0165	7.98
	11.00	0.34	0.24			0.24	0.0680	0.0164	7.92
	11.20	0.34	0.18			0.19	0.0680	0.0127	6.15
	11.40	0.34	0.24			0.24	0.0680	0.0164	7.92
	11.60	0.33	0.29			0.29	0.0660	0.0188	9.12
	11.80	0.32	0.31			0.30	0.0640	0.0194	9.40
	12.00	0.30	0.19			0.20	0.0600	0.0117	5.69
	12.20	0.25	0.03			0.05	0.0625	0.0033	1.58
grass	12.50	0.20	0.04			0.06	0.0700	0.0043	2.07
grass	12.90	0.19	0.00			0.03	0.1615	0.0041	1.96
grass	14.20	0.17	0.06			0.08	0.1360	0.0107	5.20
grass	14.50	0.11	0.07			0.09	0.0275	0.0024	1.17
right bank	14.70	0.00	0.00			0.03	0.0000	0.0000	0.00
Total Q								**0.206**	

Appendix 2.9. Manual Discharge Measurements at REFB-H1 in 2011

Date Monitored:	9-Jul-11	**Pressure Transducer (m):**	0.266
Time (24 hr):	8:25	**Discharge Q (m^3/s):**	0.031
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.80	0.00	0.00			0.0000	0.0000	0.00
edge of flooded grass	2.50	0.14	0.00			0.0560	0.0000	0.00
	2.60	0.18	0.03			0.0180	0.0005	1.74
	2.70	0.20	0.07			0.0200	0.0014	4.52
	2.80	0.20	0.08			0.0200	0.0016	5.17
	2.90	0.18	0.11			0.0180	0.0020	6.40
	3.00	0.21	0.14			0.0210	0.0029	9.50
	3.10	0.19	0.19			0.0190	0.0036	11.66
	3.20	0.19	0.10			0.0190	0.0019	6.14
	3.30	0.18	0.06			0.0180	0.0011	3.49
	3.40	0.16	0.05			0.0160	0.0008	2.58
	3.50	0.14	0.04			0.0140	0.0006	1.81
	3.60	0.14	0.04			0.0140	0.0006	1.81
	3.70	0.16	0.02			0.0160	0.0003	1.03
	3.80	0.16	0.01			0.0160	0.0002	0.52
	3.90	0.14	0.03			0.0140	0.0004	1.36
	4.00	0.15	0.04			0.0150	0.0006	1.94
	4.10	0.21	0.02			0.0210	0.0004	1.36
	4.20	0.20	0.09			0.0200	0.0018	5.81
	4.30	0.17	0.11			0.0170	0.0019	6.04
	4.40	0.16	0.10			0.0160	0.0016	5.17
	4.50	0.15	0.17			0.0150	0.0025	8.24
	4.60	0.14	0.12			0.0140	0.0017	5.43
	4.70	0.14	0.09			0.0140	0.0013	4.07
	4.80	0.14	0.06			0.0140	0.0008	2.71
	4.90	0.12	0.03			0.0120	0.0004	1.16
	5.00	0.11	0.01			0.0110	0.0001	0.36
edge of flooded grass	5.10	0.10	0.00			0.0175	0.0000	0.00
left bank	5.35	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.031**	

Appendix 2.9. Manual Discharge Measurements at REFB-H1 in 2011

Date Monitored:	17-Sep-11	**Pressure Transducer (m):**	0.269
Time (24 hr):	13:05	**Discharge Q (m^3/s):**	0.023
Personnel:	C.Hall		
Method:	Velocity - area with FloMate	**Staff Gauge (m):**	n/a
Propeler	n/a		
Instrument Zeroed	Y		
FPA interval (seconds)	40.00		

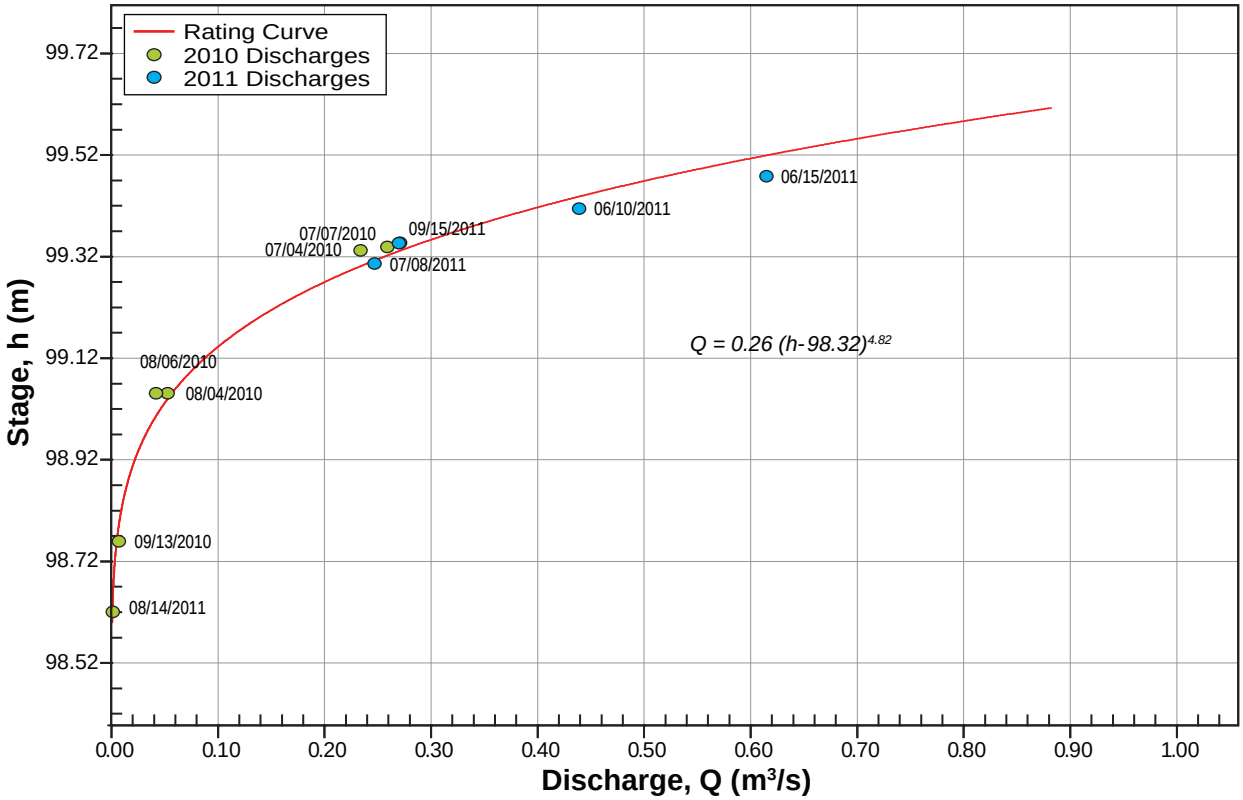
Notes	Station (m)	Depth (m)	Velocity (m/s)			Cross Sectional Area	Q (m^3/s)	% of Total Q
			60%	20%	80%			
right bank	1.20	0.00	0.00			0.0000	0.0000	0.00
	2.00	0.07	0.00			0.0630	0.0000	0.00
	3.00	0.09	0.00			0.0900	0.0000	0.00
	4.00	0.06	0.00			0.0510	0.0000	0.00
edge of flooded grass	4.70	0.18	0.03			0.0765	0.0023	10.07
	4.85	0.21	0.04			0.0315	0.0013	5.53
	5.00	0.20	0.09			0.0300	0.0027	11.84
	5.15	0.20	0.07			0.0300	0.0021	9.21
	5.30	0.19	0.04			0.0285	0.0011	5.00
	5.45	0.17	0.05			0.0255	0.0013	5.59
	5.60	0.19	0.04			0.0285	0.0011	5.00
	5.75	0.15	0.04			0.0225	0.0009	3.95
	5.90	0.14	0.00			0.0210	0.0000	0.00
	6.05	0.13	0.04			0.0195	0.0008	3.42
	6.20	0.14	0.04			0.0210	0.0008	3.68
	6.35	0.20	0.06			0.0300	0.0018	7.89
	6.50	0.20	0.05			0.0300	0.0015	6.58
	6.65	0.15	0.08			0.0225	0.0018	7.89
	6.80	0.14	0.09			0.0210	0.0019	8.29
	6.95	0.14	0.04			0.0210	0.0008	3.68
	7.10	0.12	0.03			0.0180	0.0005	2.37
edge of flooded grass	7.25	0.12	0.00			0.0540	0.0000	0.00
	8.00	0.06	0.00			0.0525	0.0000	0.00
	9.00	0.02	0.00			0.0145	0.0000	0.00
left bank	9.45	0.00	0.00			0.0000	0.0000	0.00
Total Q							**0.023**	

Appendix 3
Rating Curves

Rescan™
Engineers and Scientists



GL-H1, looking upstream along the monitored reach. The water elevation in the pool where the transducer is positioned is controlled by the bedrock channel constriction downstream. The yellow tape across the channel indicates the channel cross section where mannual flow measurements were conducted. Photograph taken September 16, 2011.



Note: pressure transducer stage readings are referenced to datum

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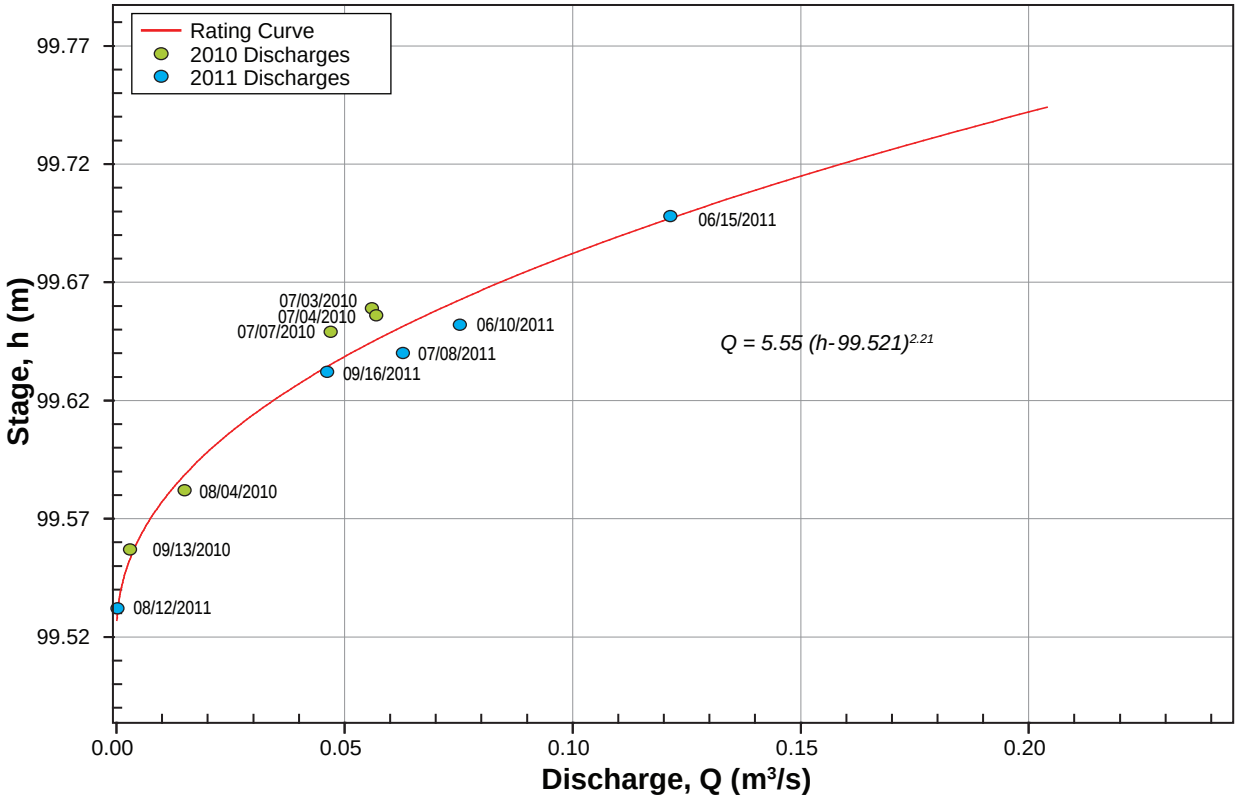
GL-H1 - Stage-Discharge Rating Curve
(Rating Period from July 7, 2010 to September 16, 2011)

Appendix 3.1

Rescan™ Engineers & Scientists



GL-H2, looking upstream from the hydrometric station along the monitored reach. The location of the pressure transducer is indicated in the photograph. This is a low energy system typicall of small streams in the region. Vegitation along the sides of the stream contribute to bank stability and flow in the stream is well confined within the channel. Photograph taken on July 8, 2011.

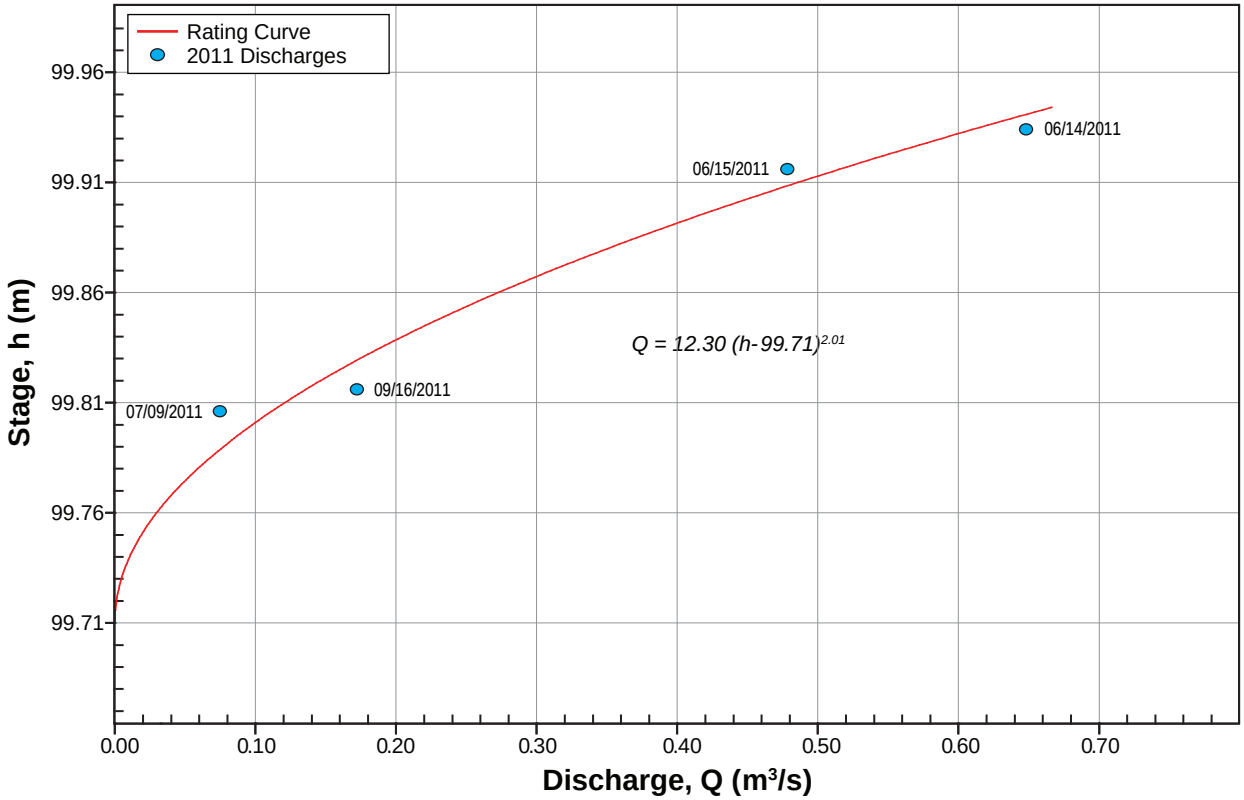


Note: pressure transducer stage readings are referenced to datum

Appendix 3.2

GL-H2 - Stage-Discharge Rating Curve
(Rating Period from July 3, 2010 to September 19, 2011)





Note: pressure transducer stage readings are referenced to datum

Sabina GOLD & SILVER CORP.

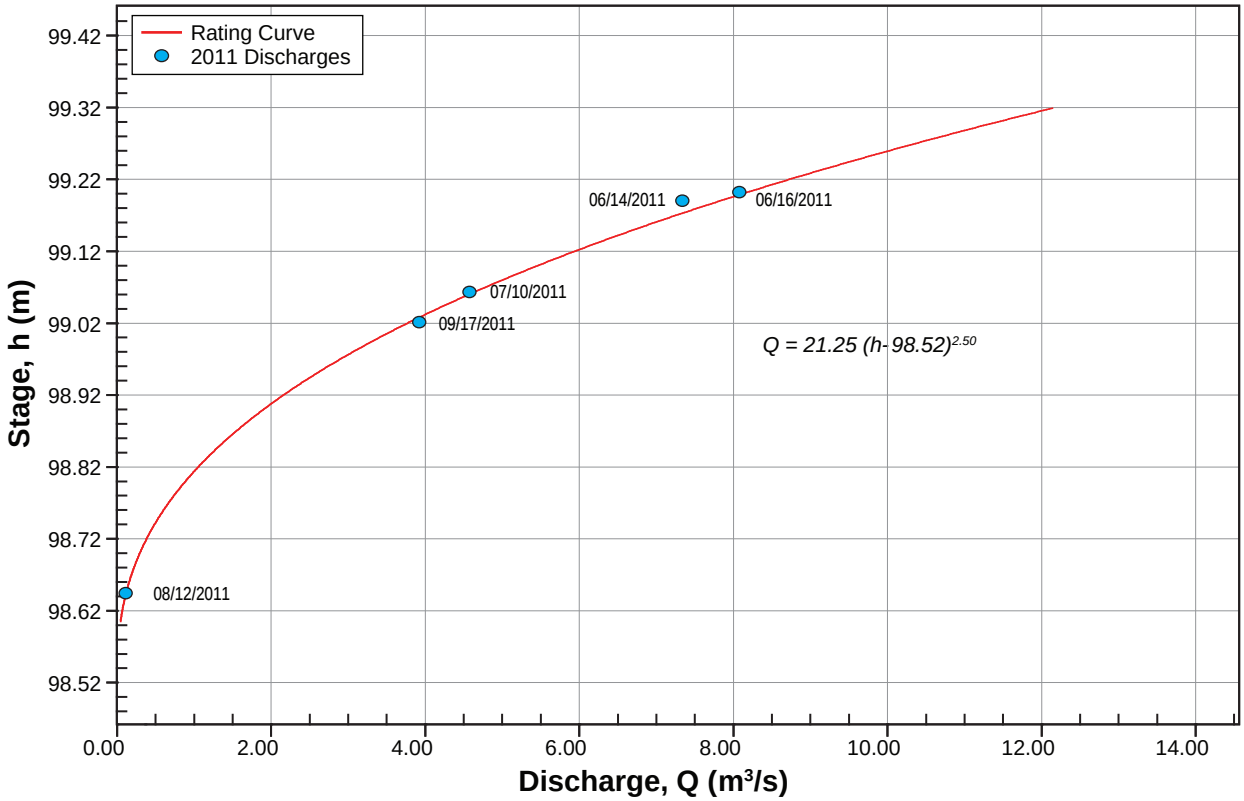
GL-H3 - Stage-Discharge Rating Curve
(Rating Period from June 13 to September 17, 2011)

Appendix 3.3

Rescan™ Engineers & Scientists



PL-H1, looking upstream from the station installed on the right bank. The monitored reach is a low energy stream confined within a boulder lined channel and bedrock banks. Photograph taken July 10, 2011.



Note: pressure transducer stage readings are referenced to datum

Sabina GOLD & SILVER CORP.

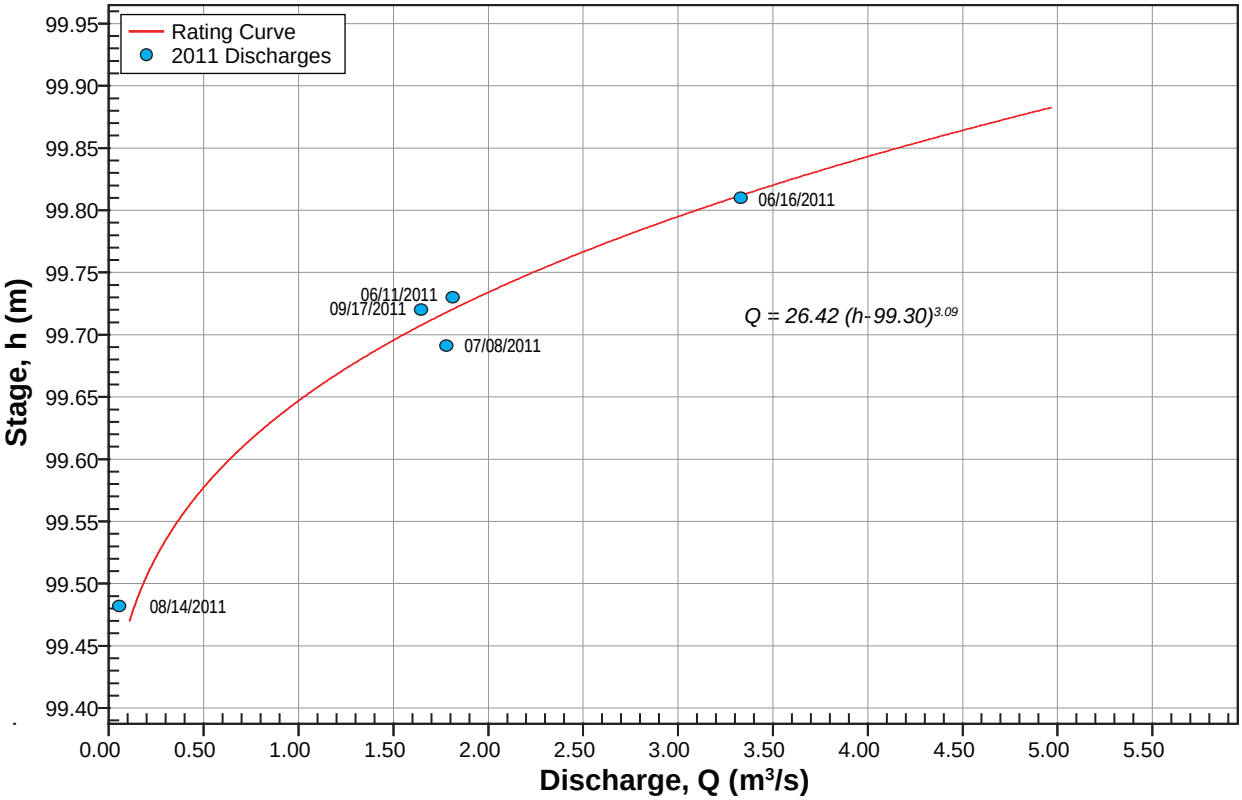
PL-H1 - Stage-Discharge Rating Curve
(Rating Period from June 12 to September 18, 2011)

Appendix 3.4

Rescan™ Engineers & Scientists



PL-H2, looking downstream from the station. The monitored reach is approximately 55 m wide at this location. The channel has a cobble/boulder bed substrate and is confined by low vegetated banks. Photograph taken on July 8, 2011.



Note: pressure transducer stage readings are referenced to datum

Sabina GOLD & SILVER CORP.

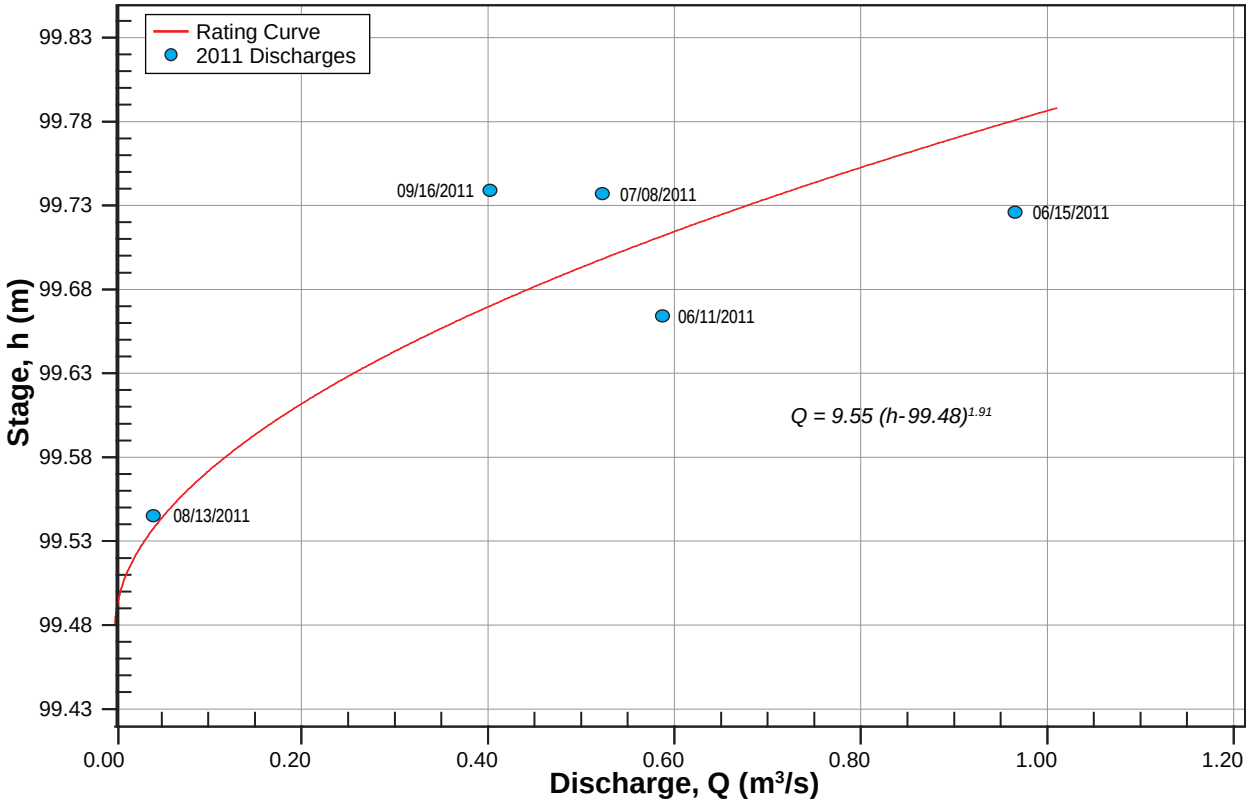
PL-H2 - Stage-Discharge Rating Curve
(Rating Period from June 10 to September 19, 2011)

Appendix 3.5

Rescan™ Engineers & Scientists



GI-H1, looking out over Giraffe Lake where the station is located at the outflow. The stage at the transducer location is governed by a section control located downstream in the channel. The section control is a riffle where boulders protrude from the water surface at all stages. Photograph taken on June 11, 2011.



Note: pressure transducer stage readings are referenced to datum

Sabina GOLD & SILVER CORP.

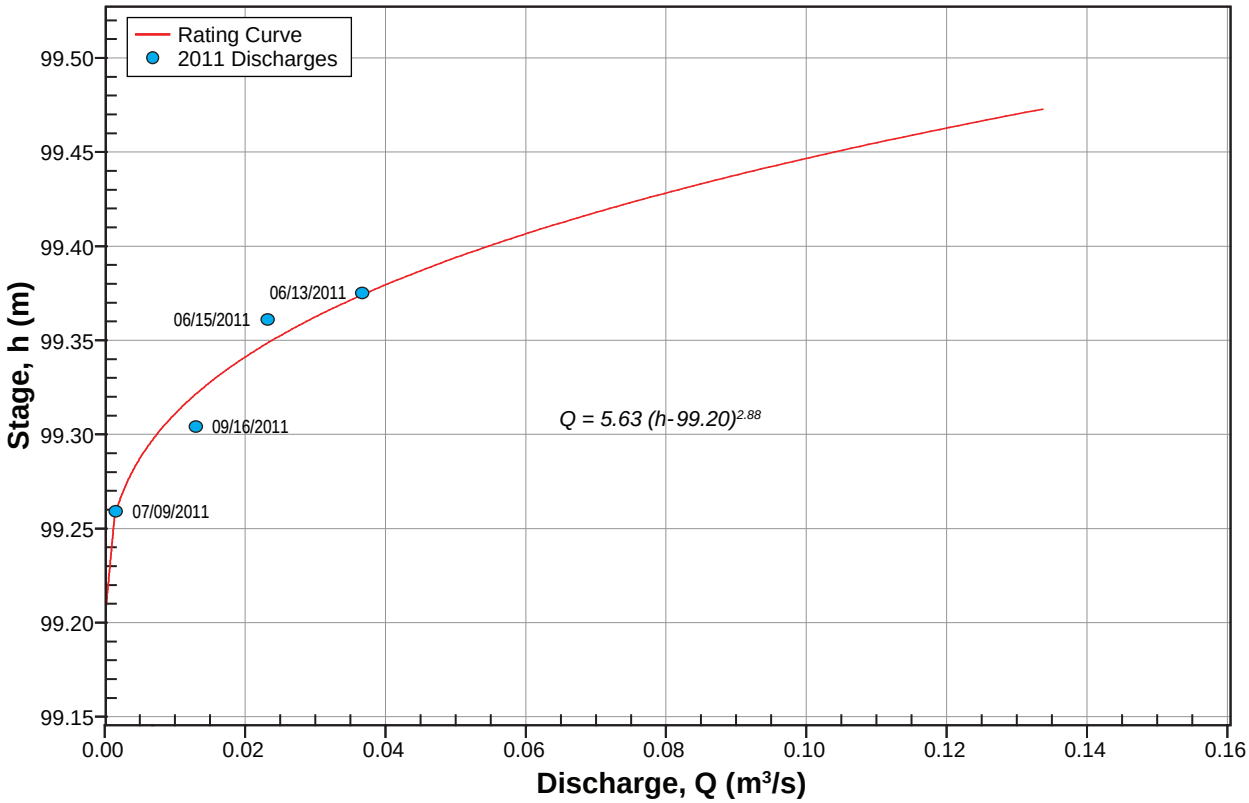
GI-H1 - Stage-Discharge Rating Curve
(Rating Period from June 10 to September 16, 2011)

Appendix 3.6

Rescan™ Engineers & Scientists



EL-H1, looking downstream along the channel. Note the water flowing through the tundra vegetation of this small ephemeral channel. The stream was observed to only flow during spring freshet and for short periods after precipitation events. Due to the ephemeral nature of the stream, the channel is lined with grasses. Photograph taken on June 13, 2011.



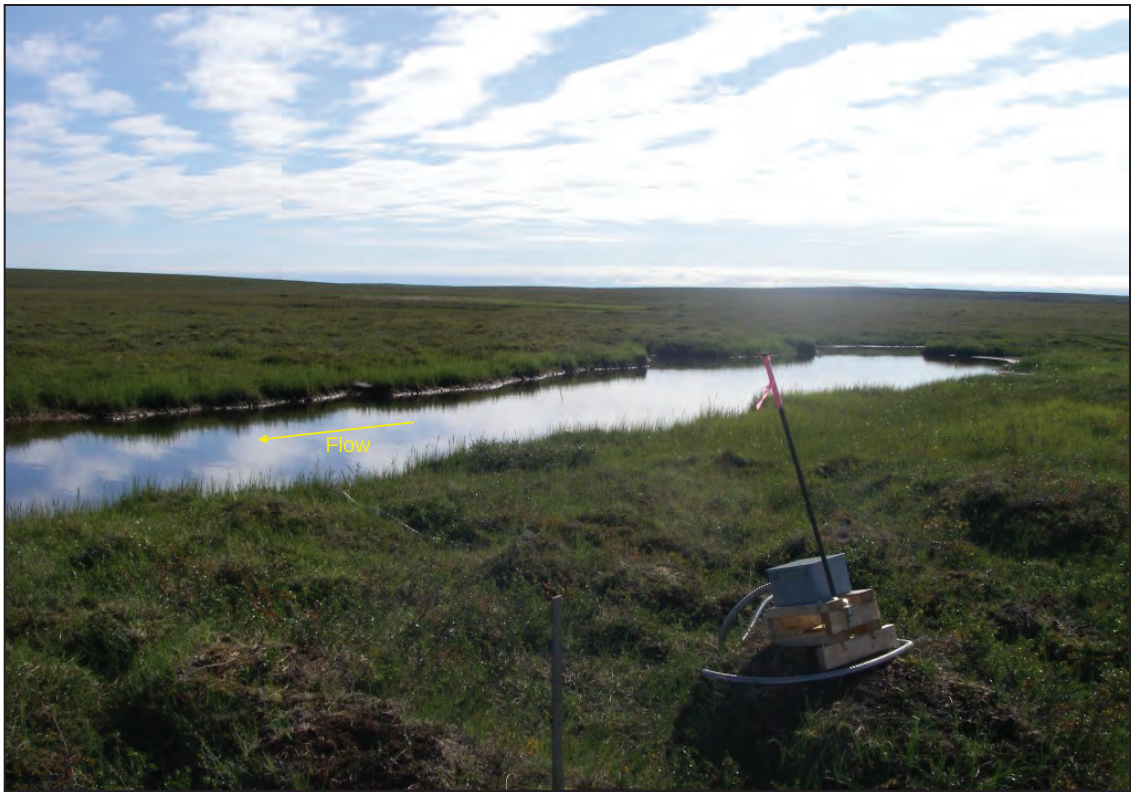
Note: pressure transducer stage readings are referenced to datum

Sabina GOLD & SILVER CORP.

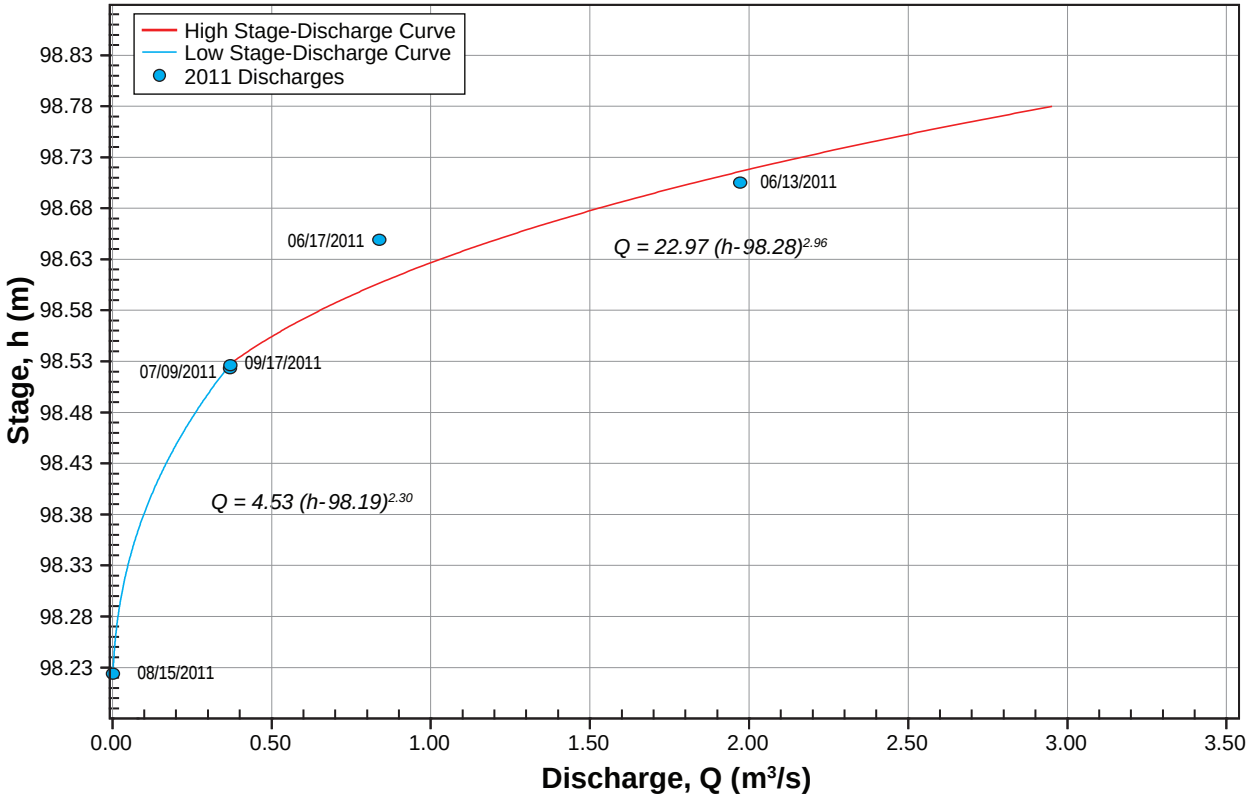
EL-H1 - Stage-Discharge Rating Curve
(Rating Period from June 11 to September 18, 2011)

Appendix 3.7

Rescan™ Engineers & Scientists



WL-H1, looking upstream along the monitored reach during low flow conditions. During low to medium flows conditions the stream is well confined by steep, almost vertical banks. In contrast, during high flow conditions the stream overflows onto the adjacent low gradient flood plain. This leads to different rating relationships between low and high stage conditions. Photograph taken on August 14, 2011.



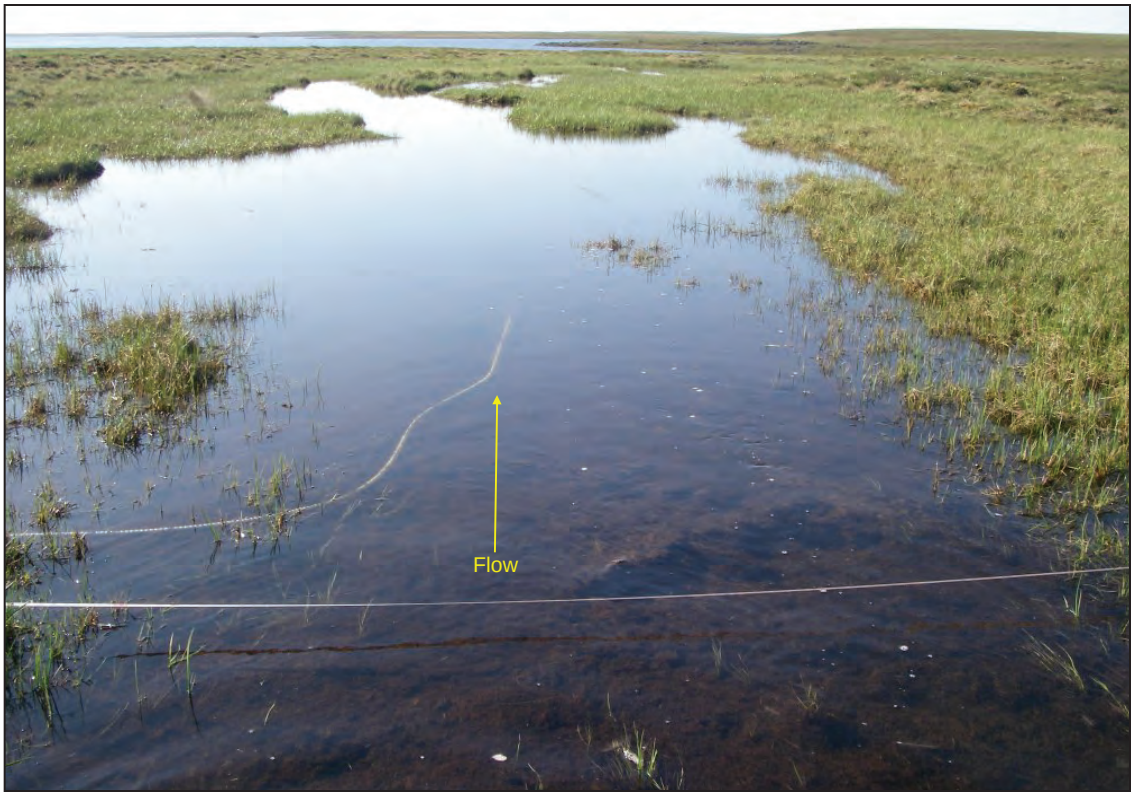
Note: pressure transducer stage readings are referenced to datum

Sabina GOLD & SILVER CORP.

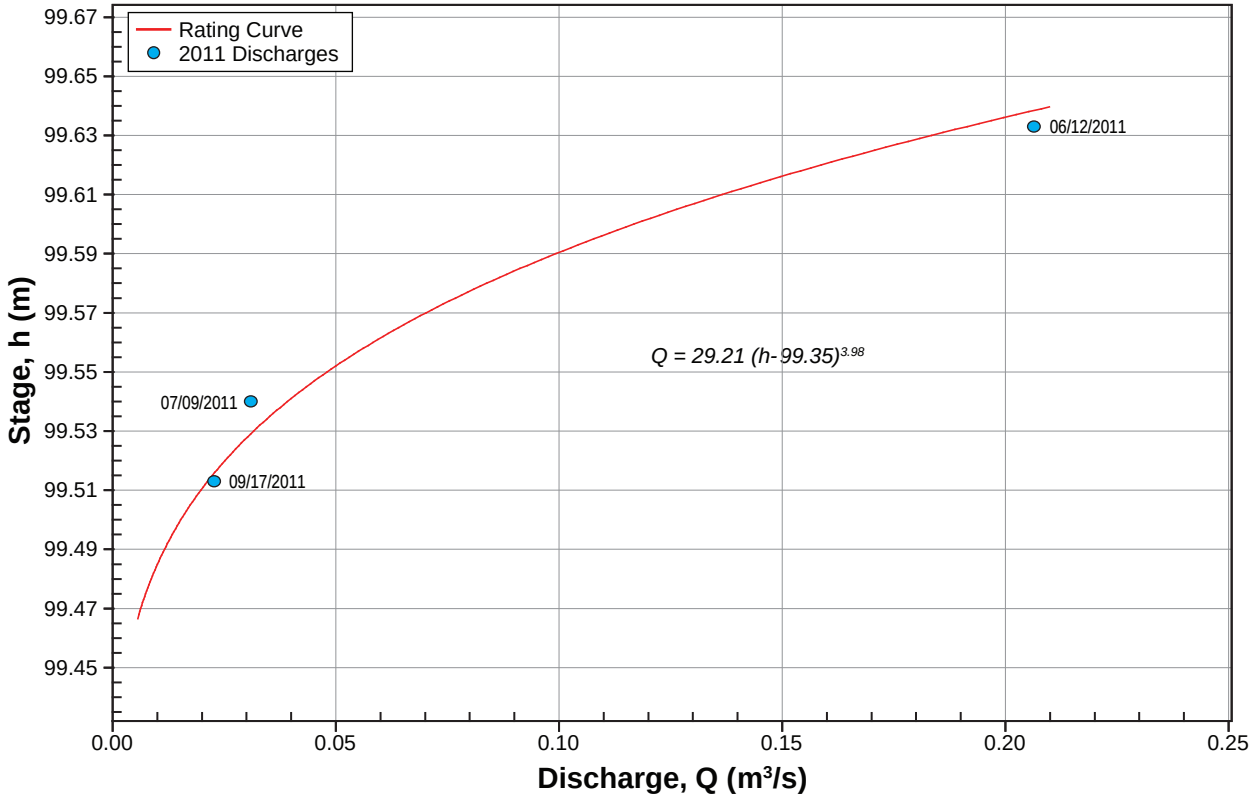
WL-H1 - Stage-Discharge Rating Curve
(Rating Period from June 12 to September 18, 2011)

Appendix 3.8

Rescan™ Engineers & Scientists



REFB-H1, looking downstream along the monitored reach. Note the water flowing through the gass along the edges of the channel. Vegetation growth in the channel is made possible by the periods of low flow during summer months when little to no flow conditions were observed. The tape across the channel indicates where mannual flow measurements were conducted. Photograph taken July 9, 2011.



Note: pressure transducer stage readings are referenced to datum

Appendix 3.9

REFB-H1 - Stage-Discharge Rating Curve
(Rating Period from June 12 to September 18, 2011)

Appendix 4
Mean Daily Discharge Tables

Rescan™
Engineers and Scientists

Appendix 4.1. Summary of Daily Mean Discharge [Q] at Hydrometric Station GL-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.339	0.005	0.026	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.653	0.004	0.024	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.561	0.004	0.023	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.483	0.003	0.029	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.003*	0.414	0.003	0.045	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.007*	0.347	0.002	0.160	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.017*	0.290	0.002	0.206	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.038*	0.247	0.002	0.192	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.087*	0.214	0.001	0.170	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.451	0.189	0.001	0.321	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.477	0.164	0.001	0.502	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.511	0.145	0.001	0.462	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.601	0.130	0.001	0.404	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.583	0.106	0.001	0.360	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.548	0.088	0.001	0.332	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.554	0.073	0.001	0.303	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.574	0.060	0.006	*0.275*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.579	0.051	0.010	*0.247*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.579	0.044	0.014	*0.219*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.535	0.037	0.017	*0.191*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.487	0.031	0.018	*0.163*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.443	0.026	0.026	*0.135*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.403	0.022	0.037	*0.107*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.367	0.019	0.040	*0.079*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.336	0.016	0.040	*0.051*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.313	0.013	0.039	*0.022*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.269	0.011	0.036	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.233	0.010	0.034	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.232	0.008	0.031	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.256	0.007	0.029	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.006	0.027		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.316**	**0.155**	**0.014**	**0.168**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.601**	**0.653**	**0.040**	**0.502**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.006**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**9.486**	**4.806**	**0.438**	**5.045**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.2. Summary of Daily Mean Discharge [Q] at Hydrometric Station GL-H2

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.097	0.000	0.006	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.118	0.000	0.005	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.118	0.001	0.006	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.107	0.000	0.010	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.093	0.000	0.015	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.078	0.000	0.020	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	0.065	0.000	0.022	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.008*	0.053	0.000	0.026	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.016*	0.045	0.000	0.024	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.063	0.038	0.000	0.046	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.066	0.032	0.000	0.063	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.078	0.027	0.000	0.064	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.099	0.021	0.000	0.056	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.124	0.017	0.000	0.051	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.127	0.013	0.000	0.049	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.141	0.011	0.000	0.045	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.157	0.008	0.003	*0.042*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.170	0.007	0.004	*0.038*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.180	0.005	0.006	*0.035*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.175	0.004	0.006	*0.031*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.167	0.004	0.007	*0.028*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.155	0.003	0.007	*0.024*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.139	0.003	0.008	*0.021*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.126	0.002	0.008	*0.017*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.117	0.002	0.009	*0.014*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.107	0.002	0.009	*0.010*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.084	0.002	0.008	*0.007*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.077	0.001	0.008	*0.003*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.073	0.001	0.008	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.078	0.000	0.008	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.000	0.007		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.085**	**0.032**	**0.004**	**0.026**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.180**	**0.118**	**0.009**	**0.064**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**2.537**	**0.977**	**0.110**	**0.779**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.3. Summary of Daily Mean Discharge [Q] at Hydrometric Station GL-H3

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.271	0.000	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.478	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.434	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.351	0.000	0.012	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.273	0.000	0.067	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.221	0.000	0.113	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	0.178	0.000	0.116	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.008*	0.142	0.000	0.093	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.016*	0.107	0.000	0.097	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.323*	0.073	0.000	0.245	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.345*	0.051	0.000	0.267	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.376*	0.036	0.000	0.225	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.455*	0.019	0.000	0.193	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.575	0.009	0.000	0.181	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.528	0.003	0.000	0.157	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.487	0.000	0.000	0.141	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.468	0.000	0.000	*0.114*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.442	0.000	0.000	*0.087*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.420	0.000	0.000	*0.060*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.379	0.000	0.000	*0.033*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.335	0.000	0.000	*0.006*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.309	0.000	0.002	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.281	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.252	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.218	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.166	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.160	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.176	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.174	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.201	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.237**	**0.085**	**0.000**	**0.074**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.575**	**0.478**	**0.002**	**0.267**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**7.104**	**2.646**	**0.005**	**2.209**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.4. Summary of Daily Mean Discharge [Q] at Hydrometric Station PL-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.009	0.344	0.212	*0.601*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.460	0.321	0.204	*0.371*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	7.115	0.273	0.224	*0.141*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	7.398	0.248	0.291	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.005*	7.086	0.234	0.353	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.012*	6.576	0.222	0.467	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.030*	6.036	0.202	0.592	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.072*	5.553	0.182	0.623	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.176*	5.033	0.159	0.754	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.427*	4.566	0.138	1.296	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.038*	4.170	0.129	2.098	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.134	3.832	0.116	2.658	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.726	3.470	0.084	3.265	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.595	3.138	0.075	3.748	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.081	2.735	0.069	3.778	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.194	2.411	0.060	3.905	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.168	2.168	0.174	3.821	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.133	1.968	0.248	*3.591*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.000	1.763	0.261	*3.361*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.832	1.510	0.241	*3.131*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.577	1.297	0.239	*2.901*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.185	1.155	0.262	*2.671*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.769	1.032	0.266	*2.441*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.328	0.924	0.271	*2.211*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.949	0.847	0.269	*1.981*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.582	0.756	0.250	*1.751*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.227	0.623	0.252	*1.521*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.899	0.552	0.254	*1.291*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	4.684	0.515	0.253	*1.061*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	4.770	0.429	0.256	*0.831*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.378	0.234		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**4.320**	**3.113**	**0.212**	**1.901**	**0.036**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**8.194**	**7.398**	**0.344**	**3.905**	**0.601**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.378**	**0.060**	**0.204**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**129.596**	**96.506**	**6.586**	**57.029**	**1.112**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.5. Summary of Daily Mean Discharge [Q] at Hydrometric Station PL-H2

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.697	0.147	0.517	*0.150*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.668	0.150	0.541	*0.030*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	2.849	0.160	0.587	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	2.483	0.160	0.662	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.003*	2.183	0.158	0.783	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.008*	1.873	0.153	1.109	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.018*	1.630	0.144	1.345	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.040*	1.430	0.136	1.316	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.091*	1.255	0.131	1.292	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.208*	1.139	0.128	1.758	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.972*	1.024	0.132	2.466	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.361	0.944	0.138	2.527	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.394	0.823	0.143	2.430	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.825	0.738	0.142	2.267	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.578	0.636	0.138	2.025	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.318	0.610	0.122	1.889	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.169	0.557	0.214	1.830	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.094	0.497	0.314	*1.710*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.020	0.422	0.422	*1.590*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.909	0.398	0.407	*1.470*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.707	0.369	0.419	*1.350*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.506	0.353	0.420	*1.230*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.294	0.322	0.496	*1.110*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.125	0.311	0.520	*0.990*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.985	0.287	0.520	*0.870*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.907	0.262	0.538	*0.750*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.715	0.241	0.541	*0.630*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.603	0.224	0.545	*0.510*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	1.479	0.209	0.555	*0.390*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	1.535	0.179	0.542	*0.270*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.166	0.513		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**1.696**	**0.928**	**0.298**	**1.274**	**0.006**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**3.825**	**2.849**	**0.555**	**2.527**	**0.150**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.166**	**0.122**	**0.270**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**50.869**	**28.776**	**9.246**	**38.213**	**0.180**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.6. Summary of Daily Mean Discharge [Q] at Hydrometric Station GI-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.707	0.053	0.280	*0.190*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.905	0.103	0.280	*0.153*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.961	0.129	0.290	*0.117*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.920	0.091	0.390	*0.081*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.003*	0.868	0.063	0.448	*0.045*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.007*	0.815	0.060	0.491	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.015*	0.769	0.047	0.525	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.034*	0.713	0.043	0.571	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.077*	0.686	0.035	0.528	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.174*	0.648	0.027	0.710	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.393*	0.612	0.035	0.875	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.451	0.587	0.077	0.886	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.581	0.532	0.047	0.817	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.656	0.493	0.007	0.774	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.665	0.449	0.002	0.769	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.716	0.422	0.002	0.732	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.758	0.378	0.134	*0.696*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.823	0.342	0.259	*0.660*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.862	0.293	0.310	*0.624*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.867	0.272	0.298	*0.588*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.854	0.259	0.261	*0.551*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.832	0.240	0.241	*0.515*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.797	0.223	0.297	*0.479*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.771	0.213	0.284	*0.443*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.749	0.191	0.296	*0.407*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.708	0.191	0.312	*0.371*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.633	0.205	0.268	*0.334*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.612	0.108	0.296	*0.298*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.598	0.112	0.286	*0.262*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.626	0.100	0.297	*0.226*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.063	0.291		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.476**	**0.461**	**0.160**	**0.527**	**0.019**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.867**	**0.961**	**0.312**	**0.886**	**0.190**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.063**	**0.002**	**0.226**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**14.267**	**14.277**	**4.952**	**15.821**	**0.586**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.7. Summary of Daily Mean Discharge [Q] at Hydrometric Station EL-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.056	0.000	0.001	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.071	0.000	0.001	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.036	0.000	0.002	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.021	0.000	0.015	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.011	0.000	0.034	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.007	0.000	0.025	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	0.004	0.000	0.018	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.007*	0.002	0.000	0.012	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.013*	0.002	0.000	0.011	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.050*	0.001	0.000	0.062	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.088*	0.001	0.000	0.043	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.072*	0.001	0.000	0.024	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.055	0.001	0.000	0.016	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.038	0.000	0.000	0.012	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.034	0.000	0.000	0.010	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.039	0.000	0.000	0.009	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.042	0.000	0.000	*0.007*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.038	0.000	0.001	*0.005*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.036	0.000	0.004	*0.004*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.028	0.000	0.004	*0.002*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.022	0.000	0.003	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.017	0.000	0.004	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.013	0.000	0.004	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.009	0.000	0.002	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.008	0.000	0.002	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.008	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.005	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.006	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.007	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.022	0.000	0.001	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.000	0.001		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.022**	**0.007**	**0.001**	**0.010**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.088**	**0.071**	**0.004**	**0.062**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.668**	**0.213**	**0.032**	**0.315**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 4.8. Summary of Daily Mean Discharge [Q] at Hydrometric Station WL-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.730	0.013	0.066	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.255	0.016	0.064	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.161	0.014	0.081	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.967	0.011	0.138	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.785	0.009	0.252	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	0.638	0.008	0.336	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.009*	0.533	0.007	0.353	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.019*	0.452	0.006	0.305	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.040*	0.378	0.005	0.293	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.362*	0.329	0.005	0.633	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.394*	0.291	0.006	0.735	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.439*	0.258	0.006	0.637	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.737	0.210	0.005	0.570	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.556	0.176	0.003	0.541	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.348	0.141	0.002	0.463	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.246	0.115	0.004	0.416	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.187	0.103	0.034	0.375	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.135	0.096	0.042	*0.335*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.083	0.085	0.061	*0.295*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.025	0.066	0.082	*0.255*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.937	0.055	0.097	*0.215*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.872	0.049	0.113	*0.175*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.791	0.044	0.103	*0.135*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.726	0.040	0.108	*0.095*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.640	0.036	0.101	*0.055*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.532	0.033	0.090	*0.015*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.535	0.028	0.087	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.539	0.021	0.084	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.500	0.020	0.082	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.565	0.016	0.080	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.013	0.073		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.707**	**0.294**	**0.044**	**0.261**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**1.737**	**1.255**	**0.113**	**0.735**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.013**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**21.223**	**9.122**	**1.358**	**7.833**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

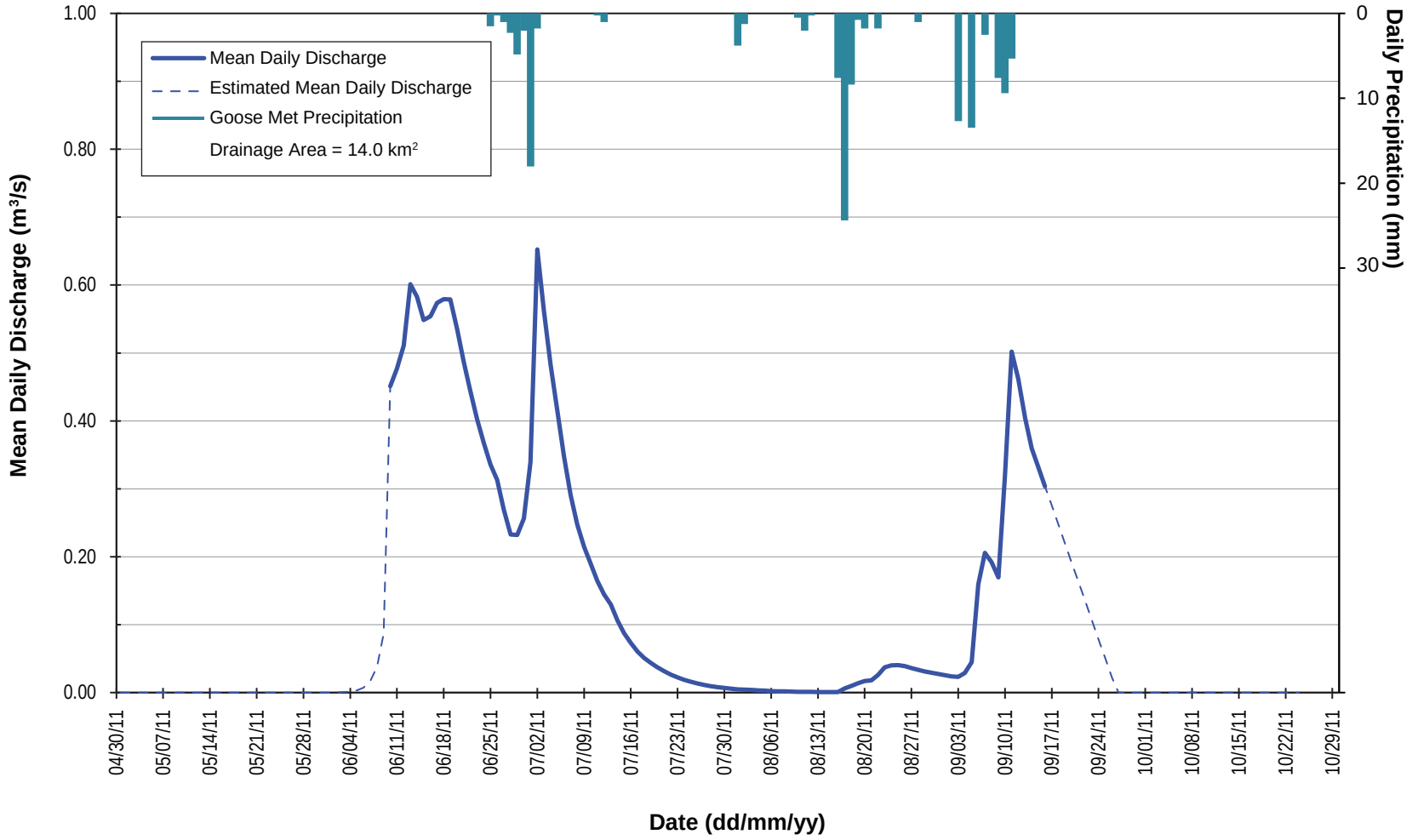
Appendix 4.9. Summary of Daily Mean Discharge [Q] at Hydrometric Station REFB-H1

2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.102	0.000	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.161	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.156	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.128	0.000	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.102	0.000	0.012	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.079	0.000	0.009	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.004*	0.060	0.000	0.008	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.007*	0.045	0.000	0.018	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.014*	0.038	0.000	0.009	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.104*	0.030	0.000	0.047	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.112*	0.022	0.000	0.066	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.200	0.018	0.000	0.061	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.188	0.011	0.000	0.047	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.177	0.003	0.000	0.035	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.159	0.000	0.000	0.034	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.144	0.000	0.000	0.026	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.131	0.000	0.000	0.021	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.118	0.000	0.000	*0.017*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.105	0.000	0.000	*0.012*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.093	0.000	0.000	*0.007*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.085	0.000	0.000	*0.003*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.071	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.055	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.042	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.043	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.049	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.028	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.023	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*		*0.000*	*0.000*	*0.000*	0.024	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.000*	0.040	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.000*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.067**	**0.031**	**0.000**	**0.014**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.200**	**0.161**	**0.000**	**0.066**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**2.021**	**0.956**	**0.000**	**0.433**	**0.000**	**0.000**	**0.000**

Note: Estimated values are italicized

Appendix 5
Annual Hydrographs

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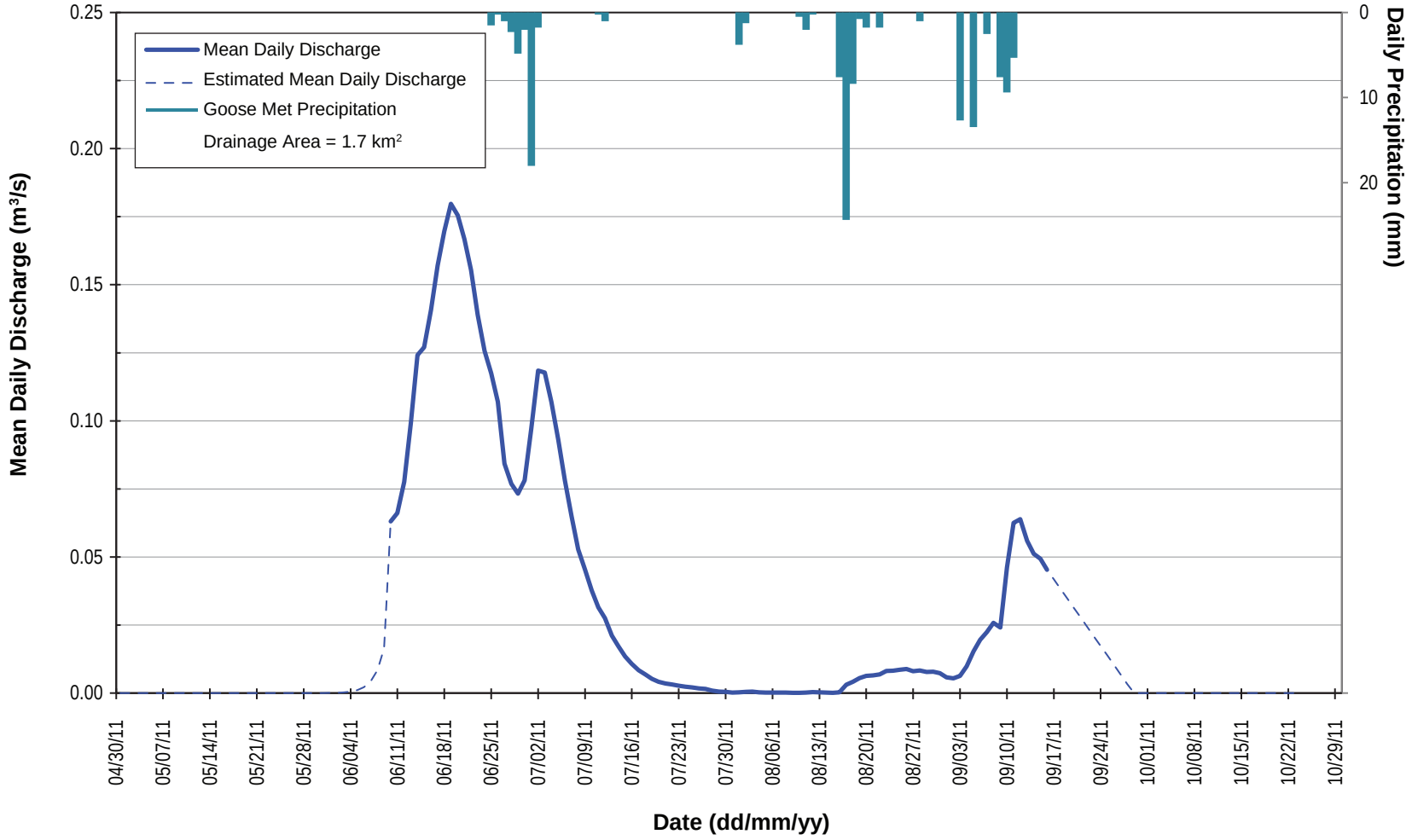
Appendix 5.1

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-*H1* Hydrometric Monitoring Station, 2011

Appendix 5.1

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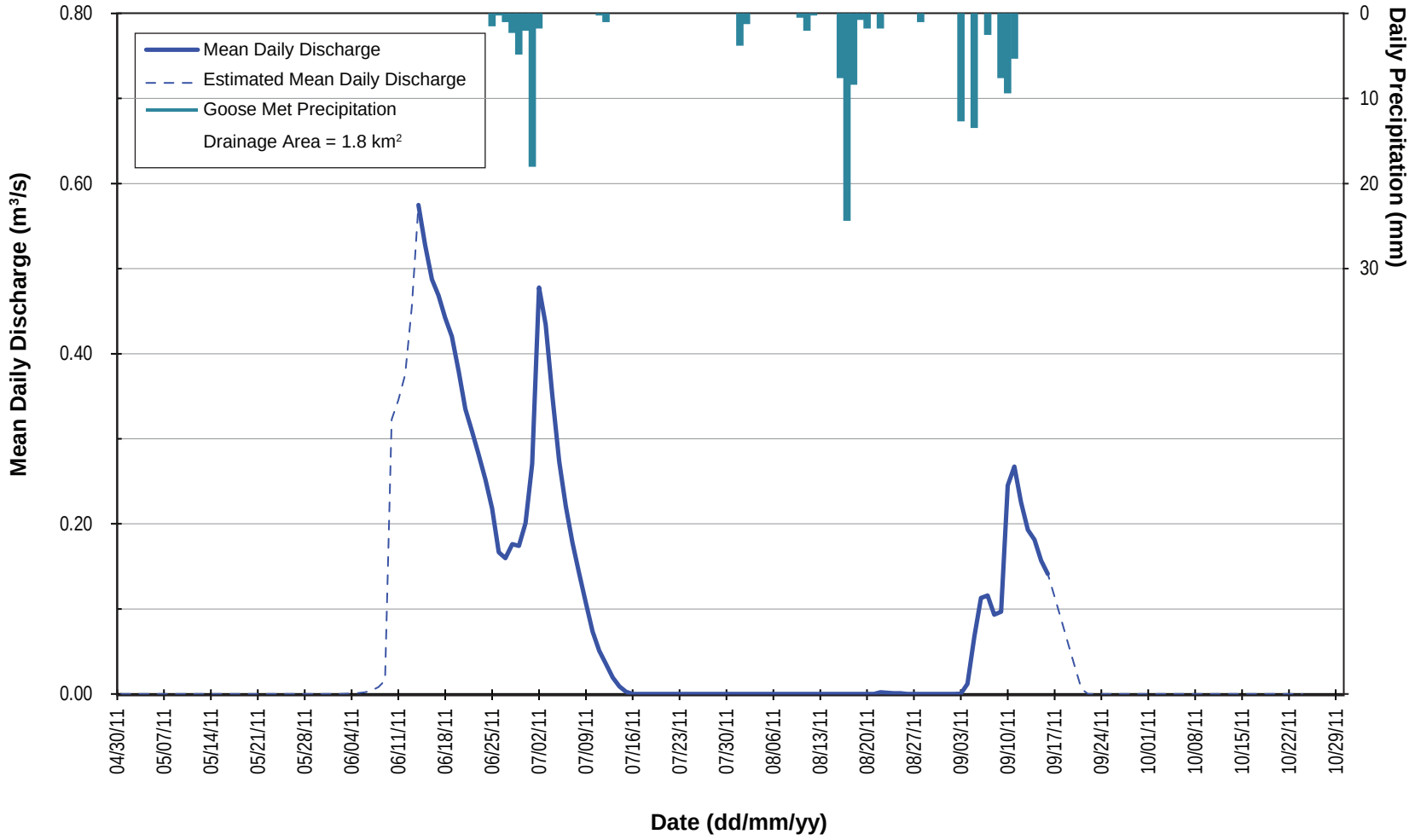
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Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-*H2* Hydrometric Monitoring Station, 2011

Appendix 5.2

Rescan™ Engineers & Scientists



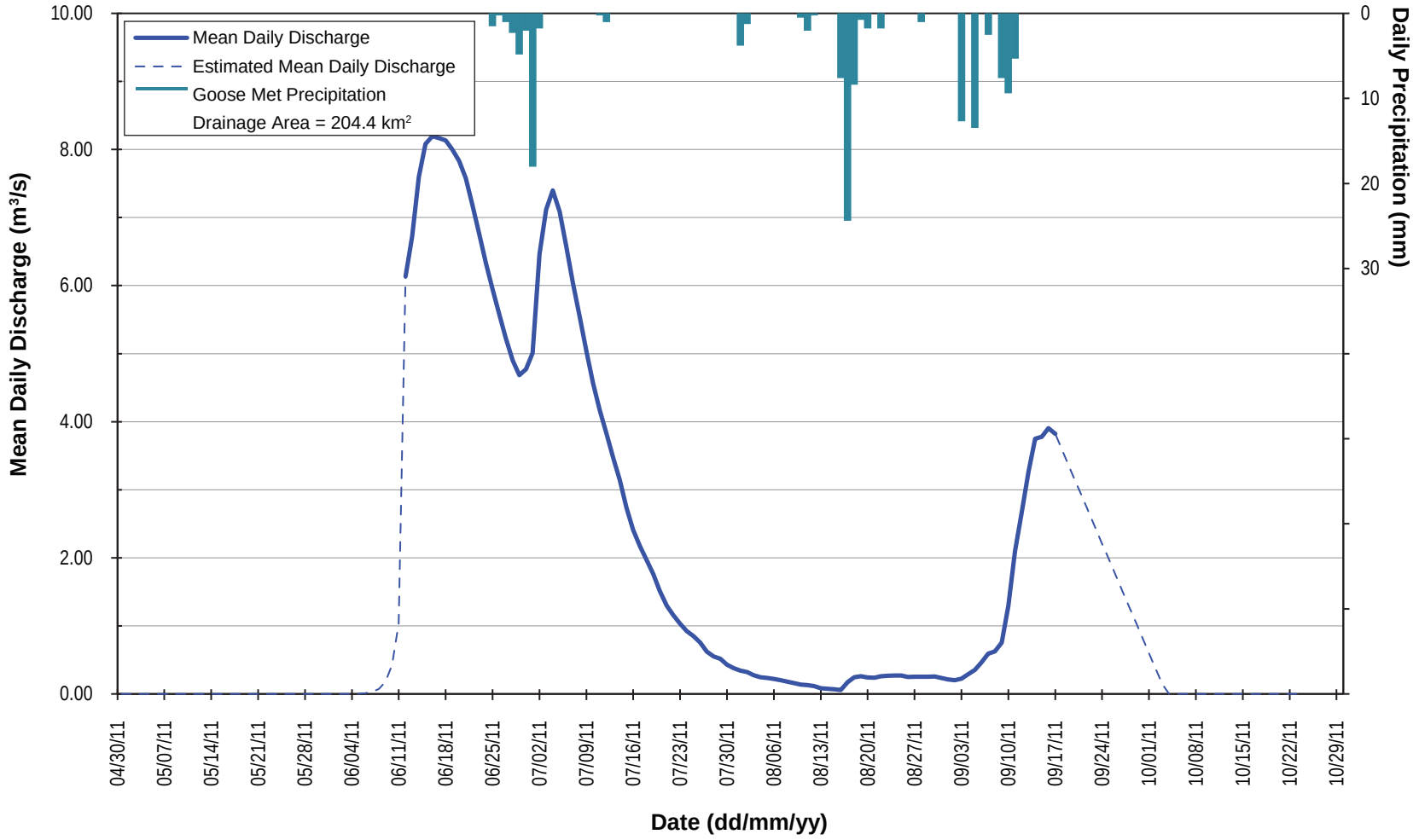
Appendix 5.3

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-*H3*
Hydrometric Monitoring Station, 2011

Appendix 5.3

Rescan™ Engineers & Scientists



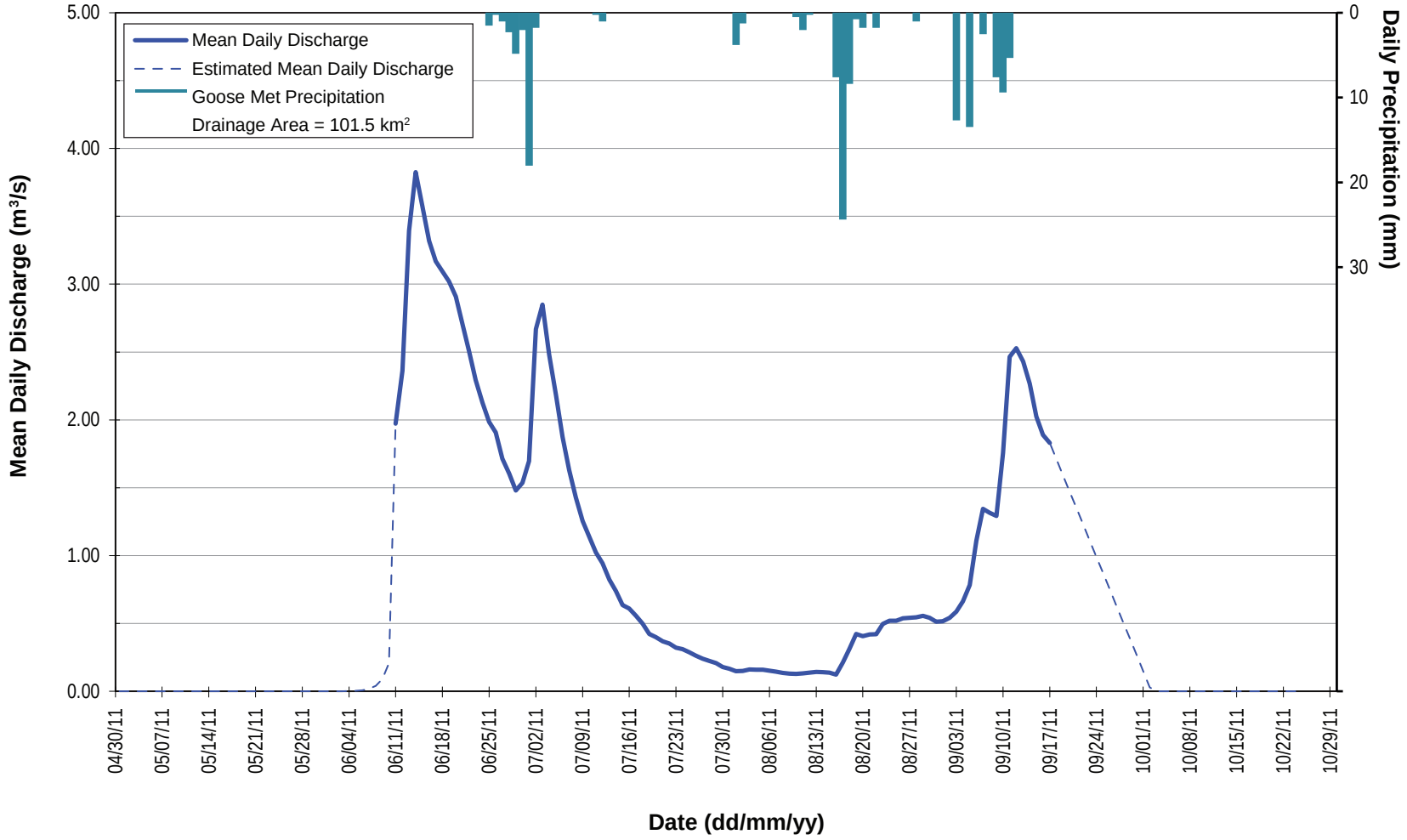
Appendix 5.4

Sabina GOLD & SILVER CORP.

Annual Hydrograph at PL-*H1*
Hydrometric Monitoring Station, 2011

Appendix 5.4

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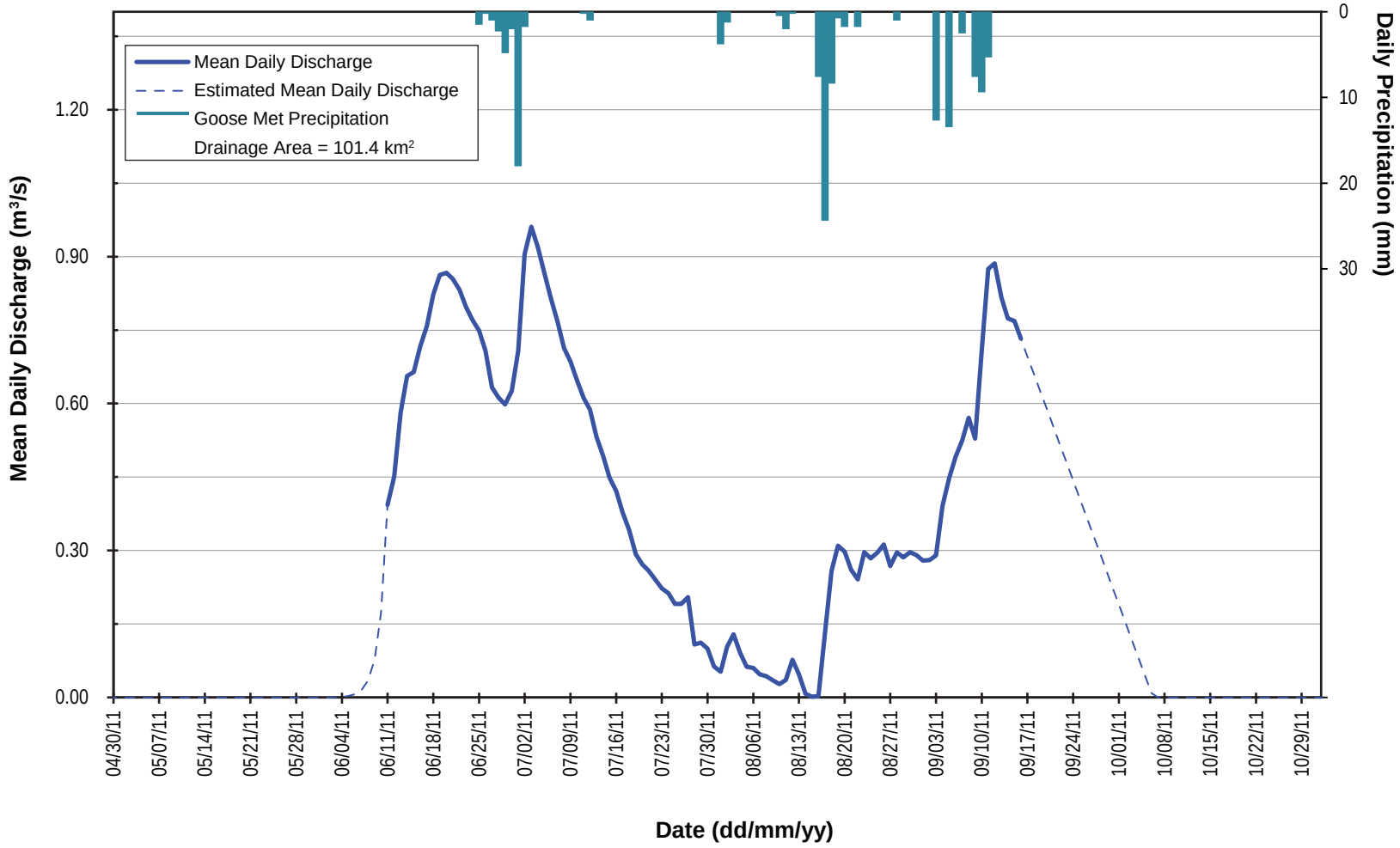


Sabina GOLD & SILVER CORP.

Annual Hydrograph at PL-*H2* Hydrometric Monitoring Station, 2011

Appendix 5.5

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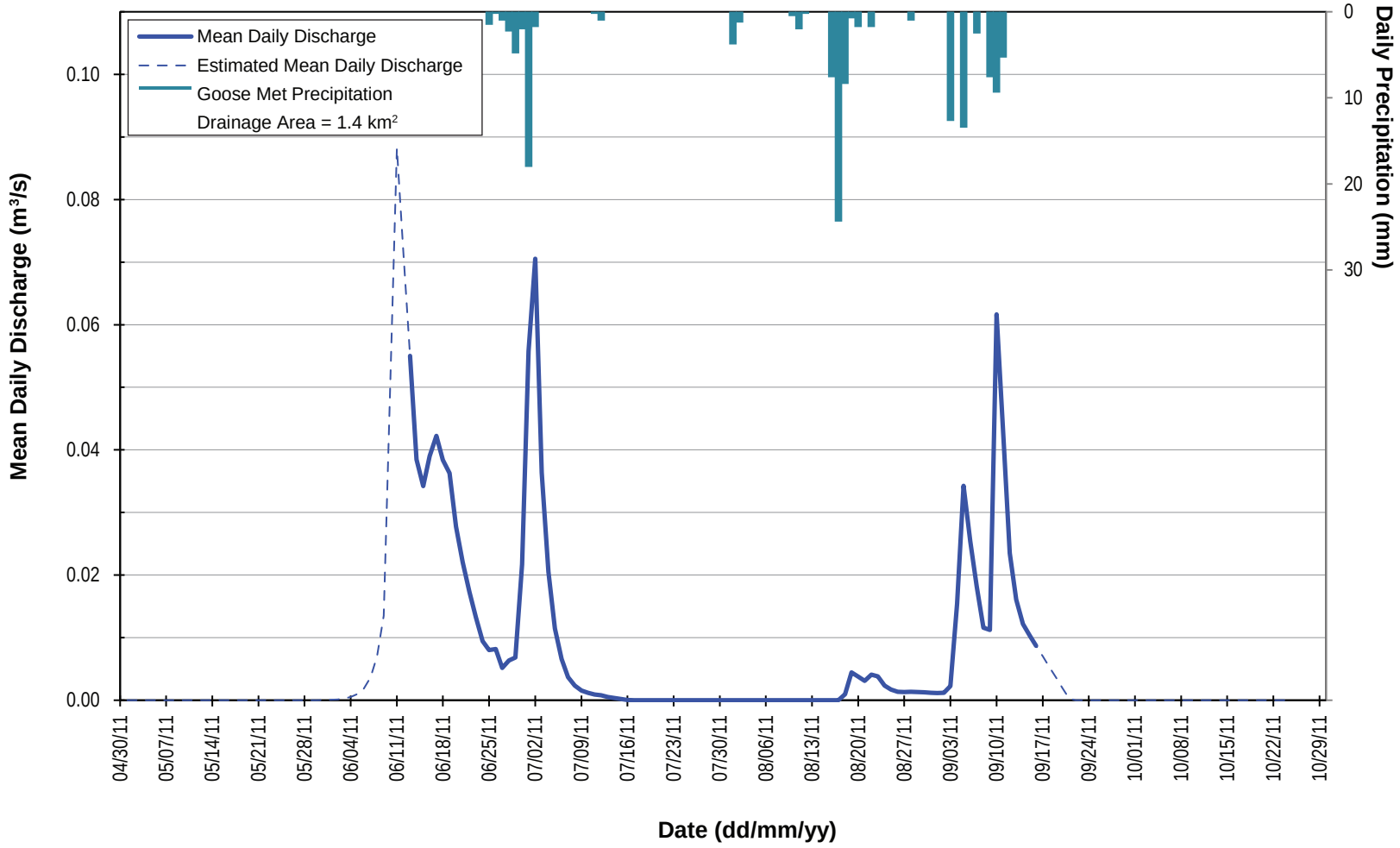
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Sabina GOLD & SILVER CORP.

Annual Hydrograph at GI-*H1* Hydrometric Monitoring Station, 2011

Appendix 5.6

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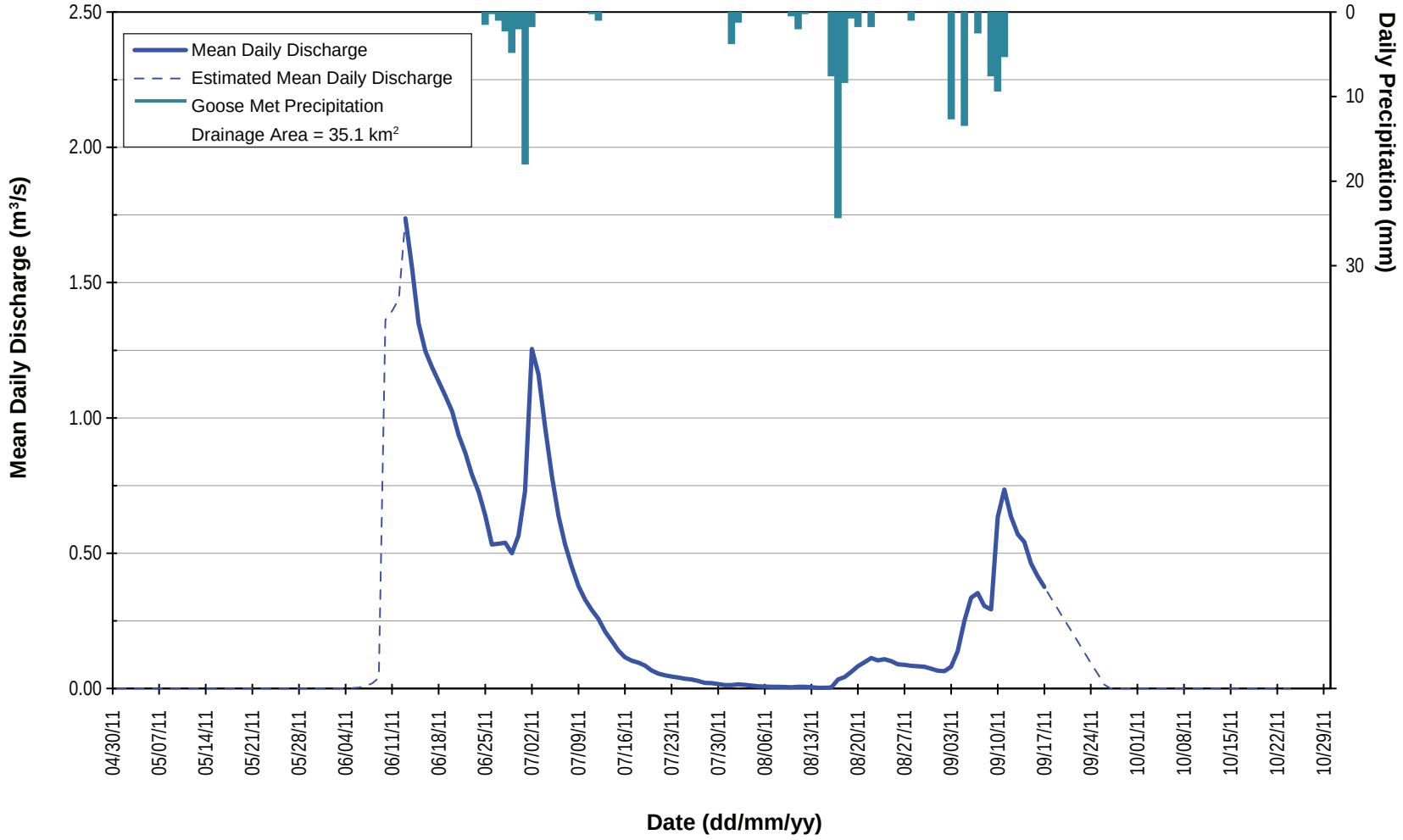


Sabina GOLD & SILVER CORP.

Annual Hydrograph at EL-*H1* Hydrometric Monitoring Station, 2011

Appendix 5.7

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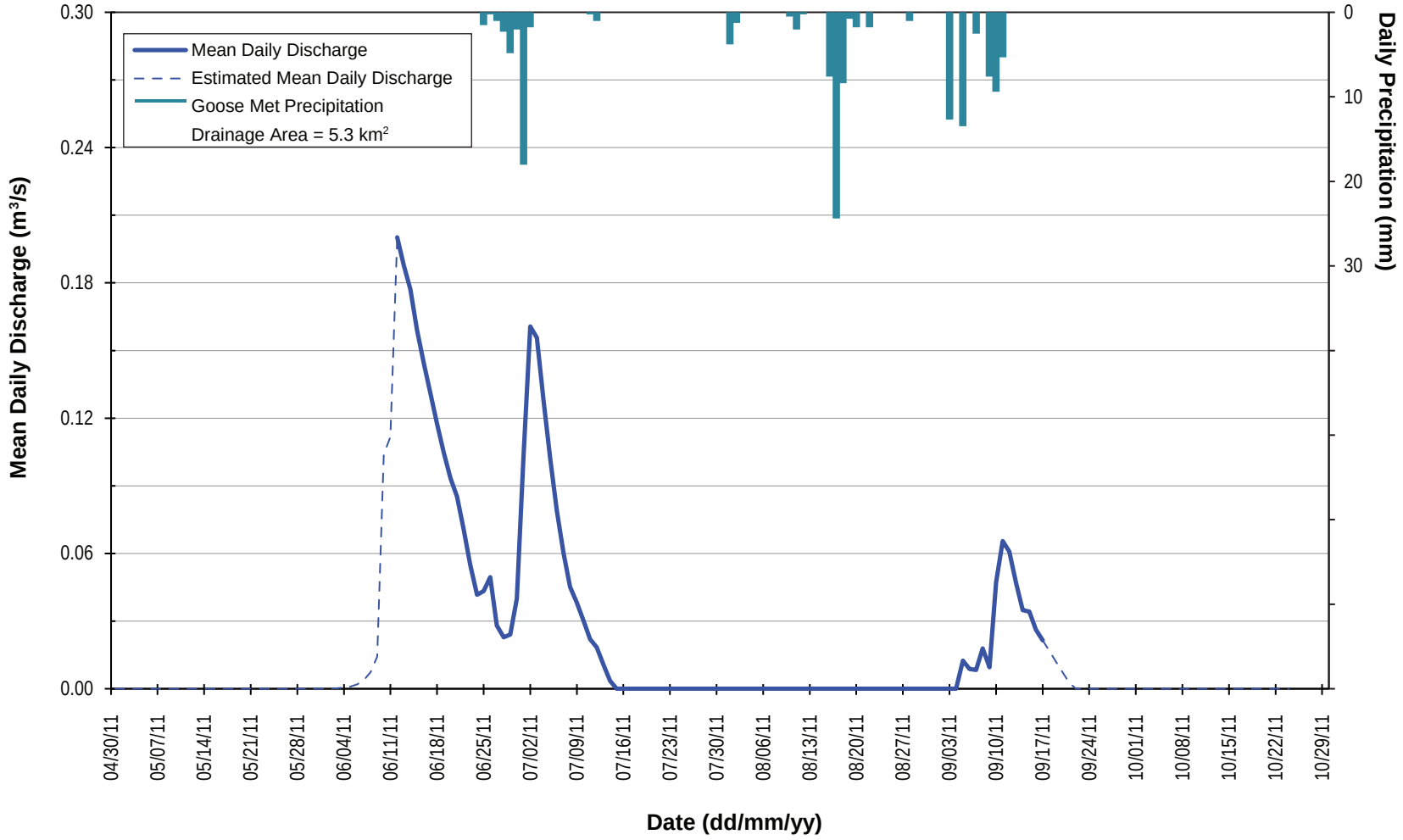
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Sabina GOLD & SILVER CORP.

Annual Hydrograph at WL-*H1* Hydrometric Monitoring Station, 2011

Appendix 5.8

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Sabina GOLD & SILVER CORP.

Annual Hydrograph at REFB-*H1*
Hydrometric Monitoring Station, 2011

Appendix 5.9

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Channel Geometry Surveys

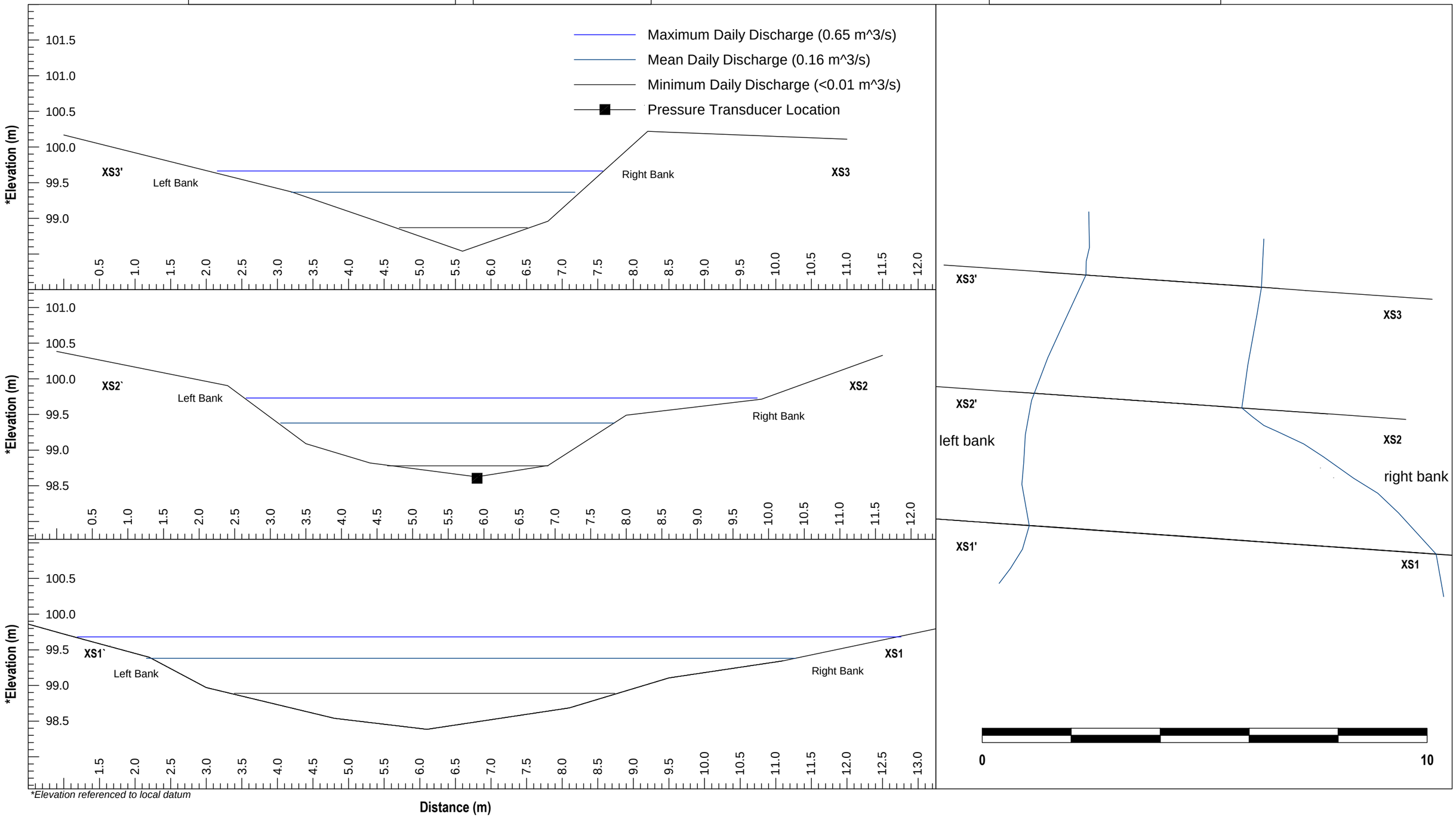
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Station GL-H1 Cross Sections

Profile Vert Scale 1:50
Profile Horz Scale 1:50

Station GL-H1 Plan View

Plan Scale 1:80



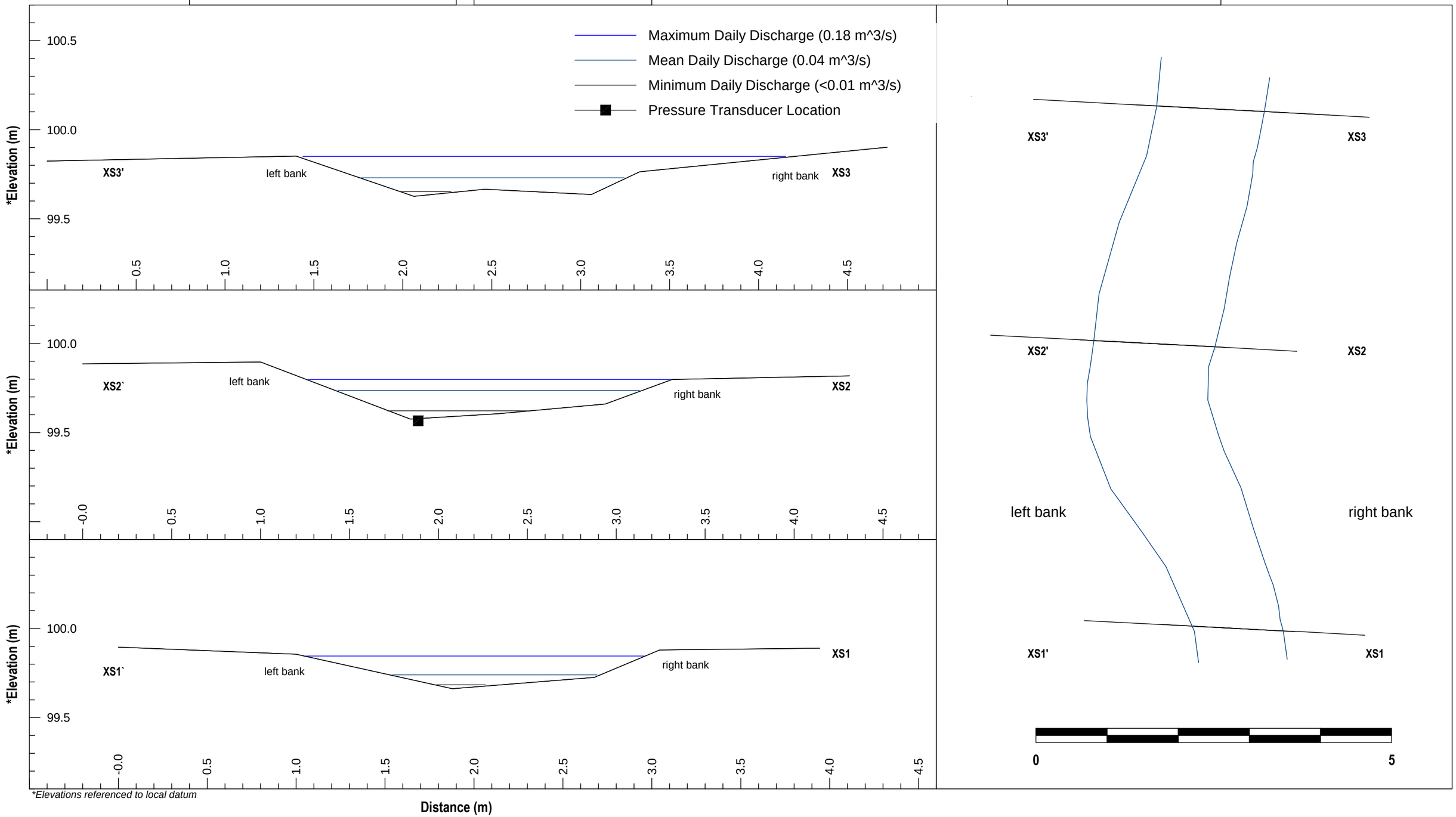
Appendix 6.1: 2011 Channel Geometry Survey at Hydrometric Monitoring station GL-H1

Station GL-H2 Cross Sections

Profile Vert Scale 1:20
Profile Horz Scale 1:20

Station GL-H2 Plan View

Plan Scale 1:50



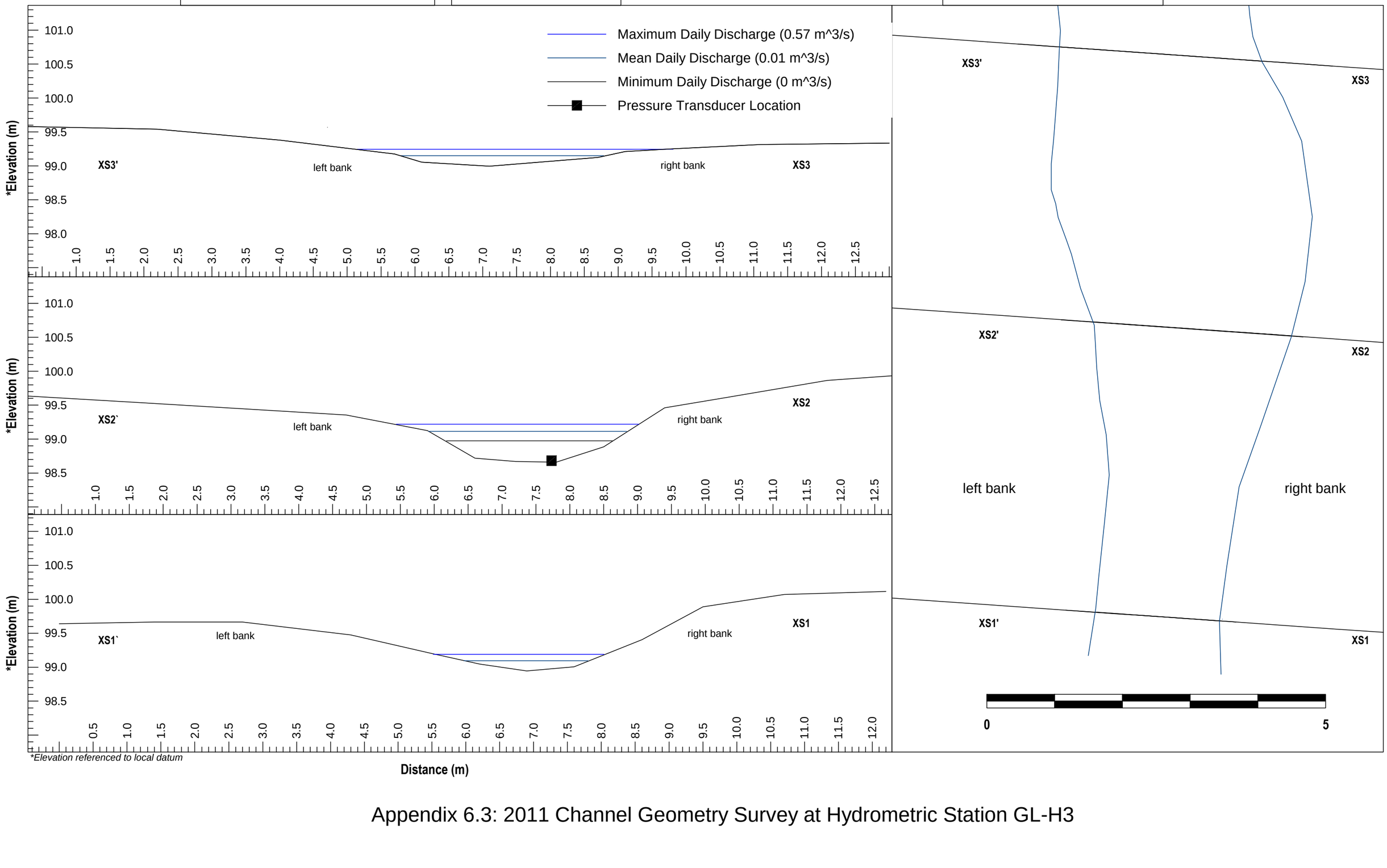
Appendix 6.2: 2011 Channel Geometry Survey at Hydrometric Monitoring Station GL-H2

Station GL-H3 Cross Sections

Profile Vert Scale 1:50
Profile Horz Scale 1:50

Station GL-H3 Plan View

Plan Scale 1:50



*Elevation referenced to local datum

Appendix 6.3: 2011 Channel Geometry Survey at Hydrometric Station GL-H3

Station PL-H1 Cross Sections

Profile Vert Scale 1:75
Profile Horz Scale 1:150

Maximum Daily Discharge (8.19 m^3/s)
Mean Daily Discharge (0.33 m^3/s)
Minimum Daily Discharge (0.10 m^3/s)
Pressure Transducer Location

***Elevation (m)**

103
102
101
100
99
98
97
96
95

XS1`

left bank

right bank

XS1

5 10 15 20 25 30 35 40 45 50 55 60

Distance (m)

Station PL-H1 Plan View

Plan Scale 1:200

XS1'

left bank

right bank

XS1

0 **25**

**Elevation referenced to local datum*

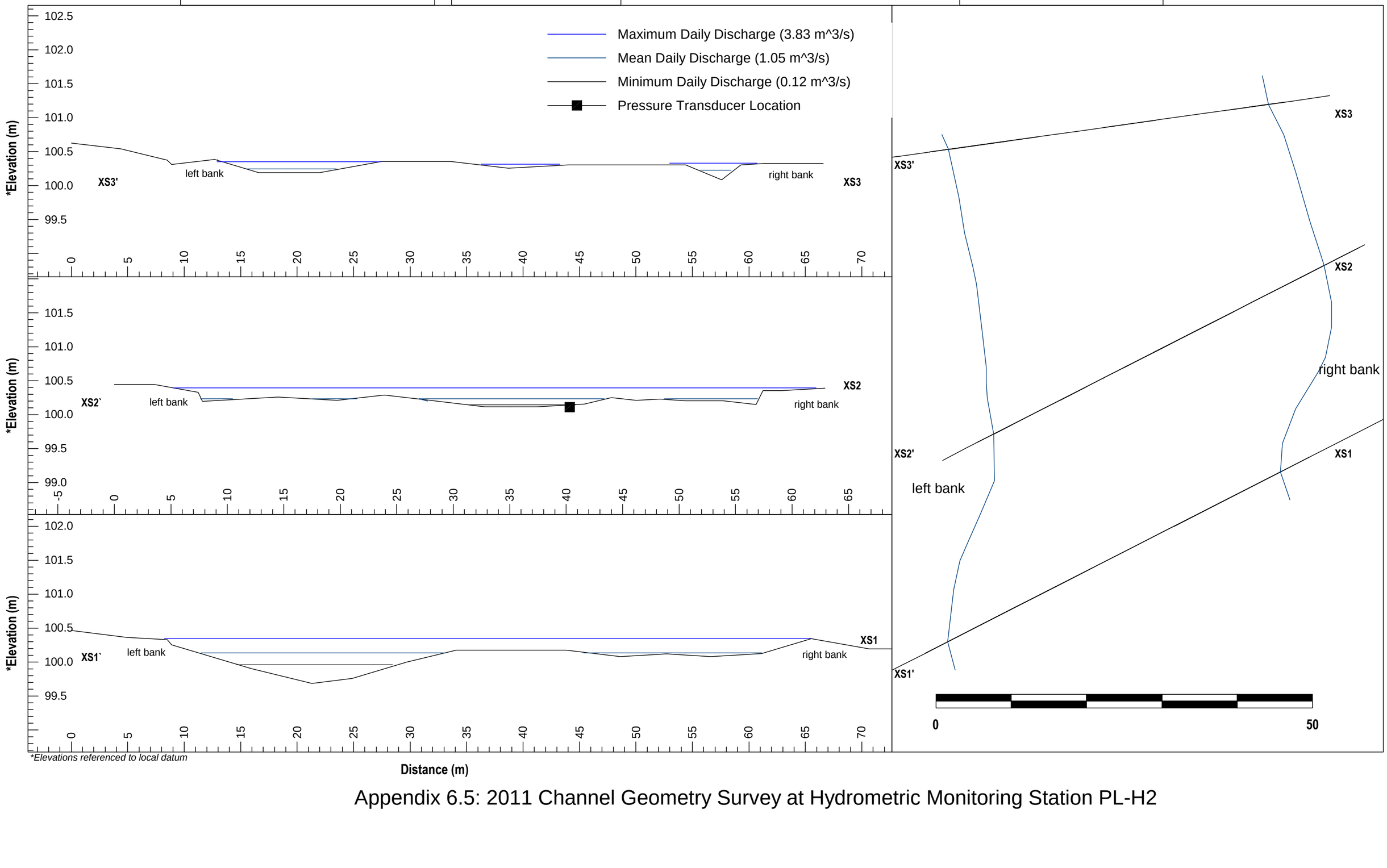
Appendix 6.4: 2011 Channel Geometry Survey at Hydrometric Monitoring Station PL-H1

Station PL-H2 Cross Sections

Profile Vert Scale 1:50
Profile Horz Scale 1:300

Station PL-H2 Plan View

Plan Scale 1:450



*Elevations referenced to local datum

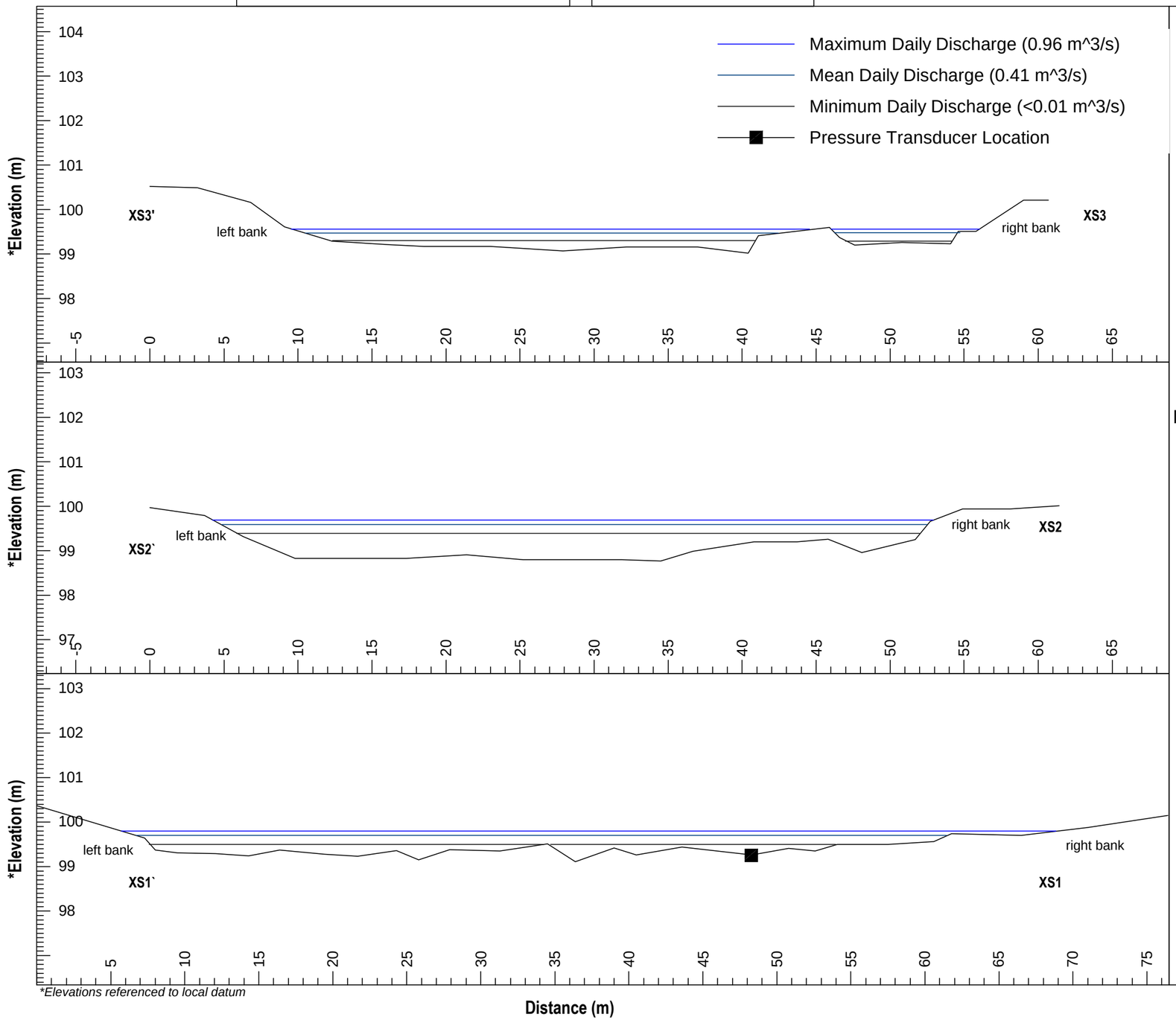
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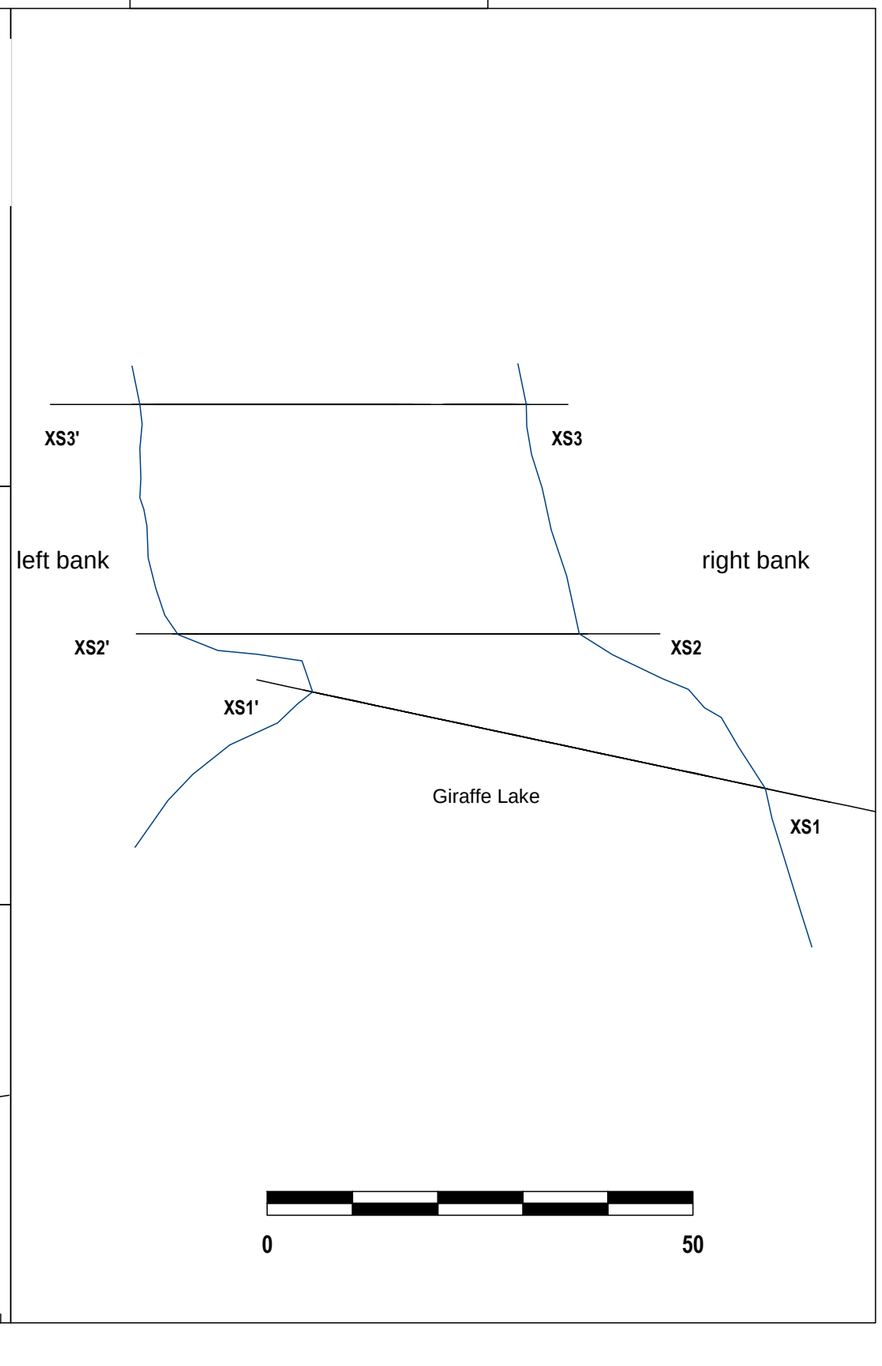
Station GI-H1 Cross Sections

Profile Vert Scale 1:100
Profile Horz Scale 1:300

Station GI-H1 Plan View

Plan Scale 1:700





*Elevations referenced to local datum

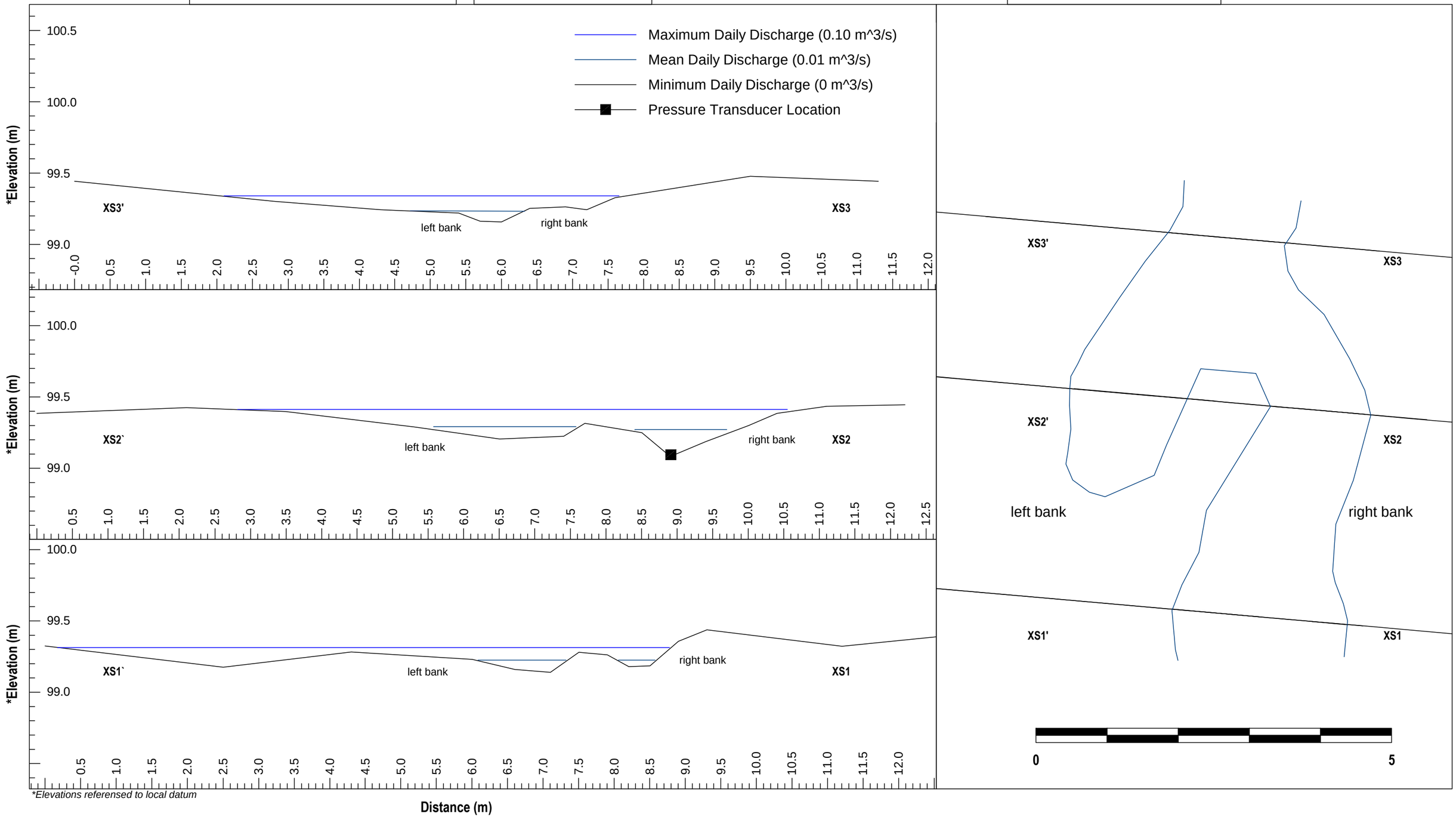
Appendix 6.6: 2011 Channel Geometry Survey at Hydrometric Monitoring Station GI-H1

Station EL-H1 Cross Sections

Profile Vert Scale 1:25
Profile Horz Scale 1:50

Station EL-H1 Plan View

Plan Scale 1:50



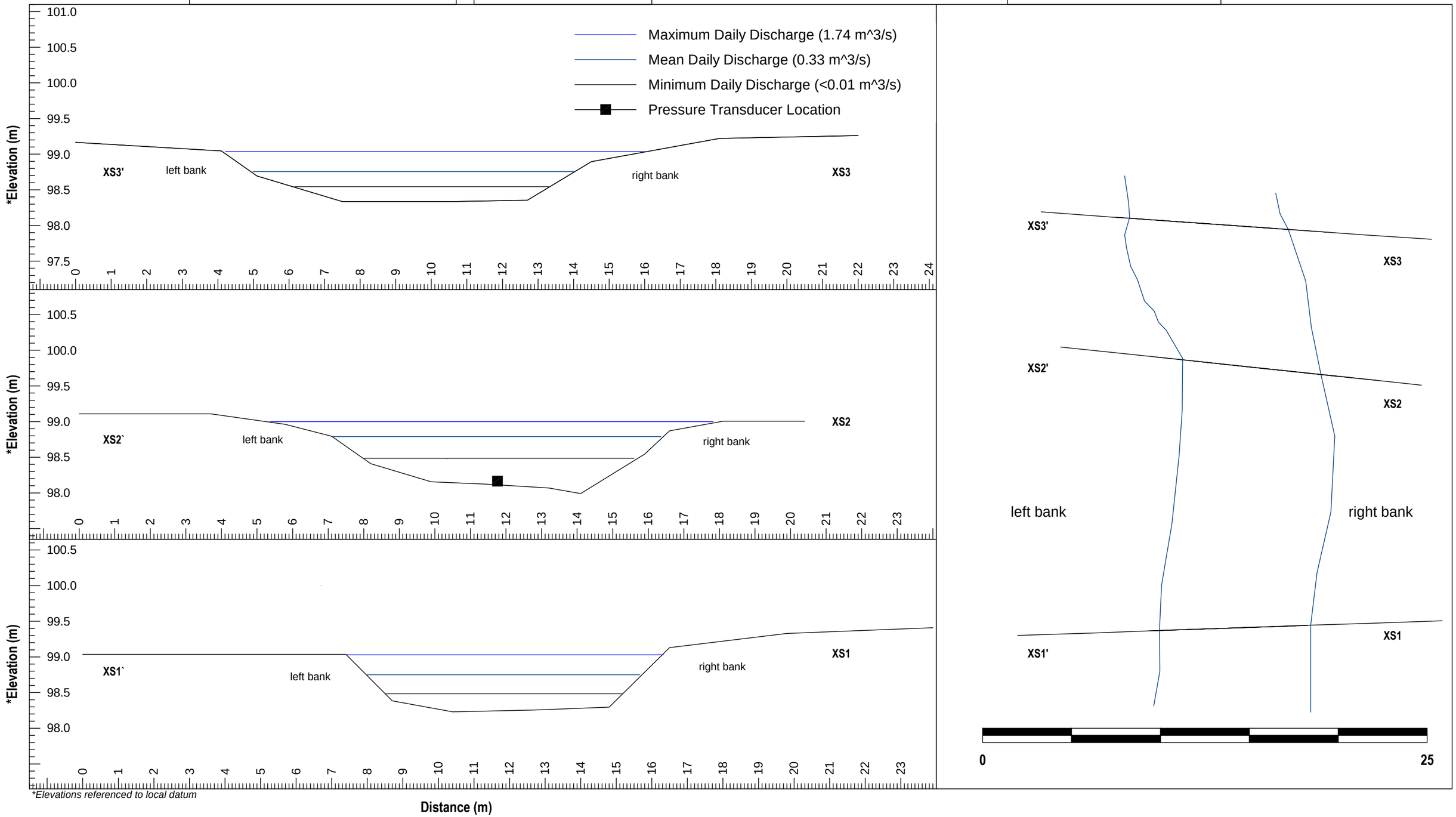
Appendix 6.7: 2011 Channel Geometry Survey at Hydrometric Monitoring Station EL-H1

Station WL-H1 Cross Sections

Profile Vert Scale 1:50
Profile Horz Scale 1:100

Station WL-H1 Plan View

Plan Scale 1:200

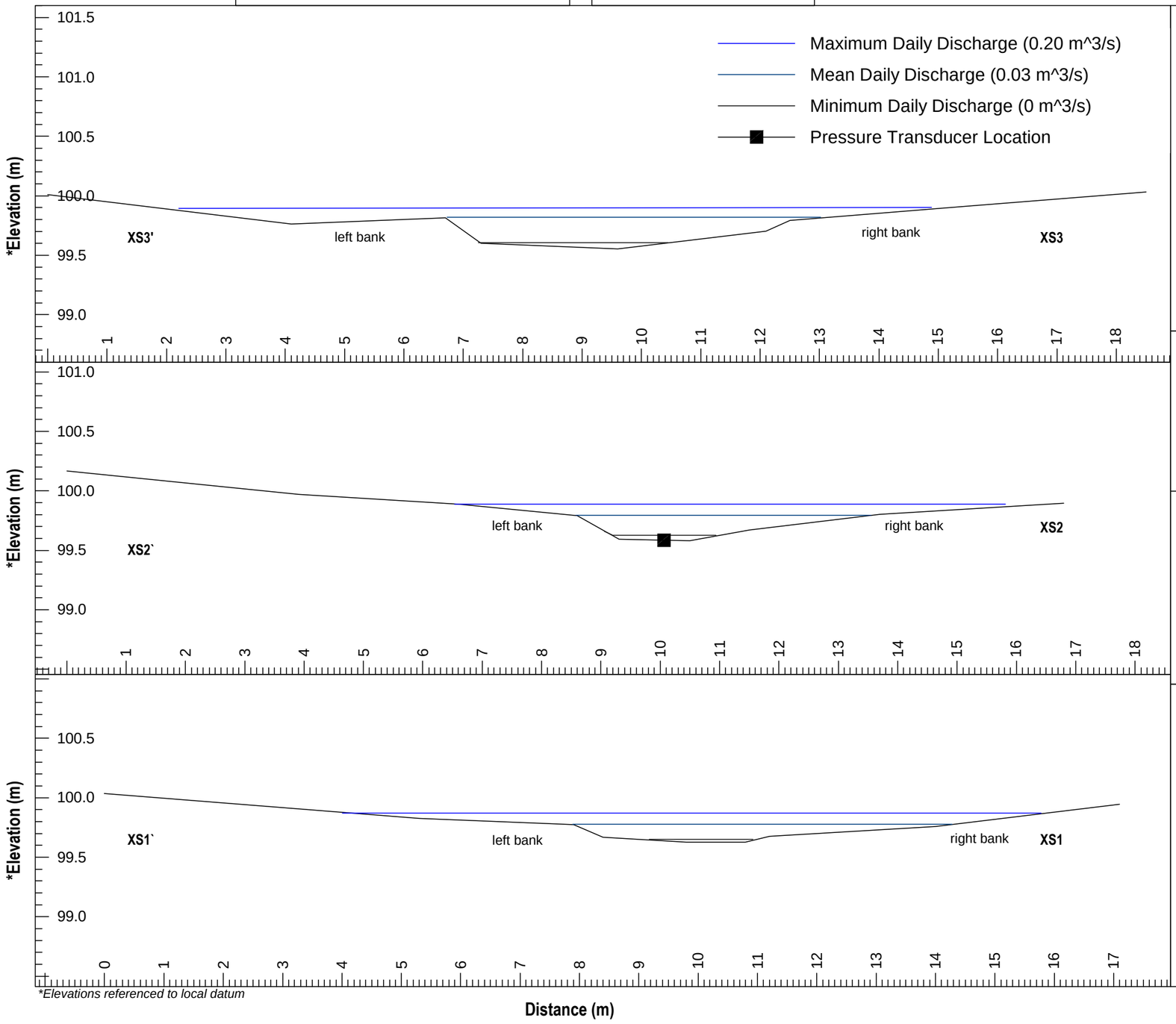


*Elevations referenced to local datum

Appendix 6.8: 2011 Channel Geometry Survey at Hydrometric Monitoring Station WL-H1

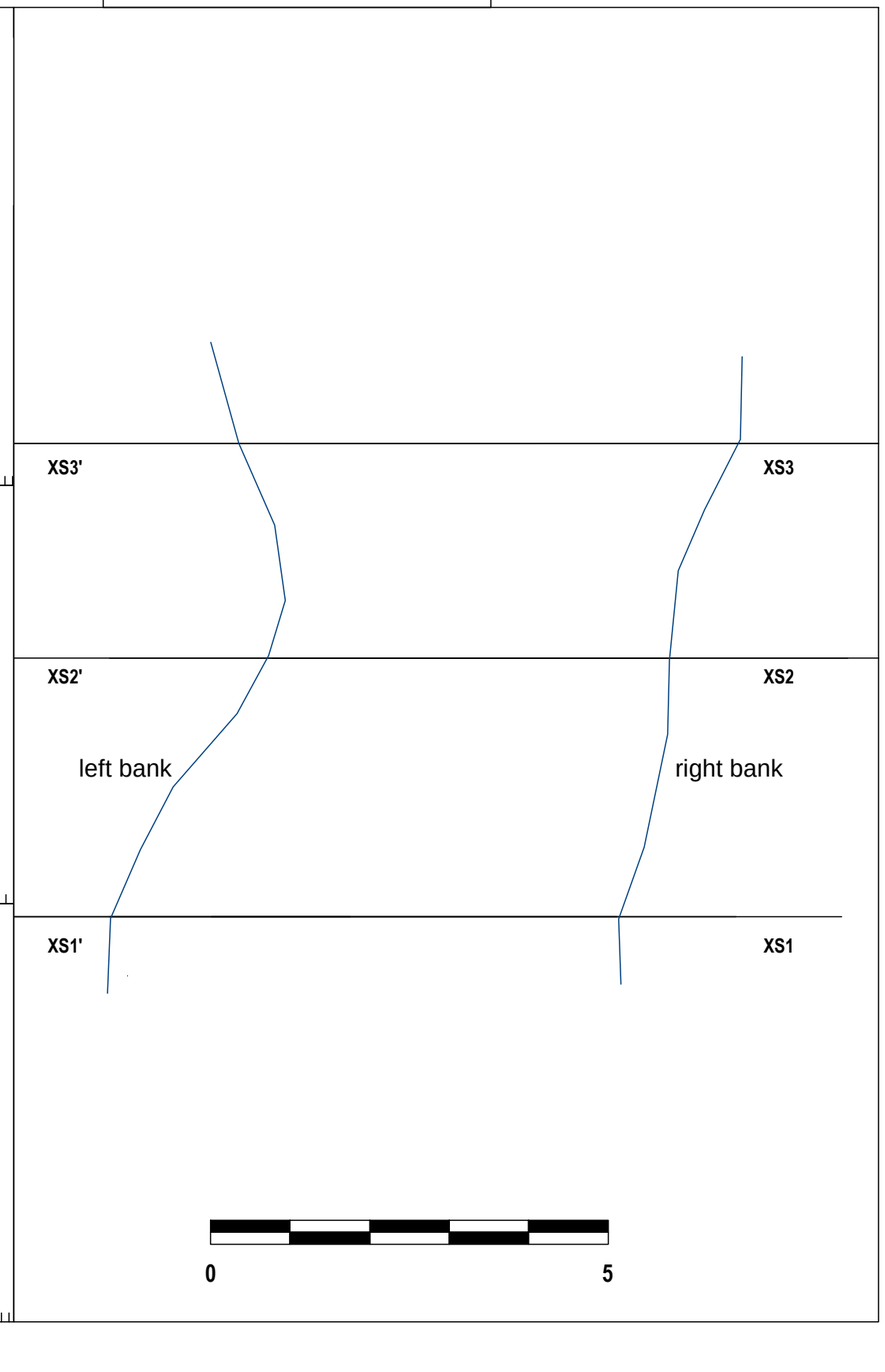
Station REFB-H1 Cross Sections

Profile Vert Scale 1:38
Profile Horz Scale 1:75



Station REFB-H1 Plan View

Plan Scale 1:75



Appendix 6.9: 2011 Channel Geometry Survey at Hydrometric Station REFB-H1

Appendix V6-1B

Back River Project: 2012 Hydrology Baseline Report

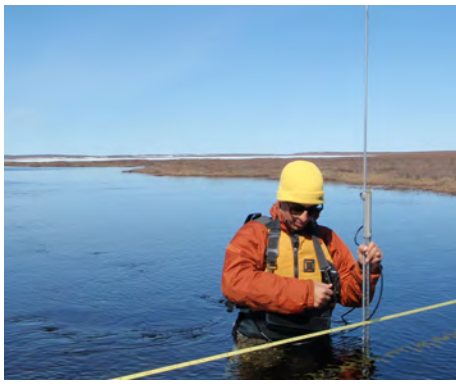
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Sabina Gold & Silver Corp.

BACK RIVER PROJECT
2012 Hydrology Baseline Report

Sabina
GOLD & SILVER CORP.







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November 2012

BACK RIVER PROJECT
2012 HYDROLOGY BASELINE REPORT

November 2012
Project #0833-002-02

Citation:
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Prepared for:

Sabina Gold & Silver Corp.

Prepared by:

Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

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Executive Summary

The Back River Project lies in the West Kitikmeot region of Nunavut and is situated within the continuous permafrost zone of the continental Canadian Arctic. It consists of several property areas, and the baseline work in 2012 focused on the Goose Property and the George Property areas.

The 2012 monitoring network on the Goose Property included nine hydrometric stations that were operated in 2011 and the addition of three new hydrometric stations, monitoring a total drainage area of 391.3 km^2. The monitoring network on the George Property comprised three hydrometric stations installed in 2012, monitoring a total drainage area of 33.47 km^2. The hydrometric networks were operated through the open water season from June 5, 2012 to September 14, 2012. During this time period, continuous time series water level (stage) data were collected at each station and a total of 82 manual discharge measurements were completed. Based on the stage and discharge data collected, stage-discharge rating equations were determined and annual hydrographs produced.

The annual hydrographs in 2012 were characterized by snowmelt-driven high flows during the spring freshet. One prominent snowmelt-driven high flow event occurred in each of the hydrographs during the freshet period in early May to mid-June in most basins. One minor rainfall-driven flow occurred in early September. Instantaneous peak flows ranged from 0.130 m^3/s at BL-H1 to 21.9 m^3/s at PL-H1 in the Goose Property area and from 0.569 m^3/s at REFC-H1 to 2.16 m^3/s at the station KL-H1 in the George Property area. Daily peak unit yield varied from 26.5 $L/s/km^2$ at BL-H1 to 286.7 $L/s/km^2$ at GL-H3 in the Goose Property area and from 44.6 $L/s/km^2$ at REFC-H1 to 72.5 $L/s/km^2$ at KL-H1 in the George Property.

Volumetric outflows from each of the monitored drainages were generally found to be a function of drainage area. Within the Goose Property area, the minimum annual volumetric output was 0.08 million m^3 at EL-H1, while the maximum annual volumetric output was 27.39 million m^3 at PL-H1. Within the George Property area, the minimum annual volumetric output was 0.59 million m^3 at REFC-H1 and the maximum annual volumetric output was 3.43 million m^3 at KL-H1.

Average annual runoff was 99 mm for the Goose Property area and 116 mm for the George Property area. Annual Runoff varied from a minimum of 36 mm at BL-H1 to a maximum of 219 mm at GL-H3 in the Goose Property area, and from a minimum of 61 mm at REFC-H1 to a maximum of 143 mm at KL-H1 and KL-H2 in the George Property area.

In all drainages the maximum monthly runoff occurred in June. Approximately 85% of annual runoff for the Goose Property area and 74% for the George Property area occurred in this month. On average, the monitored streams flowed for 27% of the year in the Goose Property area and for 31% of the year in the George Property area, and they were either frozen or dry for the remainder of the year.

Snow depth, snow water equivalent, and snow density were surveyed on twelve snow courses, at nine locations within the Goose Property and four locations within the George Property. The recorded SWE values varied from 12.1cm to 35.3cm on the Goose Property and from 12.2 cm to 24 cm on the George Property. The recorded snow densities varied from 33% to 37% on the Goose Property and from 28% to 41% on the George Property.

Acknowledgements

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Acknowledgements

This Report was prepared by Rescan Environmental Services Ltd. (Rescan) for Sabina Gold and Silver Corporation (Sabina). Field data collection was conducted by Eli Heyman (B.Sc.), Coby Hall (B.Sc.), and Chris Ho. The report was prepared and written by Cenling Xia (Ph.D., P. Eng.) and Eli Heyman (B.Sc.), and technically reviewed by David Luzi (M.Sc.). The project was managed by Deborah Muggli (Ph.D., M.Sc., R.P.Bio.). Field assistance and on-site logistical support were gratefully provided by Sabina personnel, and Northern Air Support provided helicopter services.

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BACK RIVER PROJECT
2012 HYDROLOGY BASELINE REPORT

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ADCP	Acoustic Doppler current profiler.
Annual runoff	Annual runoff is a measure of the hydrologic response of a watershed. It is often presented as a depth of water, in mm, over an entire watershed allowing direct comparison with precipitation totals.
Arctic nival	Hydrological regime defined by Church (1974). In this regime snow melt is the major hydrological event producing runoff and continuous permafrost impedes deep infiltration reducing base flow and winter flow.
Baseflow	The groundwater component of flow discharge that is attributed to soil moisture and groundwater drainage into a channel.
Break-up	The melting and dissipation of this ice cover on a water body.
Canadian Shield	A vast geologic area of exposed Precambrian crystalline igneous and high-grade metamorphic rocks that form tectonically stable areas covered by a thin layer of soil. It has a deep, common, joined bedrock region in eastern and central Canada and stretches North from the Great Lakes to the Arctic Ocean, covering over half of Canada.
Drainage Basin	The zone or portion of land that contributes water to the surface water runoff that flows past a given point along a stream channel.
Ephemeral	A stream which flows only during or after rain or snow-melt and has no baseflow component.
Freeze-up	The formation of an ice cover on a water body.
Freshet	In channels, the relatively high annual peak water discharge period resulting from spring/summer meltwater runoff of the snowpack accumulated over the winter.
Hydrograph	A graphical plot of water discharge versus time.
Intermittent	A stream which flows only part of the year.
ISO	International Organization for Standardization
MAD	The mean annual discharge (MAD), computed as an average discharge over the year.
NAD 83	North American Datum 1983. A datum is a reference system for computing or correlating the results of a survey. The NAD83 datum is based on the spheroid (GRS80).
Permafrost	Bedrock, organic or earth material that has temperatures below 0°C persisting over at least two consecutive years.
Snow Water Equivalent (SWE)	The amount of water stored in the snowpack. It represents the depth of water present if the snowpack were to melt instantaneously.

Stage	The depth of water in a water course or channel.
Stage-Discharge Curve	A curve derived from concurrently measured stage and discharge data that is used to estimate the discharge for any given observed stage. Often referred to as a rating curve for a hydrometric station.
Talik	An unfrozen section of ground within a layer of discontinuous permafrost. Taliks can also be found underneath water bodies in a layer of continuous permafrost.
Unit Yield	It is a ratio of water discharges normalized to the drainage area for a basin. This parameter allows for direct comparison of the hydrological response of basins with different size drainage areas.
WSC	Water Survey of Canada.
UTM	Universal Transverse Mercator. A mathematical transformation (map projection) of the earth's surface to create a flat map sheet.

1. Introduction

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1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. Exploration programs were run out of both the Goose and George camps in 2012 (Figure 1-1).

For 2012, Sabina contracted Rescan Environmental Services (Rescan) to conduct a comprehensive baseline program that covered the geographical area of the Goose Property, the George Property, and a Marine Laydown Area located on the southern part of Bathurst Inlet. The following components were included in the 2012 baseline program:

- Meteorology
- Air Quality and Dust
- Noise
- Hydrology and Bathymetry
- Freshwater Water Quality, Sediment Quality, Aquatic Biology
- Freshwater Fish and Fish Habitat
- Marine Water Quality, Sediment Quality, Aquatic Biology
- Marine Fish and Fish Habitat
- Wildlife (Terrestrial and Marine)
- Wildlife DNA Study (Grizzly Bear and Wolverine)
- Ecosystem Mapping
- Vegetation and Wetlands (including Rare Plants)
- Soils and Terrain
- Country Foods
- Archaeology
- Socio-Economics
- Land Use
- Metal Leaching/Acid Rock Drainage (ML/ARD)

The 2012 baseline program was designed around potential infrastructure and known deposits at the Goose Property, the George Property, and the Marine Laydown Area. It was assumed that access from the Marine Laydown Area to George and Goose properties would be by winter road, and that access between the George and Goose properties would also be by winter road.

This report presents the results from the hydrology portion of the 2012 baseline program. The Hydrology Baseline Program included the collection of site-specific data from streams and rivers in the Goose Property area and the George Property area. Monitoring was focussed on drainages that contain known deposits, the farthest downstream river associated with the property and all the main inflows and outflows of Goose Lake and George Lake which are central to each of the properties. Additionally, monitoring sites were established as reference drainages for the Goose Property area and George Property area.



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Back River Project Location

Figure 1-1

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The objectives of the 2012 hydrology program were:

- the continued operation of the nine hydrometric monitoring stations in the Goose Property area that were established in 2011;
- the expansion of the 2011 hydrometric monitoring network with the installation and operation of three additional hydrometric monitoring stations in the Goose Property area;
- the installation and operation of the hydrometric monitoring network with two hydrometric monitoring stations on the George Property area and a reference station adjacent to the area;
- the development of stage-discharge relations for each of the hydrometric monitored stations;
- the calculation of water discharges and production of annual hydrographs for each of the monitored drainage basins; and
- the calculation of hydrologic indices, including annual runoff, seasonal runoff distribution, peak flows, and low flows.

A description of the hydrological setting, overall sampling design, and the methods used for data collection is provided in Chapter 2 of this report. Results of the 2012 monitoring program are provided in Chapter 3. All raw data collected in 2012 are provided as appendices to this report.

2. Hydrological Setting

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2. Hydrological Setting

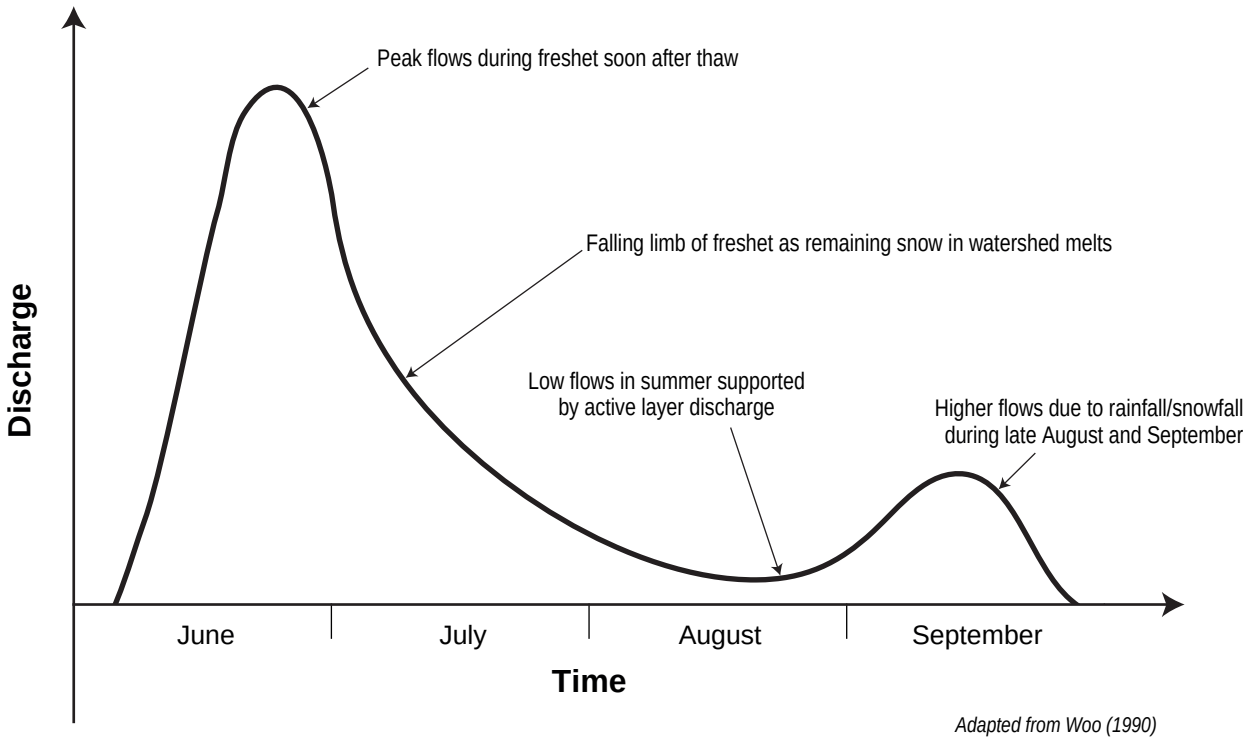
2.1 ARCTIC HYDROLOGY

The Project area lies within the continuous permafrost zone of the continental Canadian Arctic. The presence of permafrost is hydrologically significant as it has a very low hydraulic conductivity and thus acts as a barrier to deep groundwater recharge. This process increases surface runoff and decreases subsurface flow. Compared to non-permafrost regions, permafrost watersheds tend to have higher peak flow and lower base flow (Kane 1997). Hydrologic processes in permafrost watersheds are generally dominated by snow accumulation and melt, surface runoff, and runoff routed through lakes. The annual flow hydrograph is defined by the long cold winters and the short summers. Most of the annual runoff occurs during spring freshet and is derived from the melting snow pack. Additionally, frontal systems may generate precipitation events that produce moderate runoff. Following freshet, a low flow period typically develops through July and August. Due to the presence of permafrost, there is limited groundwater support for smaller streams; however, there may be interaction between groundwater systems and larger rivers and/or lakes through taliks or openings in the permafrost. As a result of the permafrost, baseflow in streams is supported only by flow through the shallow upper active layer of the soil and release from storage features including lakes and wetlands. Overall, surface runoff in Arctic basins is largely controlled by snowmelt and the presence of permafrost, which accentuates runoff peaks while reducing base flow conditions (Woo 1990).

The hydrologic year for the region is defined by break-up and freeze-up. According to regional data from the Water Survey of Canada (WSC), break-up typically occurs in early June and freeze-up in early October. Water is stored in the snowpack during winter and is released as temperatures increase during the spring freshet. Small to medium sized streams typically freeze dry during the winter, due to the limited storage capacity of the surrounding landscape. Even some large rivers in the continuous permafrost region cease to flow after freeze-up (Woo 1990).

A conceptual hydrograph showing typical annual discharge patterns for small watersheds is shown in Figure 2.1-1. The hydrograph is characterized by a steep rising limb leading to a peak during the freshet period and a second rainfall-generated peak that can be observed in certain years in late August or early to mid-September. Generally, within the continuous permafrost region discharge is dominated by snowmelt floods, referred to as a nival regime. Church (1974) distinguished between a Subarctic and an Arctic Nival regime. The Subarctic regime experiences limited winter low flow sustained by the discharge of intrapermafrost and subpermafrost groundwater, and a spring freshet associated with ice jams. During summer, low flow conditions predominate, but large flood peaks can be generated by frontal precipitation systems in zones of discontinuous permafrost. The Arctic Nival regime has one major flood period in the spring, followed by a rapid recession to base flow, with the occasional peak related to rainstorm events. Winter flow is absent because the suprapermafrost groundwater reservoir is too limited to maintain flow.

In very small basins the freshet can be as short as a few days and will often occur immediately after ice break-up in the lakes, if lakes are present in the basin. Streamflow in these basins may cease after freshet and streams remain dry until the late summer rains begin. In contrast to smaller basins, in rivers draining larger watersheds the freshet peak may be delayed after ice break-up. The delay occurs as snowmelt from upper portions of the larger watershed is routed through the system. Smaller basins can also have more dramatic responses to precipitation than larger watersheds. In larger watersheds the presence of lakes creates significant flow attenuation, which may diminish the magnitude of peak flows.



Adapted from Woo (1990)

Note: Approximate scale only

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Theoretical Typical Annual Flow Hydrograph for a Small Arctic Watershed

Figure 2.1-1

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The amount of runoff during summer and fall is controlled by rainfall and evaporation. Open water evaporation rates in summer often exceed total rainfall such that soil moisture deficits build up in the shallow active layer of the soil and summer rainfall may produce little or no runoff from hillslopes in the permafrost zone (Quinton and Marsh 1998). In this case, streamflow increases only due to rain falling directly onto lake surfaces or when there is high intensity or lower intensity/longer duration rainfall.

A number of factors influence the volume of freshet runoff in Arctic watersheds, these factors include:

- *Amount of snowpack available to be melted in spring*. Snowpack depth is dependent on the amount of snowfall during the previous winter and the amount of snow remaining in each watershed in May or June. Snow can be lost or redistributed due to sublimation, melting, or wind;
- *Rate of temperature rise in spring*. This can greatly affect peak flow rates as a rapid increase in temperature after the snowpack is already saturated can produce high melt rates. Differential melt rates on north and south facing slopes can also occur which may affect the size of the area contributing to the melt;
- *Timing of opening of stream channels linking lakes*. Snowmelt from hillslopes surrounding lakes can occur before the stream channels draining the lakes become ice free. In this case, meltwater can be stored in the lake and then released once the channels are open to flow; and
- *Soil moisture conditions and lake levels at the end of the previous summer*. If there was a dry summer during the previous year, lake levels could have been lowered and a soil moisture deficit could have developed within the hillslopes surrounding the lakes. As a result, a portion of the annual runoff will recharge the lakes and soil moisture and not be transmitted from the watershed as streamflow.

2.2 AVAILABLE REGIONAL HYDROLOGIC DATA

Regional data are available from hydrometric stations operated by WSC (Table 2.2-1 and Figure 2.2-1). Data from the five stations with the closest proximity to the Project area were analyzed to provide background information on the regional surface water hydrology.

Table 2.2-1. Regional Water Survey of Canada (WSC) Stations Relevant to the Study Area

Station Name	Station Number	Geographic Location		Drainage Area (km^2)	Period of Record
Back River below Beechy Lake	10RA001	65°11'14"N	106°5'9"W	19,600	1978 - present
Baily River near the mouth	10RA002	65°0'38"N	104°29'26"W	14,500	1978 - present
Burnside River near the mouth	10QC001	66°43'34"N	108°48'47"W	16,800	1976 - present
Gordon River near the mouth	10QC002	66°48'36"N	107°6'4"W	1,530	1977 - 1994
Ellice River near the mouth	10QD001	67°42'30"N	104°8'21"W	16,900	1971 - present

Analysis of historical data revealed the break-up in these rivers has typically occurred in between late May to early June and freeze-up in early October (Figure 2.2-2). Peak flows generally were observed in early to mid-June during freshet and some stations recorded a second substantial peak in late summer or early autumn. The Gordon River and Ellice River hydrometric stations frequently report zero flow throughout the winter.

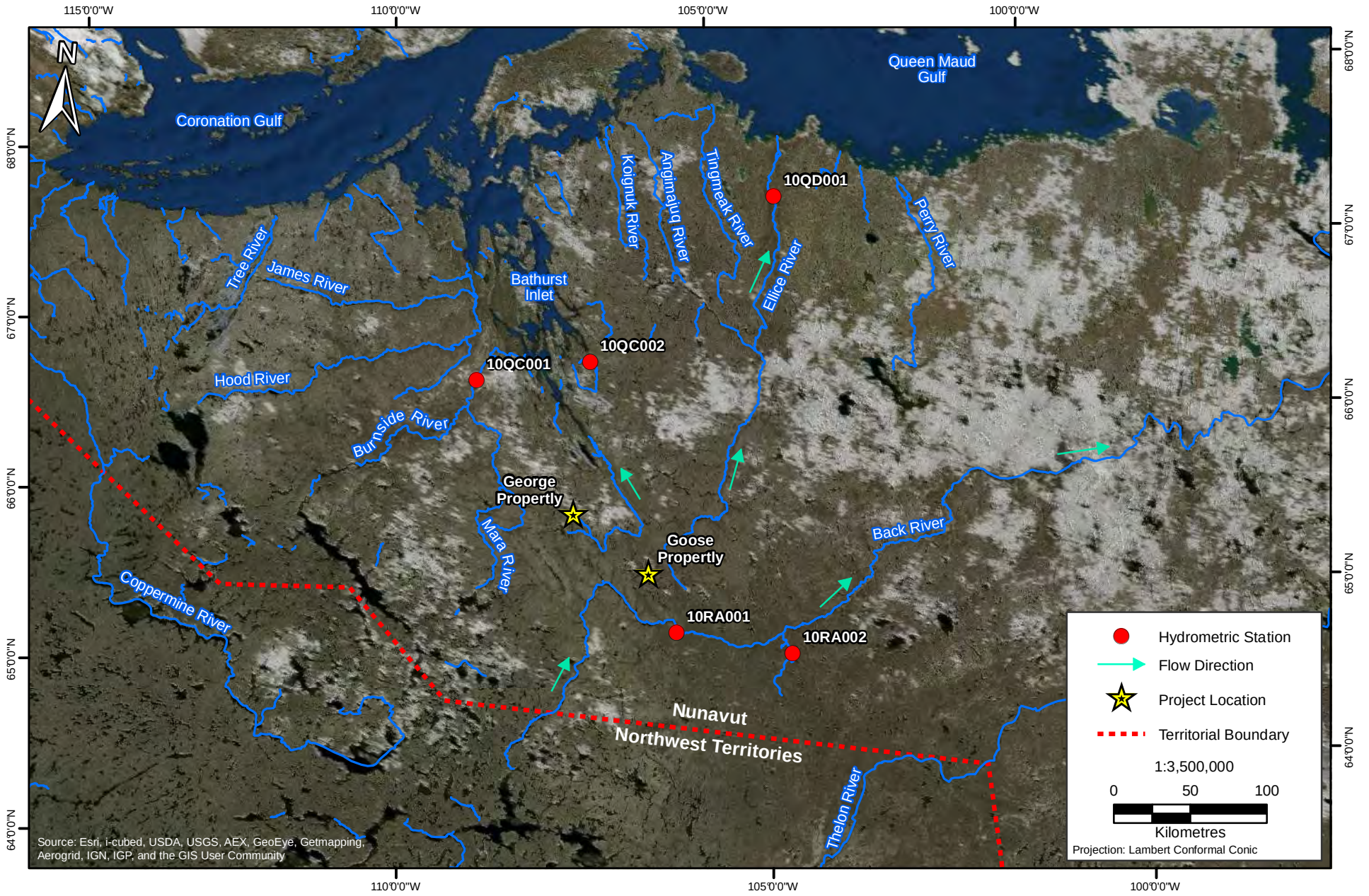


Figure 2.2-1

Sabina

Water Survey of Canada (WSC) Hydrometric Stations Relevant to the Study Area

Figure 2.2-1

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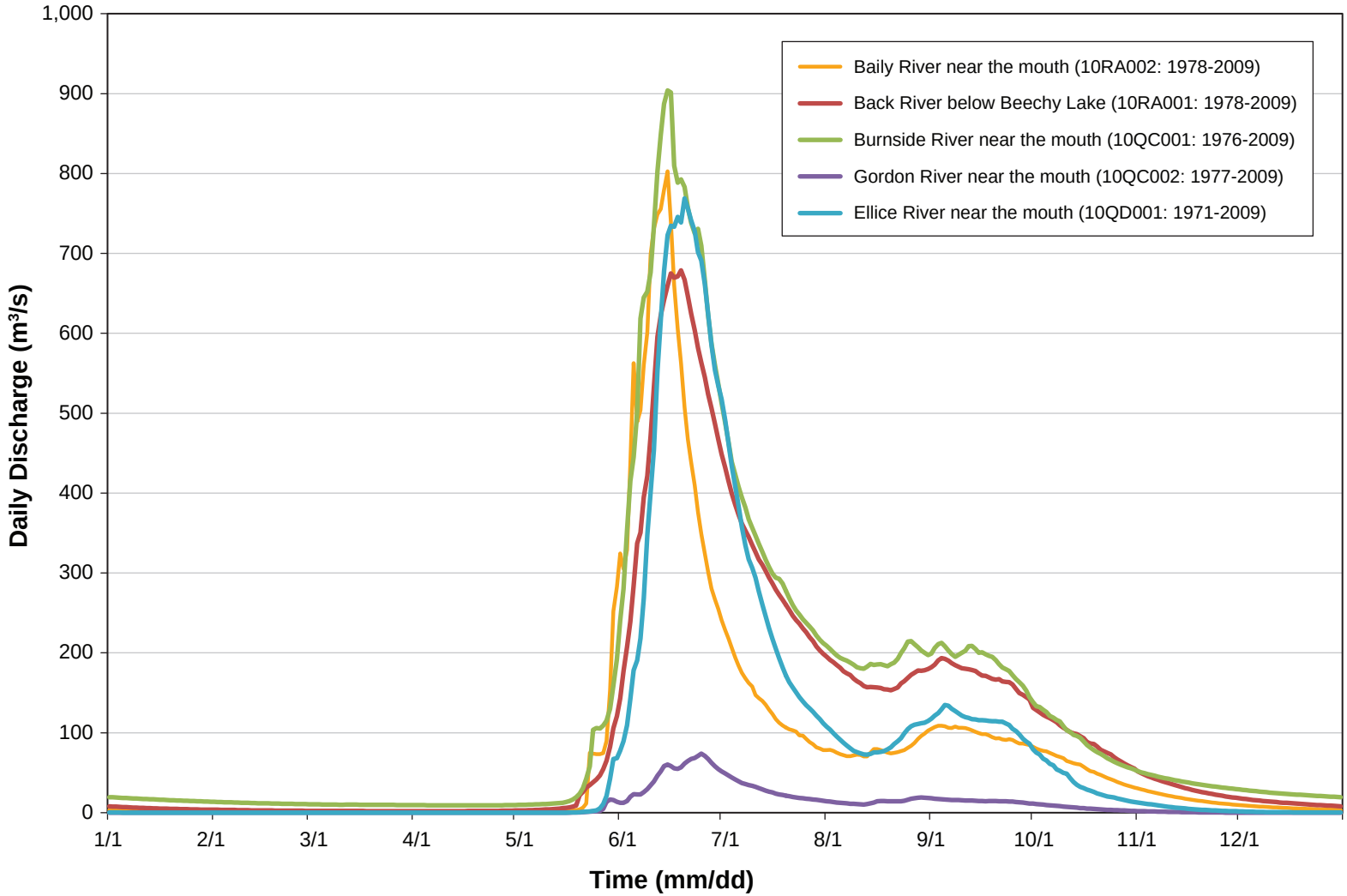


Figure 2.2-2

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Historical Hydrographs of Water Survey of Canada (WSC) Hydrometric Stations Relevant to the Study Area

Figure 2.2-2

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2.3 STUDY AREA

The study area is located near the watershed boundaries of the Ellice River, the Back River, and the Western River (Figure 2.3-1). The Ellice River discharges north to the Arctic Ocean into the Queen Maud Gulf approximately 300 km from the project area and the Western River discharges north to the Bathurst inlet approximately 80 km from the project area. The Back River flows northeast to its mouth at Cockburn Bay on the Arctic Ocean in the eastern portion of the Kitikmeot Region, south of Gjoa Haven.

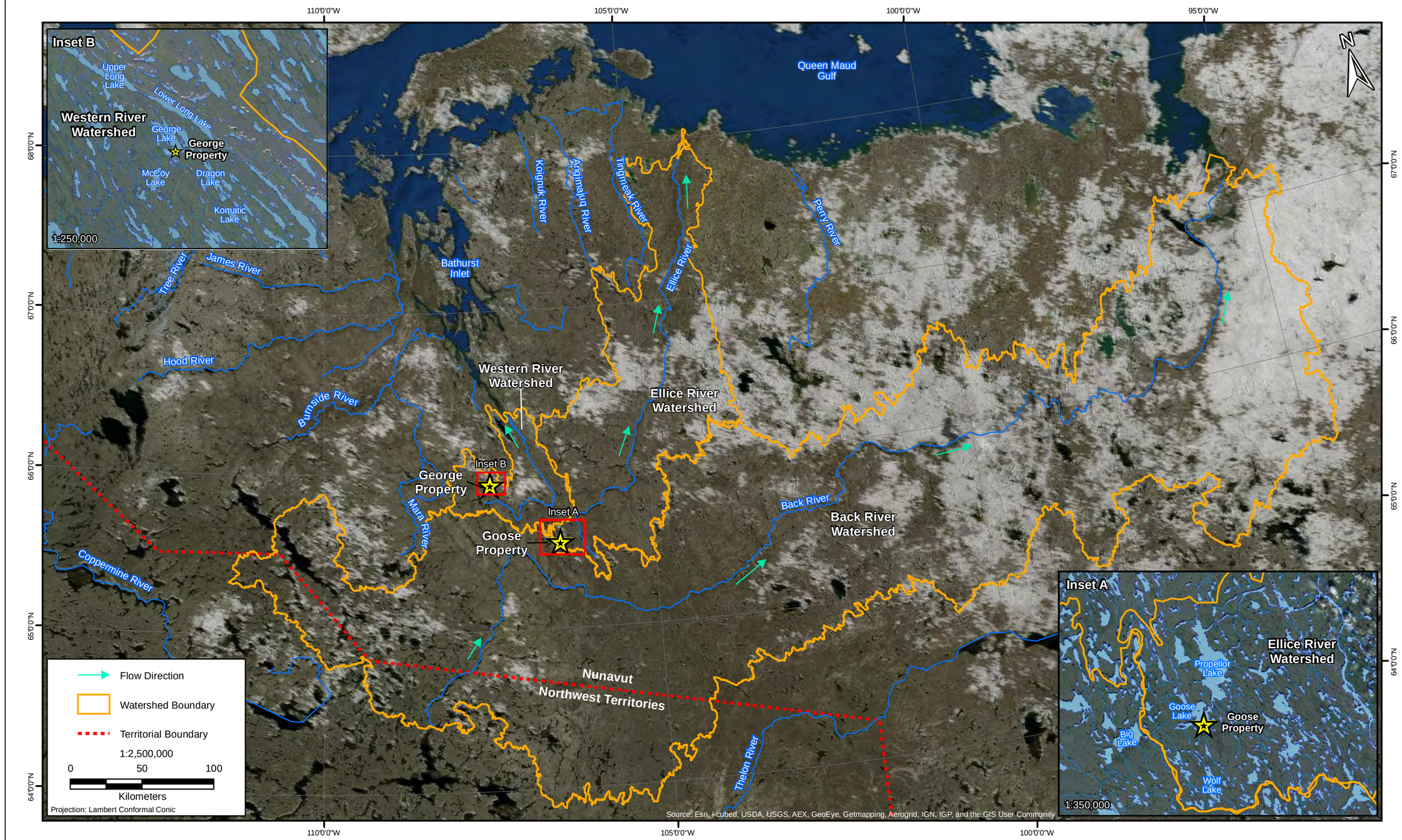
For the Goose Property, the 2012 study area was expanded from 209.8 km^2 in 2011 to a total drainage area of 391.3 km^2. Figure 2.3-2 shows the locations of the hydrometric stations within the sub-watershed boundaries of the Goose Property, whereas Figure 2.3-3 shows the upstream drainage boundaries associated with each station. The study was designed to monitor a 204.4 km^2 area within the Ellice River watershed and a 181.6 km^2 area within the Back River watershed, encompassing the potential infrastructure within the Goose Property. An additional reference station was located in a 5.3 km^2 drainage basin within the Back River watershed approximately 14 km to the south of the potential infrastructure (Figure 2.3-3).

For the George Property, the 2012 study area comprised a total drainage area of 33.47 km^2. Figure 2.3-4 shows the locations of the hydrometric stations within the sub-watershed boundaries of the George Property, whereas Figure 2.3-5 shows the upstream drainage boundaries associated with each station. The study was designed to monitor a 24.0 km^2 area encompassing the potential infrastructure within the George Property which is located within the Western watershed. An additional reference station was located in a 9.47 km^2 drainage basin approximately 40 km to the northeast of the potential infrastructure (Figure 2.3-5).

The basins within the Project area are characterized by extensive networks of lakes, low relief hummocky topography, and exposed bedrock uplands (Plates 2.3-1 and 2.3-2).



Plate 2.3-1. High angle oblique view showing the extensive lake coverage and low relief hummocky topography typical of the Goose and the George Property areas. This photograph was taken of the George Camp and surrounding area on July 7, 2012.

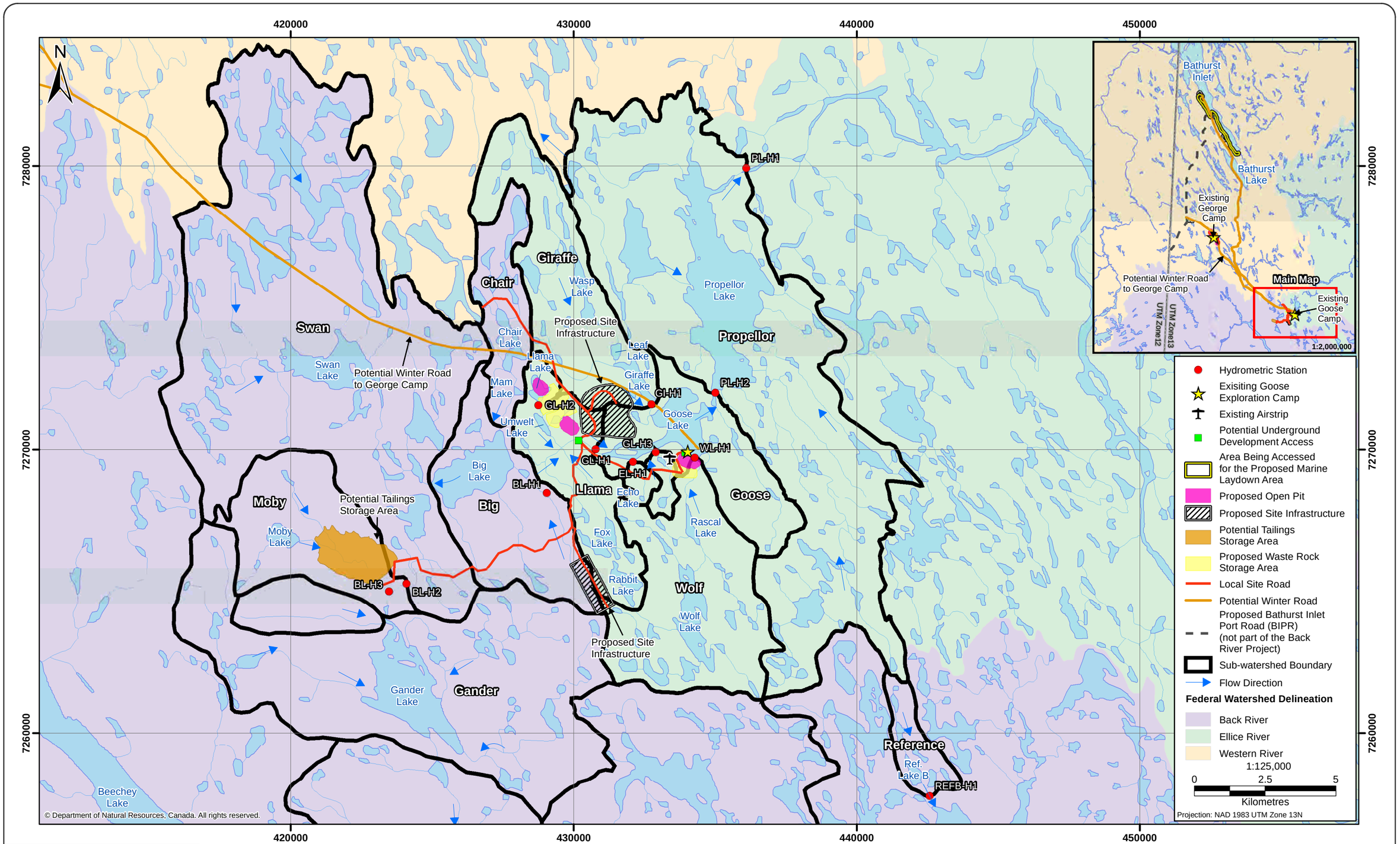


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Figure 2.3-1

Regional Watersheds of the Back River Project

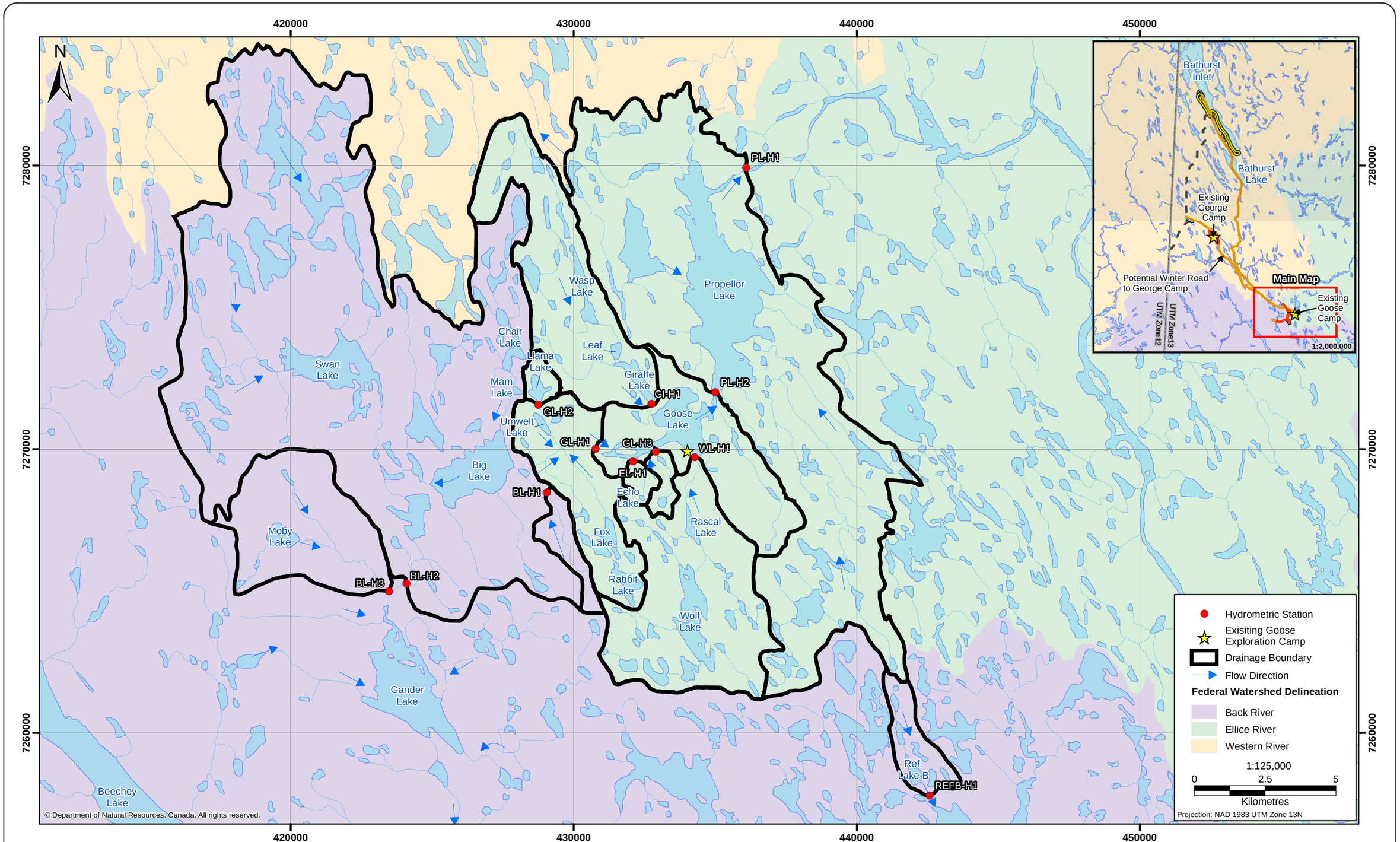


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Figure 2.3-2

2012 Study Area within the Back River Project - Goose Area



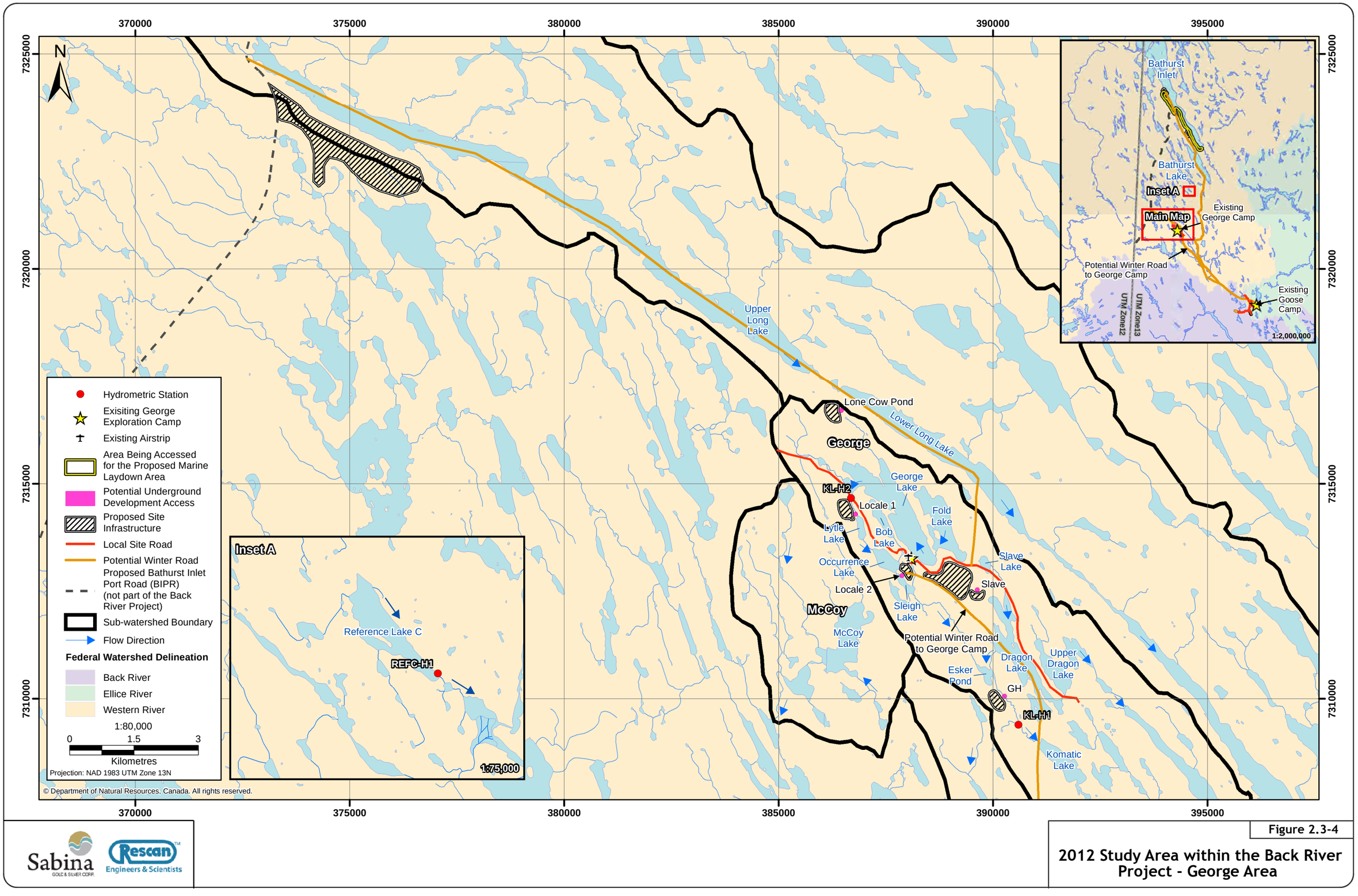
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Figure 2.3-3

2012 Study Area Drainage Basins - Goose Area



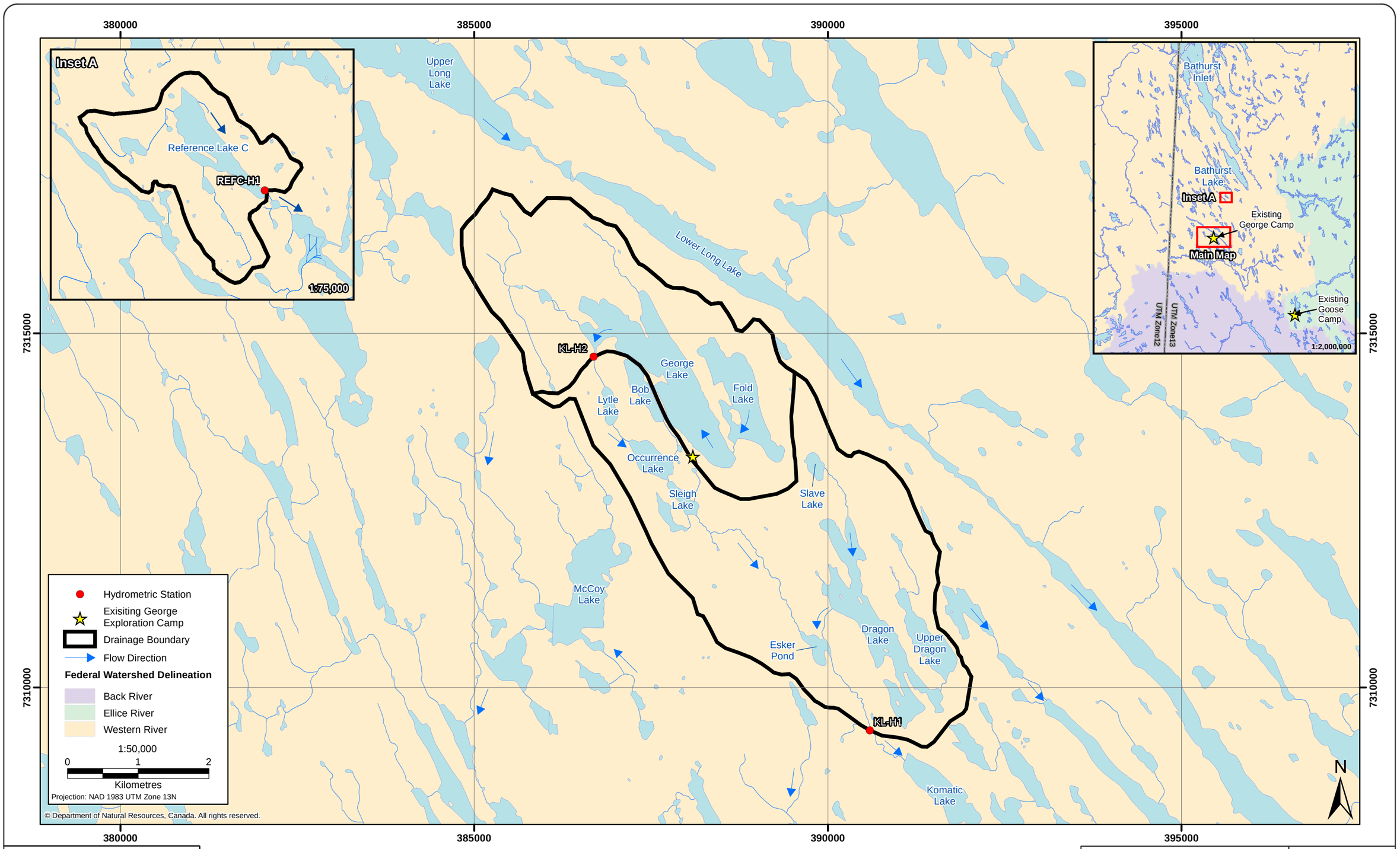
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Figure 2.3-4

2012 Study Area within the Back River Project - George Area



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Figure 2.3-5

2012 Study Area Drainage Basins - George Area



Plate 2.3-2. Looking south along the outflow from Llama Lake on the Goose Property. Note the relatively low relief topography, bedrock outcrops and low tundra vegetation typical of the region. This photograph was taken on September 7, 2012.

For the Goose Property, the study area has approximately 13% lake coverage, an average ground slope of 2.8%, and a total relief of 313 m. The gauged streams within the study area range from small ephemeral channels, less than 1 m in width, to larger streams with widths exceeding 50 m. Larger streams are located at the outlets of the larger lakes. Although some large rivers in the region may still have flow during the winter, it is likely that most stream channels around the Project area freeze to their bed and have zero flow during the winter months. Based on available data from WSC, the Ellice River near its mouth typically stops flowing over the winter period.

For the George Property, the study area has approximately 20% lake coverage, an average ground slope of 5.4%, and a total relief of 325 m. This region exhibits higher relief than the Goose Property, with ridges of bedrock and esker deposits separating well-defined glacial valleys. The gauged streams on the George Property were deep and narrow and meandered within the over-widened valleys created by glaciers.

3. Methodology

3. Methodology

3.1 HYDROMETRIC MONITORING NETWORK

A network of hydrometric monitoring stations was established to collect continuous water level data at selected locations within the Project area. The automated stations recorded stream water level data at ten minute intervals during the open water season.

3.1.1 2010 Network

In 2010, a small network of two hydrometric monitoring stations within the Goose Property area was operated from July 3 to September 13, 2010 (Table 3.1-1).

Table 3.1-1. 2010 Hydrometric Monitoring Stations in the Goose Property Area

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	Monitoring Type
		Easting	Northing			
GL-H1	Goose Lake inflow	430,772	7,270,016	14.0	July 3 to Sept. 13	stream water level
GL-H2	Llama Lake outflow	428,746	7,271,567	1.7	July 3 to Sept. 13	stream water level

** UTM, Datum NAD 83, Zone 13 W*

3.1.2 2011 Network

In 2011, a network of nine hydrometric monitoring stations was operated from June 10 to September 17 in the Goose Property area. The 2011 network included the remobilization of the two stations established in 2010, plus the installation of six new stations within the Goose Property area and one reference station south of the Project drainage boundary. The network focused on monitoring basins and sub-basins around the known deposits in the Project area, and the furthest downstream river associated with the property at Propellor Lake outflow. Location, drainage area and period of operation for each station in the 2011 network are provided in Table 3.1-2.

Table 3.1-2. 2011 Hydrometric Monitoring Stations in the Goose Property Area

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	Monitoring Type
		Easting	Northing			
GL-H1	Goose Lake inflow	430,772	7,270,016	14.0	June 10 to Sept. 16	stream water level
GL-H2	Llama Lake outflow	428,746	7,271,567	1.7	June 10 to Sept. 16	stream water level
GL-H3	Goose Lake inflow	432,891	7,269,919	1.8	June 14 to Sept. 16	stream water level
PL-H1	Propellor Lake outflow	436,094	7,279,939	204.4	June 14 to Sept. 17	stream water level
PL-H2	Propellor Lake inflow	435,007	7,272,014	101.5	June 11 to Sept. 17	stream water level
GI-H1	Giraffe Lake outflow	432,744	7,271,610	27.4	June 11 to Sept. 16	stream water level
EL-H1	Echo Drainage outflow	432,091	7,269,573	1.4	June 13 to Sept. 16	stream water level
WL-H1	Wolf Drainage outflow	434,269	7,269,719	35.1	June 10 to Sept. 17	stream water level
REFB-H1	Reference B Lake Outflow	442,573	7,257,794	5.3	June 13 to Sept. 17	stream water level

** UTM, Datum NAD 83, Zone 13 W.*

3.1.3 2012 Network

2012 was the first year of hydrometric monitoring in the George Property area. The network in the Goose Property area was operated from June 5 to September 14 and the network in the George Property area was operated from June 10 to September 12. The 2012 networks focused on monitoring basins and sub-basins around the known deposits in each property area. Location, drainage area and period of operation for each station in the 2012 network are provided in Tables 3.1-3 and 3.1-4, and Figures 3.1-1 through 3.1-9. Station information sheets are provided in Appendix 1.

Table 3.1-3. 2012 Hydrometric Monitoring Stations in the Goose Property Area

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	MonitoringType
		Easting	Northing			
GL-H1	Goose Lake inflow	430,772	7,270,016	18.0**	June 5 to Sept. 7	stream water level
GL-H2	Llama Lake outflow	428,746	7,271,567	1.7	June 5 to Sept. 7	stream water level
GL-H3	Goose Lake inflow	432,891	7,269,919	1.8	June 7 to Sept. 9	stream water level
PL-H1	Propellor Lake outflow	436,094	7,279,939	204.4	June 6 to Sept. 8	stream water level
PL-H2	Propellor Lake inflow	435,007	7,272,014	101.5	June 12 to Sept. 12	stream water level
GI-H1	Giraffe Lake outflow	432,744	7,271,610	27.4	June 9 to Sept. 14	stream water level
EL-H1	Echo Drainage outflow	432,091	7,269,573	1.4	June 6 to Sept. 7	stream water level
WL-H1	Wolf Drainage outflow	434,269	7,269,719	32.7**	June 7 to Sept. 14	stream water level
REFB-H1	Reference B Lake outflow	442,573	7,257,794	5.3	June 9 to Sept. 13	stream water level
BL-H1	Big Lake inflow	429,044	7,268,478	3.59	June 12 to Sept. 10	stream water level
BL-H2	Swan Lake	424,087	7,265,274	160.0	June 8 to Sept. 9	stream water level
BL-H3	Moby Lake outflow	423,467	7,264,998	21.4	June 8 to Sept. 9	stream water level

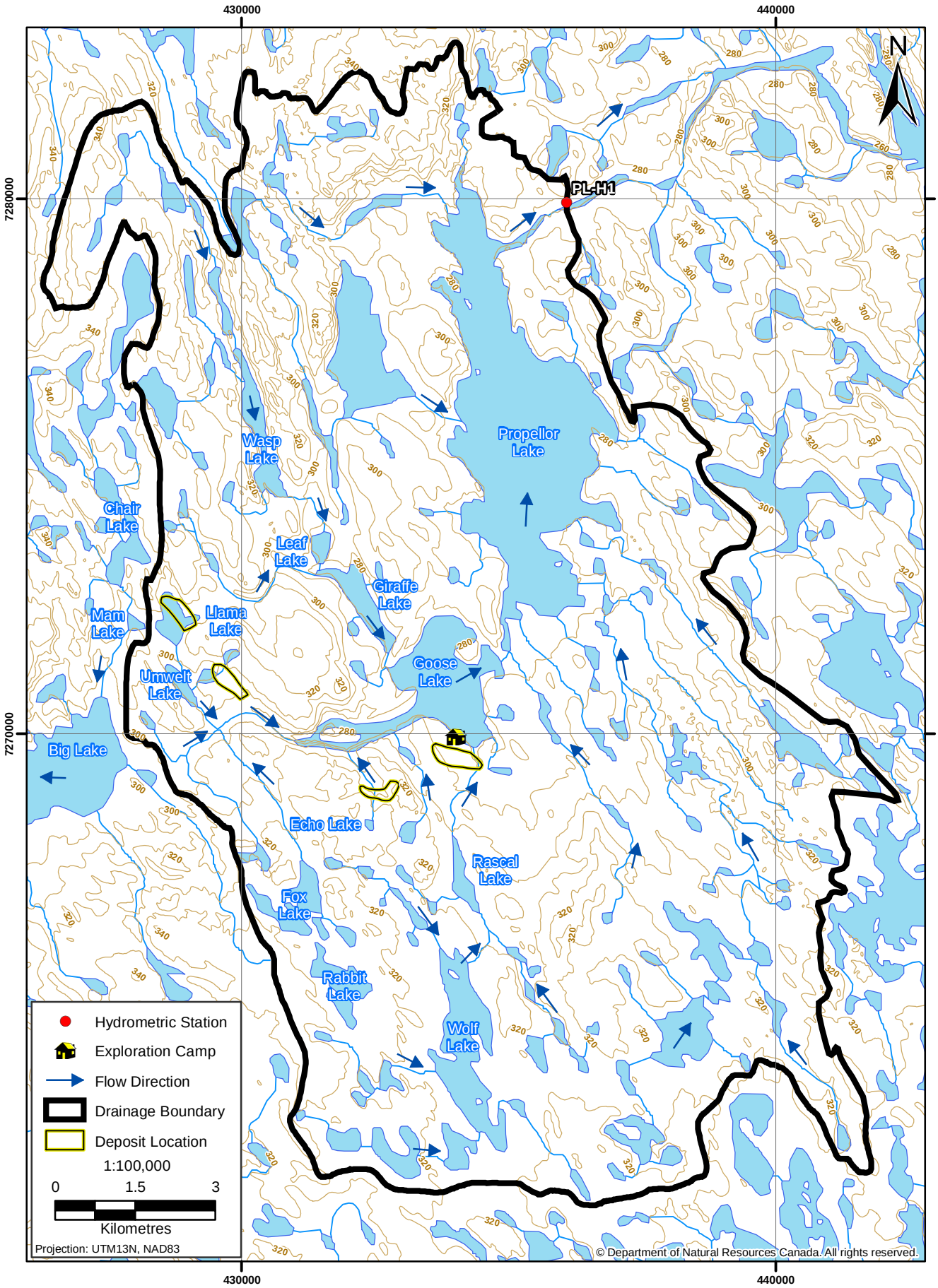
** UTM, Datum NAD 83, Zone 13 W*
*** Adjusted in 2012*

Table 3.1-4. 2012 Hydrometric Monitoring Stations in the George Property Area

Hydrometric Station	Location	Geographic Coordinates*		Drainage Area (km^2)	Period of Operation	Monitoring Type
		Easting	Northing			
REFC-H1	Reference Lake C outflow	396,495	7,335,612	9.47	June 11 to Sept. 11	stream water level
KL-H1	Komatic Lake inflow	390,592	7,309,400	24.0	June 10 to Sept. 12	stream water level
KL-H2	George Lake outflow	386,687	7,314,673	9.66	June 10 to Sept. 12	stream water level

** UTM, Datum NAD 83, Zone 13 W*

The 2012 network in the Goose Property area included the remobilization of the nine stations established in 2011, plus the installation of three new stations. All of the three new stations were located within the Back River Watershed. The 2012 network in the George Property area included the installation of three new stations. Two of the stations, KL-H1 and KL-H2, encompassed the George Property, and the other one, REFC-H1, operated as a reference station.

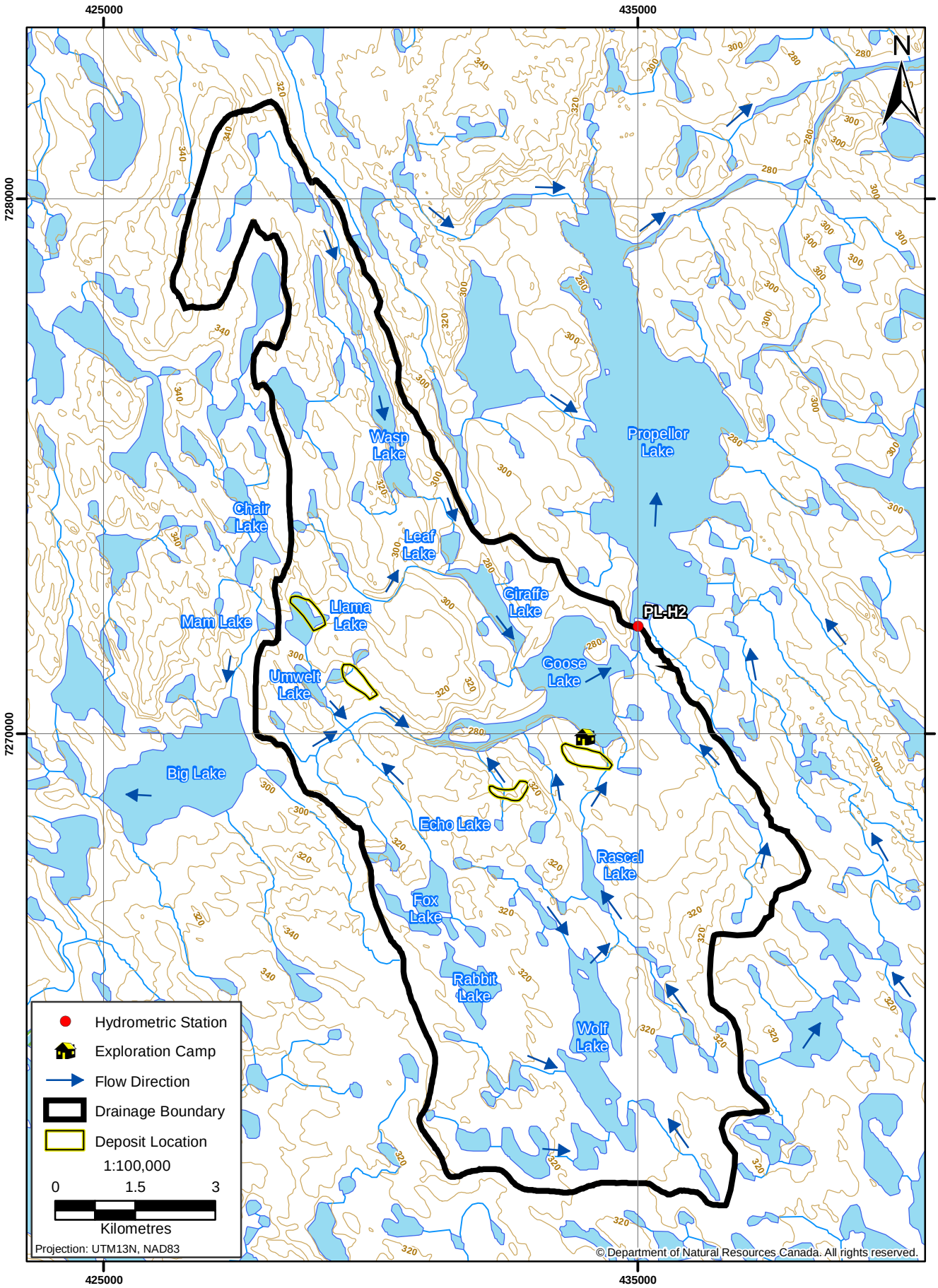


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Drainage Boundary for Propellor Lake Hydrometric Monitoring Station PL-H1

Figure 3.1-1

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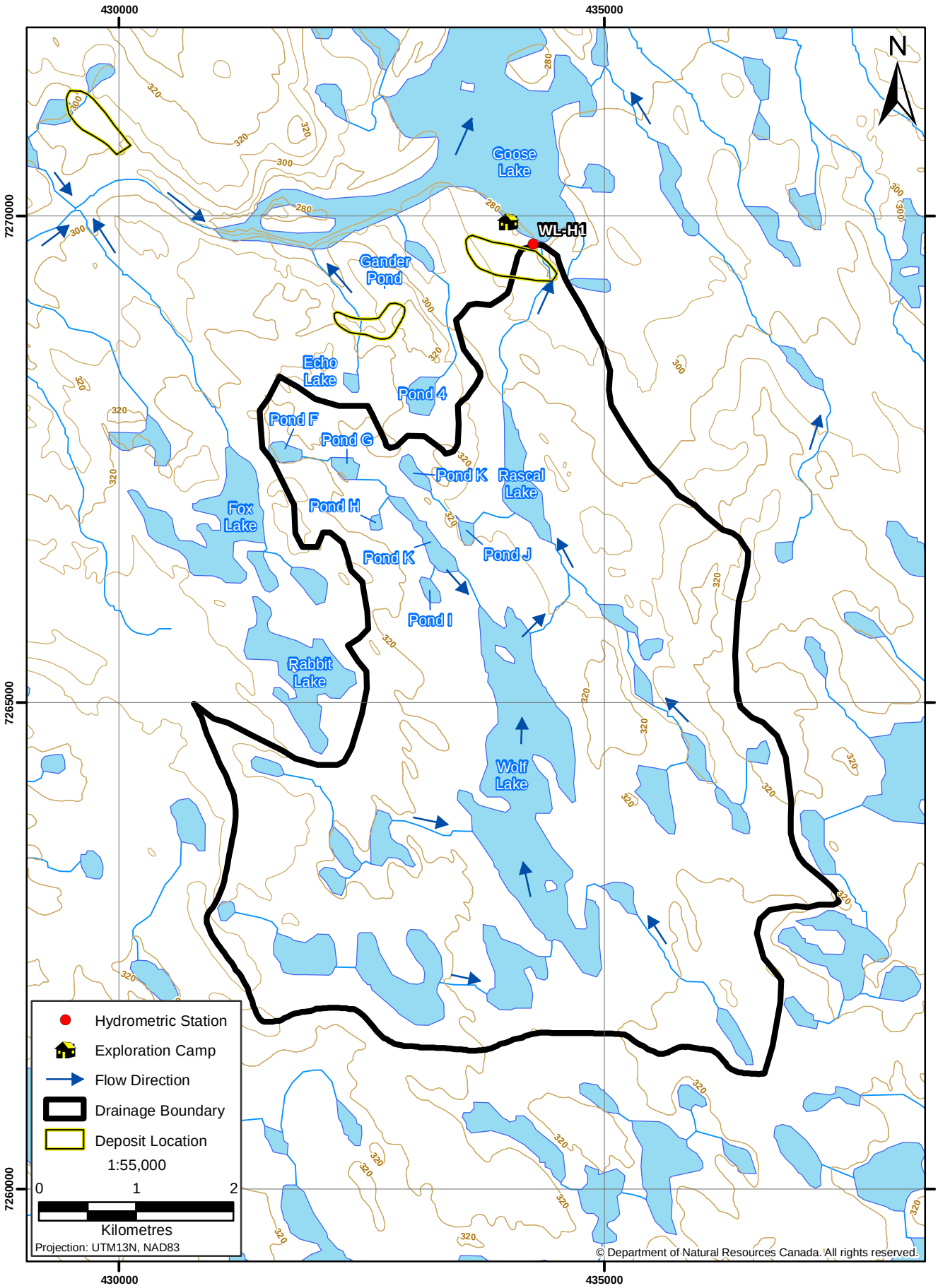


Sabina GOLD & SILVER CORP

Drainage Boundary for Propellor Lake Hydrometric Monitoring Station PL-H2

Figure 3.1-2

Rescan Engineers & Scientists

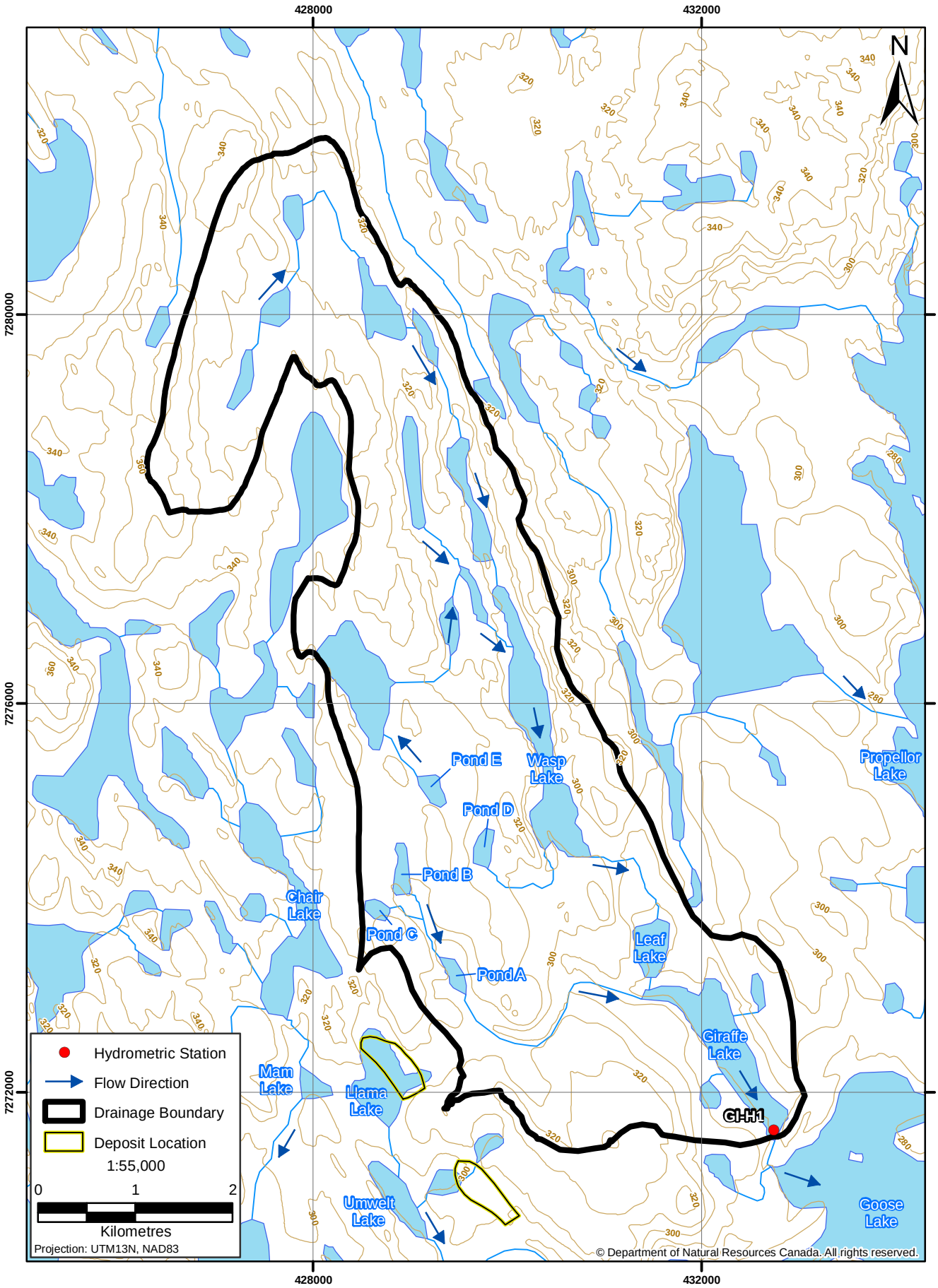


Sabina GOLD & SILVER CORP.

Drainage Boundary for Goose Lake Hydrometric Monitoring Station WL-H1

Figure 3.1-3

Rescan™ Engineers & Scientists

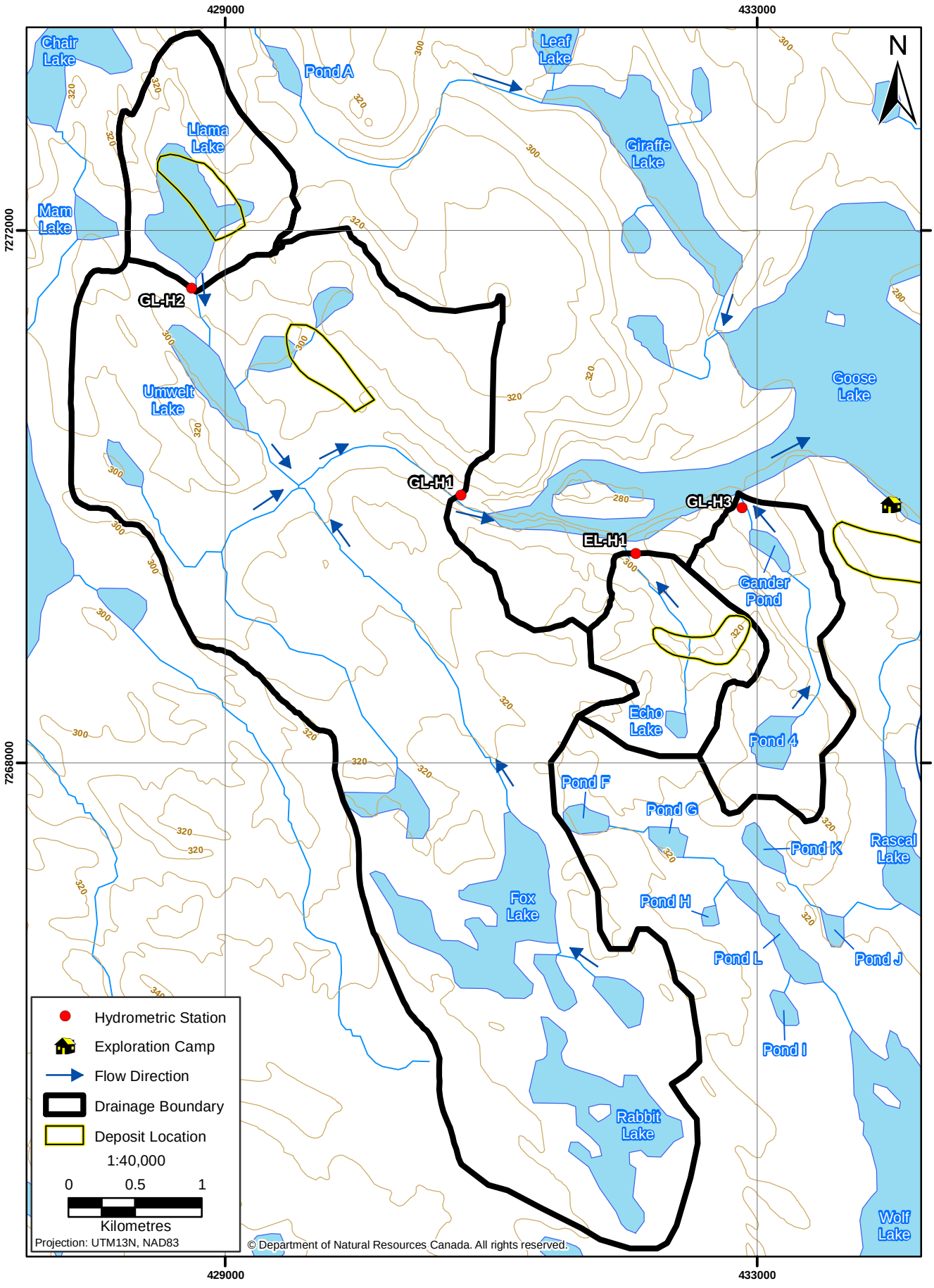


Sabina GOLD & SILVER CORP.

Drainage Boundary for Giraffe Lake Hydrometric Monitoring Station GI-H1

Figure 3.1-4

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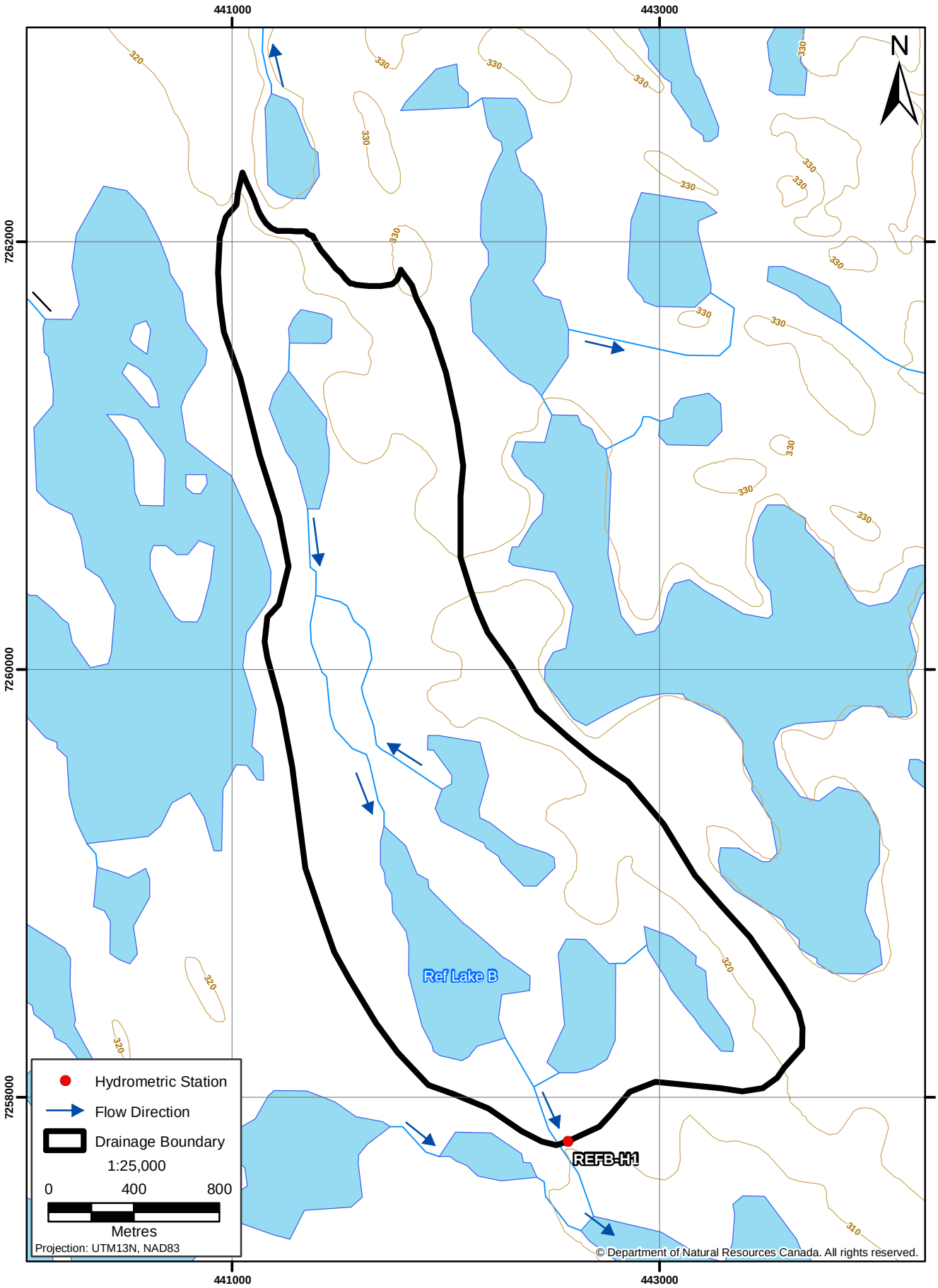


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Drainage Boundaries for GL-H1, GL-H2, GL-H3 and EL-H1 Hydrometric Monitoring Stations

Figure 3.1-5

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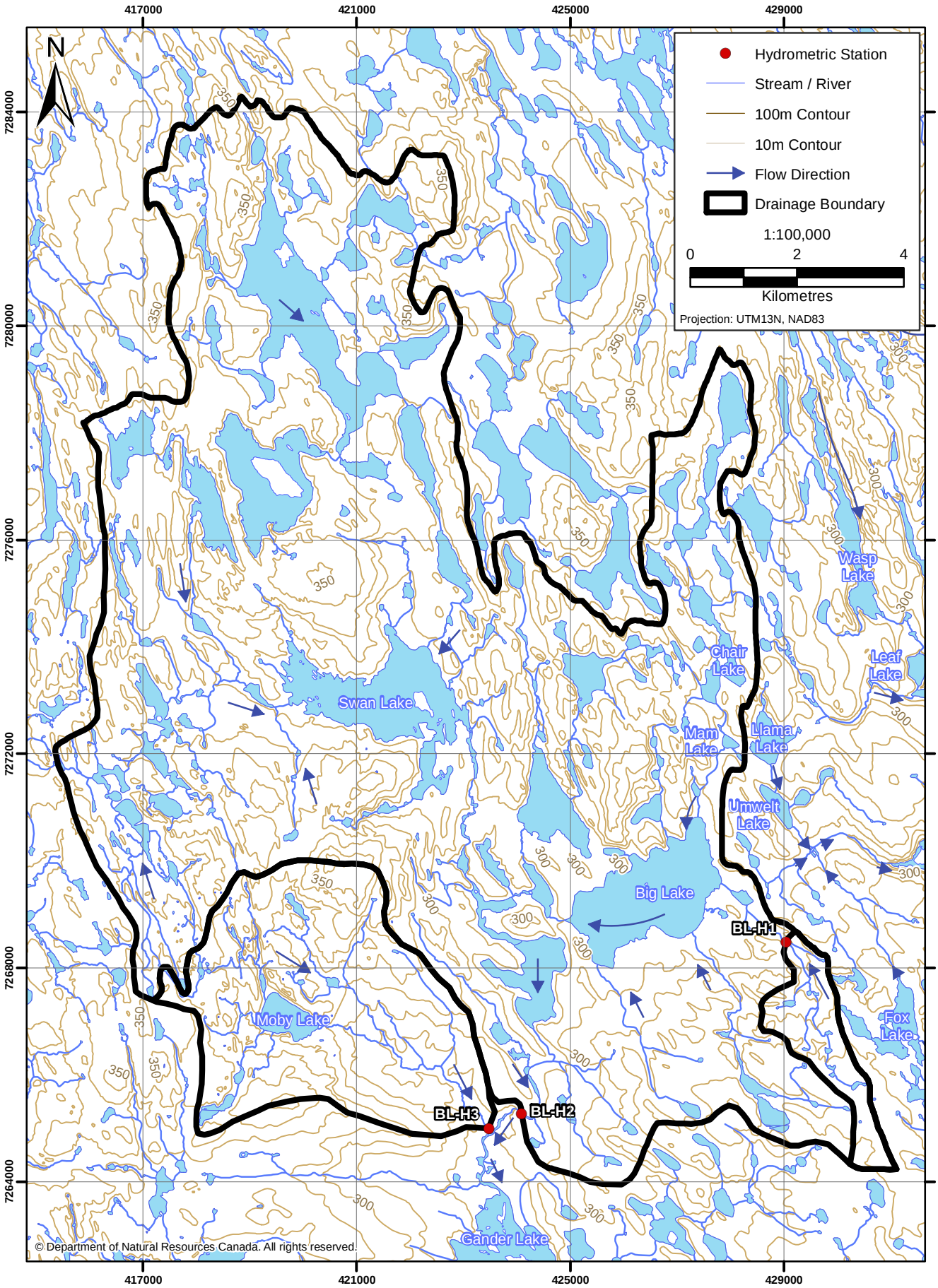


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Drainage Boundary for Reference Lake B Hydrometric Monitoring Station REFB-H1

Figure 3.1-6

Rescan™ Engineers & Scientists

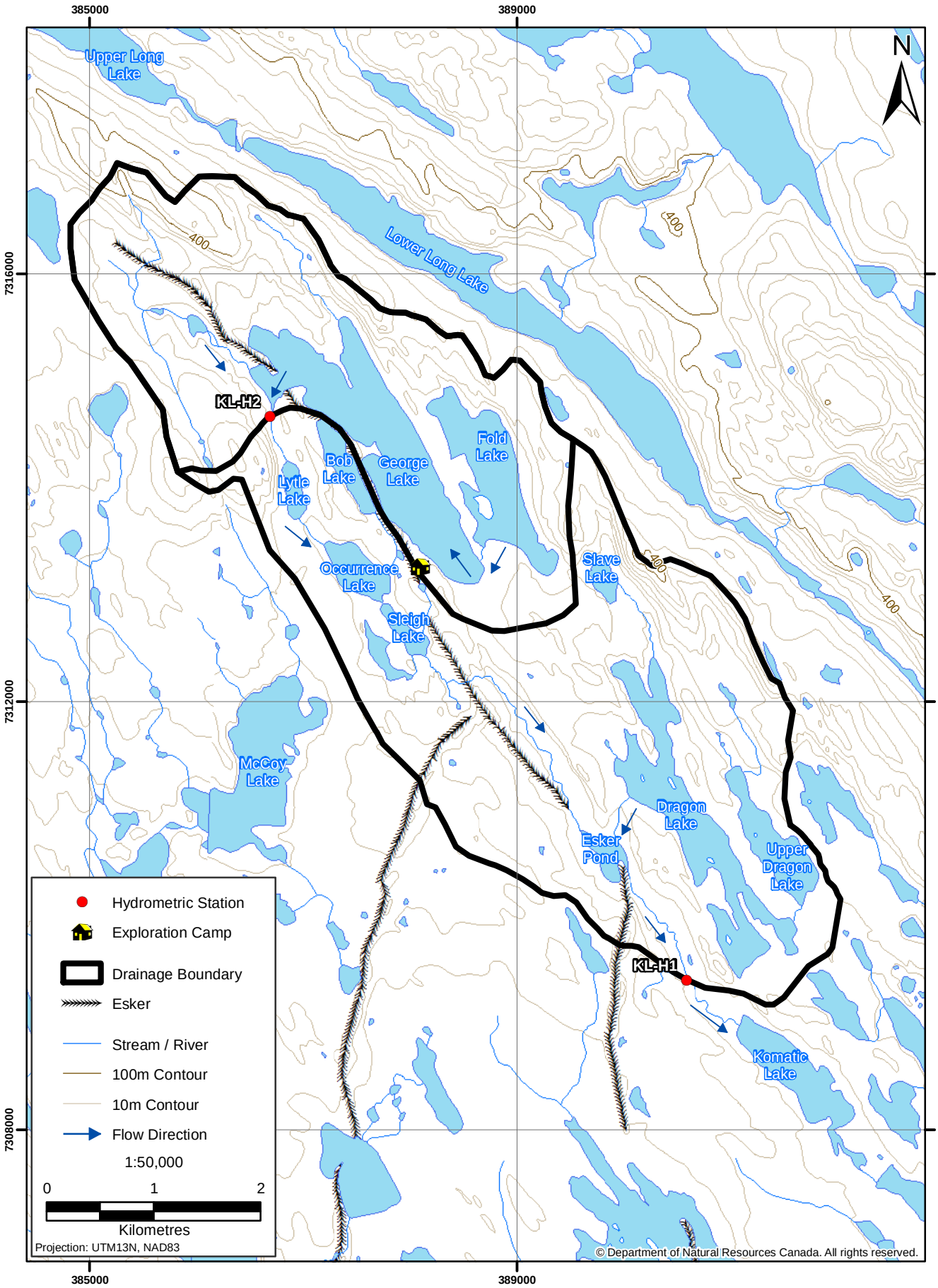


Sabina GOLD & SILVER CORP.

Drainage Boundaries for BL-H1, BL-H2, and BL-H3 Hydrometric Monitoring Stations

Figure 3.1-7

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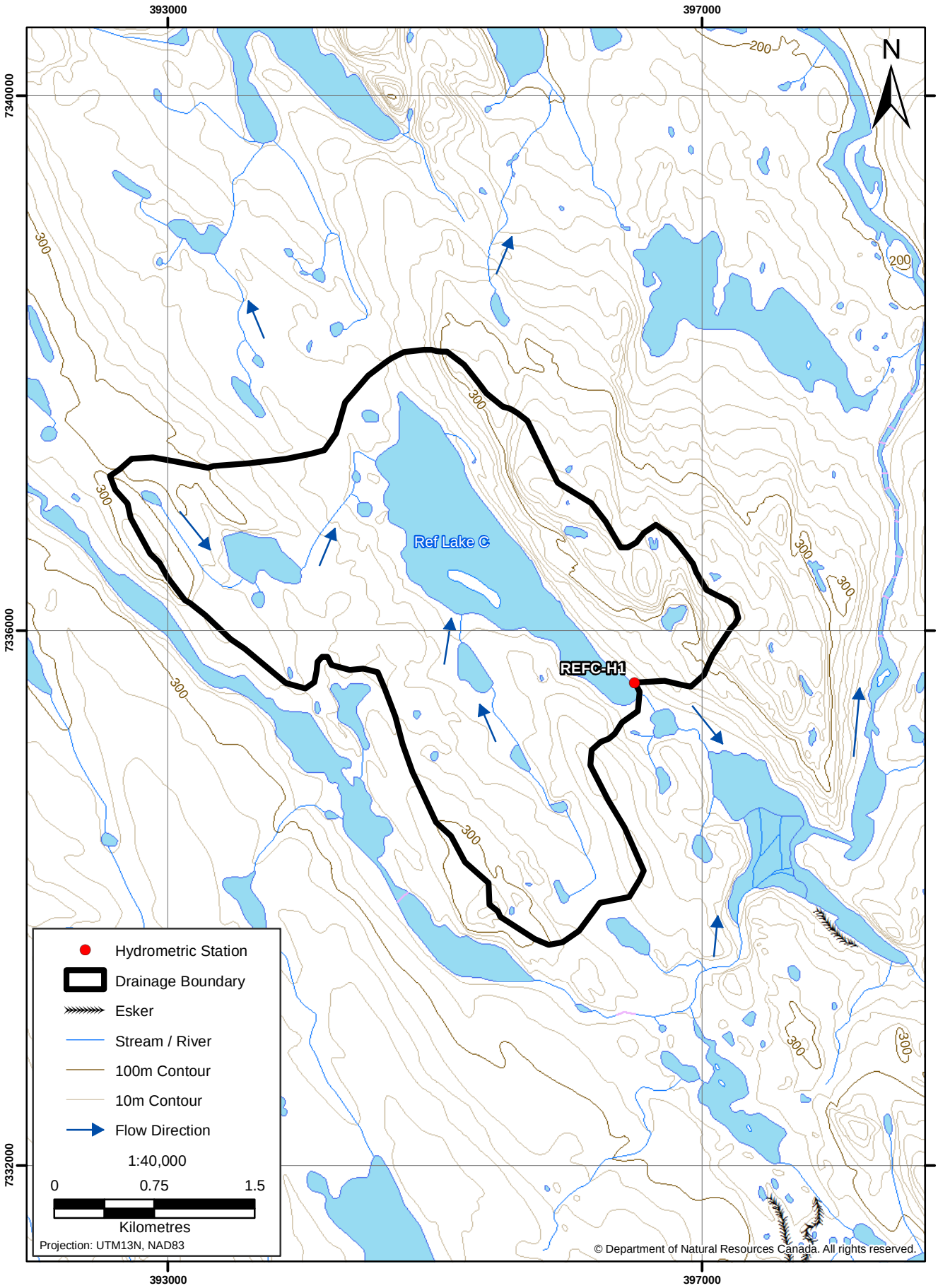


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Drainage Boundaries for KL-H1 and KL-H2 Hydrometric Monitoring Stations

Figure 3.1-8

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Drainage Boundary for REFC-H1 Hydrometric Monitoring Station

Figure 3.1-9

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3.2 HYDROMETRIC MONITORING STATION SETUPS

Hydrometric monitoring stations were setup within the Project area to obtain water level data at selected stream and lake sites. Several factors influenced the selection of the location for the monitoring sites in 2012: the monitored watershed contained known mineral deposits; the location was either a main inflow or outflow of Goose Lake or George Lake (located at the centre of the deposit area); and the location was at the drainage outlet of the watershed associated with the property. Specific station locations were determined during the initial field reconnaissance conducted in June of 2012. Further, sites were selected to best meet the basic criteria required for desirable gauging locations. Such criteria include: the ability to obtain accurate water level data and to measure discharge at all stages; a stable natural control of water elevation at the site; and accessibility during the entire operational period.

Each hydrometric monitoring station, including the nine established in 2011, consisted of a PS-98i® 0-5 PSI vented pressure transducer (Instrumentation Northwest Inc.) paired with an ELF-2 data logger (Terrascience Ltd.) or an AquiStar® PT2X Integrated transducer (INW). The instrumentation measured and recorded water levels at 10 minute intervals. Pressure transducers were encased within an aluminum flex conduit which was secured to angle iron (1.5 m lengths by 50 mm width and 6 mm thickness) and laid flat on the stream/lake bed in order to keep the transducer weighted in place. The flex conduit housing the transducer cable was routed to a steel weather proof enclosure containing the data logger. The box was securely installed above the high water mark. An example of a typical station set-up is shown in Plate 3.2-1.

3.3 DISCHARGE MEASUREMENTS

At each hydrometric station, current velocity measurements were performed so that discharges could be determined. Measurements were taken throughout the open water season in order to obtain a wide range of discharges under different flow conditions. Four site visits were conducted during mid-June, mid-July, mid-August, and mid-September time periods.

Manual flow measurements were carried out at each site using two different methods depending on the flow conditions and morphology of the stream. At one site where the channel was too deep to wade, an acoustic Doppler current profiler (ADCP) was used to determine discharge. At all the rest of the sites, where the stream channels could be safely waded, a handheld current velocity meter was used.

3.3.1 Current Velocity Measurements

The location of the metered section at each site was determined based on channel geometry and flow conditions at time of measurement. Generally, the stream was measured along a straight reach near the station where the bed was as uniform as possible. Areas with submerged vegetation and/or immovable rocks were avoided where possible.

Current velocities were measured using either a mechanical current meter (Swoffer 2100^{TM}) fitted with a 75 mm diameter propeller or an electromagnetic current meter (Marsh-McBirney Flo-mate^{TM}). A fixed sampling interval of 40 seconds was selected for each velocity measurement, during which an average velocity was determined.

Water discharge was computed from stream velocity measurements by employing the velocity - area method, which determines discharge per unit width for each sounding or vertical. In this method it is assumed that the velocity sampled at each vertical represents the mean velocity in a segment. The segment area extends laterally from half the distance from the preceding vertical to half the distance to the next, and vertically from the water surface to the sounded depth. The partial

discharges across the channel are then summed to obtain the estimated total discharge measurement. Typically a minimum of 20 current velocity measurements are obtained across the width of a channel with the aim of having each measurement interval accounting for less than 10% of the total discharge (Plate 3.3-1).



Plate 3.2-1. Photographs illustrating the hydrometric monitoring station design.

At each sounding point, if the observed water depth was less than 0.75 m, the current water velocities were measured at 60% of the flow depth of water. The measurement at 60% of the flow depth is generally accepted as representing the mean velocity of the vertical water section (Herschy 2009). When water depths were greater than 0.75 m, current velocities were measured at 20% and 80% of the flow depth of water and the average of the two readings was taken as the mean velocity for the vertical. In all cases, the adopted methods followed standard WSC operating procedures (Terzi 1981).

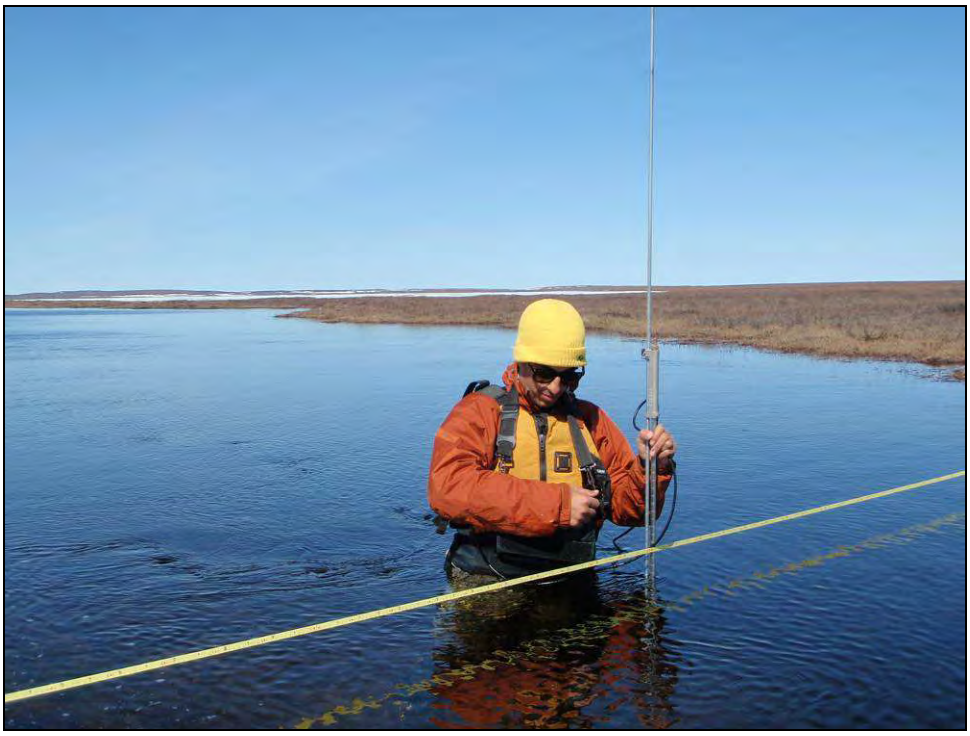


Plate 3.3-1. Velocity-area discharge measurements at hydrometric station WL-H1 using a handheld current velocity meter. Photograph taken on June 7, 2012.

3.3.2 ADCP Measurements

At one hydrometric station, water depth was too high during the open water season to allow field personnel to safely wade and measure discharge with a handheld current velocity meter. Therefore, discharge was measured at this site by means of a StreamPro® (Teledyne RD Instruments) acoustic Doppler current profiler (ADCP). All measurements were conducted according to standard operating procedures (Rehmel et al. 2003, WSC 2004).

The location of the ADCP measurements was selected following the same general principles as with the handheld current velocity meter. In addition, the section was chosen where the channel was relatively narrow to allow for better instrument control during the ADCP measurements.

At the selected location a boat was used to ferry personnel and a rope system across the channel. A cableway was used to manoeuvre the ADCP in controlled transects perpendicular to the direction of flow (Plate 3.3-2). Multiple transects were conducted until a minimum of four transects recorded discharges that were all within 5% of the measured mean discharge. The total discharge measurement was computed by taking the average of the four valid transects.

3.4 HYDROMETRIC STATION SURVEYS

3.4.1 Levelling Surveys

At stations where water surface elevation or stage is measured it is common practice to determine the stage above a specified reference surface or gauge datum. In order to check for the accuracy and consistency of the recorded data, it is necessary to periodically verify the elevation of the gauge in relation to the established station datum. To check and ensure that the gauge is properly set to the station datum, differential levelling techniques are used.

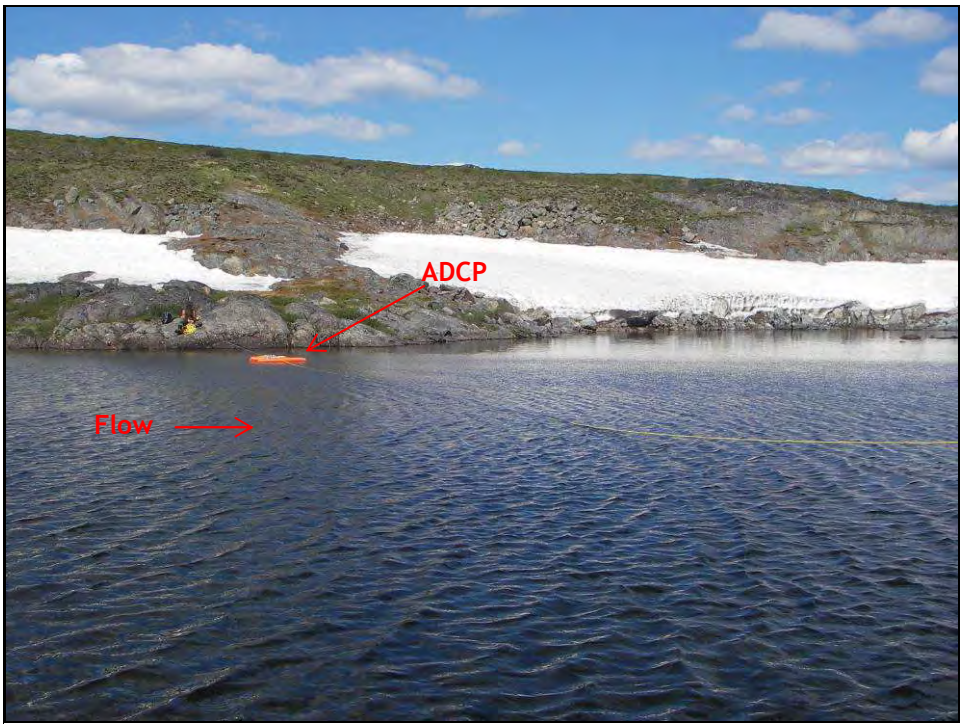


Plate 3.3-2. Discharge measurements at hydrometric station PL-H1 using an acoustic Doppler current profiler (ADCP). Photograph taken on July 14, 2012.

To establish and maintain vertical elevation control at the Project hydrometric monitoring locations, three local benchmarks were installed at each station. Benchmarks consisted of 76 mm concrete expansion bolts secured in bedrock or large stable boulders found in the vicinity of the stations. One benchmark at each station was assigned to be the primary reference point, and assigned an arbitrary local elevation of 100.000 m. All recorded water levels were then referenced to this primary benchmark.

Throughout the 2012 monitoring period, hydrometric levelling surveys were conducted during site visits in early June, mid-July, etc. Each survey was completed using an engineer's level and a calibrated levelling rod.

3.4.2 Channel Geometry Surveys

Surveys were completed at each monitored hydrometric station in order to define the channel geometry of the gauged stream section. At the majority of hydrometric stations, a suitable channel reach with a total length of approximately three to six channel widths was selected, using the hydrometric station as the midpoint of the surveyed section. Three evenly spaced cross-sections, perpendicular to the channel reach, were surveyed using an engineer's level and calibrated levelling rod.

For the stations located at the outflows of Giraffe Lake (GI-H1), George Lake (KL-H2) and Reference Lake C (REFC-H1), a near-shore longitudinal profile was measured at the station. Two additional channel cross-sections were measured downstream from these stations. At the outflow of Propellor Lake (PL-H1), information of the channel bed topography was obtained from the ADCP, and was merged with topographic information of the adjacent banks surveyed using an engineer's level and rod. At each station, all surveyed cross-sections were referenced to the established arbitrary local datum.

3.5 STAGE – DISCHARGE RELATIONS

In 2012, stage-discharge relations were developed for each hydrometric station. For stations that operated before 2012, data collected before and during 2012 were combined in the development of the stage-discharge relations. Stage-discharge relations are expressed as rating curves. Rating curves are used to convert water level data (stage) recorded by the hydrometric monitoring stations into a continuous discharge time-series or hydrograph. The quality of a rating curve is a function of the number and accuracy of the individual data points that are used to generate the curve as well as the hydraulic characteristics of the monitoring location. To develop a robust stage-discharge relation 10 to 15 manual streamflow measurements are recommended. Although a rating curve can be developed with as few as three points, each additional point adds increased robustness, particularly if the newly added measurements have a different magnitude than preceding measurements. Flow measurements at the higher end of the flow range are especially important as they help to define the upper end of the rating curve, which is important for quantifying hydrologically important periods such as peak flow and rainfall-runoff. The stage-discharge relation can also change from low flow periods to high flow periods, due to alterations in the geometry of the channel. When this is the case, a two-stage rating relation may be developed. One relation satisfies low stage conditions, while the other relation represents high stage conditions.

In the absence of a stage–discharge measurement corresponding to high flow conditions, the rating curve is often extrapolated to a high flow value that is beyond the range of the observed data used to generate the curve. Most stage-discharge relations in this study were extrapolated to values less than or equal to 1.5 times the greatest measured discharge. Any discharge extrapolation beyond that limit is not recommended as the resulting value will have a high uncertainty associated with it (ISO 2010). The stage-discharge relation for the hydrometric stations GL-H1, GL-H2, EL-H1, BL-H1, BL-H3, and REFC-H1 was extended beyond 1.5 times the highest measured discharge to account for the range of measured stages; therefore there is greater uncertainty in the high discharges calculated at these stations.

Rating curves were developed using Aquarius™ Time Series Hydrologic Software (Aquatics Informatics Inc.). The software uses standard methods outlined by the United States Geological Survey and the International Organization for Standardization (Kennedy 1984, ISO 2010). Plotted on a logarithmic scale, a least-squares regression procedure was used to produce a line of best fit and logarithmic equation for the concurrently measured water level (stage) and discharge data. Taking the antilogarithmic transformation, discharge was determined by a power function of the form:

$$Q = C\,(h - a)^{b} \qquad (1)$$

where Q is the discharge (m^3/s), C and b are regression coefficients, h is the stage (water level; m), and a is the stage at zero flow (datum correction; m).

3.6 DAILY DISCHARGE HYDROGRAPHS

Annual hydrographs, presented as daily discharge, were generated for each of the hydrometric monitoring stations operated in 2012. Daily discharge is the average discharge calculated over a 24 hour period.

For the operational period at each station, discharges were calculated by applying the developed rating curves to the recorded stage data. Prior to recorded stage data, rising limbs of the hydrographs were estimated assuming a logarithmic growth function. The onset of the spring freshet was determined using available temperature data from the George and Goose meteorological stations along with 2012 provisional daily discharge hydrograph of the regional WSC stations shown in Table 2.2-1. The recession

limb of each hydrograph was extended down to a zero flow date based on a linear decay function. This function is an extrapolation of the initial recession of the hydrograph that was captured in the data record.

3.7 MONTHLY VOLUMETRIC OUTFLOW

At each hydrometric station, the monthly and annual volumetric water outflows were determined. Volumetric outflows are expressed in millions of cubic meters per month for each of the monitored basins.

3.8 FLOW DURATION ANALYSIS

Flow duration analysis considers the percent of time that a specific discharge level has been exceeded or equalled during a period of record. A flow duration curve is the relation between the magnitudes of streamflow at a point and the frequency (probability) with which those magnitudes are exceeded over an extended period of time (Dingman 2002).

For each monitored basin within the Project area, a flow duration curve was generated. The flow duration curve is a useful planning tool in evaluating water discharge, as a function of basin characteristics.

A flow duration curve is constructed by ranking discharge values over a period of record, and then calculating their associated probabilities of exceedance using the following equation:

$$P = [M/(n+1)] \times 100\% \qquad (2)$$

Where *P* is the probability that a given flow will be equalled or exceed, *M* is the ranked position on the listing, and n is the number of events for the period of record (Dingman 2002).

3.9 HYDROLOGIC INDICES

Calculated annual runoff, seasonal runoff distribution, mean annual discharge (MAD), peak flow, and low flow are important hydrologic indices that provide useful information when undertaking a hydrologic assessment for design of mine Project infrastructure as well as when managing the water resources once a mine has entered operations.

3.9.1 Annual Runoff

Calculated annual runoff (expressed as a depth) represents the difference between annual precipitation, snowmelt, and evaporation. It is a valuable metric for obtaining gross estimates of the water available from a basin. Because it is standardized by watershed area it is also a useful index for comparing the hydrologic response of basins of different sizes. Annual runoff was expressed as observed annual runoff and as estimated annual runoff. Observed annual runoff only included runoff values for the period of record at each hydrometric station. Estimated annual runoff was the total runoff for the entire open water season, which includes both estimated and observed values.

3.9.2 Seasonal Runoff Distribution

Seasonal runoff distribution was determined by summing the daily runoff by month for each basin. Monthly runoff as a depth and as a percent of the total annual runoff was calculated and presented to illustrate the spatial and temporal distribution of runoff in the Project area.

3.9.3 Mean Annual Discharge

The mean annual discharge (MAD), computed as an average discharge over the year, is an additional variable that gives an indication of the potential amount of water a basin can provide as a function of drainage area, geology, and climate.

3.9.4 Annual Peak and Low Flow

Peak flows represent the maximum flow rate of a catchment during a year in response to precipitation events or snowmelt. Peak flows are used in combination with flood frequency analysis techniques in order to estimate design flows used in the sizing of ditches, diversion channels, or stream crossings. Conversely, low flows provide an estimate of the normal baseflow conditions during the open water season, which is important to the sustained health of a stream's aquatic community.

3.10 SNOW COURSE SURVEYS

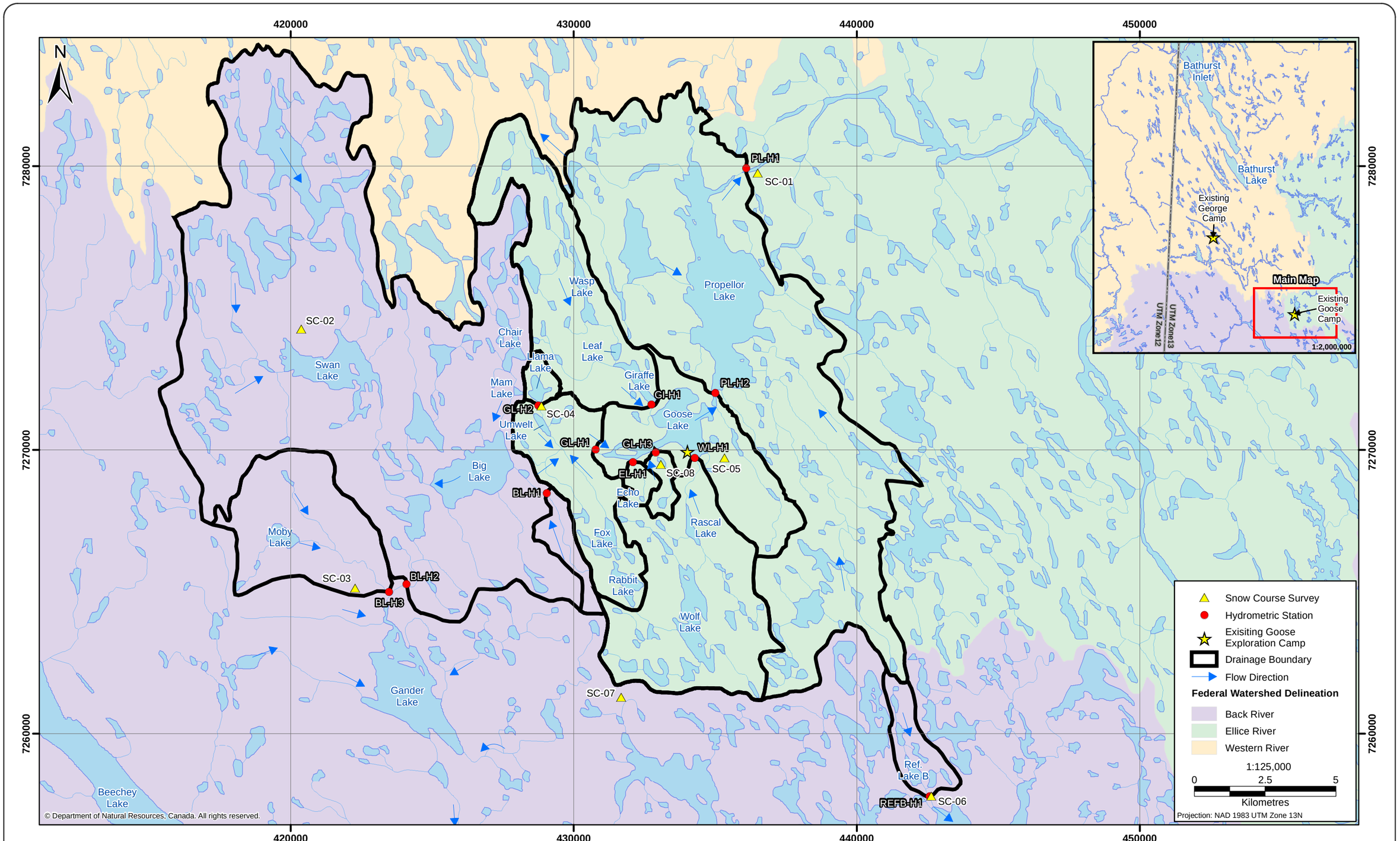
Snow course surveys are manual measurements of snowpack used to provide estimates of available runoff during spring freshet conditions. Snow surveys collect snow depth and density data in order to calculate Snow Water Equivalent (SWE) for a specific region of interest (Woo 1997). SWE is the amount of water stored in the snowpack, and represents the depth of water present if the snowpack were to melt instantaneously.

There were twelve snow courses conducted in 2012, eight within the Goose Property and four within the George Property. Each snow course was a transect of 10 sampling points spaced by 25 meters. All snow courses were sampled once in mid-April 2012 in order to measure maximum snowpack depth. The transects throughout both the George Property and the Goose Property were intended to characterize the regional snowpack for the Project area. Different terrain types (hill slopes, gullies, channel banks, etc.) were sampled within the snow course network to determine the average snow conditions within the Project area. Snow course locations on the Goose Property are shown in Figure 3.10-1 and listed in Table 3.10-1. Snow course locations on the George Property are shown in Figure 3.10-2 and listed in Table 3.10-2.

Table 3.10-1. 2012 Snow Course Survey Locations in the Goose Property Area

Station Number	Geographic Coordinates*		2012 Sampling Date	Station Location
	Easting	Northing		
SC-01	436502	7279764	April 25	PL-H1 drainage
SC-02	420367	7274271	April 21	BL-H2 drainage
SC-03	422265	7265136	April 24	BL-H3 drainage
SC-04	428855	7271553	April 21	GL-H2 drainage
SC-05	435325	7269732	April 24	PL-H2 drainage
SC-06	442629	7257810	April 23	REFB-H1 drainage
SC-07	431670	7261290	April 23	South of WL-H1 drainage
SC-08	433071	7269498	April 25	GL-H3 drainage

**UTM, Datum NAD 83, Zone 13 W*

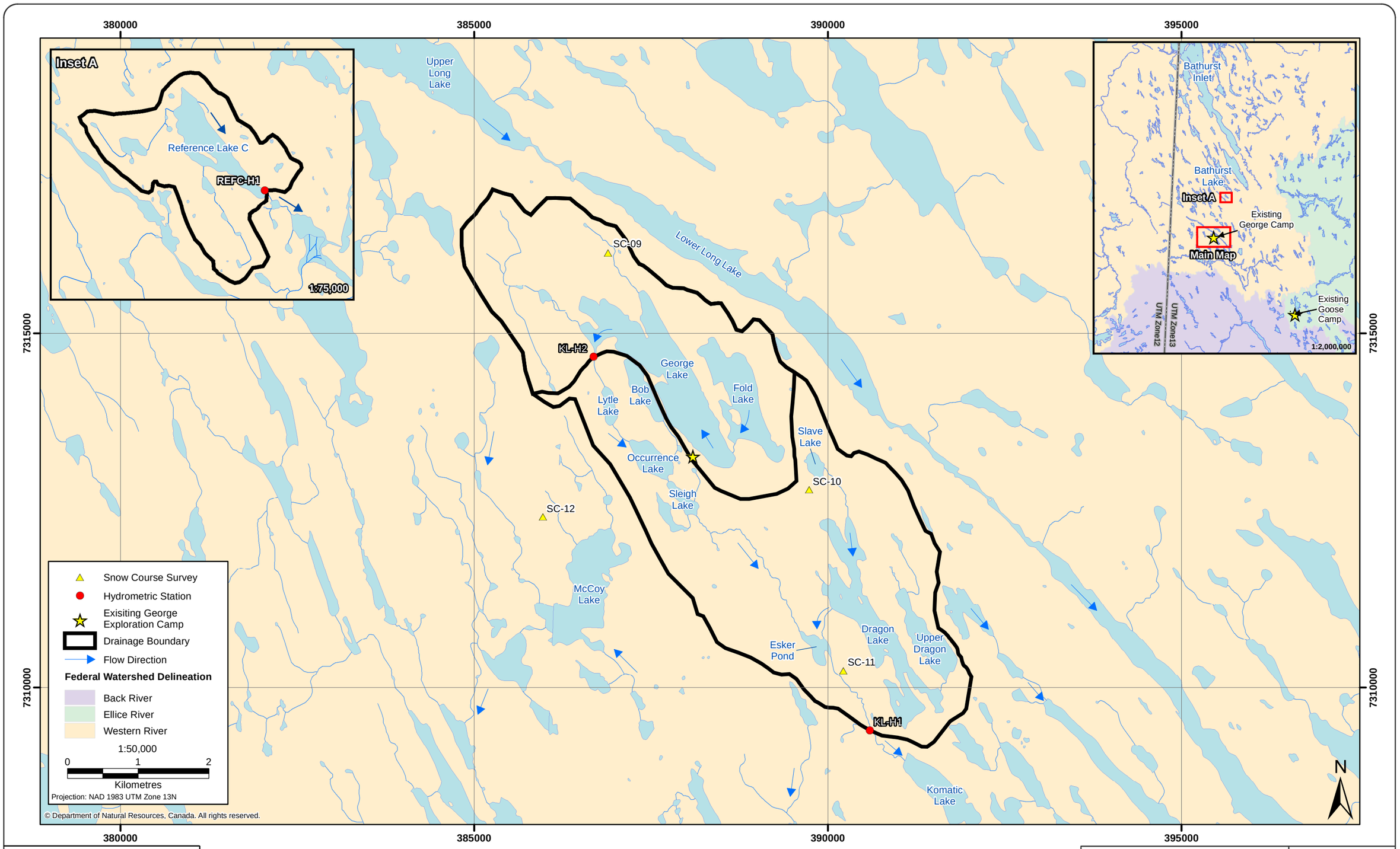


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Figure 3.10-1

2012 Snow Course Survey Locations within the Back River Project - Goose Area



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Figure 3.10-2

2012 Snow Course Survey Locations within the Back River Project - George Area

Table 3.10-2. 2012 Snow Course Survey Locations in the George Property Area

Station Number	Geographic Coordinates*		2012 Sampling Date	Station Location
	Easting	Northing		
SC-09	386892	7316137	April 20	KL-H2 drainage (North of George Lake)
SC-10	389735	7312798	April 20	KL-H2 drainage (South of George Lake)
SC-11	390220	7310240	April 22	KL-H1 drainage
SC-12	385971	7312414	April 22	Dragon Lake drainage

** UTM, Datum NAD 83, Zone 13 W*

The Standard Federal Snow Sampler was used for all measurements. Snow depth was measured by pushing the tube down through the snowpack to the ground surface and extracting a core (Plate 3.10-1). To obtain an accurate snow core sample, the base of the tube was examined to determine if the tube had reached ground level. Any soil from the bottom end of the tube was cleared out.

The Standard Snow Sampling Procedure was used for all snow courses except at sites SC-09 and SC-10 where the Bulk Sampling Procedure was used due to the shallow depth of snow pack (BC MOE 1981, 1982). When the Standard Snow Sampling Procedure was used, the amount of water in the snowpack was determined by weighing the tube with its snow core (Plate 3.10-2). The density of a snow core was calculated by:

$$\rho = w/(\pi d r^2) \qquad (3)$$

where ρ is the snow density (kg/m^3 or %), w is the weight of the snow core, d is snow depth, and r is the inside radius of the core cutter (Woo 1997). An average of all the samples taken along the transect was calculated to represent the snow course.



Plate 3.10-1. Snow course sampling, drilling snow core.



Plate 3.10-2. Snow course sampling, weighing snow core.

When the Bulk Sampling Procedure was used, instead of measuring the SWE of individual snow cores, the content of all snow cores from the transect was emptied into a container, then this container was weighed in order to determine the total value for SWE in the entire snow course. This value was then divided by the number of samples to obtain the average SWE for the snow course. The snow density of the snow course was calculated as:

$$\rho = SWE/d \qquad (4)$$

where *SWE* is the average snow water equivalent of the snow course and *d* is the average depth of the samples (BC MOE 1981).

4. Results

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4. Results

Results from the 2012 hydrology program are presented as follows: (1) completed discharge measurements, (2) hydrometric surveys, (3) determined stage-discharge relations, (4) daily discharge hydrographs, (5) volumetric outflows, (6) flow duration analysis, and (7) hydrologic indices for the Project area.

4.1 DISCHARGE MEASUREMENT SUMMARY

Discharge measurements were taken during the June freshet period at each hydrometric station with additional measurements conducted in July, August, and September 2012, for a total of 82 measurements. The measurements were collected through the open water season in order to obtain a range of discharges at different flow conditions (Table 4.1-1 and Appendix 2).

Table 4.1-1. Summary of Discharge Measurements in the Project Area in 2012

Hydrometric Station	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
GL-H1	June 13	99.402	0.384	Velocity-Area (FlowMate)
	July 12	99.089	0.0842	Velocity-Area (FlowMate)
	August 10	98.653	0.00452	Velocity-Area (FlowMate)
	September 7	98.664	0.00652	Velocity-Area (Swoffer)
GL-H2	June 12	99.678	0.116	Velocity-Area (FlowMate)
	July 6	99.601	0.0270	Velocity-Area (FlowMate)
	August 10	99.531	0.00127	Velocity-Area (FlowMate)
	September 7	99.538	0.00151	Velocity-Area (Swoffer)
GL-H3	June 7	99.837	0.335	Velocity-Area (FlowMate)
	June 13	99.748	0.0503	Velocity-Area (FlowMate)
	July 9	99.678	0.0167	Velocity-Area (FlowMate)
	August 15	99.567	No Flow	
	September 9	99.641	0.00352	Velocity-Area (Swoffer)
PL-H1	June 6	99.433	19.27	Velocity-Area (ADCP)
	June 14	99.154	6.922	Velocity-Area (ADCP)
	July 14	98.819	1.473	Velocity-Area (ADCP)
	July 15	98.809	1.051	Velocity-Area (FlowMate)
	August 13	98.624	0.316	Velocity-Area (FlowMate)
	September 8	98.563	0.116	Velocity-Area (FlowMate)
PL-H2	June 12	99.770	3.456	Velocity-Area (FlowMate)
	June 16	99.708	1.731	Velocity-Area (FlowMate)
	July 7	99.596	0.668	Velocity-Area (FlowMate)
	August 11	99.481	0.0421	Velocity-Area (FlowMate)
	September 13	99.530	0.172	Velocity-Area (FlowMate)

(continued)

Table 4.1-1. Summary of Discharge Measurements in the Project Area in 2012 (continued)

Hydrometric Station	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
GI-H1	June 9	99.781	1.827	Velocity-Area (FlowMate)
	June 14	99.721	0.841	Velocity-Area (FlowMate)
	July 13	99.648	0.131	Velocity-Area (FlowMate)
	August 14	99.561	0.0342	Velocity-Area (FlowMate)
	September 10	99.552	0.0295	Velocity-Area (FlowMate)
	September 14	99.546	0.0456	Velocity-Area (FlowMate)
EL-H1	June 13	99.308	0.00675	Velocity-Area (FlowMate)
	June 17	99.279	0.00263	Velocity-Area (FlowMate)
	July 9	99.207	No Flow	
	August 14	99.172	No Flow	
	September 7	99.329	0.00818	Velocity-Area (Swoffer)
WL-H1	June 7	98.766	1.743	Velocity-Area (FlowMate)
	June 13	98.679	1.069	Velocity-Area (FlowMate)
	July 5	98.370	0.189	Velocity-Area (FlowMate)
	August 11	98.262	0.0494	Velocity-Area (FlowMate)
	September 14	98.297	0.0508	Velocity-Area (FlowMate)
REFB-H1	June 14	99.558	0.113	Velocity-Area (FlowMate)
	June 17	99.512	0.0127	Velocity-Area (FlowMate)
	July 7	99.444	0.0099	Velocity-Area (FlowMate)
	August 11	99.353	No Flow	
	September 13	99.394	0.00202	Velocity-Area (FlowMate)
BL-H1	June 12	99.755	0.0569	Velocity-Area (FlowMate)
	June 16	99.701	0.0213	Velocity-Area (FlowMate)
	July 13	99.611	0.00837	Velocity-Area (FlowMate)
	August 10	99.587	0.00106	Velocity-Area (FlowMate)
	August 15	99.619	0.00308	Velocity-Area (FlowMate)
	September 10	99.684	0.00871	Velocity-Area (Swoffer)
BL-H2	June 8	99.223	10.17	Velocity-Area (FlowMate)
	June 16	99.003	3.98	Velocity-Area (FlowMate)
	July 8	98.819	1.67	Velocity-Area (FlowMate)
	August 14	98.673	0.339	Velocity-Area (FlowMate)
	September 6	98.632	0.125	Velocity-Area (Swoffer)
	September 9	98.679	0.260	Velocity-Area (Swoffer)
BL-H3	June 8	100.173	0.969	Velocity-Area (FlowMate)
	June 16	99.913	0.232	Velocity-Area (FlowMate)
	July 8	99.780	0.0604	Velocity-Area (FlowMate)
	August 11	99.785	0.0304	Velocity-Area (FlowMate)
	September 9	99.862	0.0862	Velocity-Area (Swoffer)

(continued)

Table 4.1-1. Summary of Discharge Measurements in the Project Area in 2012 (completed)

Hydrometric Station	Date Measured	Pressure Transducer Stage (m)*	Measured Discharge (m^3/s)	Method (Equipment Used)
REFC-H1	June 11	99.345	0.249	Velocity-Area (FlowMate)
	June 15	99.310	0.143	Velocity-Area (FlowMate)
	July 10	99.214	0.0447	Velocity-Area (FlowMate)
	August 12	99.104	0.00207	Velocity-Area (FlowMate)
	September 12	99.050	0.000388	Velocity-Area (FlowMate)
KL-H1	June 10	99.055	1.267	Velocity-Area (FlowMate)
	June 15	98.943	0.719	Velocity-Area (FlowMate)
	July 11	98.748	0.284	Velocity-Area (FlowMate)
	August 12	98.612	0.0604	Velocity-Area (FlowMate)
	September 12	98.688	0.132	Velocity-Area (FlowMate)
KL-H2	June 10	99.636	0.497	Velocity-Area (FlowMate)
	June 15	99.580	0.271	Velocity-Area (FlowMate)
	July 12	99.509	0.179	Velocity-Area (FlowMate)
	August 12	99.422	0.0245	Velocity-Area (FlowMate)
	September 12	99.437	0.374	Velocity-Area (FlowMate)

** Pressure transducer stage referenced to site-specific arbitrary datum*

Two discharge measurements were taken during the freshet period at most of the hydrometric stations to capture the range of flow conditions observed. Discharge measurements were not conducted at the hydrometric stations GL-H3 and REFB-H1 during the August visit and at the hydrometric station EL-H1 during both the July and August visits as these streams were dry.

4.2 HYDROMETRIC STATION SURVEYS

4.2.1 Levelling Surveys

Levelling surveys were completed during each flow measurement during the 2012 field season. A summary of the survey control points at each station are provided in the station information sheets (Appendix 1). Survey data from the nine re-established stations were used to reference the 2012 stage data to existing benchmarks installed in 2011.

At the majority of new stations the surveys confirmed that the pressure transducers measuring water level remained stationary and properly calibrated during the monitoring period. At stations GL-H1, KL-H1, KL-H2, REFB-H1, and REFC-H1 the transducers drifted vertically during the field season and the survey data were used to confirm the changes in elevation of the pressure transducers and to correct for the errors in the stage time series.

4.2.2 Channel Geometry Surveys

Channel geometry surveys conducted at each hydrometric monitoring location are provided in Appendix 3. Surveys of the monitored reaches provide a physical representation of the channel geometry. These data will be used to determine channel stability and shifts on an annual basis. Cross-sections of the channels at the installed pressure transducers also show the 2012 minimum, mean, and maximum observed water level elevations.

4.3 STAGE-DISCHARGE RATING CURVES

At each of the hydrometric stations that were established in 2010 or 2011, the data collected before 2012 were combined with the data collected in 2012. This increased the range and the robustness of the rating curves. A wider range of flows were measured in 2012. This helped to better define the upper and lower ends of the preliminary rating curves that were developed in 2011. At each of the six new stations that were installed in 2012, five to six discharge measurements were conducted during the open water season. These measurements were used in the development of preliminary rating equations. Additional discharge measurements will continue to increase the range and robustness of the stage-discharge relations.

For stations where no substantial break points were observed, a single rating curve was fit to the full range of flows measured. A two stage (Low/High) rating curve was developed for stations where the monitored reach was confined to a fairly deep channel with steep banks during low to medium flow conditions; however, during high flow conditions the banks were overtopped and the stream was able to flood the flat tundra adjacent to the channel. Rating equations are summarized in Table 4.3-1 and rating curves are provided in Appendix 3.

Table 4.3-1. Summary of 2012 Rating Equations for the Hydrometric Monitoring Stations in the Project Area

Hydrometric Station		Rating Equation Q = C (h-a)b	Root Mean Square
GL-H1	Low Stage	$Q = 0.210(h-98.424)^{2.499}$	9.7
	High Stage	$Q = 2.171(h-98.895)^{2.497}$	
GL-H2		$Q = 3.335(h-99.528)^{1.847}$	7.7
GL-H3	Low Stage	$Q = 0.882(h-99.606)^{1.541}$	7.1
	High Stage	$Q = 6.351(h-99.710)^{1.608}$	
PL-H1	Low Stage	$Q = 21.534(h-98.549)^{2.107}$	10.0
	High Stage	$Q = 25.993(h-98.504)^{2.094}$	
PL-H2	Low Stage	$Q = 2.896(h-99.450)^{1.205}$	10.8
	High Stage	$Q = 34.591(h-99.450)^{2.113}$	
GI-H1	Low Stage	$Q = 0.745(h-99.370)^{1.875}$	8.1
	High Stage	$Q = 48.020(h-99.585)^{2.083}$	
EL-H1		$Q = 2.751(h-99.223)^{2.363}$	
WL-H1	Low Stage	$Q = 10.109(h-98.20)^{2.249}$	11.9
	High Stage	$Q = 7.368(h-98.20)^{2.573}$	
REFB-H1	Low Stage	$Q = 4.769(h-99.446)^{2.017}$	7.0
	High Stage	$Q = 4.558(h-99.50)^{1.526}$	
BL-H1	Low Stage	$Q = 0.377(h-98.546)^{1.843}$	4.0
	High Stage	$Q = 3.291(h-99.669)^{1.812}$	
BL-H2		$Q = 21.441(h-99.510)^{2.467}$	9.3
BL-H3		$Q = 3.151(h-99.714)^{1.781}$	5.9
REFC-H1		$Q = 11.852(h-99.144)^{2.405}$	8.6
KL-H1		$Q = 3.595\ (h-98.480)^{2.030}$	9.3
KL-H2		$Q = 3.561(h-99.383)^{1.509}$	12.1

Q= discharge (m^3/s); h= recorded stage (m)

Also included in the table is the Root Mean Square (RMS) which is used by the Aquarius® software as an overall measure of error of the stage-discharge relation. The RMS is a statistical parameter that describes how well the values predicted by the stage-discharge relation fit or represent the observed data. The departure from true values computed by this statistic combines both bias and lack of precision. The lower the RMS, the better the estimated values provided by the rating relationship.

4.4 ANNUAL HYDROGRAPHS

The 2012 annual daily discharge hydrographs presented in Figures 4.4-1 through 4.4-8 show similar trends over the year at each of the monitored locations in the Back River Project area. Daily discharge tables are provided in Appendix 4 and individual hydrographs in Appendix 5.

Based on air temperature recorded time series at the Goose and George meteorological stations, break-up was estimated to occur in late May (Figure 4.4-9). It was assumed that the break-up started on May 26 when the air temperatures in the Project area were consistently above the freezing point. One prominent high flow recession event driven by snowmelt was observed in each of the hydrographs during the freshet period. Only one minor rainfall-driven flow event was observed during early September. After the September precipitation event, flows continued to recede until the end of the monitoring period, which coincided with mean daily air temperatures dropping below the freezing level.

Based on the continuous time series of water level recorded at these sites, it is clear that the largest peak flow occurred during the freshet period from late May to early June. Provisional data recorded in 2012 at four WSC stations relevant to the Project area support the conclusion as well (Figure 4.4-9). The largest or the first peak flows at all these WSC stations occurred between May 30 and June 9. When the influence of drainage size is considered, the timing of peak flows in the Project area should be earlier than the WSC stations.

Pressure transducers were installed at all stations as soon as it was possible at all sites given ice conditions in the streams and lakes. However, it is usually not possible to get the instrumentation installed prior to the initial melting, and so regional data were used to help determine the onset of freshet. To estimate the spring freshet peak, linear extrapolation was used to extend the recession limb of the recorded freshet data back to June 2, which was selected based on regional streamflow and local climatic data. The exception was station BL-H2, where it was assumed that the observed peak occurred on June 8.

Compared to last year, the 2012 discharge hydrographs demonstrated a different pattern. In 2011 there were three prominent high flows - one was driven by snowmelt and the other two by rainfall (Rescan 2012). However, in 2012 there was only one high flow and it was driven by snowmelt, while the rainfall-driven flow was minor.

In addition, both the freshet break-up and peak flow in 2012 occurred earlier than in 2011. In 2012 the break-up occurred in late May and freshet peak flow occurred in early June, while the 2011 break-up occurred in early June and freshet peak flow occurred in mid-June.

4.4.1 Volumetric Outflow

The total monthly and annual volumetric water outflows for each of the drainages are presented in Tables 4.4-1 and 4.4-2. Outflows from each of the monitored drainages were generally found to be a function of drainage area. In the Goose Property area, the minimum volumetric outflows were observed at EL-H1 (drainage area = 1.4 km^2) which had a total annual water output of 0.08 million cubic meters. The maximum annual volumetric output was 27.39 million cubic meters at PL-H1 (drainage area = 204.4 km^2). In the George Property area, the minimum volumetric outflows were observed at REFC-H1 (drainage area = 9.47 km^2) which had a total annual water output of 0.59 million cubic meters. The maximum annual volumetric output was 3.43 million cubic meters at KL-H1 (drainage area = 24.0 km^2).

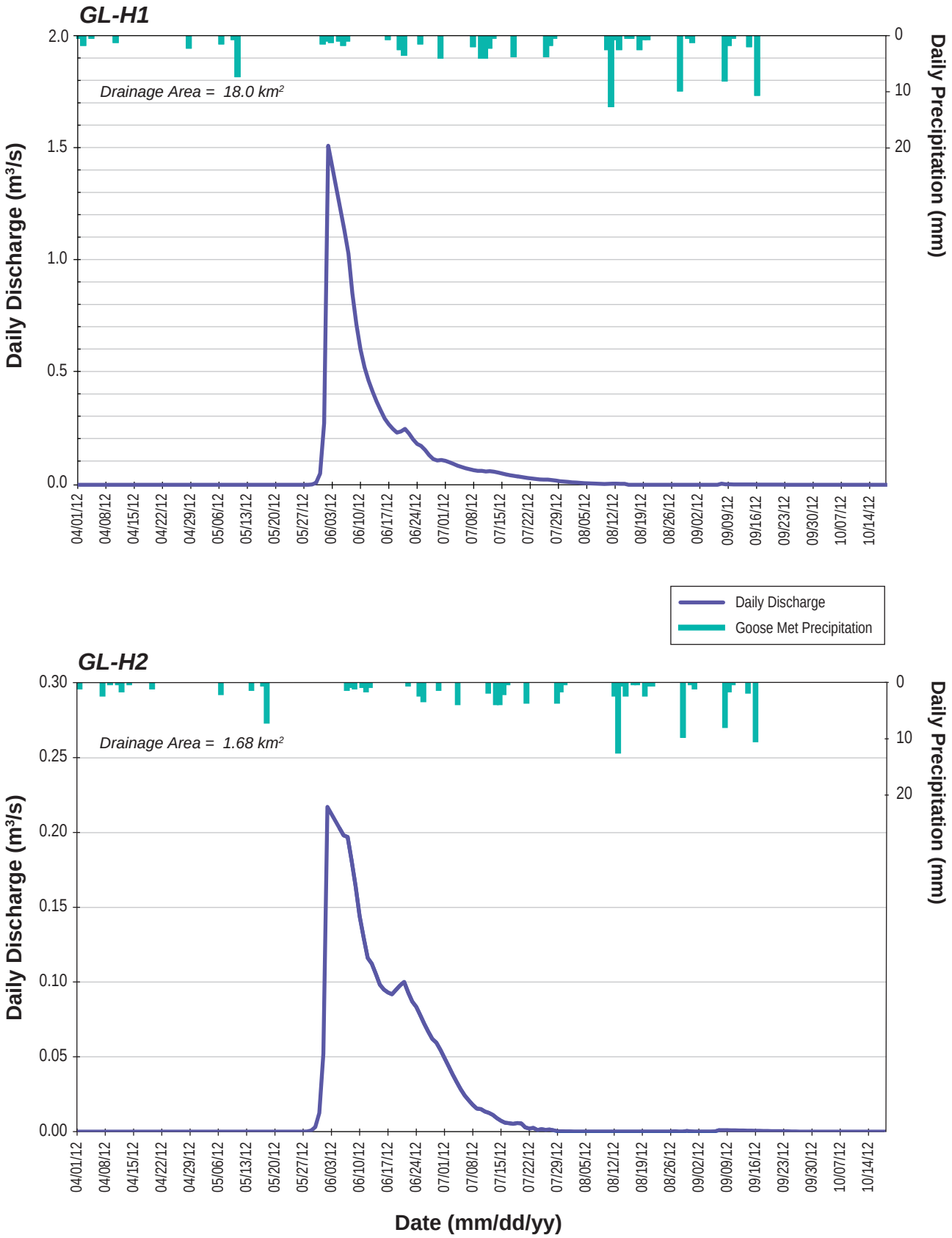
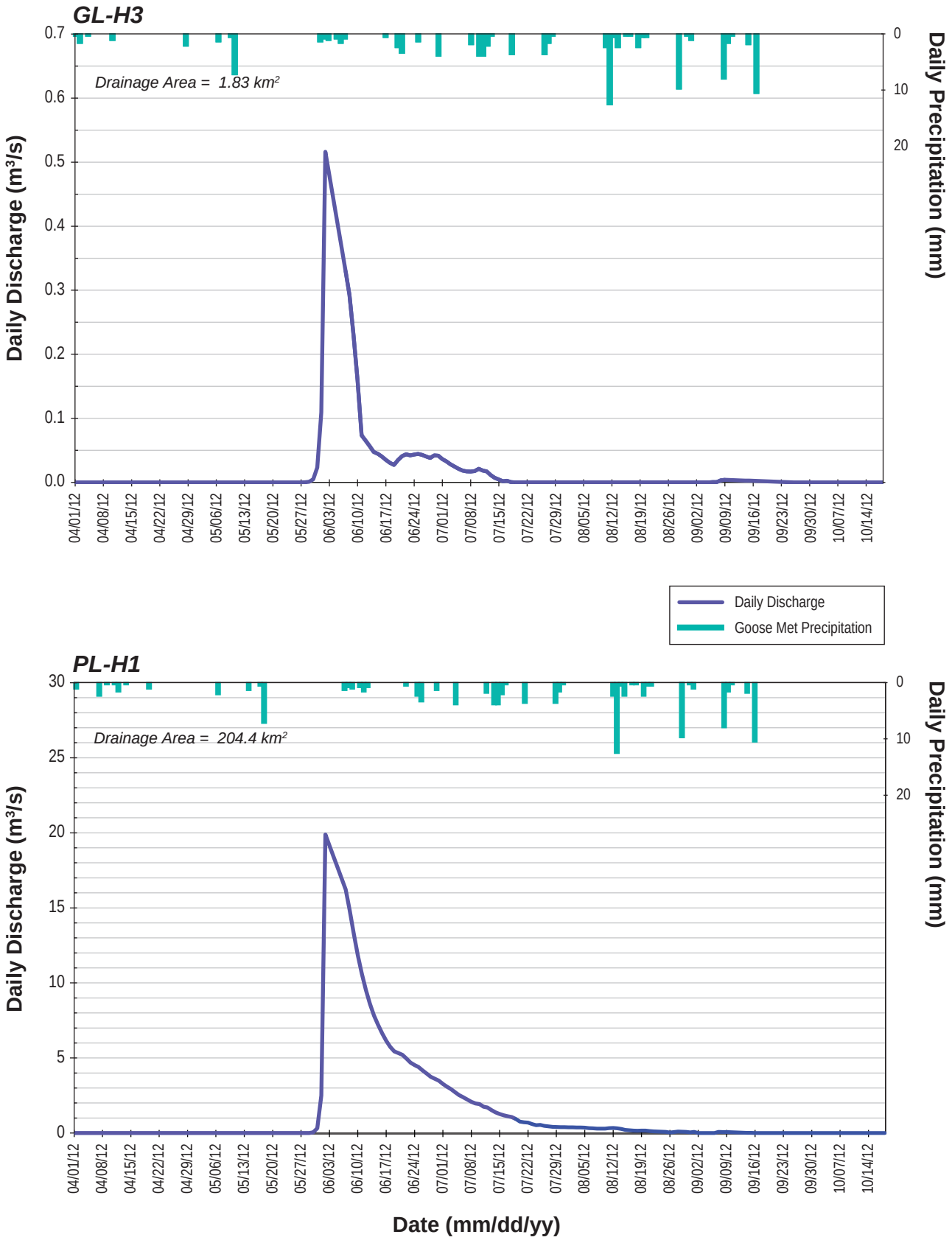


Figure 4.4-1

Annual Hydrograph at GL-H1 and GL-H2 Hydrometric Monitoring Stations, 2012

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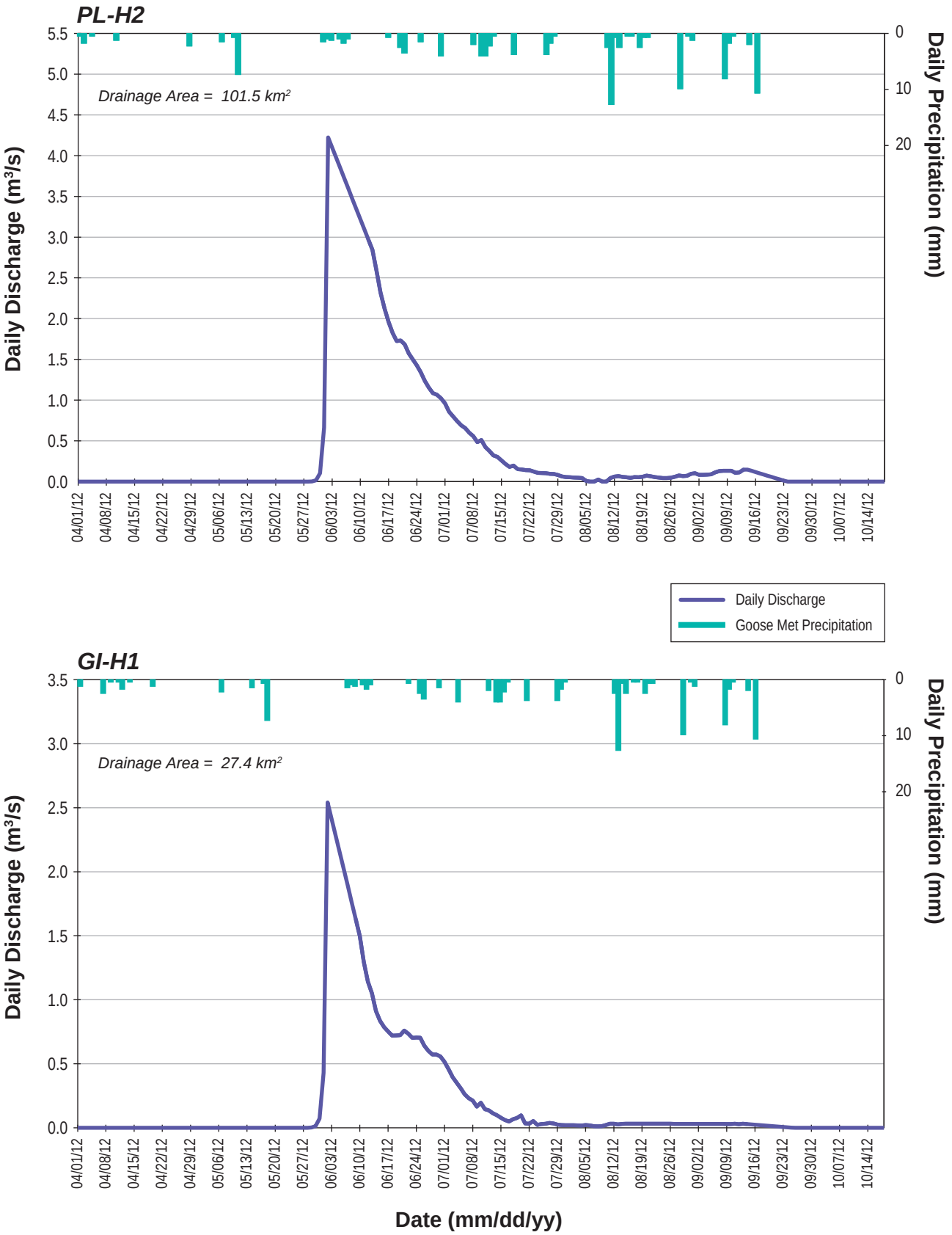


Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-H3 and PL-H1 Hydrometric Monitoring Stations, 2012

Figure 4.4-2

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Annual Hydrograph at PL-H2 and GI-H1 Hydrometric Monitoring Stations, 2012

Figure 4.4-3

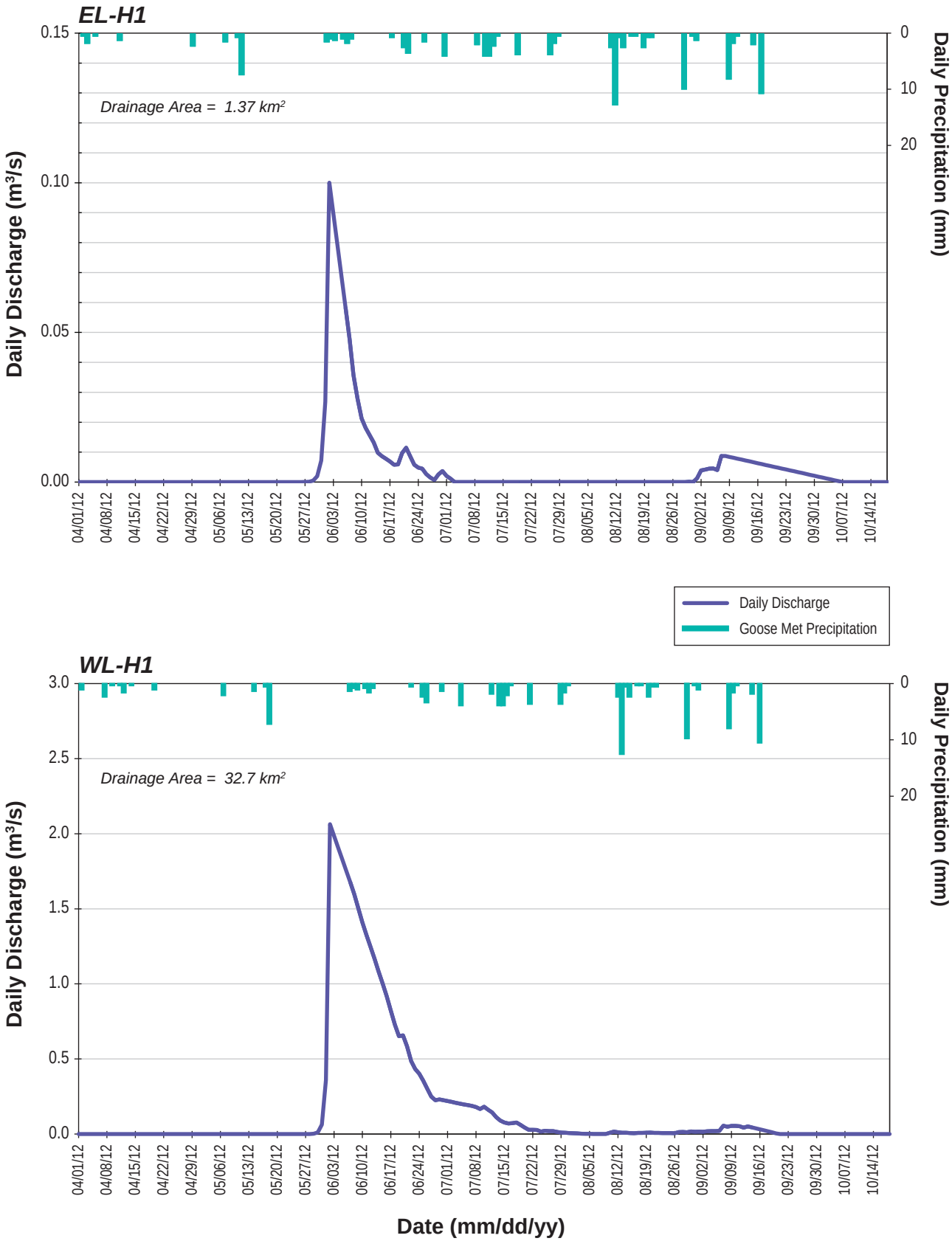


Figure 4.4-4

Annual Hydrograph at EL-H1 and WL-H1 Hydrometric Monitoring Stations, 2012

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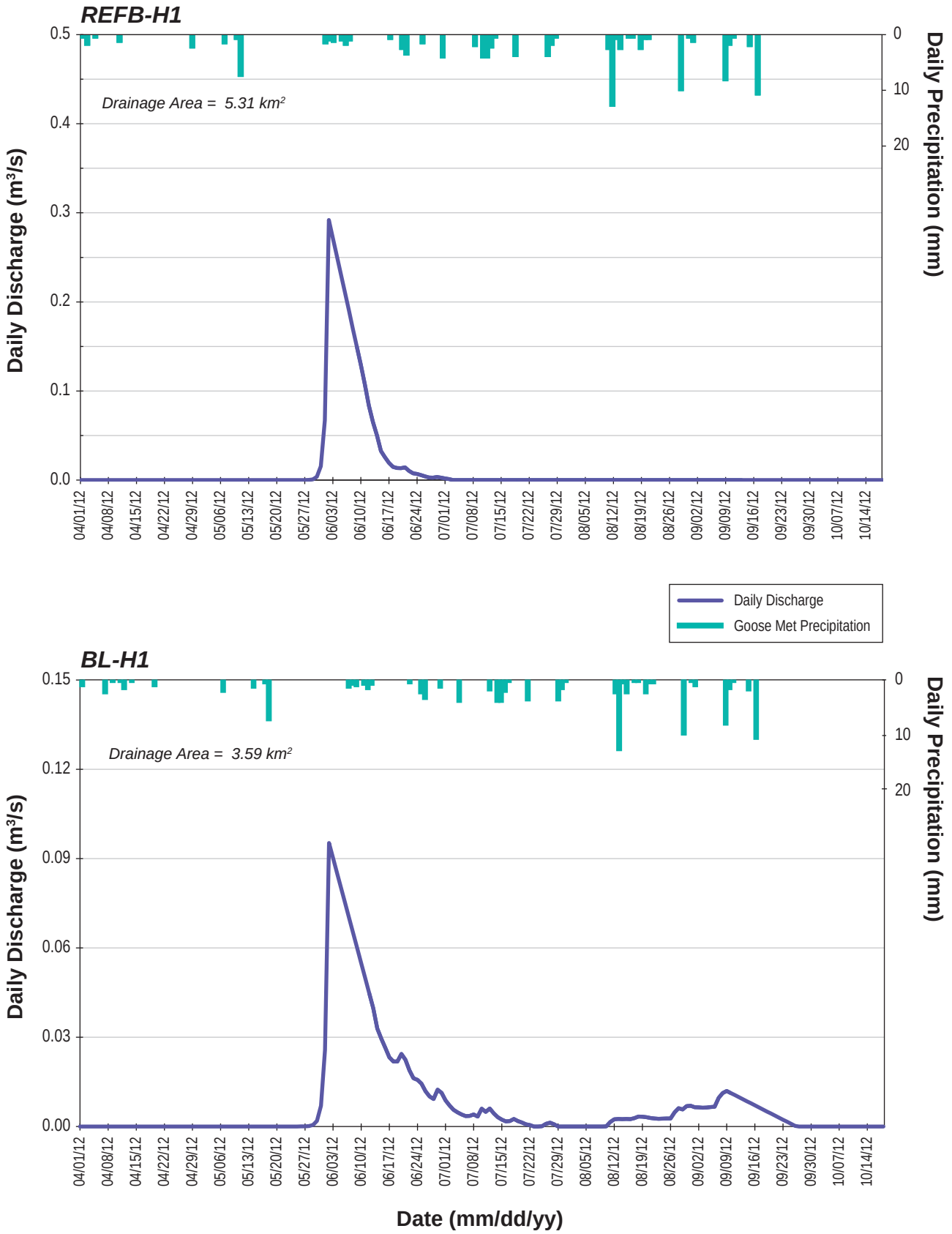
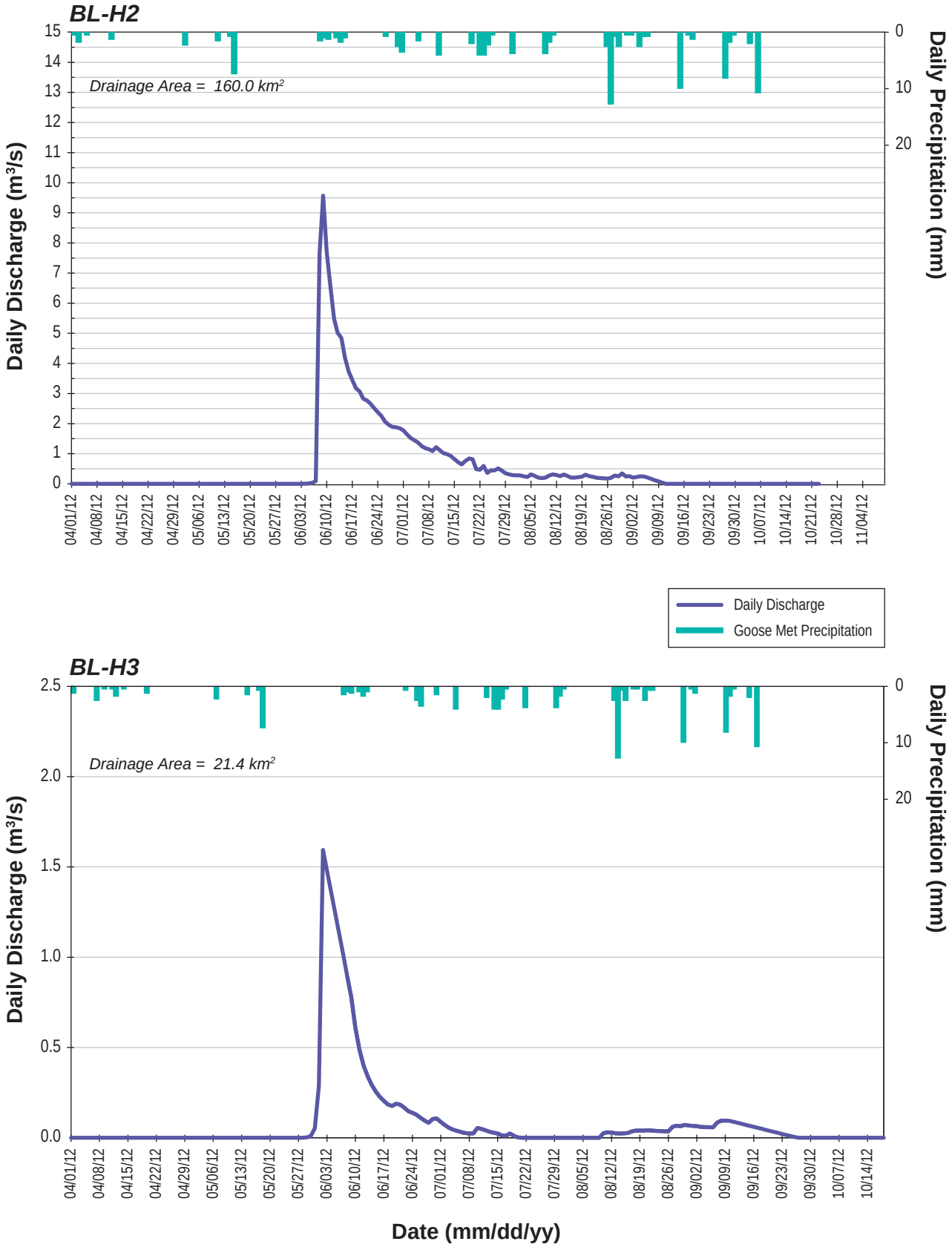


Figure 4.4-5

Annual Hydrograph at REFB-H1 and BL-H1 Hydrometric Monitoring Stations, 2012

Sabina GOLD & SILVER CORP.

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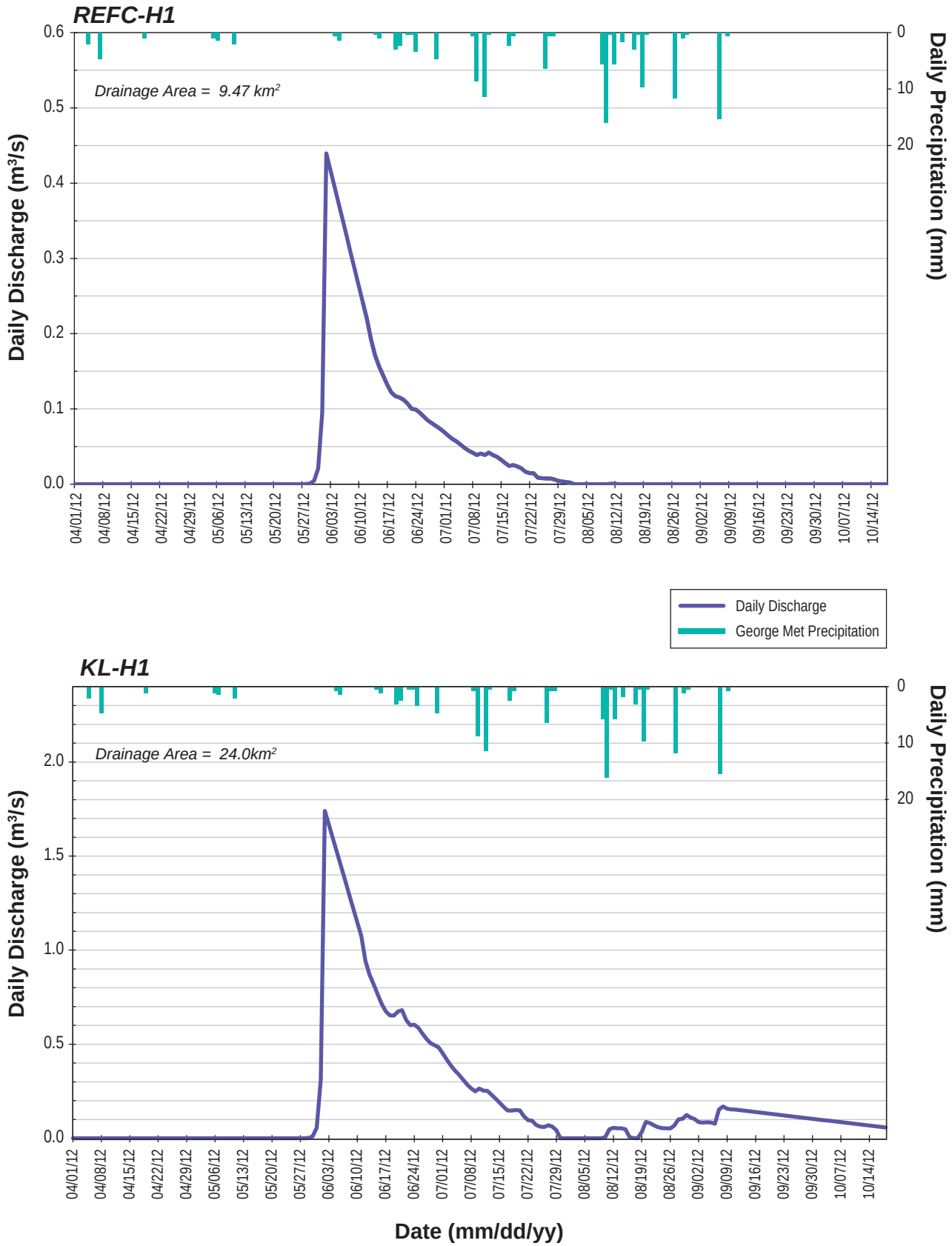


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Annual Hydrograph at BL-H2 and BL-H3 Hydrometric Monitoring Stations, 2012

Figure 4.4-6

Rescan™ Engineers & Scientists

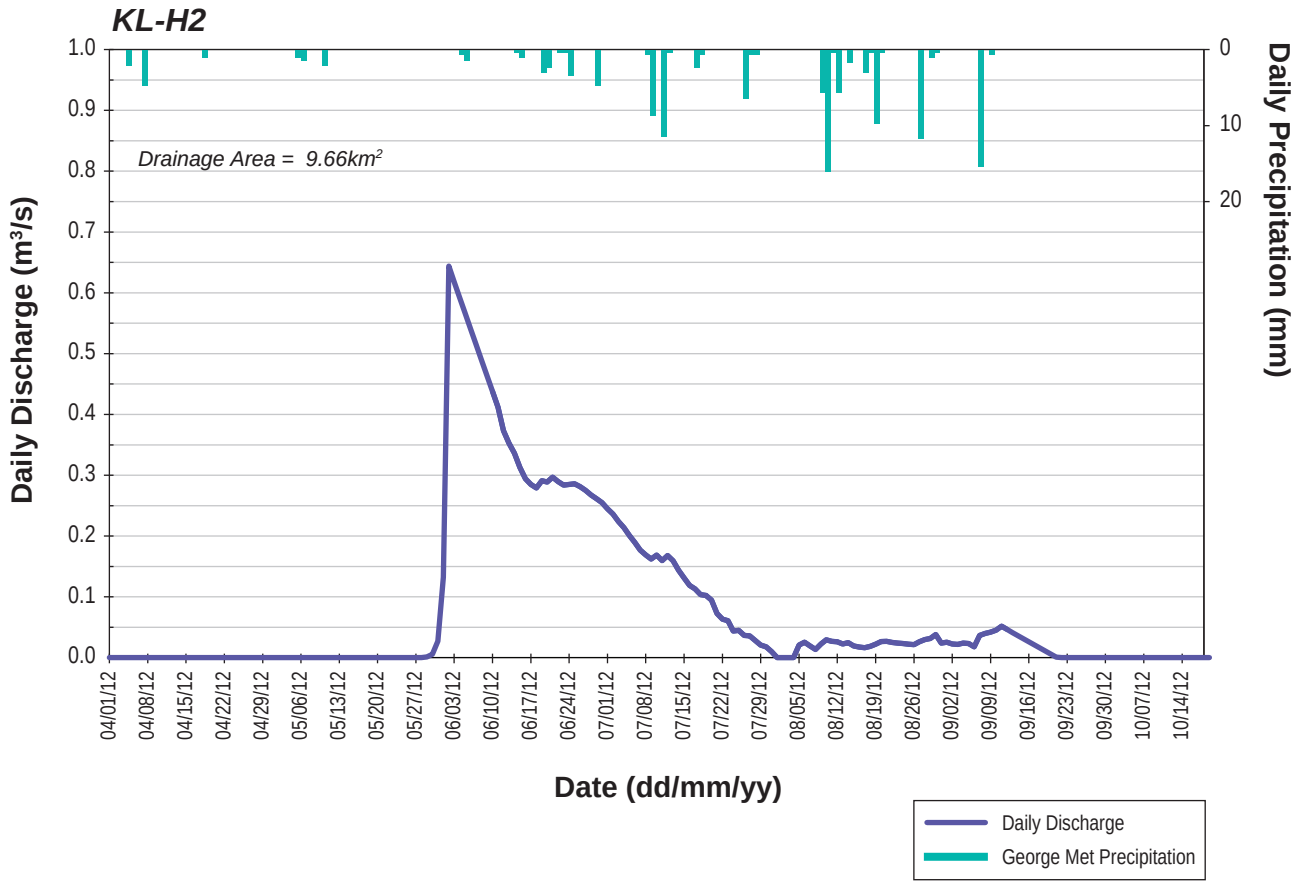


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Annual Hydrograph at REFC-H1 and KL-H1 Hydrometric Monitoring Stations, 2012

Figure 4.4-7

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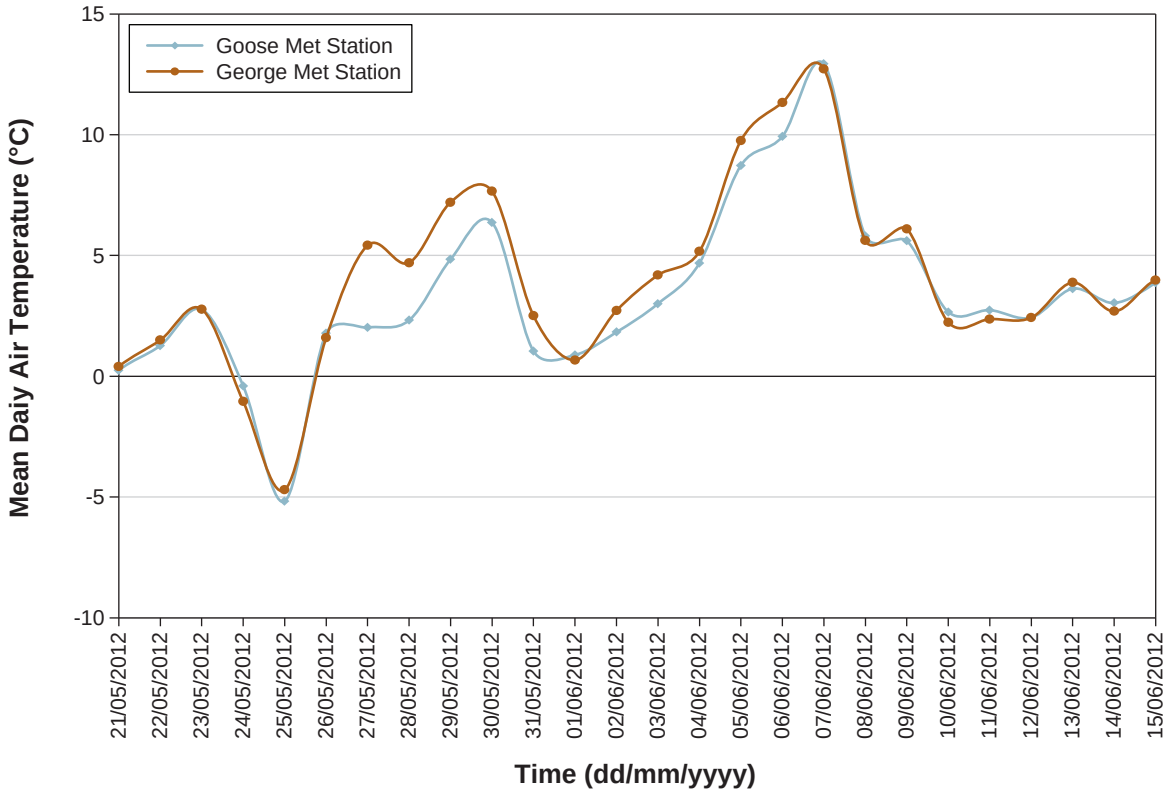


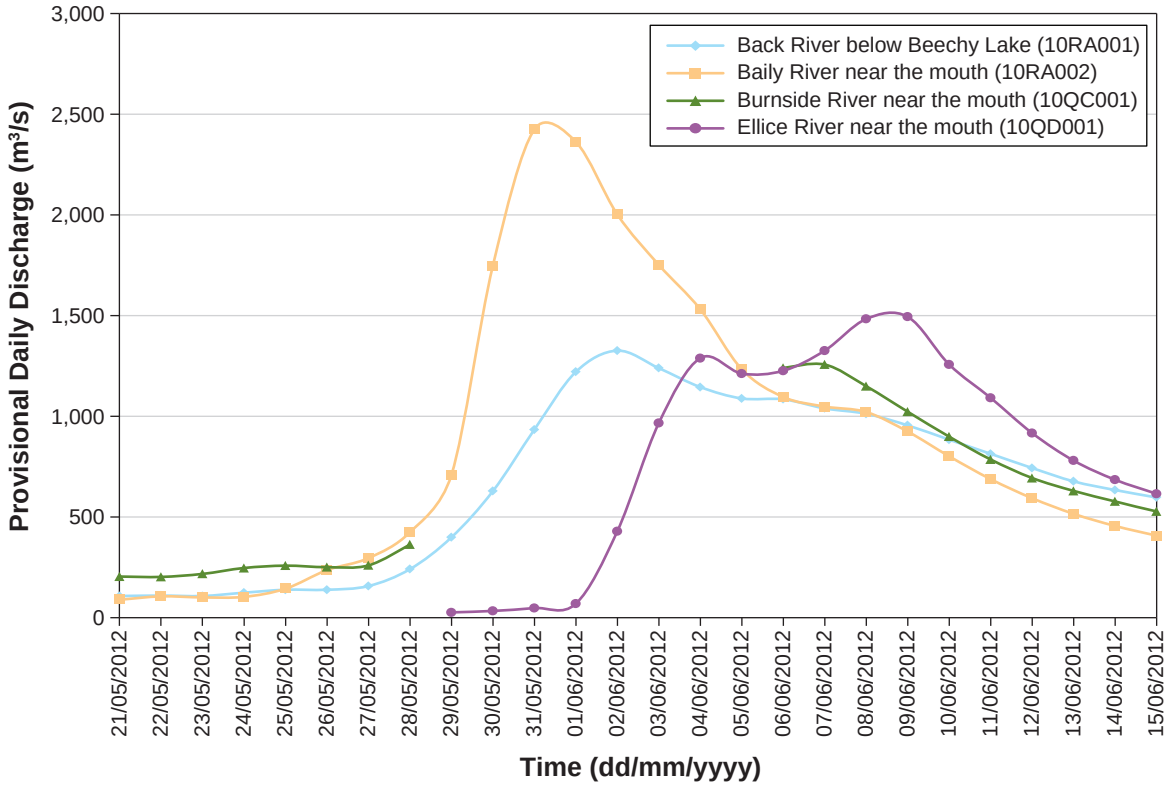
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Annual Hydrograph at KL-H2
Hydrometric Monitoring Stations, 2012

Figure 4.4-8

Rescan™ Engineers & Scientists





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Break-up Period Mean Daily Air Temperatures at Goose and George Meteorological Stations and Hydrographs of Related Water Survey of Canada Stations

Figure 4.4-9

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Table 4.4-1. 2012 Volumetric Water Yield in Millions of Cubic Meters (million m^3) for Hydrometric Stations in the Goose Property Area

Hydrometric Station	Jan-May	June	July	August	September	October	Nov-Dec	Total Annual
GL-H1	*0.01*	*1.31*	0.13	0.01	*0.00*	*0.00*	*0.00*	*1.45*
GL-H2	*0.00*	*0.31*	0.03	0.00	*0.00*	*0.00*	*0.00*	*0.34*
GL-H3	*0.00*	*0.36*	0.03	0.00	*0.00*	*0.00*	*0.00*	*0.39*
PL-H1	*0.00*	*23.10*	3.68	0.61	*0.00*	*0.00*	*0.00*	*27.39*
PL-H2	*0.00*	*6.09*	0.91	0.10	*0.20*	*0.00*	*0.00*	*7.31*
GI-H1	*0.00*	*2.96*	0.38	0.08	*0.05*	*0.00*	*0.00*	*3.48*
EL-H1	*0.00*	*0.06*	0.00	0.00	*0.01*	*0.00*	*0.00*	*0.08*
WL-H1	*0.01*	*2.52*	0.26	0.02	*0.06*	*0.00*	*0.00*	*2.87*
REFB-H1	*0.00*	*0.21*	0.00	0.00	*0.00*	*0.00*	*0.00*	*0.21*
BL-H1	*0.00*	*0.10*	0.01	0.01	*0.01*	*0.00*	*0.00*	*0.13*
BL-H2	*0.00*	*7.68*	2.40	0.64	*0.16*	*0.00*	*0.00*	*10.88*
BL-H3	*0.01*	*1.24*	0.06	0.08	*0.13*	*0.00*	*0.00*	*1.52*

Note: Estimated values are italicized

Table 4.4-2. 2012 Volumetric Water Yield in Millions of Cubic Meters (million m^3) for Hydrometric Stations in the George Property Area

Hydrometric Station	Jan-May	June	July	August	September	October	Nov-Dec	Total Annual
REFC-H1	*0.00*	*0.50*	0.08	0.00	*0.00*	*0.00*	*0.00*	*0.58*
KL-H1	*0.00*	*2.33*	0.50	0.12	*0.31*	*0.17*	*0.00*	*3.43*
KL-H2	*0.00*	*0.95*	0.32	0.06	*0.05*	*0.00*	*0.00*	*1.38*

Note: Estimated values are italicized

4.5 FLOW DURATION ANALYSIS

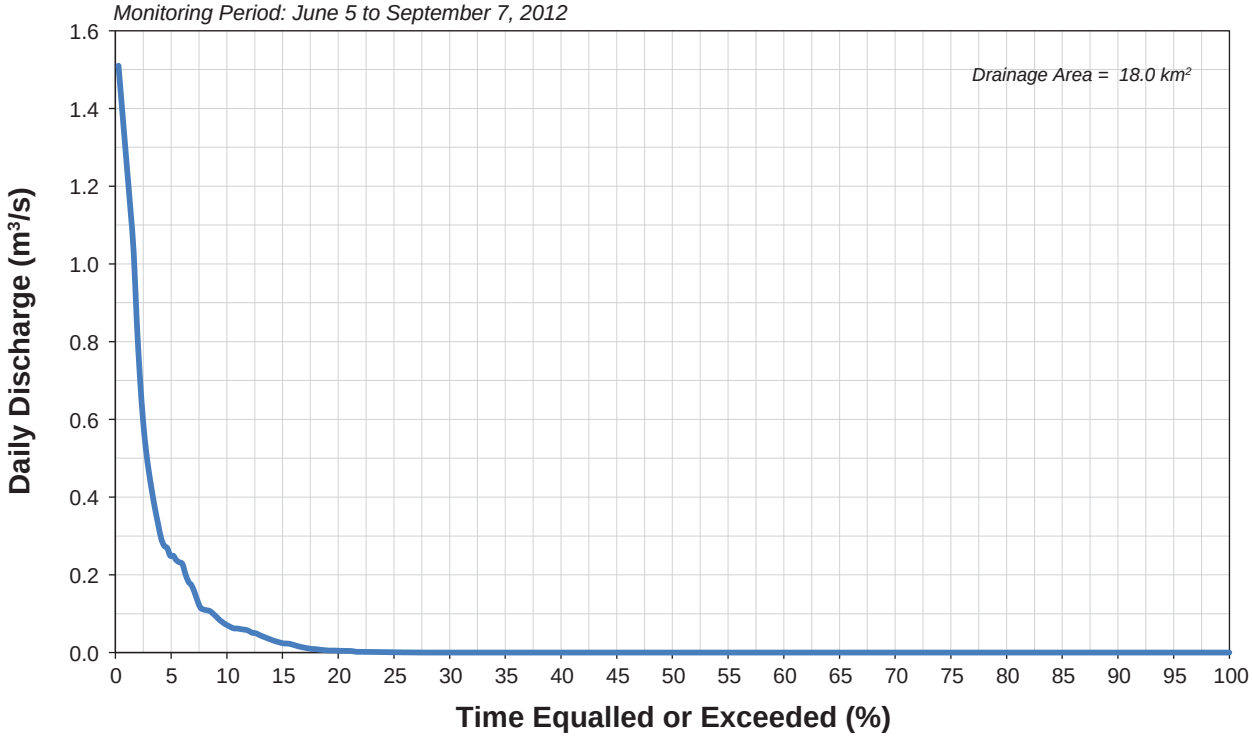
Annual flow duration curves (FDC) were produced for each of the monitored streams in 2012 (Figures 4.5-1 through 4.5-8). The trends in the FDC clearly demonstrate the seasonality of these small Arctic streams. A range of exceedance values and a percentage of time in the open water season during which streams were flowing are presented in Table 4.5-1 and 4.5-2. In the Goose Property area, the flow duration analysis reveals that on average there was streamflow during 27% of the year with a maximum of 33% observed at GI-H1 and a minimum of 10% at REFB-H1. In the Goose Property area, on average 31% of the year there was flow in streams, with a maximum of 42% observed at KL-H1 and a minimum of 20% at REFC-H1, which are longer than the stations in the Goose Property area.

The shape of the FDC describes the runoff response of each drainage basin to precipitation or snow melt events. The smaller (e.g., EL-H1) basins typically produced a steeper FDC as they responded quicker to hydrological inputs. Conversely, larger drainage basins showed a flatter FDC. This reflects a more attenuated response as water was routed through the system (e.g., station PL-H1).

The streamflow duration in 2012 was much shorter than in 2011 though the freshet in 2012 occurred earlier than in 2011. At the nine stations that were operated in 2011, the average of streamflow duration in 2012 was 26% of the year compared to 30% of the year in 2011.

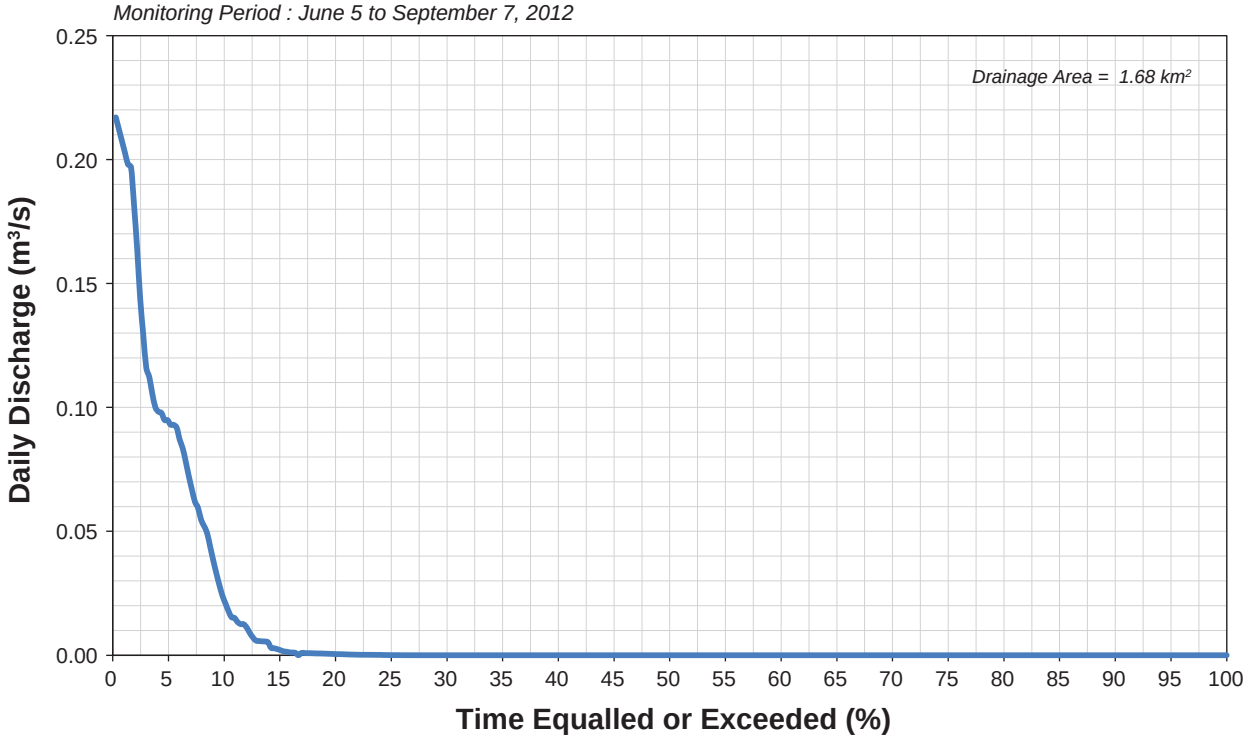
Station GL-H1

Monitoring Period: June 5 to September 7, 2012



Station GL-H2

Monitoring Period : June 5 to September 7, 2012



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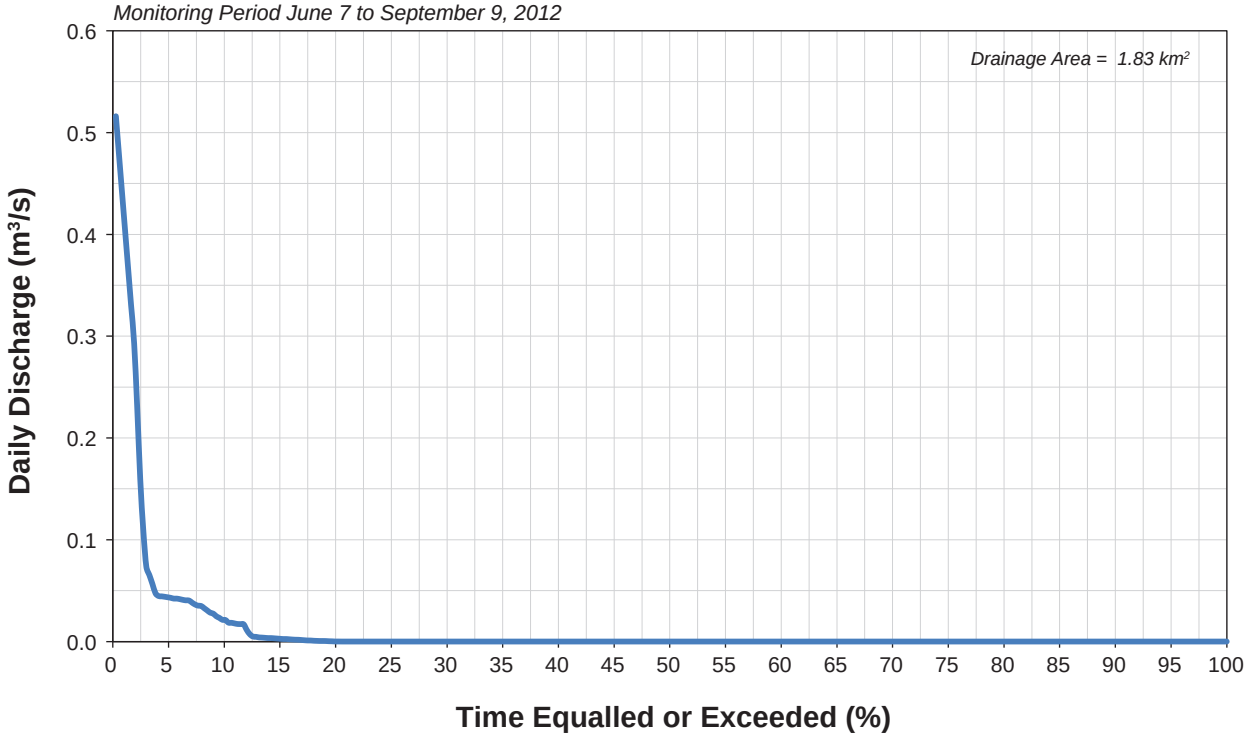
2012 Flow Duration Curves for Hydrometric Monitoring Stations GL-H1 and GL-H2

Figure 4.5-1

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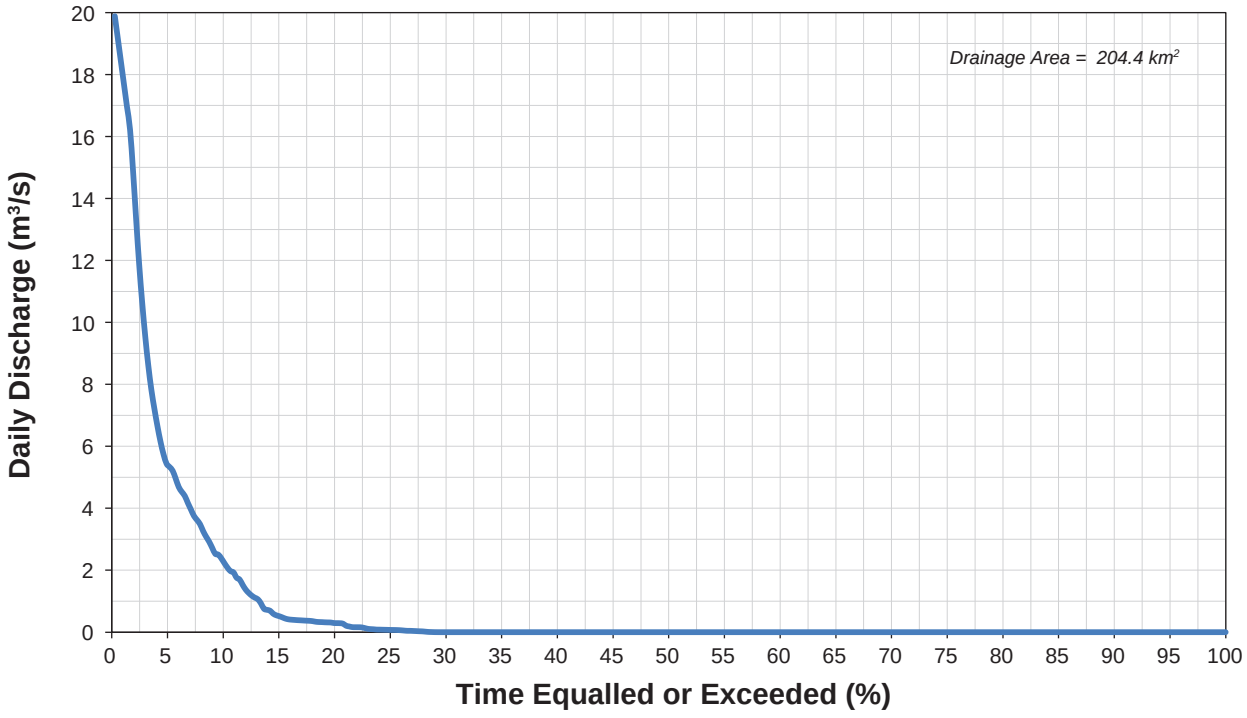
Station GL-H3

Monitoring Period June 7 to September 9, 2012



Station PL-H1

Monitoring Period June 6 to September 8, 2012



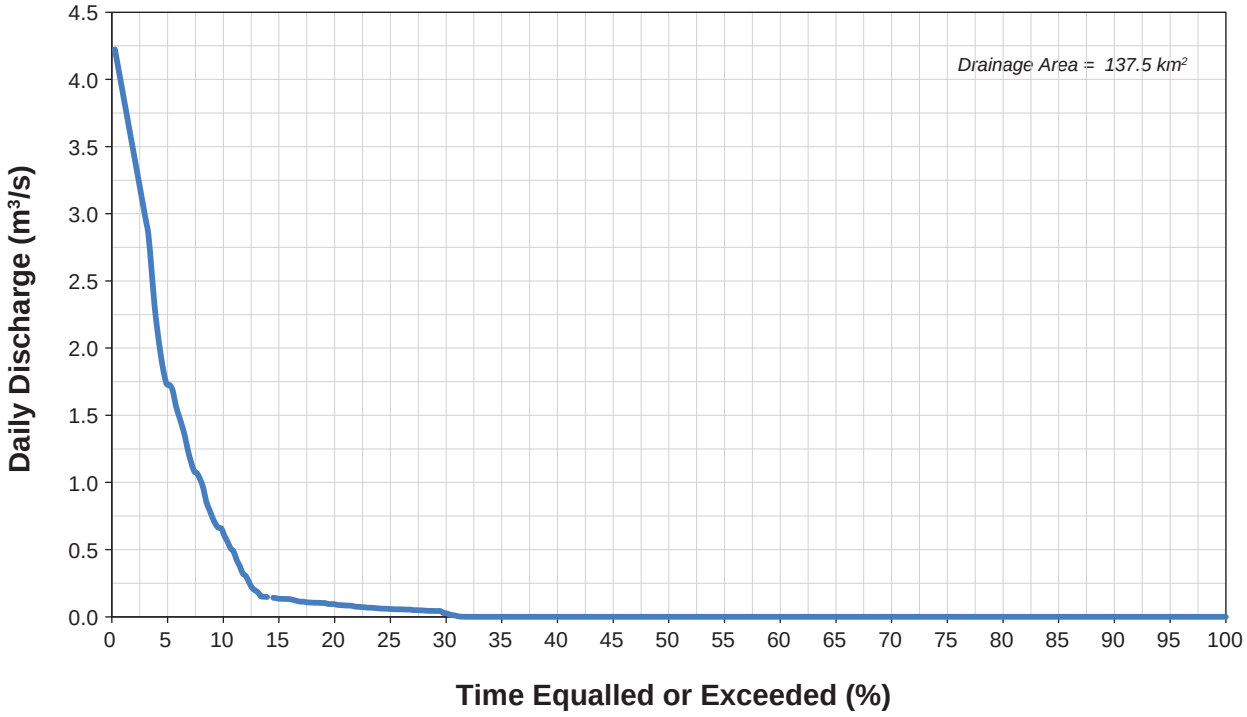
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2012 Flow Duration Curves for Hydrometric Monitoring Stations GL-H3 and PL-H1

Figure 4.5-2

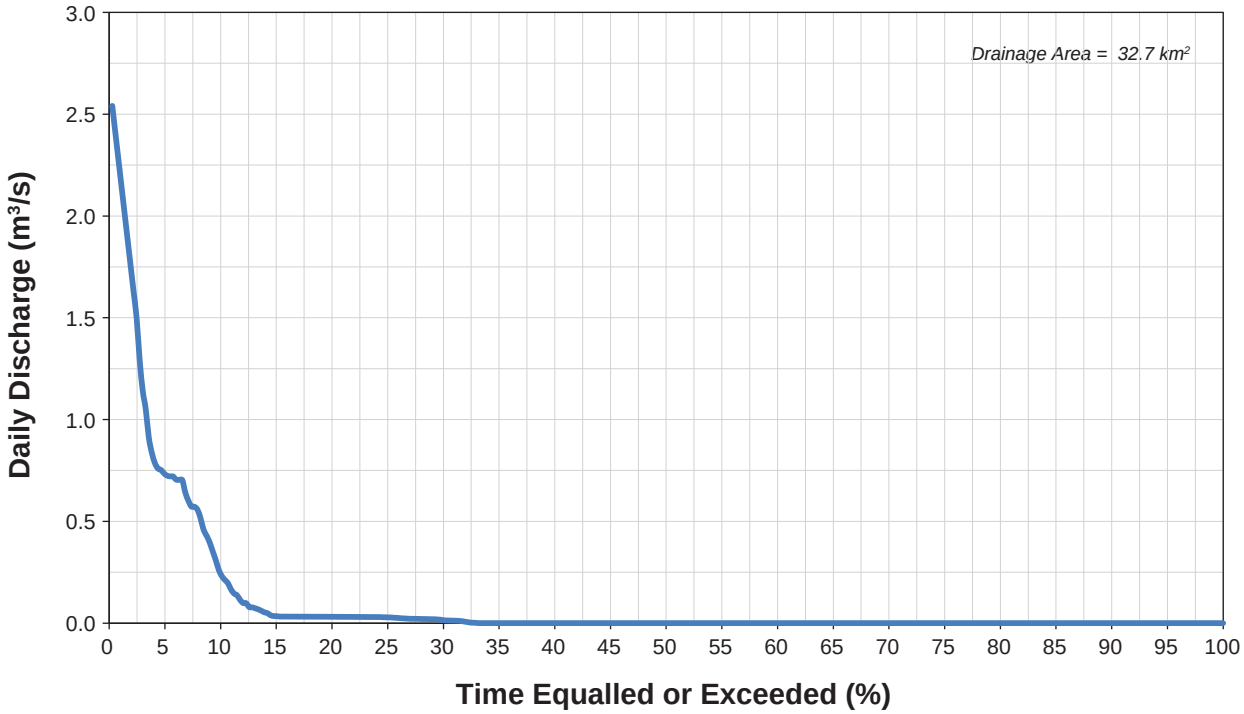
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Station PL-H2



Station GI-H1

Monitoring Period: June 9 to September 14, 2012



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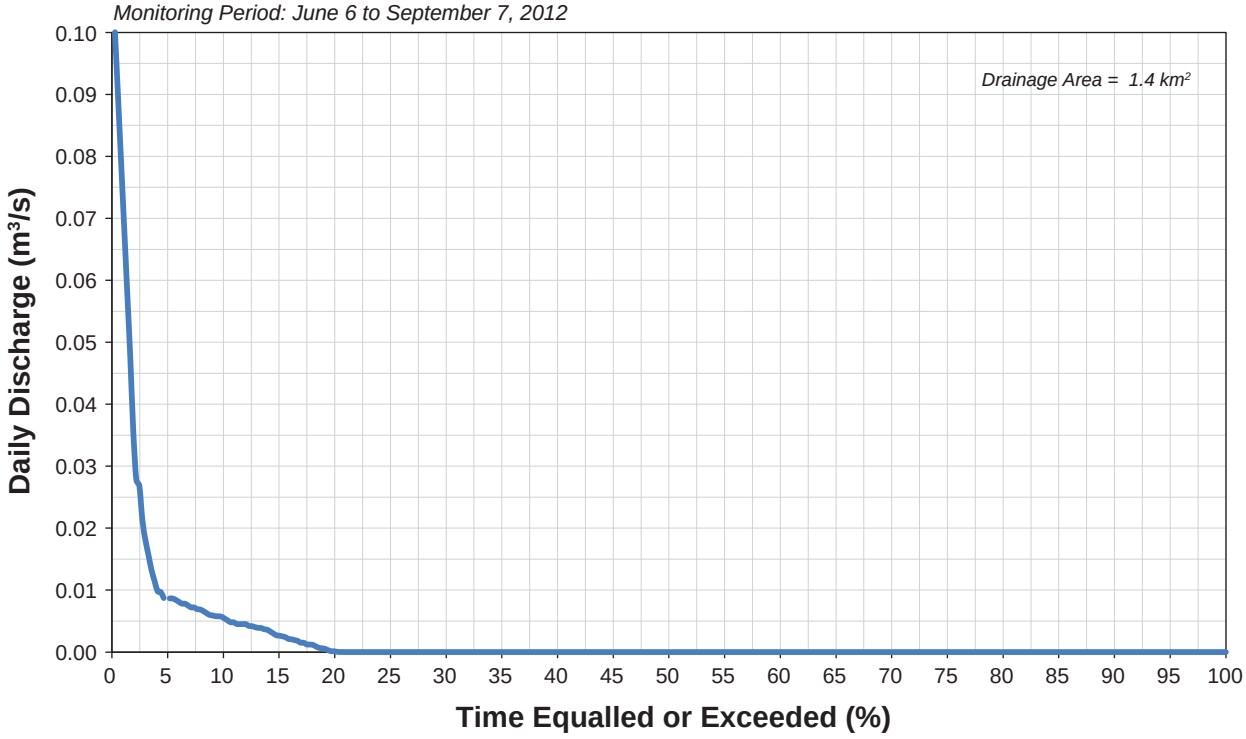
2012 Flow Duration Curves for Hydrometric Monitoring Stations PL-H2 and GI-H1

Figure 4.5-3

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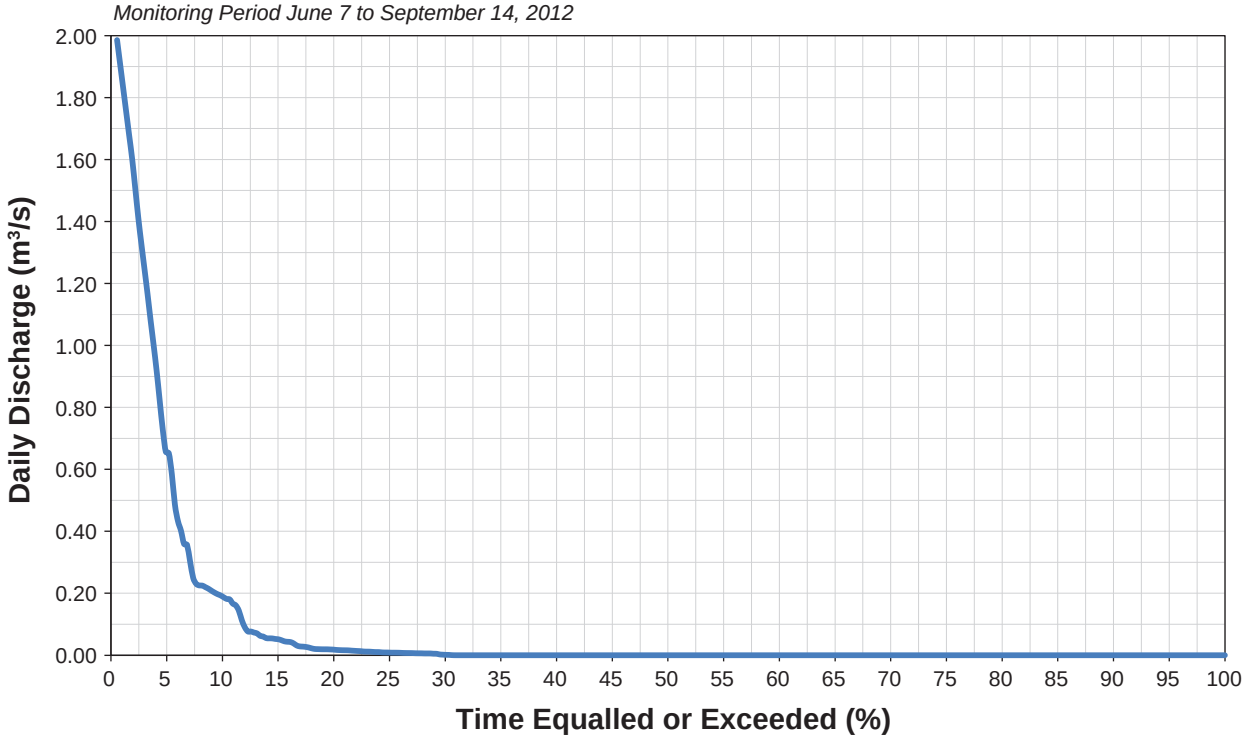
Station EL-H1

Monitoring Period: June 6 to September 7, 2012



Station WL-H1

Monitoring Period June 7 to September 14, 2012



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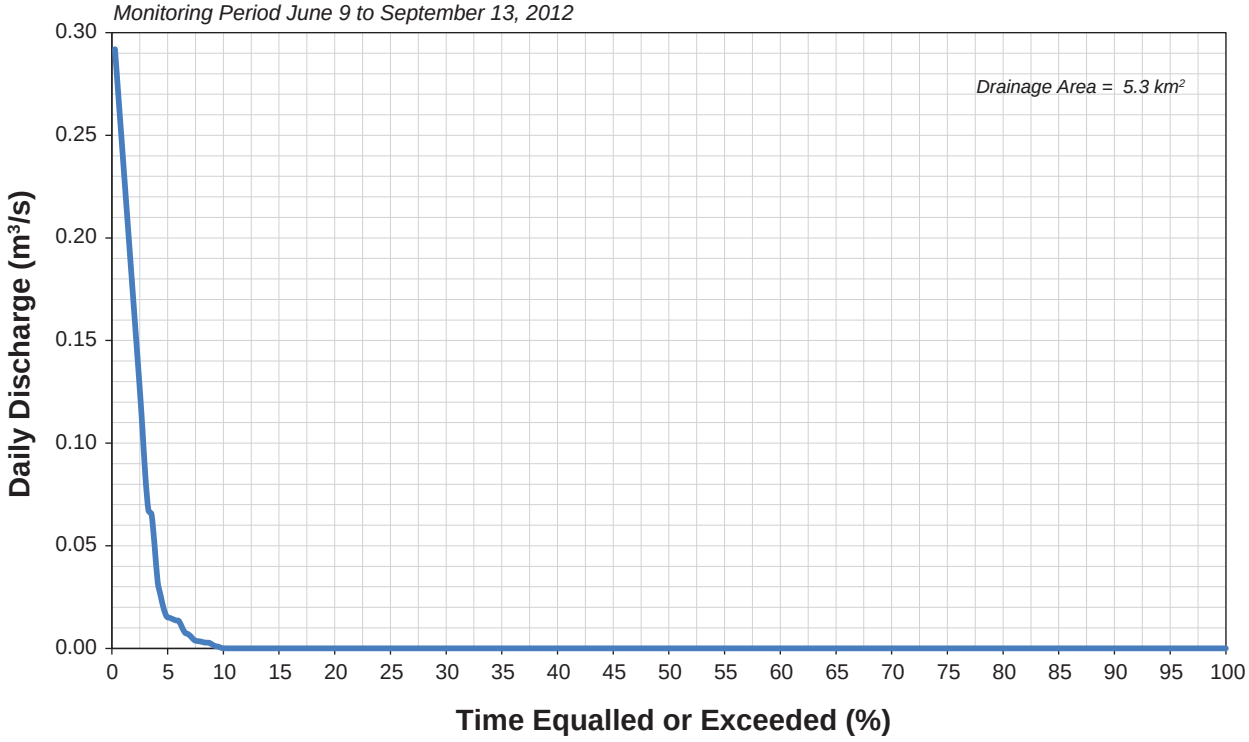
2012 Flow Duration Curves for Hydrometric Monitoring Stations EL-H1 and WL-H1

Figure 4.5-4

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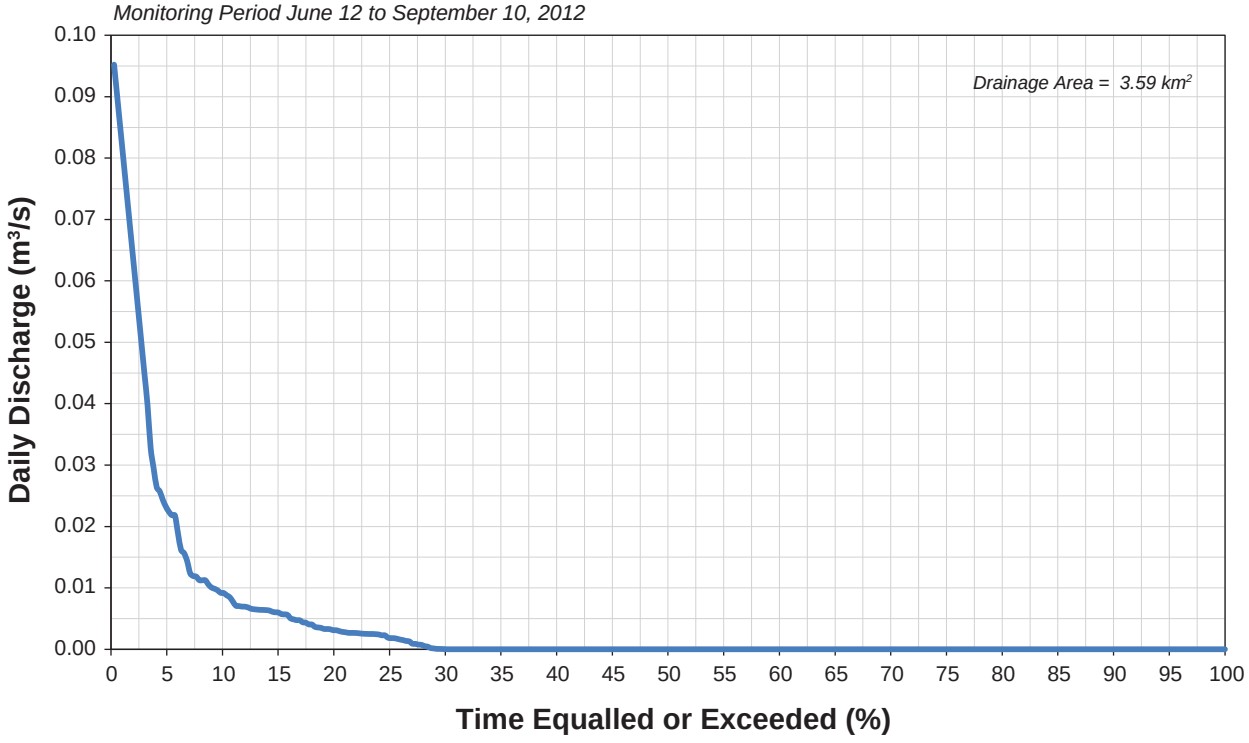
Station REFB-H1

Monitoring Period June 9 to September 13, 2012



Station BL-H1

Monitoring Period June 12 to September 10, 2012



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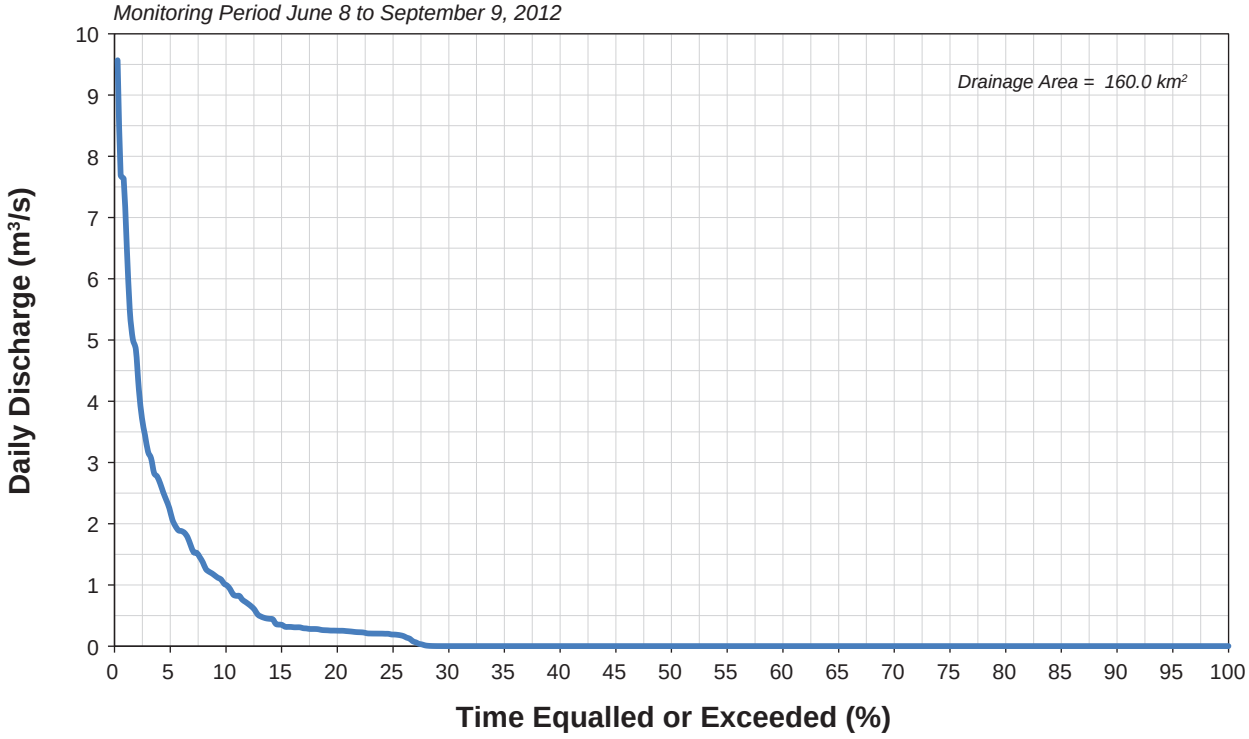
2012 Flow Duration Curves for Hydrometric Monitoring Stations REFB-H1 and BL-H1

Figure 4.5-5

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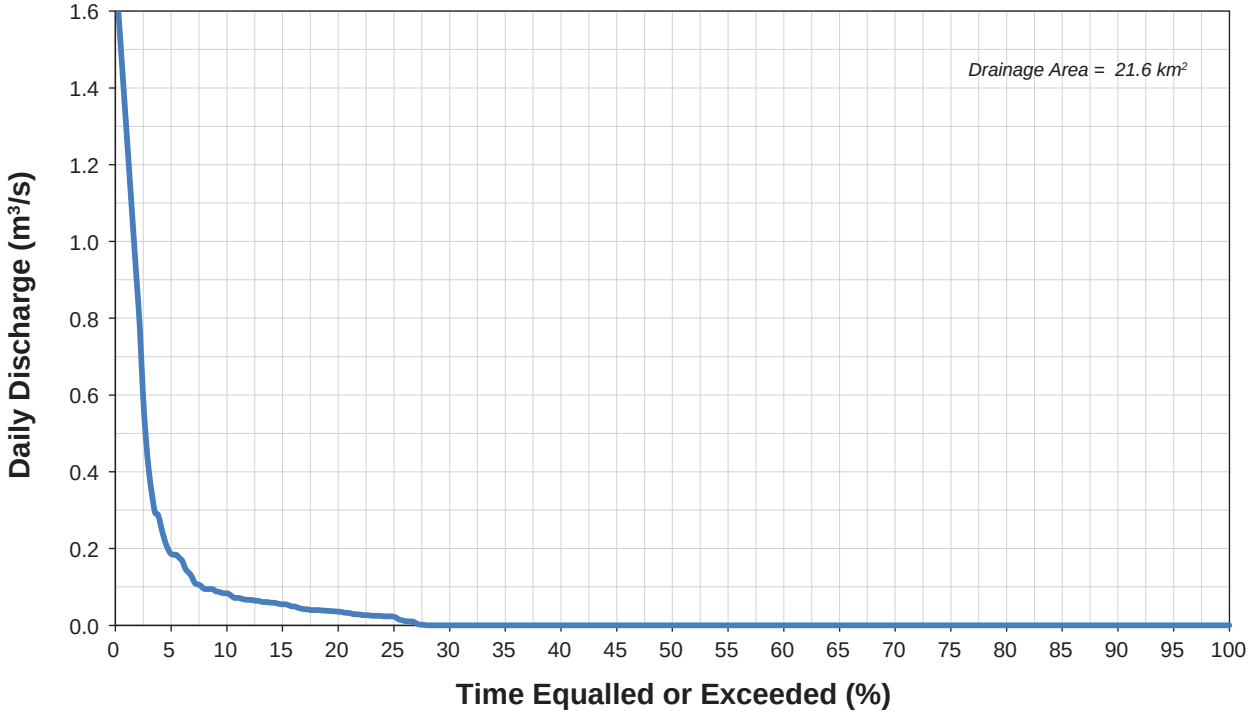
Station BL-H2

Monitoring Period June 8 to September 9, 2012



Station BL-H3

Monitoring Period June 8 to September 9, 2012



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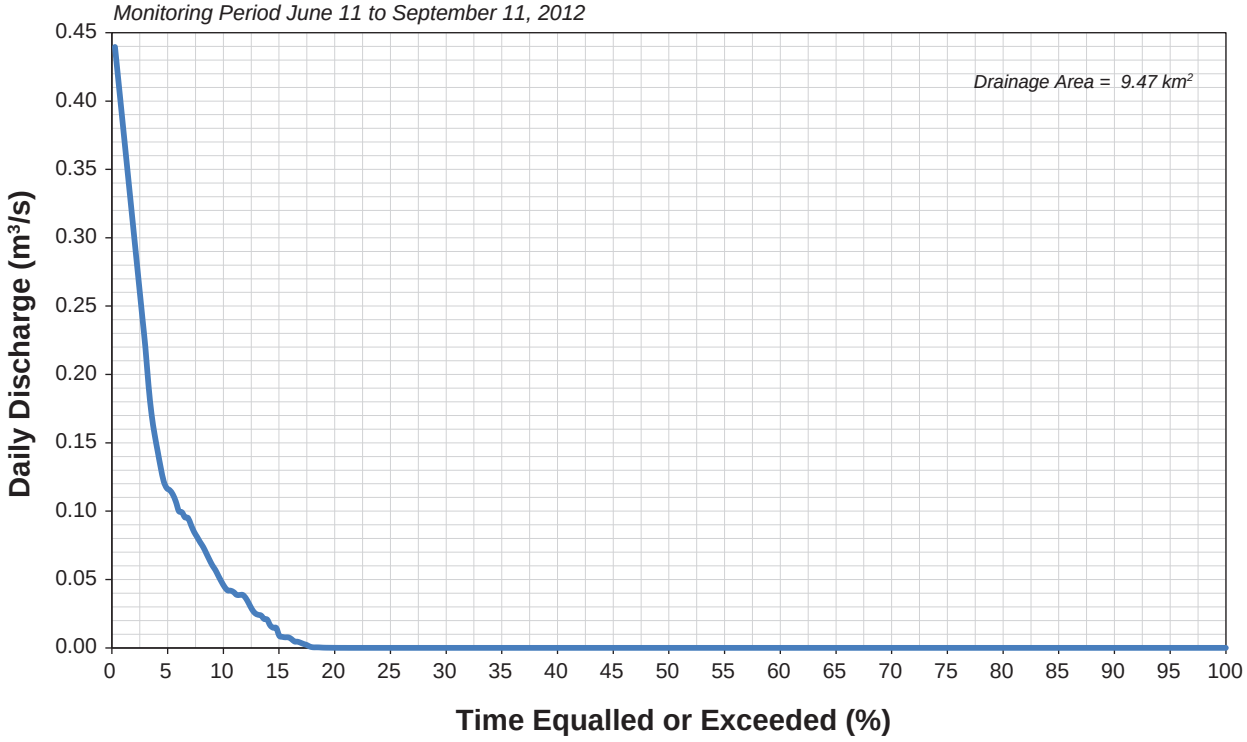
2012 Flow Duration Curves for Hydrometric Monitoring Stations BL-H2 and BL-H3

Figure 4.5-6

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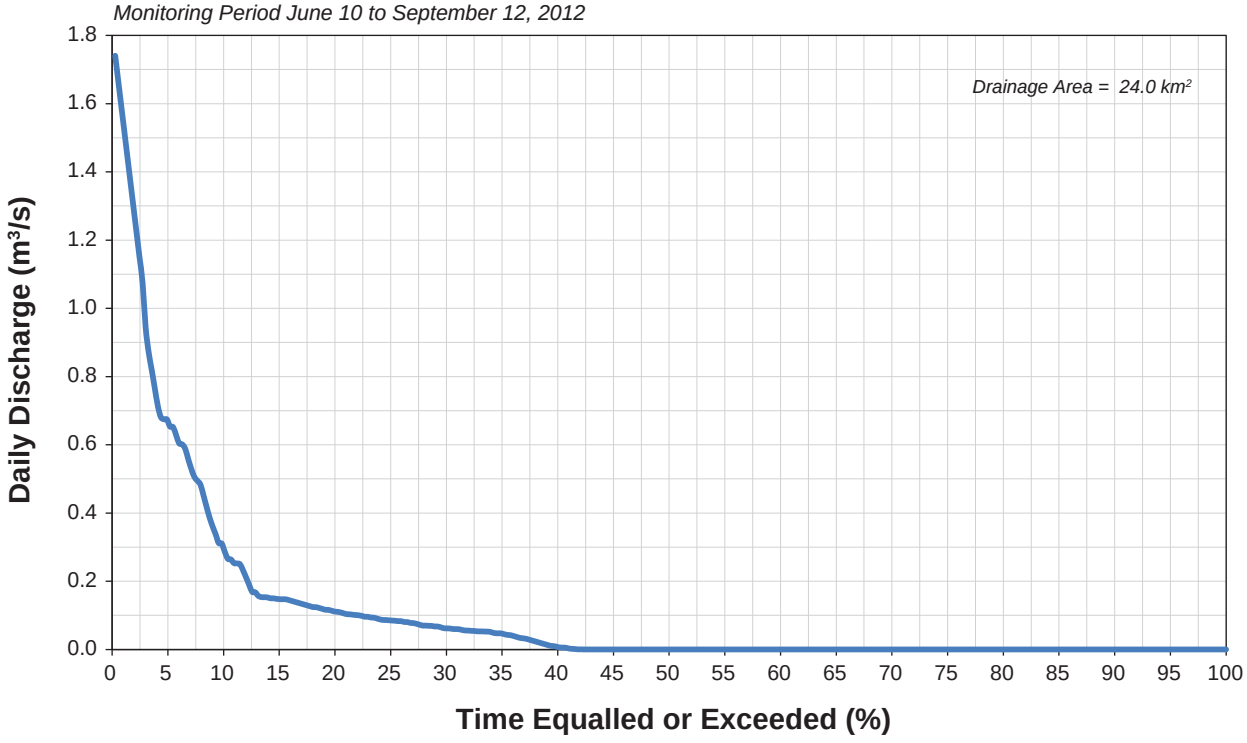
Station REFC-H1

Monitoring Period June 11 to September 11, 2012



Station KL-H1

Monitoring Period June 10 to September 12, 2012

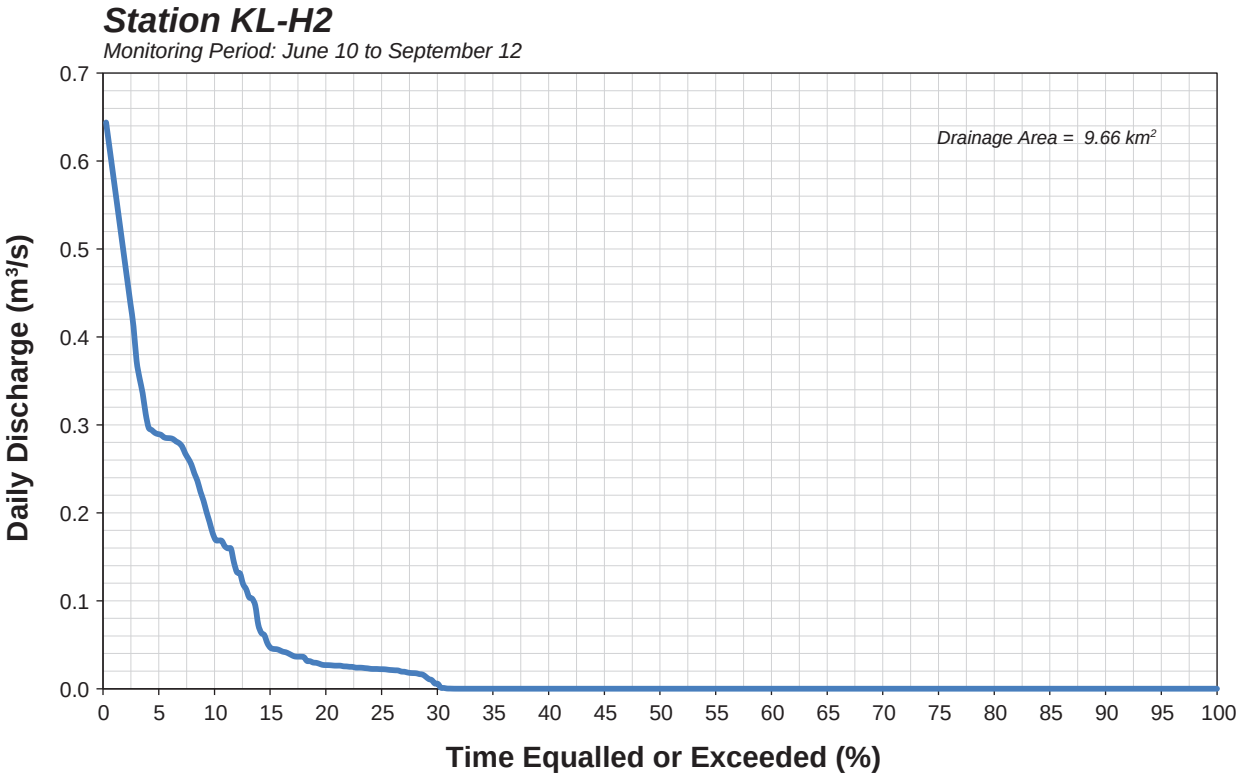


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2012 Flow Duration Curves for Hydrometric Monitoring Stations REFC-H1 and KL-H1

Figure 4.5-7

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2012 Flow Duration Curve for Hydrometric Monitoring Station KL-H2

Figure 4.5-8

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Table 4.5-1. Flow Duration Analysis Exceedance Values and Annual Flow Duration for Stations Located in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	Flow Equalled or Exceeded 5% of the Time (m^3/s)	Flow Equalled or Exceeded 10% of the Time (m^3/s)	Flow Equalled or Exceeded 20% of the Time (m^3/s)	Time of Year with Flow (%)
GL-H1	18.0	0.249	0.072	0.004	28
GL-H2	1.7	0.094	0.023	0.00048	27
GL-H3	1.8	0.043	0.021	0.00001	20
PL-H1	204.4	5.400	2.300	0.295	30
PL-H2	101.5	1.730	0.628	0.094	32
GI-H1	27.4	0.735	0.245	0.031	33
EL-H1	1.4	0.009	0.006	0.001	21
WL-H1	32.7	0.655	0.191	0.018	31
REFB-H1	5.3	0.015	0.0002	0	10
BL-H1	3.59	0.023	0.009	0.003	30
BL-H2	160.0	2.232	0.988	0.251	30
BL-H3	21.4	0.187	0.083	0.035	28

Table 4.5-2. Flow Duration Analysis Exceedance Values and Annual Flow Duration for Stations Located in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Flow Equalled or Exceeded 5% of the Time (m^3/s)	Flow Equalled or Exceeded 10% of the Time (m^3/s)	Flow Equalled or Exceeded 20% of the Time (m^3/s)	Time of Year with Flow (%)
REFC-H1	9.47	0.116	0.046	0	20
KL-H1	24.0	0.674	0.300	0.111	42
KL-H2	9.66	0.289	0.176	0.027	32

4.6 HYDROLOGIC INDICIES

4.6.1 Annual Runoff

For the gauged drainages in the Goose Property area, the estimated 2012 average annual runoff was 99 mm, ranging from 36 mm at BL-H1 to 219 mm at GL-H3. The observed runoff ranged from 16 mm to 166 mm with an average of 64 mm (Table 4.6-1).The estimated annual runoff was significantly higher than the observed runoff at all the stations because most likely the largest peak flows were not recorded.

For the gauged drainages in the George Property area, the estimated 2012 average annual runoff was 116 mm, ranging from 61 mm at REFC-H1 to 143 mm at KL-H1 and KL-H2. The observed runoff ranged from 32 mm to 100 mm with an average of 72 mm (Table 4.6-2). The George Property has higher annual runoff than the Goose Property.

The low runoff at REFB-H1 is likely related to the percent of lake coverage in the basin (19.1%), which acts as a storage reservoir. The relative large storage in the watershed coupled to the low relief topography limit drainage and promotes local ponding of runoff. The potential for hydrological losses through evaporation from this drainage basin is great due to the inputs (snowmelt or rainfall) slowly moving through the system and collecting in lakes or other depressions of the flat topography.

Table 4.6-1. 2012 Annual Runoff and Mean Annual Discharge in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	Observed Runoff (mm)	Period of Record (observed)	Estimated Annual Runoff (mm)	MAD (m^3/s)		% Lake Coverage
					Open Water	Total	
GL-H1	18.0	59	June 5 to September 7	*81*	*0.859*	*0.046*	10.6
GL-H2	1.7	166	June 5 to September 7	*202*	*1.672*	*0.011*	23.1
GL-H3	1.8	105	June 7 to September 9	*219*	*1.815*	*0.013*	7.5
PL-H1	204.4	101	June 6 to September 8	*134*	*1.112*	*0.868*	18.9
PL-H2	101.5	40	June 12 to September 13	*72*	*0.598*	*0.232*	15.1
GI-H1	27.4	76	June 9 to September 14	*126*	*1.043*	*0.109*	13.3
EL-H1	1.4	23	June 7 to September 7	*54*	*0.443*	*0.002*	2.2
WL-H1	32.7	61	June 7 to September 14	*88*	*0.677*	*0.091*	16.6
REFB-H1	5.3	13	June 9 to September 13	*40*	*0.333*	*0.007*	19.1
BL-H1	3.59	16	June 12 to September 10	*36*	*0.249*	*0.004*	2.5
BL-H2	160.0	68	June 8 to September 6	*68*	*0.574*	*0.352*	18.9
BL-H3	21.4	35	June 8 to September 9	*71*	*0.581*	*0.048*	4.7

Note: Estimated values are italicized

Table 4.6-2. 2012 Annual Runoff and Mean Annual Discharge in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Observed Runoff (mm)	Period of Record (observed)	Estimated Annual Runoff (mm)	MAD (m^3/s)		% Lake Coverage
					Open Water	Total	
REFC-H1	9.47	32	June 11 to September 11	*62*	*0.509*	*0.018*	17.0
KL-H1	24.0	84	June 10 to September 12	*143*	*1.124*	*0.109*	19.7
KL-H2	9.66	100	June 10 to September12	*143*	*1.159*	*0.044*	24.6

Note: Estimated values are italicized

The highest runoff values observed at GL-H3 may be a result of the observed snow depths (90 mm) and snow water equivalence (35.3 mm) at this site (see Section 4.7). In the Goose Property area, the average snow depth was 57 cm and the average snow water equivalence was 20.8 cm.

On average, the annual runoff in 2012 was lower than in 2011. At the nine stations that were operated in 2011, the average of the annual runoff was 113 mm in 2012, compared to 170 mm in 2011.

4.6.2 Mean Annual Discharge

Mean annual discharge (MAD) was calculated as an average of the daily discharges for the open water period from the beginning of June through September and for the total year (January to December). For the gauged drainages in the Goose Property area, MAD during the open water season was the lowest at BL-H1 (0.249 m^3/s) and the highest at GL-H3 (1.815 m^3/s), with an average of 0.830 m^3/s (Table 4.6-1). For the gauged drainages in the George Property area, MAD during the open water season was the lowest at REFC-H1 (0.509 m^3/s) and the highest at KL-H2 (1.159 m^3/s), with an average of 0.931 m^3/s (Table 4.6-2).

MAD calculated for the entire year was much lower due to the large portion of the year with zero flow conditions. In the Goose Property area, on average MAD for the full year was 0.148 m^3/s with a minimum of 0.002 m^3/s at EL-H1 and a maximum of 0.868 m^3/s at PL-H1 (Table 4.6-1). In the George

Property area, on average MAD for the full year was 0.148 m^3/s with a minimum of 0.018 m^3/s at REFC-H1 and a maximum of 0.109 m^3/s at KL-H1 (Table 4.6-2).

4.6.3 Seasonal Runoff Distribution

The seasonal runoff distribution was similar for all the gauged drainages in the Project area. In all drainages the maximum monthly runoff occurred in June. Within the Goose Property area, on average over 85% of annual runoff occurred in June, 9% in July, 6% in August and September, and negligible amounts through the remainder of the year (Table 4.6-3, Figure 4.6-1). Within the George Property area, on average over approximately 75% of annual runoff occurred in June, 17% in July, 7% in August and September, and negligible amounts through the remainder of the year (Table 4.6-4 and Figure 4.6-2).

Table 4.6-3. 2012 Monthly Runoff Distribution in the Goose Property Area

Hydrometric Station	Jan-May		June		July		August		September		October		Nov-Dec	
	(mm)	(%)*	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)
GL-H1	0	0	*73*	*90*	8	9	0	0	*0*	*0*	*0*	*0*	*0*	*0*
GL-H2	1	0	*181*	*90*	19	9	0	0	*1*	*0*	*0*	*0*	*0*	*0*
GL-H3	1	0	*202*	*92*	14	6	0	0	*2*	*1*	*0*	*0*	*0*	*0*
PL-H1	0	0	*113*	*84*	18	13	3	2	*0*	*0*	*0*	*0*	*0*	*0*
PL-H2	0	0	*60*	*83*	9	13	1	1	*2*	*3*	*0*	*0*	*0*	*0*
GI-H1	0	0	*108*	*86*	14	11	3	2	*2*	*2*	*0*	*0*	*0*	*0*
EL-H1	1	2	*43*	*80*	0	0	0	0	*10*	*19*	*0*	*0*	*0*	*0*
WL-H1	0	0	*77*	*88*	8	9	1	1	*2*	*2*	*0*	*0*	*0*	*0*
REFB-H1	0	0	*40*	*100*	0	0	0	0	*0*	*0*	*0*	*0*	*0*	*0*
BL-H1	0	1	*28*	*78*	2	6	2	5	*4*	*11*	*0*	*0*	*0*	*0*
BL-H2	0	0	*48*	*71*	15	22	4	6	*1*	*1*	*0*	*0*	*0*	*0*
BL-H3	0	0	*58*	*82*	3	4	4	5	*6*	*8*	*0*	*0*	*0*	*0*

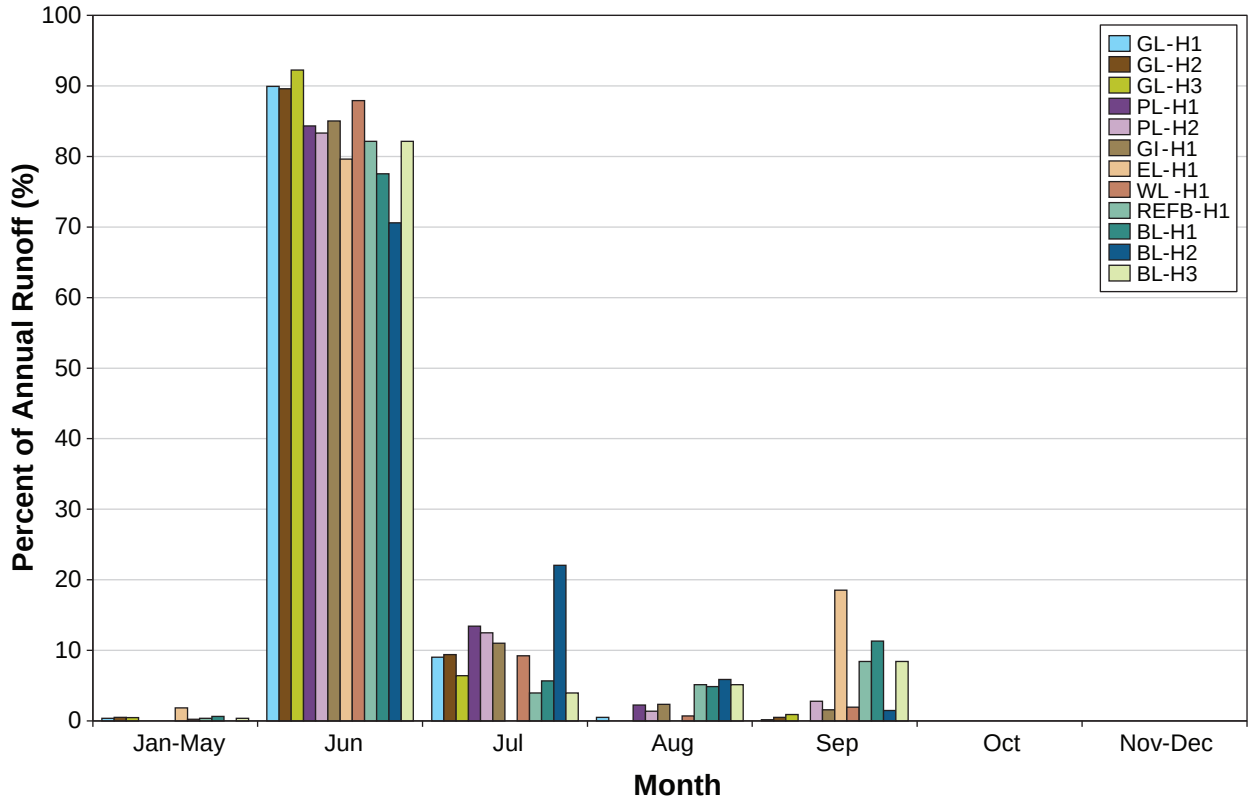
** Monthly or a certain period runoff represented as a percentage of annual runoff.*

Table 4.6-4. 2012 Monthly Runoff Distribution in the George Property Area

Hydrometric Station	Jan- May		June		July		August		September		October		Nov-Dec	
	(mm)	(%)*	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)	(mm)	(%)
REFC-H1	0	0	*53*	*85*	8	13	0	0	*0*	*0*	*0*	*0*	*0*	*0*
KL-H1	0	0	*97*	*68*	21	15	5	3	*13*	*9*	*7*	*5*	*0*	*0*
KL-H2	0	0	*98*	*69*	33	23	6	4	*5*	*4*	*0*	*0*	*0*	*0*

** Monthly or a certain period runoff represented as a percentage of annual runoff.*

Compared to last year, this year more annual runoff was concentrated in June. At the nine stations that were operated in 2011, 88% of annual runoff in 2012 occurred in June, while only 50% of annual runoff in 2011 occurred in June.

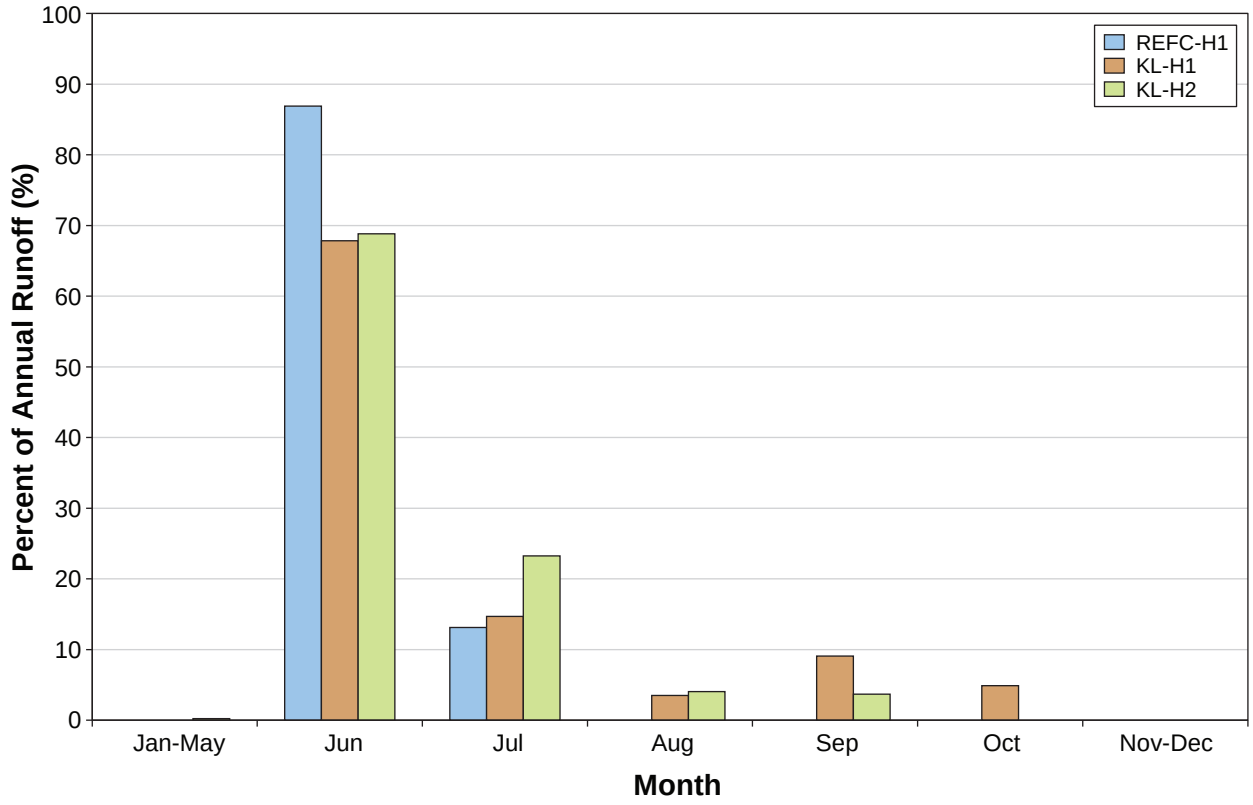


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Monthly Runoff Distribution - Goose Property Area

Figure 4.6-1

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Monthly Runoff Distribution - George Property Area

Figure 4.6-2

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4.6.4 Annual Peak and Low Flow

Peak flows for most basins in the Project area occurred in late May or early June. In the Goose Property area, instantaneous peak flows ranged from 0.130 m^3/s at BL-H1 to 21.9 m^3/s at PL-H1, while daily peak flows ranged from 0.0952 to 19.9 m^3/s (Table 4.6-5). In the George Property area, instantaneous peak flows ranged from 0.569 m^3/s at REFC-H1 to 9.82 m^3/s at KL-H2, while daily peak flows ranged from 0.440 m^3/s to 1.74 m^3/s (Table 4.6-6). Both instantaneous and daily peak flows of all stations except BL-H2 were assumed to occur on June 2.

Table 4.6-5. 2012 Peak Flows and Peak Unit Yields in the Goose Proper Area

Hydrometric Station	Drainage Area (km^2)	Peak Flow (m^3/s)			Peak Unit Yield ($L/s/km^2$)	
		Instantaneous	Daily	Date	Instantaneous	Daily
GL-H1	18.0	*1.56*	*1.51*	*June 2*	*86.7*	*83.9*
GL-H2	1.7	*0.221*	*0.217*	*June 2*	*130.0*	*127.7*
GL-H3	1.8	*0.633*	*0.516*	*June 2*	*351.7*	*286.7*
PL-H1	204.4	*21.9*	*19.9*	*June 2*	*107.4*	*97.3*
PL-H2	101.5	*5.25*	*4.22*	*June 2*	*51.7*	*41.6*
GI-H1	27.4	*2.94*	*2.54*	*June 2*	*107.1*	*92.7*
EL-H1	1.4	*0.148*	*0.100*	*June 2*	*105.9*	*71.5*
WL-H1	32.7	*2.29*	*2.06*	*June 2*	*70*	*63.0*
REFB-H1	5.3	*0.350*	*0.292*	*June 2*	*66.0*	*55.1*
BL-H1	3.59	*0.130*	*0.0952*	*June 2*	*36.2*	*26.5*
BL-H2	160.0	*11.1*	*9.57*	*June 9*	*69.4*	*59.8*
BL-H3	21.4	*2.08*	*1.59*	*June 2*	*97.2*	*74.3*

Note: Estimated values are italicized

Table 4.6-6. 2012 Peak Flows and Peak Unit Yields in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Peak Flow (m^3/s)			Peak Unit Yield ($L/s/km^2$)	
		Instantaneous	Daily	Date	Instantaneous	Daily
REFC-H1	9.47	*0.569*	*0.440*	*June 2*	*60.1*	*46.6*
KL-H1	24.0	*2.16*	*1.74*	*June 2*	*89.9*	*72.5*
KL-H2	9.66	*0.728*	*0.644*	*June 2*	*75.4*	*66.7*

Note: Estimated values are italicized

In the Goose Property area, instantaneous peak unit yields were at a minimum of 36.2 $L/s/km^2$ at BL-H1 and at a maximum of 351.7 $L/s/km^2$ at GL-H3 (Table 4.6-5). In the George Property area, instantaneous peak unit yields were at a minimum of 60.1 $L/s/km^2$ at REFC-H1 and at a maximum of 89.9 $L/s/km^2$ at KH-H1 (Table 4.6-6). The largest peak unit yields were at the station GL-H3. This is likely due to deepest snow pack depth and snow water equivalence.

Annual low flows are expected to reach zero in all the basins once freeze-up occurs, and zero flow conditions will last throughout the winter months (approximately October to May). The observed low flows are those that occurred during the 2012 period of record from early June to mid-September (Table 4.6-7 and 8). Observed low flows for the majority of basins in the Project area occurred in early August. Most streams except the streams monitored by the hydrometric stations GI-H1, WL-H1, and BL-H2 experienced zero or extreme low flow conditions during the open water period. Zero flow

conditions on the streams monitored by stations GL-H1, GL-H3, PL-H1, REFB-H1 and REFC-H1 continued up until early September.

Table 4.6-7. 2012 Observed Daily Minimum Flows (June through September) in the Goose Property Area

Hydrometric Station	Drainage Area (km^2)	Daily minimum Flow (m^3/s)	Date
GL-H1	14.0	0	August 16 – September 6
GL-H2	1.7	<0.001	August 20 - 29
GL-H3	1.8	0*	July 19 – September 5
PL-H1	204.4	<0.0002	September 3 - 6
PL-H2	101.5	<0.001	August 6 - 7
GI-H1	27.4	0.011	August 8
EL-H1	1.4	0*	July 3 – August 31
WL-H1	35.1	0.001	August 6-9
REFB-H1	5.3	0*	July 23 – September 13
BL-H1	4.28	0	July 29 August 9
BL-H2	160.0	0.176	August 26
BL-H3	21.6	0	July 21 – August 9

** Dry channel conditions between the indicated dates.*

Table 4.6-8. 2012 Observed Daily Minimum Flows (June through September) in the George Property Area

Hydrometric Station	Drainage Area (km^2)	Daily minimum Flow (m^3/s)	Date
REFC-H1	9.47	0	August 22 – September 11
KL-H1	24.0	0	July 30 – August 9
KL-H2	9.82	0	August 2-4

** Dry channel conditions between the indicated dates.*

4.7 SNOW COURSE SURVEYS

Tables 4.7-1 and 4.7-2 summarize snow depth, snow water equivalent (SWE) and snow density on the twelve Back River Project snow courses. The snow course field data sheets are included in Appendix 6.

Table 4.7-1. 2012 Snow Course Survey Summary - Goose Property Area

Station ID	Station Location	Date	Snow Depth (cm)	SWE (cm)	Snow Density (%)
SC-01	PL-H1 drainage	April 25	36	12.1	34
SC-02	BL-H2 drainage	April 21	53	20.2	37
SC-03	BL-H3 drainage	April 24	46	15.5	34
SC-04	GL-H2 drainage	April 21	51	17.4	33
SC-05	PL-H2 drainage	April 24	48	15.7	33
SC-06	REFB-H1 drainage	April 23	56	19.2	34
SC-07	South of WL-H1 drainage	April 23	79	30.8	39
SC-08	GL-H3 drainage	April 25	90	35.3	38
Mean			**57**	**20.8**	**35**

Table 4.7-2. 2012 Snow Course Survey Summary - George Property Area

Station ID	Station Location	Date	Snow Depth (cm)	SWE (cm)	Snow Density (%)
SC-09	KL-H2 drainage (North of George Lake)	April 20	33	13.5	41
SC-10	KL-H2 drainage (South of George Lake)	April 20	85	24	28
SC-11	KL-H1 drainage	April 22	33	12.2	37
SC-12	Dragon Lake drainage	April 22	50	19.9	40
Mean			**50**	**17.4**	**36**

On the Goose Property, the highest recorded SWE value was 35.3 cm on snow course SC-08 near hydrometric station GL-H3 and the lowest recorded SWE was 12.1 cm on snow course SC-01 near hydrometric station PL-H1. On the George Property, the highest recorded SWE was 24 cm on snow course SC-10 near hydrometric station KL-H2 and the lowest recorded SWE value was 12.2 cm on snow course SC-11 near hydrometric station KL-H1.

Snow density is a measure of the compactness of the snowpack. The sampling that was performed in mid-April was intended to catch the peak snow pack. On the Goose Property, recorded snow densities varied between 33% and 37%. On the George Property, recorded snow densities varied between 28% and 41%.

5. Summary

5. Summary

The 2012 hydrology program included two networks that encompassed both the Goose and George Properties. The network in the Goose Property area was comprised of the nine stations from 2011 and three new stations to monitor a total drainage area of 391.3 km^2, including a reference drainage area of 5.3 km^2. The network in the George Property area was comprised of three new stations to monitor a total drainage area of 33.47 km^2, including a reference drainage area of 9.47 km^2.

The hydrometric network was operated through the open water season from June 5, 2012 to September 14, 2012. During this time period, continuous time series water level (stage) data were collected at each station and a total of 82 manual discharge measurements were completed. Based on the stage and discharge data collected, stage-discharge rating equations were determined and annual hydrographs produced.

The annual hydrographs show that basins within the Project area have an Arctic nival hydrologic regime characterized by snowmelt-driven high flows during the spring freshet and no flows during the winter. In 2012 one prominent snowmelt-driven high flow event was observed in late May to mid-June in most basins. After this high flow, discharge steadily decreased throughout the Project area until mid-August. Only one minor rainfall-driven flow occurred in early September.

Peak flows varied substantially between gauged streams. Instantaneous peak flows in the Goose Property area ranged from 0.130 m^3/s at the hydrometric station BL-H1 (Big Lake inflow) to 21.9 m^3/s at the station PL-H1 (Propellor Drainage outflow). Instantaneous peak flows in the George Property area ranged from 0.569 m^3/s at the hydrometric station REFC-H1 (Reference Lake inflow) to 2.16 m^3/s at the station KL-H1 (Komatic Lake outflow).

Volumetric outflows from each of the monitored drainages were generally found to be a function of drainage area. In the Goose Property area, the minimum volumetric outflows were observed at EL-H1 (Echo Drainage outflow; drainage area = 1.4 km^2) which had a total annual water output of 0.08 million m^3. The maximum annual volumetric output was 27.39 million m^3 at PL-H1 (Propellor Drainage outflow; drainage area = 204.4 km^2). In the George Property area, the minimum volumetric outflows were observed at REFC-H1 (drainage area = 9.47 km^2) which had a total annual water output of 0.59 million m^3. The maximum annual volumetric output was 3.43 million m^3 at KL-H1 (drainage area = 24.0 km^2).

The calculated peak unit yields varied among the monitored drainages, generally increasing as drainage area decreased. Daily peak unit yields in the Goose Property area were at a minimum of 26.5 $L/s/km^2$ at BL-H1 (Big Lake inflow) and at a maximum of 286.7 $L/s/km^2$ at GL-H3 (Goose Lake inflow). Daily peak unit yields in the George Property area were at a minimum of 44.6 $L/s/km^2$ at REFCL-H1 (Reference lake C outflow) and at a maximum of 72.5 $L/s/km^2$ at KL-H1 (Komatic Lake inflow).

Average annual runoff was 99 mm for the Goose Property area and 116 mm for the George Property area. Annual Runoff in the Goose Property area varied between drainages from a minimum of 36 mm at BL-H1 (Big Lake inflow) to a maximum of 219 mm at GL-H3 (Goose Lake inflow); annual Runoff in the George Property area varied between drainages from a minimum of 62 mm at REFC-H1 (Reference Lake C outflow) to a maximum of 143 mm at KL-H1 (Komatic Lake inflow).

In all drainages the maximum monthly runoff occurred in June. In the Goose Property area, approximately 85% of annual runoff occurred in June, 9% in July, 6% in August and September, and negligible amounts through the remainder of the year. In the George Property area, approximately 74% of runoff occurred in June, 17% in July, 7% in August and September, and negligible amounts through the remainder of the year.

All monitored streams can be considered either intermittent or ephemeral. The majority are considered intermittent (seasonal) with zero flow in the winter when they freeze to their bed. On average the monitored streams flowed for 27% of the year in the Goose Property area and for 31% of the year in the George Property area, and they were either frozen or dry for the remainder of the year.

Snow depth, snow water equivalent, and snow density were surveyed on twelve snow courses, nine on the Goose Property and four on the George Property. The recorded SWE values varied from 12.1 cm to 35.3 cm on the Goose Property and from 12.2 cm to 24 cm on the George Property. The recorded snow densities varied from 33% to 37% on the Goose Property area and from 28% to 41% on the George Property area.

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Engineers and Scientists

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Appendix 1

Hydrometric Monitoring Station Information

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Appendix 1.1. Station Information Sheet for Hydrometric Station GL-H1

Site ID:	GL-H1	**Drainage Area (km^2):**	14.0
Site Location:	Near the mouth of the southwestern inflow to Goose Lake		
UTM:	NAD 83, Zone 13W	430,772 E	7,270,016 N

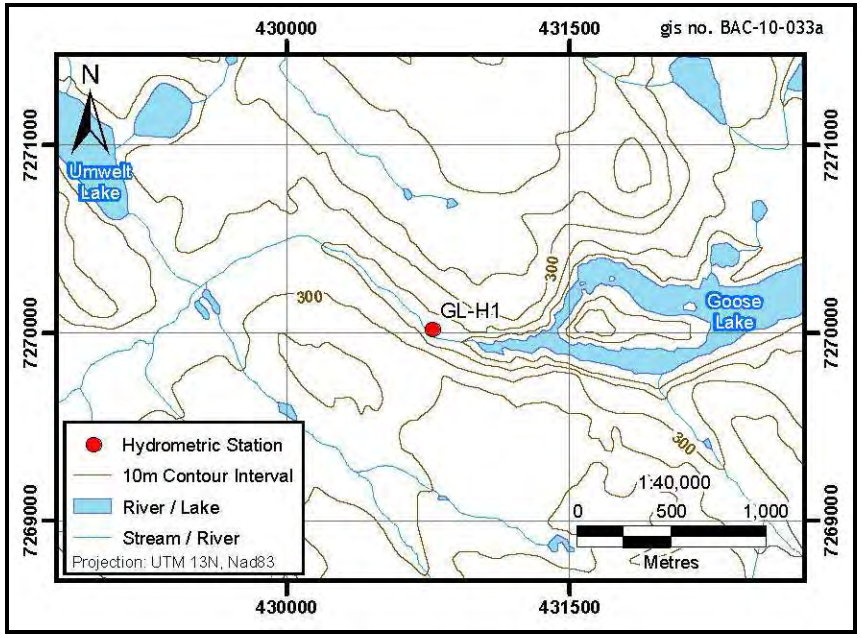
Benchmarks	**Elevation (m)**	**Description**
BM3	100.000	Bolt on left bank upstream of the station
BM4	100.217	Rebar on left bank downstream of the station
BM5	100.526	Rebar on left bank at the data logger box

Transducer:	PS-98i	**Logger:**	ELF-2

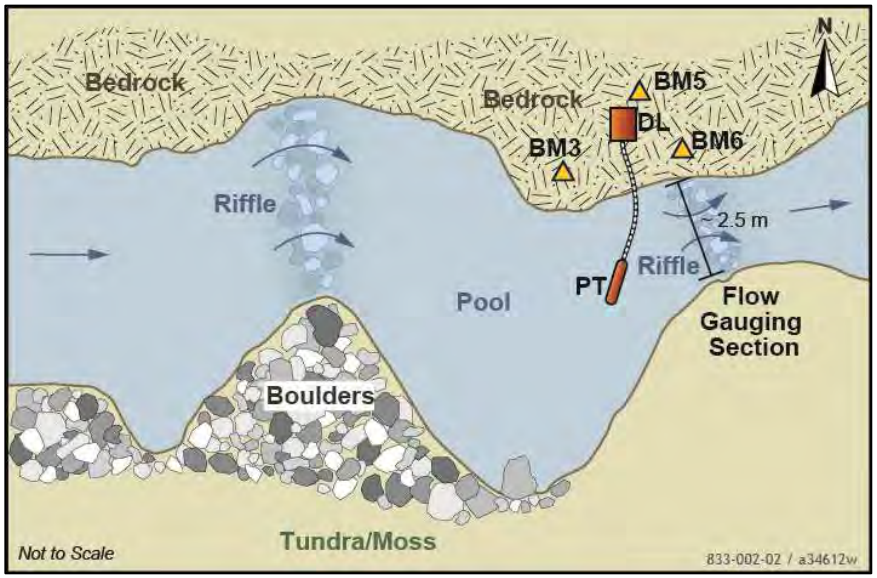
Operating Periods:		
2010	June 10- Sep 16	Established June 16, 2010
2011	June 10- Sep 16	
2012	June 5 – Sep 7	

General Comments:

- Location previously established and monitored from 2007 to 2009 as D32 by Gartner Lee.
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter



Site Map



Plan View of Hydrometric Station GL-H1



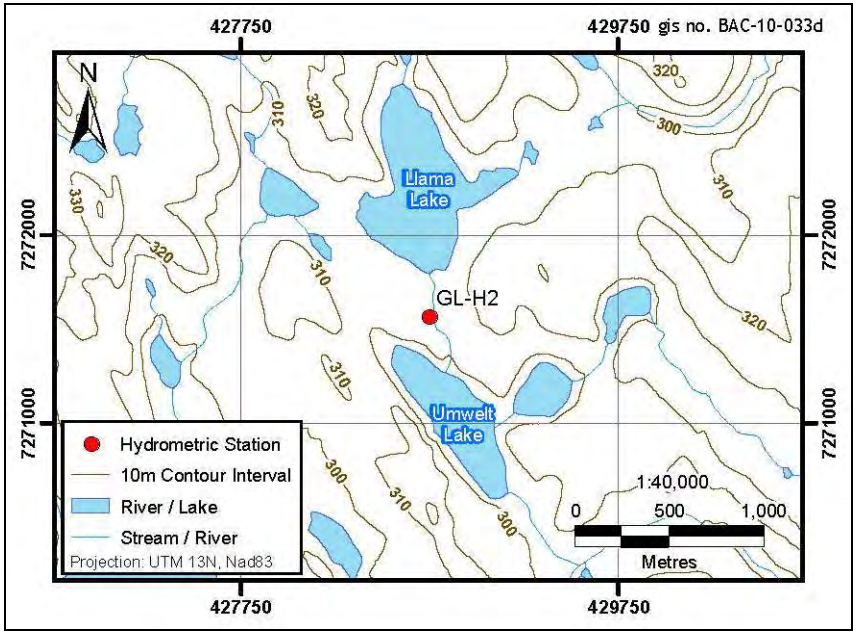
Low angle view looking across the channel and downstream. The enclosure for the data logger can be seen on the left bank. June 5, 2012.

Site Photo

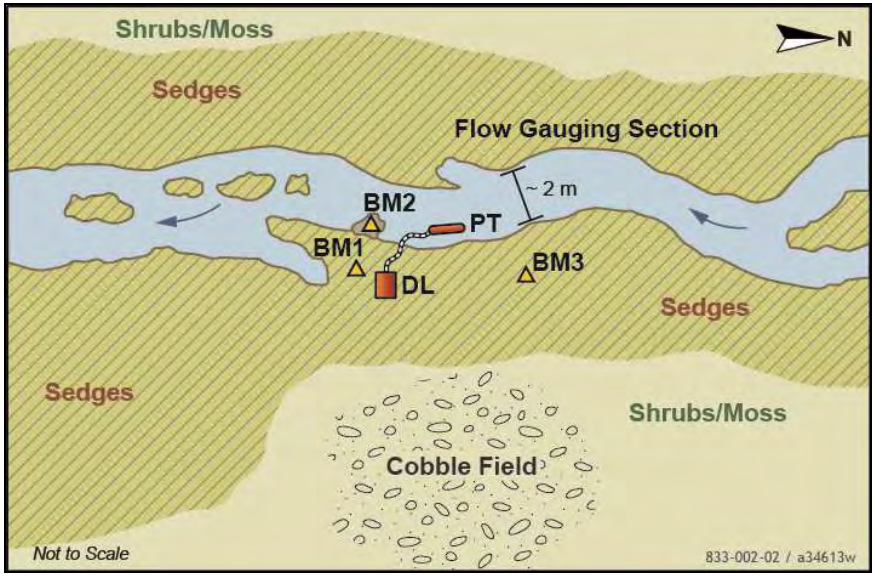
Appendix 1.2. Station Information Sheet for Hydrometric Station GL-H2

Site ID:	GL-H2	**Drainage Area (km^2):**	1.7
Site Location:	Llama Lake outflow		
UTM:	NAD 83, Zone 13W	428,746 E	7,271,567 N
Benchmarks	**Elevation (m)**	**Description**	
BM1	100.000	Bolt at base of DL enclosure box	
BM2	99.746	Bolt in boulder embedded in LB	
BM3	99.781	Bolt in buried boulder ~5m upstream of station	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2010	July 06- Sept 29	Established June 16, 2010	
2011	June 10 – Sept 16		
2012	June 5 – Sept 7		
General Comments:			

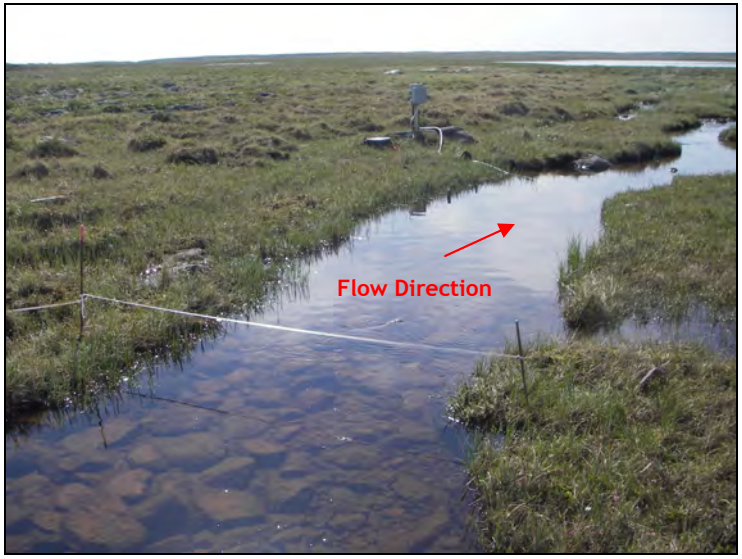
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter



Site Map



Plan View of Hydrometric Station GL-H2



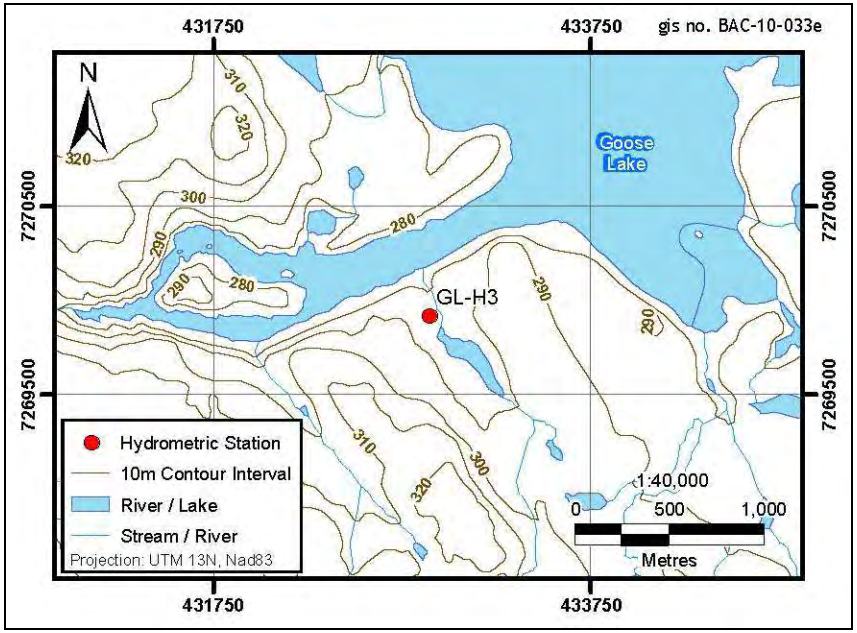
Low angle view looking downstream to the south along the monitored stream reach. July 6, 2012.

Site Photo

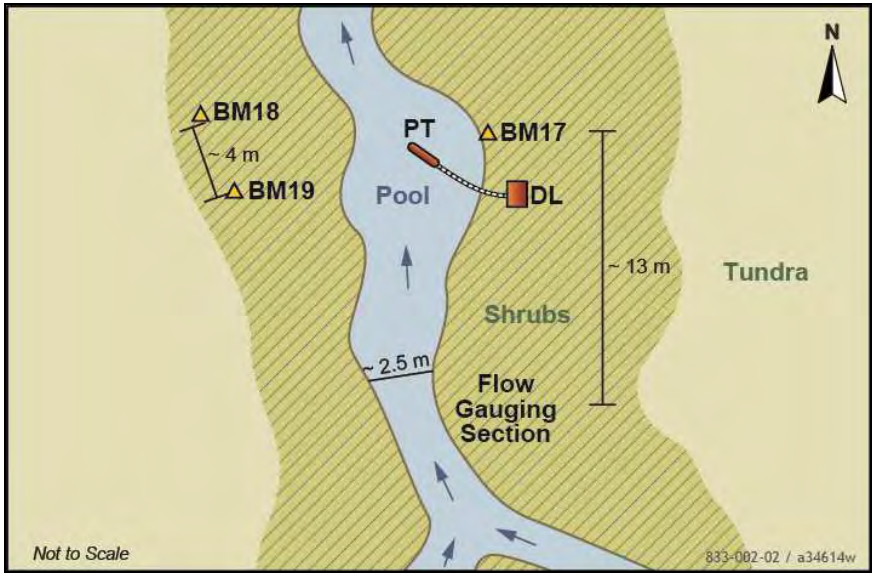
Appendix 1.3. Station Information Sheet for Hydrometric Station GL-H3

Site ID:	GL-H3	**Drainage Area (km^2):**	1.8
Site Location:	Near the mouth of a small inflow to the West arm of Goose Lake		
UTM:	NAD 83, Zone 13W	432,891 E	7,269,919 N
Benchmarks	**Elevation (m)**	**Description**	
BM17	100.00	Bolt on right bank downstream of the station	
BM18	100.153	Bolt on left bank downstream of the station	
BM19	100.053	Bolt on left bank even with the station	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June 14 - Sep 16	Established June 16, 2011	
2012	June 7 - Sep 9		
General Comments:			

- Zero flow during summer low flow period
- Wadeable under all conditions
- Bench marks marked with rebar stakes for locating
- Access by helicopter or on foot from camp

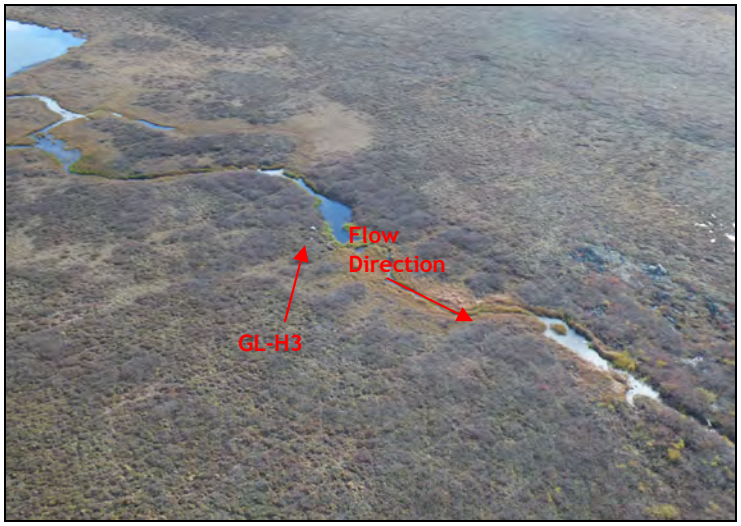


Site Map



Plan View of Hydrometric Station GL-H3

General Site Information



High Angle oblique view of the monitored stream reach. September 9, 2012.

Site Photo

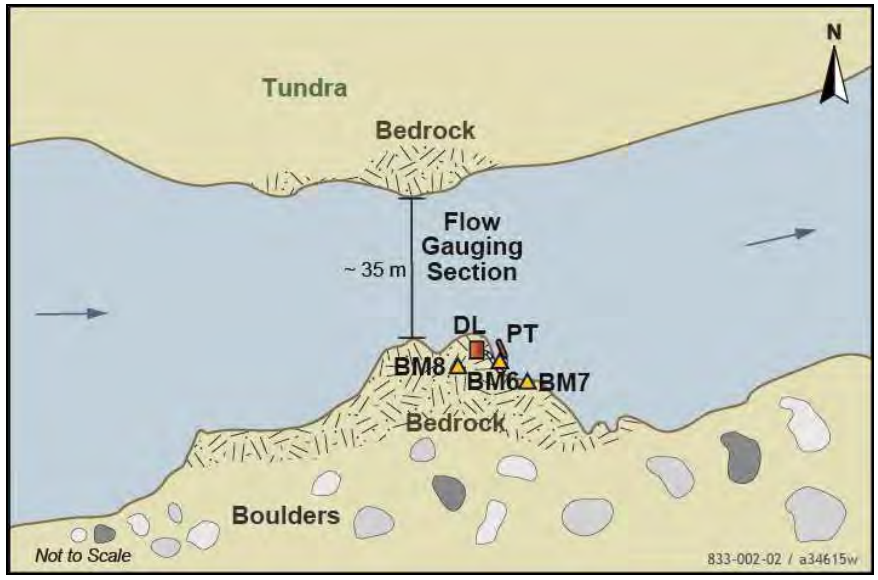
Appendix 1.4. Station Information Sheet for Hydrometric Station PL-H1

Site ID:	PL-H1	**Drainage Area (km^2):**	204.4
Site Location:	Downstream from Propellor Lake outflow		
UTM:	NAD 83, Zone 13W	436,094 E	7,279,939 N
Benchmarks	**Elevation (m)**	**Description**	
BM8	100.00	Bolt upstream from station	
BM7	99.538	Bolt downstream from station	
BM6	99.601	Bolt near station	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June14 - Sep 17	Established June 14, 2011	
2012	June 6 - Sep 8		

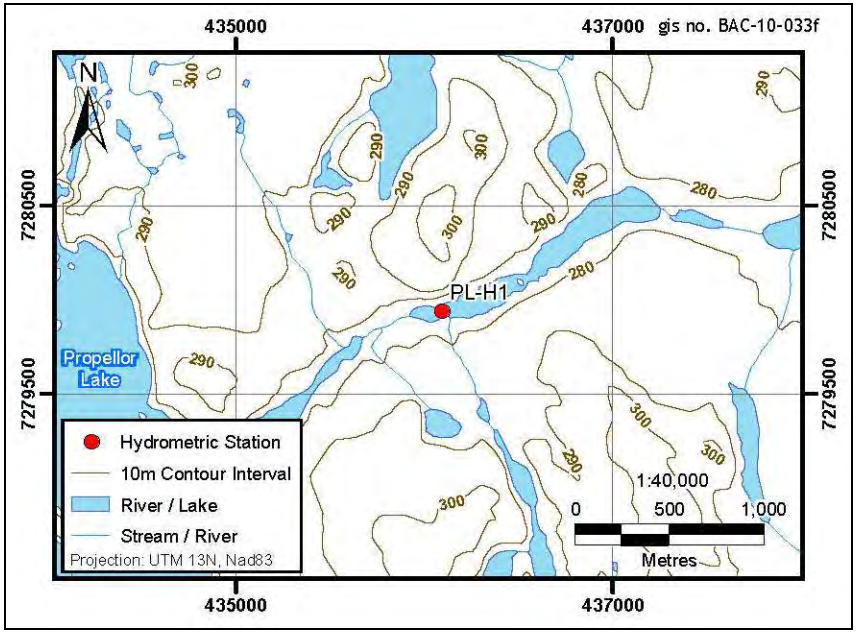
General Comments:

- Boat required to cross channel
- Deep but relatively low velocity reach
- Not wadeable under any conditions
- Access by helicopter
- Under 2012 August and September 2012 low flow conditions, manual flow measurement taken 400 m upstream of station.

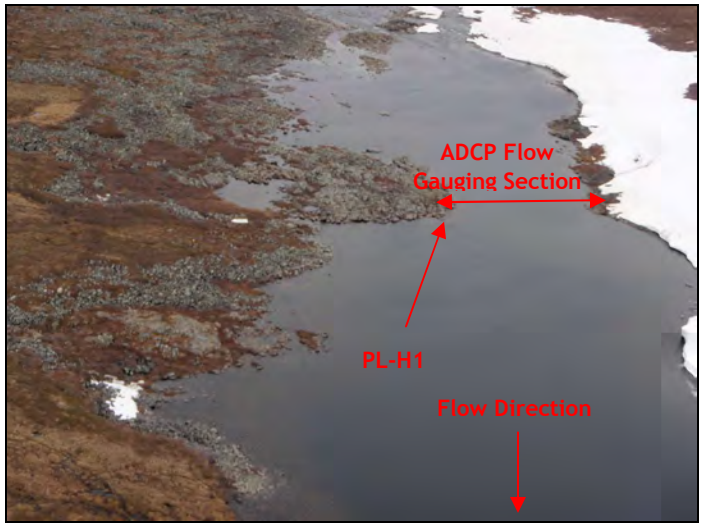
General Site Information



Plan View of Hydrometric Station PL-H1



Site Map



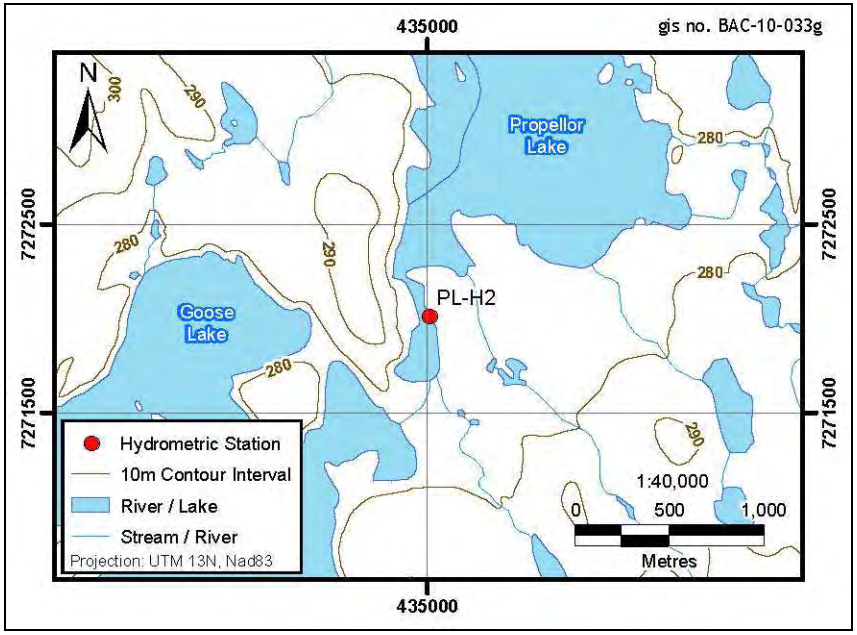
High angle view looking upstream towards station PL-H1 and the monitored reach. At low flow (Aug., Sep.) manual measurement was taken 400 m further upstream. June 14, 2012.

Site Photo

Appendix 1.5. Station Information Sheet for Hydrometric Station

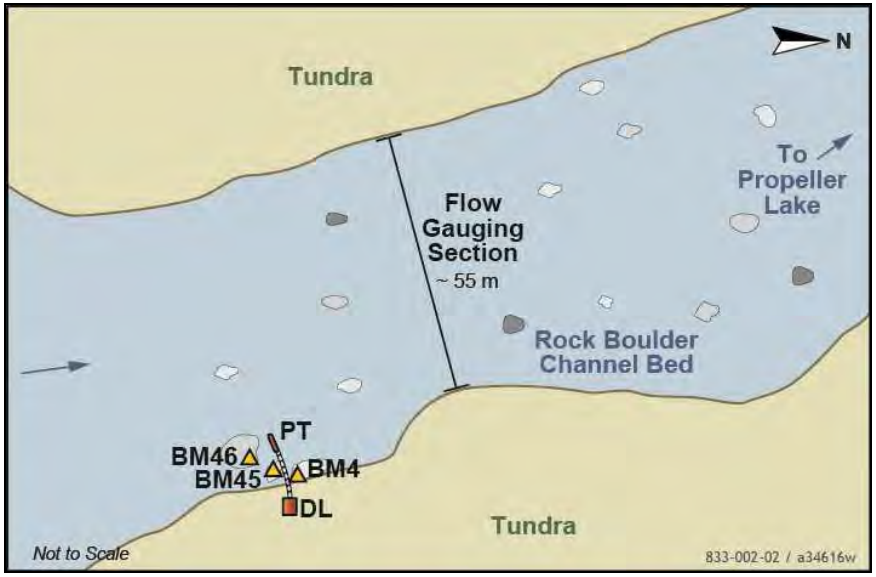
Site ID:	PL-H2	**Drainage Area (km^2):**	101.5
Site Location:	Between the outflow of Goose Lake and the inflow of Propellor Lake		
UTM:	NAD 83, Zone 13 W	435,007 E	7,272,014 N
Benchmarks	**Elevation (m)**	**Description**	
BM4	100.000	Bolt on in-stream boulder near the station	
BM45	99.856	Bolt on in-stream boulder near the station	
BM46	100.169	Bolt on in-stream boulder near the station	
Transducer:	PT-2X	**Logger:**	Self-Contained
Operating Periods:			
2011	June 11 – Sep 17	Established June 11, 2011	
2012	June 12 – Sep 13		
General Comments:			

- Wide boulder strewn channel
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter



General Site Information

Site Map



Plan View of Hydrometric Station PL-H2



Low angle view looking downstream from the right bank along the monitored stream reach. June 16, 2012.

Site Photo

Appendix 1.6. Station Information Sheet for Hydrometric Station GI-H1

Site ID:	GI-H1	**Drainage Area (km²):**	27.4
Site Location:	Outflow of Giraffe Lake		
UTM:	NAD 83, Zone 13W	432,744 E	7,271,610 N

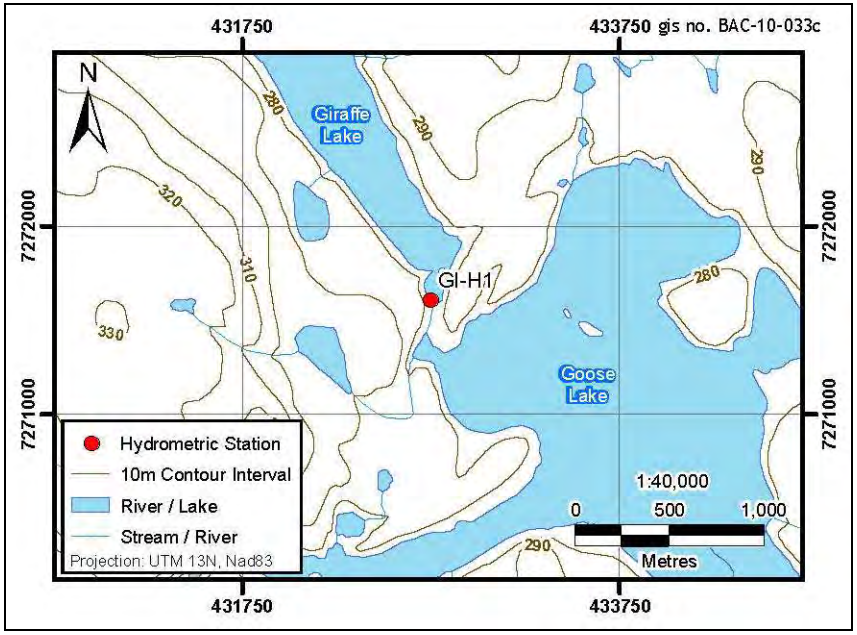
Benchmarks	**Elevation (m)**	**Description**
BM5	100.000	Bolt near station
BM47	99.922	Bolt downstream from station
Bm49	100.037	Bolt downstream from station

Transducer:	PS-98i	**Logger:**	ELF2

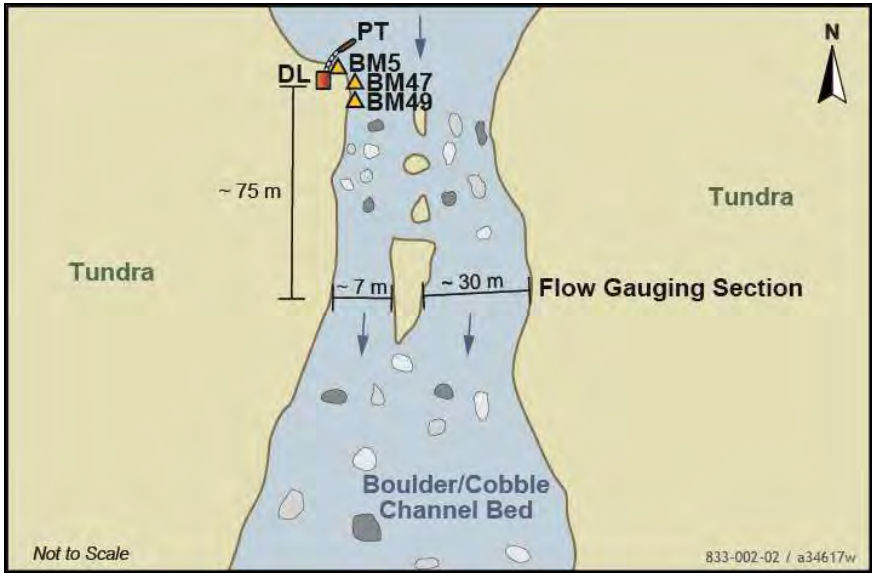
Operating Periods:		
2011	June 11 - Sep 16	Established June 16, 2011
2012	June 9 - Sep 14	

General Comments:

- Wide boulder strewn channel
- Relatively low flow
- Wadeable under all conditions
- Access by helicopter



Site Map



Plan View of Hydrometric Station GI-H1

General Site Information



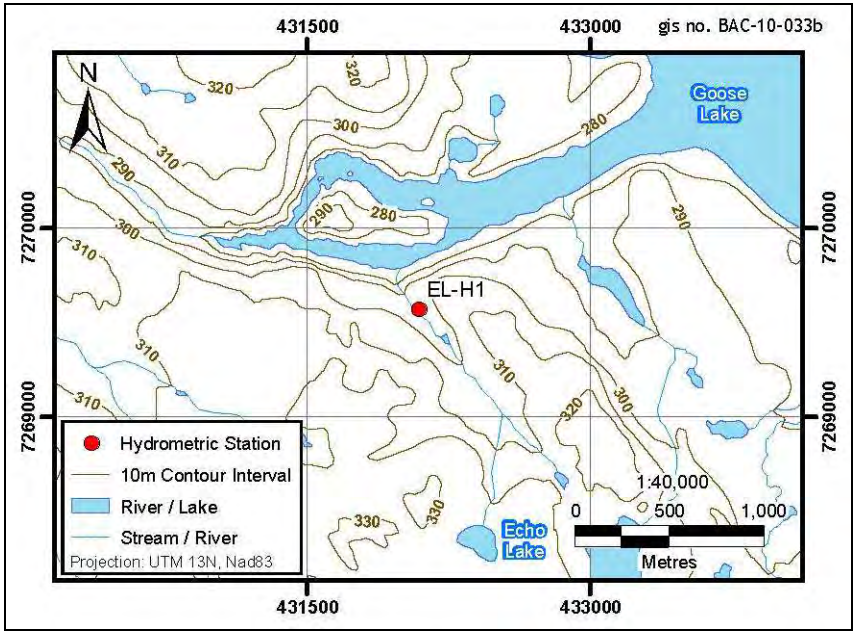
Upstream view of Giraffe Lake outflow. Photograph was taken during very low flow conditions and shows flow gauging section. August 10, 2012.

Site Photo

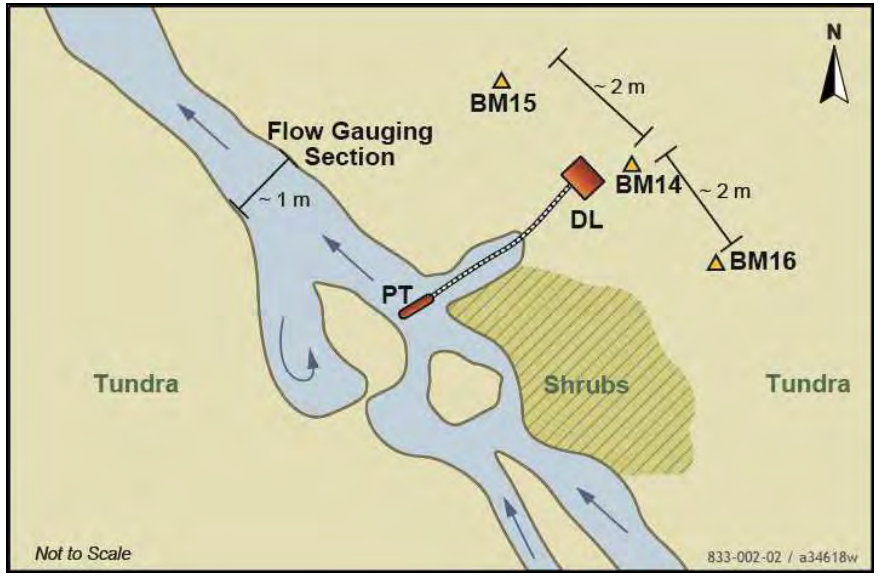
Appendix 1.7. Station Information Sheet for Hydrometric Station EL-H1

Site ID:	EL-H1	**Drainage Area (km²):**	1.4
Site Location:	Near the inflow to the West arm of Goose Lake		
UTM:	NAD 83, Zone 13W	432,091 E	7,269,573 N
Benchmarks	**Elevation (m)**	**Description**	
BM14	100.000	Bolt near the station	
BM15	99.924	Bolt downstream from the station	
BM16	99.991	Bolt upstream from the station	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June 13 - Sep 16	Established June 13, 2011	
2012	June 6 - Sep 7		
General Comments:			

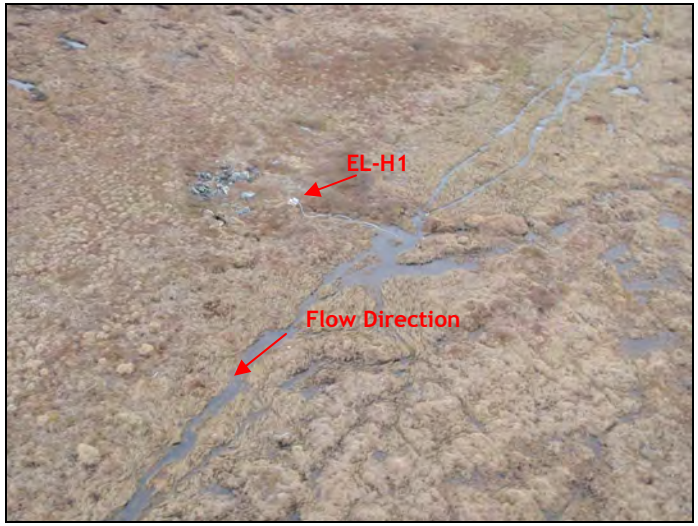
- Ephemeral channel prone to flooding
- Wadeable under all conditions
- Access by helicopter



Site Map



Plan View of Hydrometric Station EL-H1



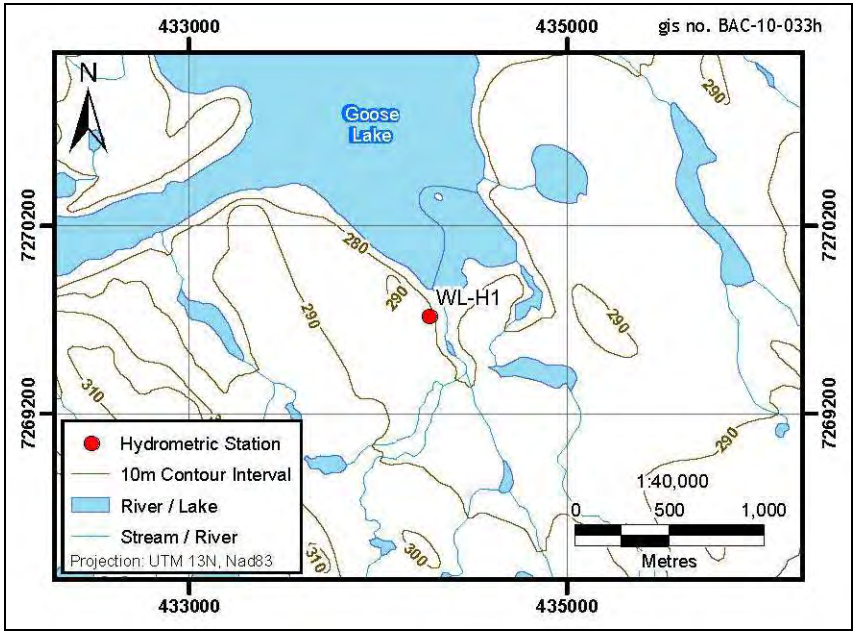
High angle oblique view of the monitored reach under high flow conditions. Due to the ephemeral nature of the channel, it is lined with grasses. June 13, 2012.

Site Photo

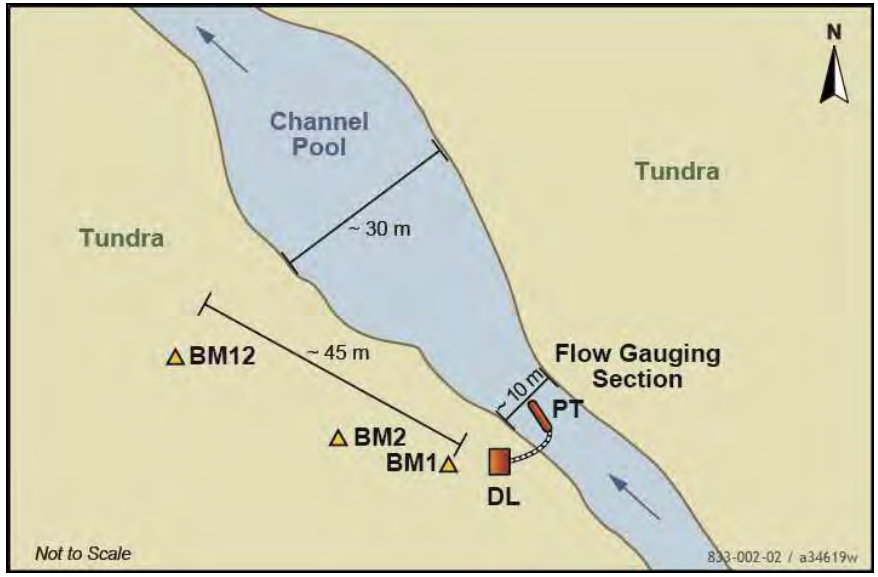
Appendix 1.8. Station Information Sheet for Hydrometric Station WL-H1

Site ID:	WL-H1	**Drainage Area (km²):**	35.1
Site Location:	Near the southern most inflow to Goose Lake		
UTM:	NAD 83, Zone 13W	434,269 E	7,269,719 N
Benchmarks	**Elevation (m)**	**Description**	
BM12	100.00	Bolt ~65m northwest of the station	
BM1	99.237	Tip of drill casing near station	
BM2	99.929	Tip of drill casing between station and BM12	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June 10 - Sep 17	Established June 10, 2011	
2012	June 7 - Sep 14		
General Comments:			

- Relatively deep channel
- Relatively low velocity
- Wadeable under most conditions
- Access by helicopter



Site Map



General Site Information

Plan View of Hydrometric Station WL-H1



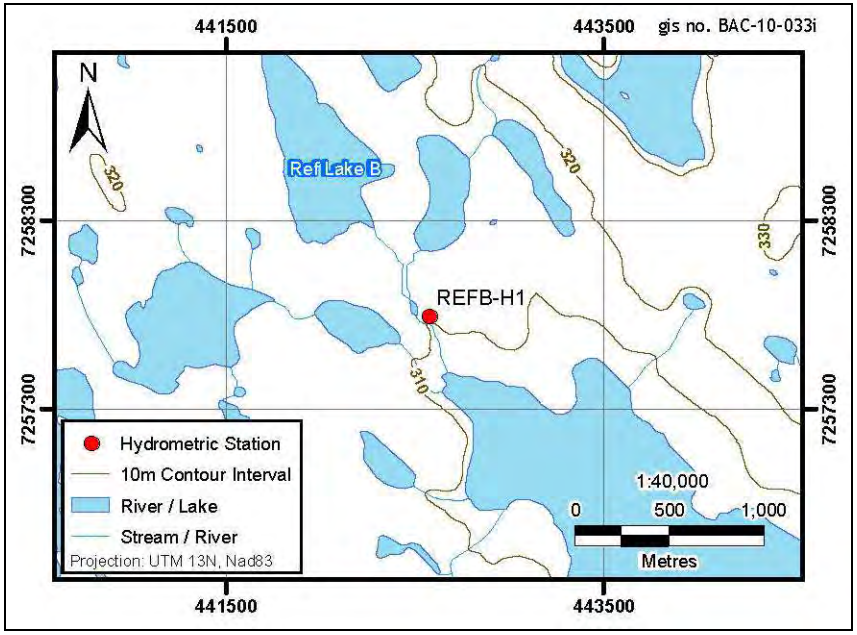
Downstream view of the monitored reach looking West towards Goose Camp under low flow conditions. Sep 14, 2012.

Site Photo

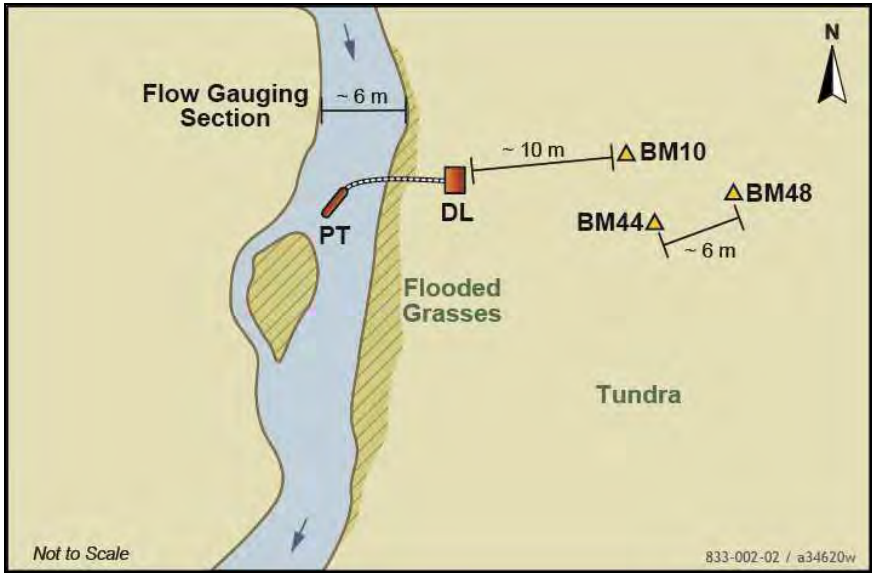
Appendix 1.9. Station Information Sheet for Hydrometric Station REFB-H1

Site ID:	REFB-H1	**Drainage Area (km²):**	5.3
Site Location:	Near the outflow of Reference Lake B		
UTM:	NAD 83, Zone 13W	442,573 E	7,257,794 N
Benchmarks	**Elevation (m)**	**Description**	
BM10	100.000	Bolt ~10m west of the data logger	
BM44	99.954	Bolt ~5m south of BM10	
BM48	100.104	Bolt ~ 6m west of BM44	
Transducer:	PS-98i	**Logger:**	ELF-2
Operating Periods:			
2011	June 13 - Sep 17	Established June 13, 2011	
2012	June 9 - Sep 13		
General Comments:			

- Ephemeral stream
- Soft bed (transducer sinks over the summer)
- Wadeable under all conditions
- Access by helicopter



General Site Information



Plan View of Hydrometric Station REFB-H1

Site Map



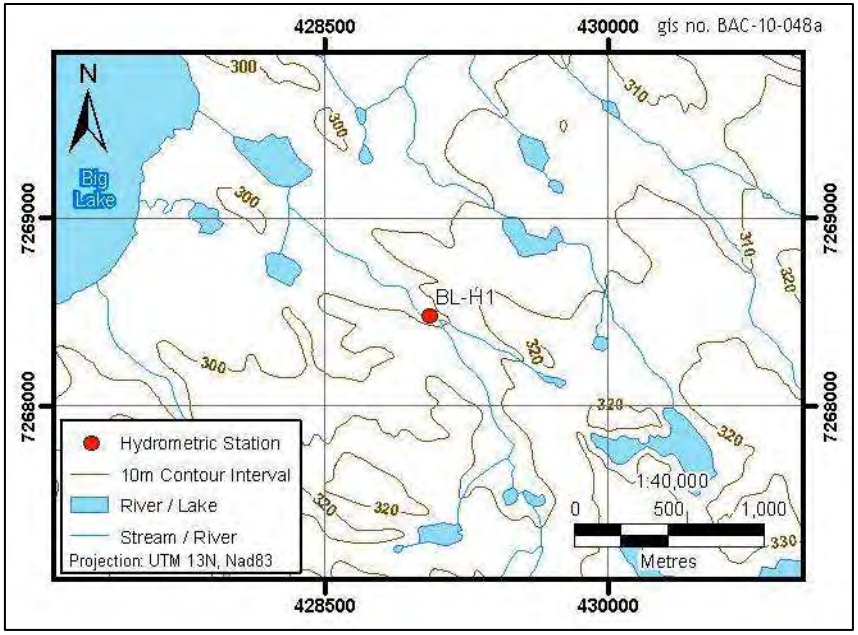
High angle oblique view looking West at the monitored reach. Photograph taken September 13, 2012.

Site Photo

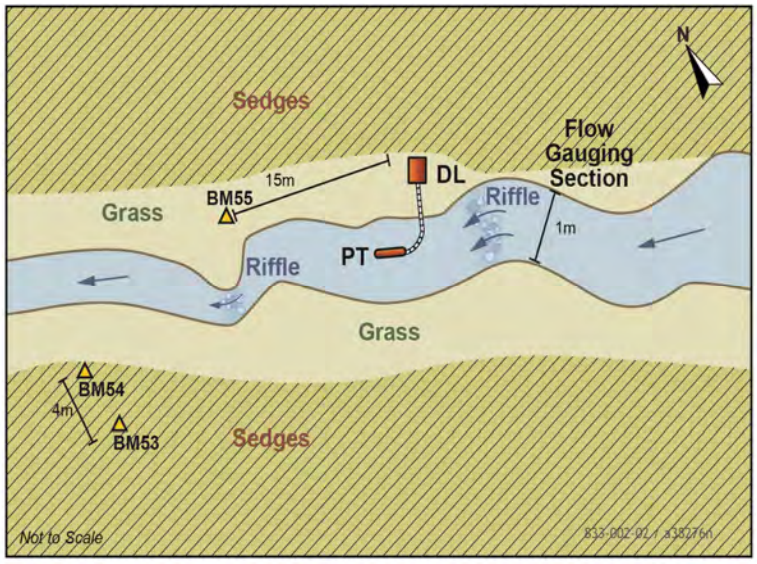
Appendix 1.10. Station Information Sheet for Hydrometric Station BL-H1

Site ID:	BL-H1	Drainage Area (km^2):	4.28
Site Location:	Near the north eastern inflow to Big Lake		
UTM:	NAD 83, Zone 13W	429,044 E	7,268,478 N
Benchmarks	**Elevation (m)**	**Description**	
BM 53	100.000	Bolt in rock left bank downstream of station	
BM 54	99.939	Bolt in rock left bank downstream of station	
BM 55	99.922	Bolt on right bank 15m downstream of station	
Transducer:	PS-98i	Logger:	ELF-2
Operating Period:			
2012	June 12 – Sep 10	Established on June 12, 2012	
General Comments:			

- Small channel with low flow
- Wadeable under all conditions
- Pool-riffle morphology with cobble bed (gradient = 2%)
- Access by helicopter



General Site Information



Plan View of Hydrometric Station BL-H1

Site Map



Low angle view looking upstream towards the station. The enclosure for the data logger can be seen on the right bank. June 16, 2012.

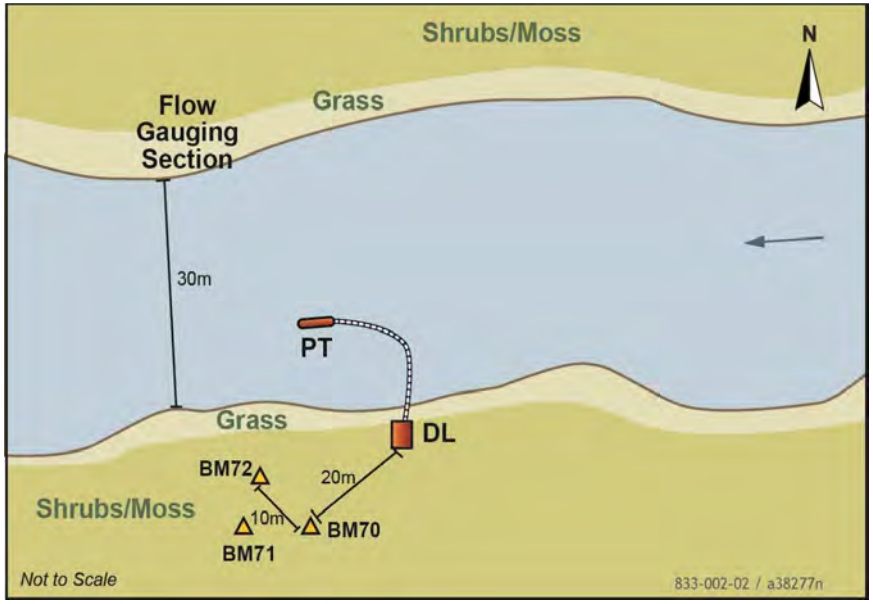
Site Photo

Appendix 1.11. Station Information Sheet for Hydrometric Station BL-H2

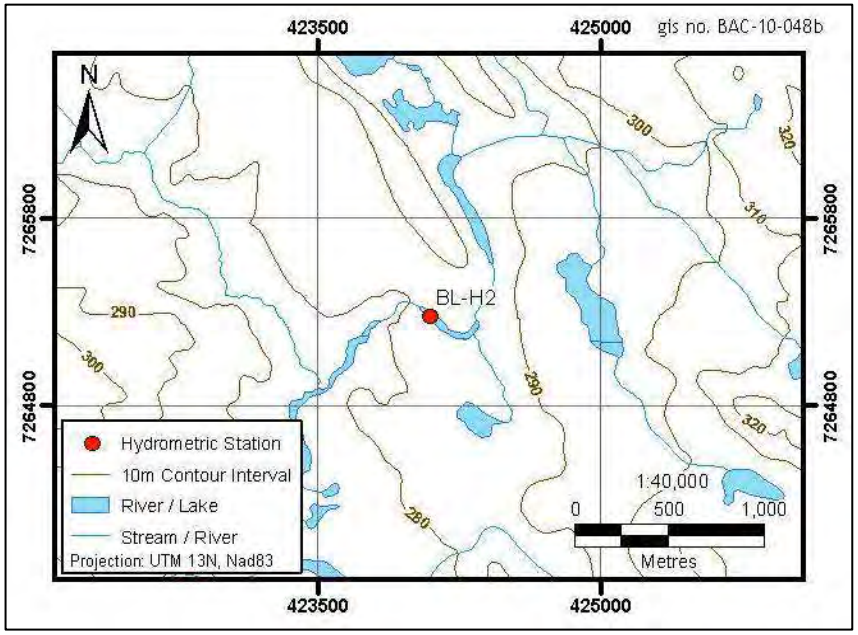
Site ID:	BL-H2	**Drainage Area (km²):**	160.0
Site Location:	On Swan Lake Outflow 1km upstream of Gander Lake		
UTM:	NAD 83, Zone 13W	424,087 E	7,265,274 N
Benchmarks	**Elevation (m)**	**Description**	
BM 70	100.000	Bolt on left bank downstream of station	
BM 71	99.942	Bolt on left bank downstream of BM 70	
BM 72	99.608	Bolt on left bank closer to stream than BM 71	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 8 – Sep 9	Established on June 8, 2012	
General Comments:			

- Large, wide (30 m) channel with relatively high flow
- Wadeable under all conditions
- Pool-riffle morphology with silt/boulder bed (gradient = 1%)
- Access by helicopter

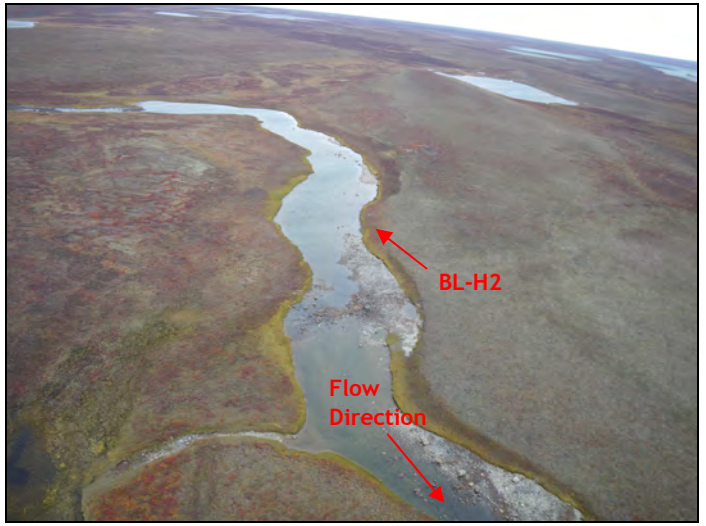
General Site Information



Plan View of Hydrometric Station BL-H2



Site Map



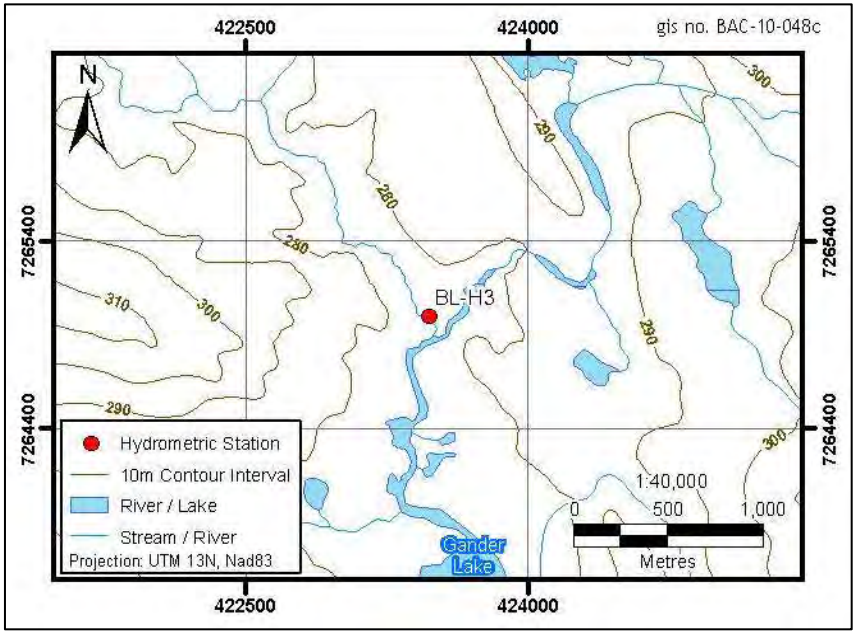
High angle oblique view looking upstream at the channel section under low flow conditions. The station is shown on the left bank. September 9, 2012.

Site Photo

Appendix 1.12. Station Information Sheet for Hydrometric Station BL-H3

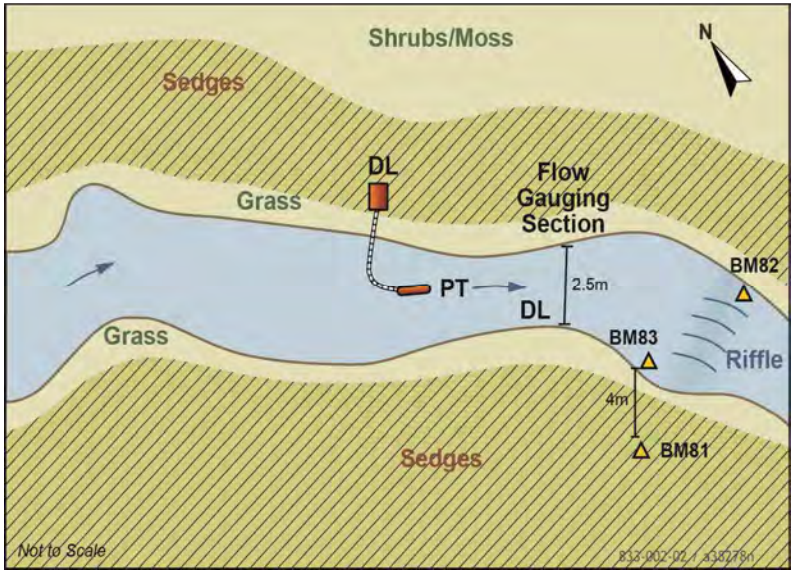
Site ID:	BL-H3	**Drainage Area (km²):**	21.6
Site Location:	Moby lake outflow		
UTM:	NAD 83, Zone 13W	423,467N	7,264,998E
Benchmarks	**Elevation (m)**	**Description**	
BM 81	100.000	Bolt in rock on Right Bank near downstream riffle	
BM 82	99.710	Bolt in rock on left side of downstream riffle	
BM 83	99.836	Bolt on right side of downstream riffle	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 8 – Sep 9	Established on June 8, 2012	
General Comments:			

- Narrow, deep channel swift flows at high water
- Wadeable under all conditions
- Pool-riffle morphology with undercut banks near pressure transducer location
- Access by helicopter

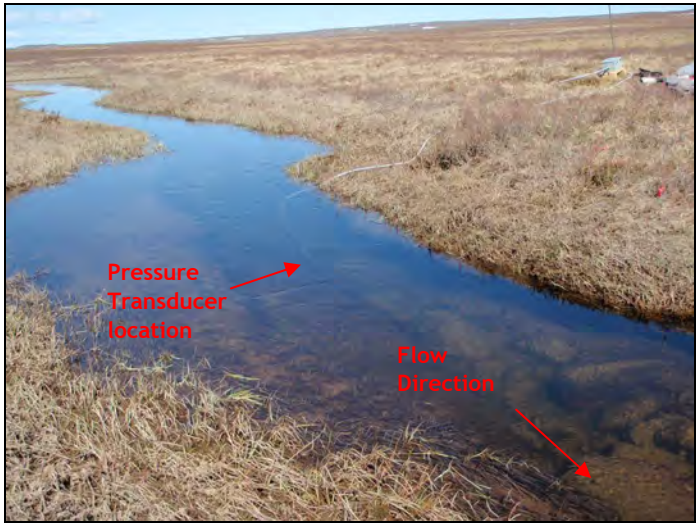


Site Map

General Site Information



Plan View of Hydrometric Station BL-H3



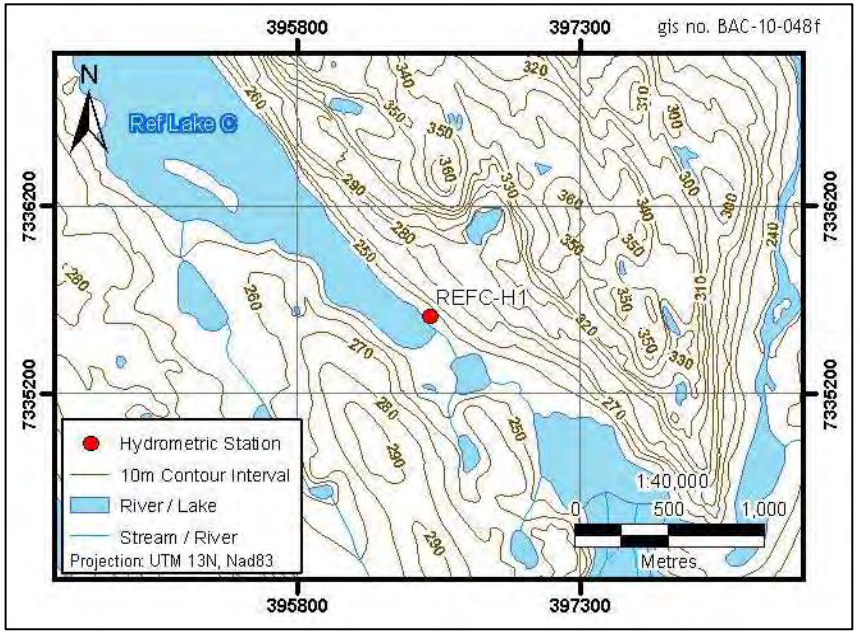
Low angle oblique view looking upstream at the channel section under high flow conditions. The station is shown on the left bank. June 8, 2012.

Site Photo

Appendix 1.13. Station Information Sheet for Hydrometric Station REFC-H1

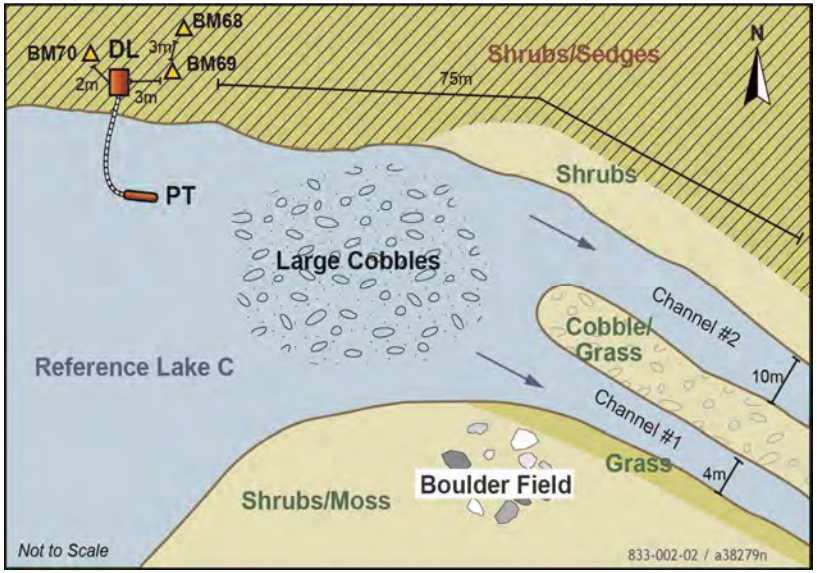
Site ID:	REFC-H1	**Drainage Area (km^2):**	9.47
Site Location:	Near Reference Lake C outflow		
UTM:	NAD 83, Zone 13W	396,495E	7,335,612N
Benchmarks	**Elevation (m)**	**Description**	
BM 68	100.000	Bolt in rock 3m up bank of BM 69	
BM 69	99.687	Bolt in rock 3m downstream of station	
BM 70	99.879	Bolt in rock 2m upstream of station	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 11 – Sep 11	Established on June 11, 2012	
General Comments:			

- Braided channel with two braids at location of flow measurement (Right braid only at low water)
- Wadeable under all conditions
- Cobble bed with water flowing mainly deep in loose cobbles at low water
- Access by helicopter

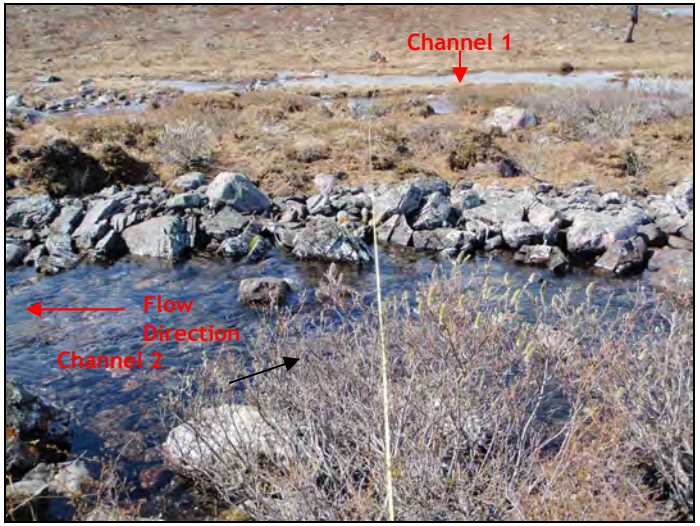


Site Map

General Site Information



Plan View of Hydrometric Station REFC-H1



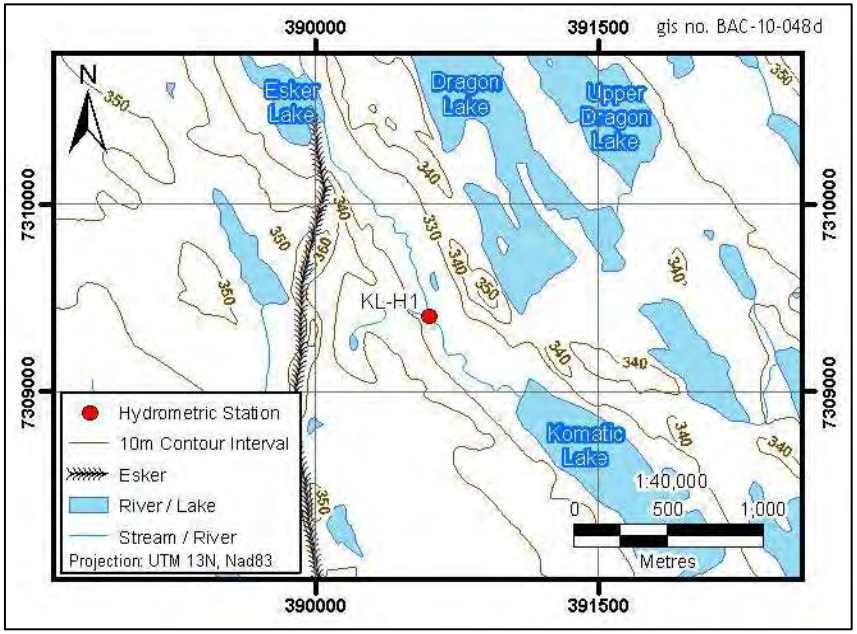
View from left bank at location of flow gauging section. The channel is split into two main braids along its length under high water conditions June 15, 2012.

Site Photo

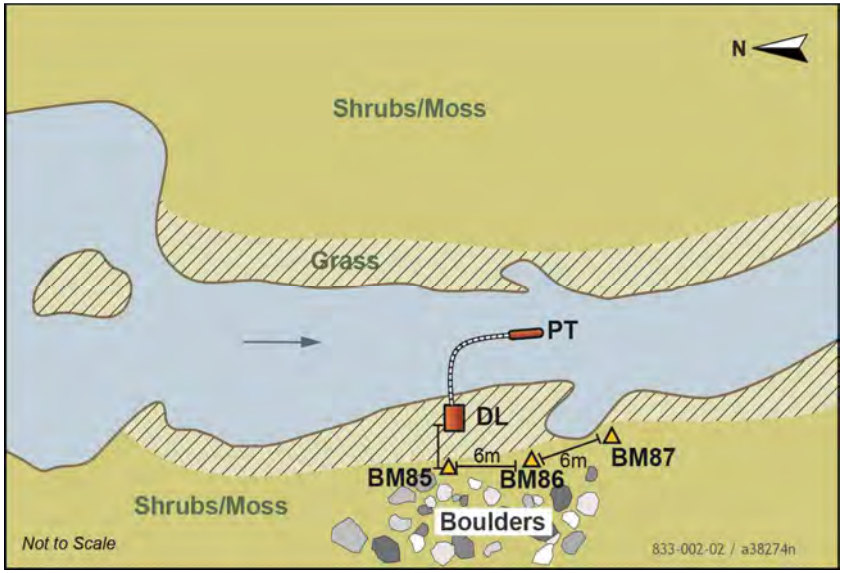
Appendix 1.14. Station Information Sheet for Hydrometric Station KL-H1

Site ID:	KL-H1	**Drainage Area (km²):**	24.0
Site Location:	On Channel between Esker Pond and Komatic Lake		
UTM:	NAD 83, Zone 13W	390,592E	7,309,400N
Benchmarks	**Elevation (m)**	**Description**	
BM 85	100.000	Bolt in rock 5m behind station	
BM 86	100.126	Bolt in rock 6m downstream of station	
BM 87	99.627	Bolt in rock 6m downstream of BM 86	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 10 – Sep 12	Established on June 10, 2012	
General Comments:			

- Narrow, deep channel with swift flows at high water
- Wadeable under all conditions
- Pool-riffle morphology with large, deep pool downstream of station
- Access by helicopter



Site Map



Plan View of Hydrometric Station KL-H1



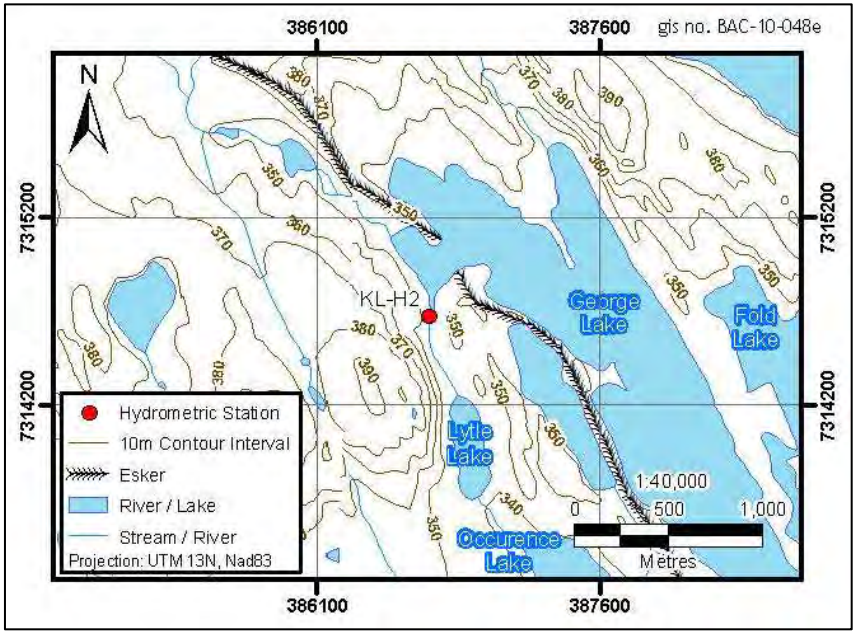
High angle oblique view looking upstream at the channel section under high flow conditions. The station is shown on the right bank. June 15, 2012.

Site Photo

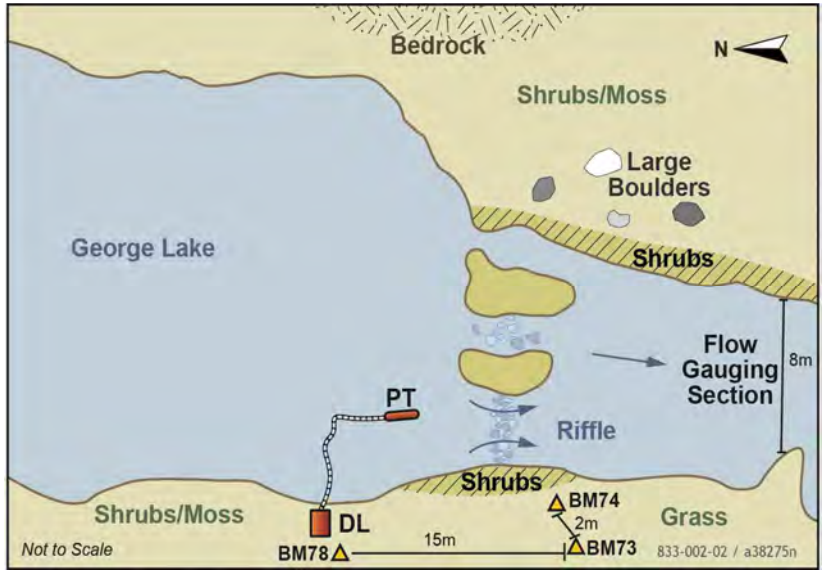
Appendix 1.15. Station Information Sheet for Hydrometric Station KL-H2

Site ID:	KL-H2	**Drainage Area (km²):**	9.82
Site Location:	George Lake outflow		
UTM:	NAD 83, Zone 13W	386,687E	7,314,673N
Benchmarks	**Elevation (m)**	**Description**	
BM 73	100.000	Bolt in rock 15m downstream of station	
BM 74	99.848	Bolt in rock 2m east of BM 73	
BM 78	100.733	Bolt in rock behind station	
Transducer:	PT-2X	**Logger:**	Self-contained
Operating Period:			
2012	June 10 – Sep 12	Established on June 10, 2012	
General Comments:			

- Wide, boulder
- Wadeable under all conditions
- Cobble bed with water flowing mainly deep in loose cobbles at low water
- Access by helicopter



Site Map



Plan View of Hydrometric Station KL-H2



Low angle downstream view of the outlet of George Lake and KL-H2. The station can be seen on the right bank upstream of the gauging section. June 10, 2012.

Site Photo

Appendix 2
Discharge Measurements

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Appendix 2-1. Manual Discharge Measurements and Levelling Surveys at GL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	5-Jun-12			
Time at Site (24 hr)	Start Time:	2:00:00 PM	End Time:	5:30:00 PM
Personnel	Eli, Coby			
Station Cordinates	Easting	Northing	Elevation	
	430,772E	7,279,016N	275m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	2818014
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	0	Memory Free	32535 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	1.142	101.142		100.000	
BM 4			0.926	100.216	
WL			1.464	**99.678**	
PT			2.487	98.655	
BM 5			0.617	100.525	
BM 5	0.529	101.054			
PT			2.420	98.634	
WL			1.375	**99.679**	
BM 4			0.838	100.216	
BM 3			1.054	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.218	100.216	-0.002	
BM 5	100.527	100.525	-0.002	
PT	98.584	98.578	-0.006	

Summary	
Stage (m)	99.679
Discharge (m^3/s)	No Measurement on this date
Pressure Transducer Reading (m)	1.101
Pressure Transducer Elevation (m)	98.578

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:30	End	16:15	Location	4m downstream of PT				
Method				Instrument Model						
Flow Meter Type				Instrument Serial #						
Stage (m)	Start	Reading		Time		Flo-Mate not functional				
	End	Reading		Time						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	18.26	0.00	0.00	0.04					
	18.80	0.14	0.54	0.07					
	19.30	0.16	0.50	0.06					
	19.60	0.21	0.30	0.04					
	19.70	0.37	0.10	0.15					
	20.40	0.48	0.70	0.31					
	21.00	0.59	0.60	0.32					
	21.50	0.69	0.50	0.31					
	21.90	0.68	0.40	0.20					
	22.10	0.90	0.20	0.18					
	22.30	1.12	0.20	0.34					
	22.70	0.90	0.40	0.34					
	23.05	0.77	0.35	0.27					
	23.40	0.54	0.35	0.18					
	23.71	0.47	0.31	0.08					
RB	23.75	0.00	0.04	0.00					

General Notes
Higher energy arctic stream. Confined by Bedrock banks. Cascade pool morphology. Mixed bedrock and boulder bed. Gradient = -2%(pool with PT), -6% cascade downstream. Flowmate not functional June 5. Unable to survey same position on PT due to deep water.

Appendix 2-1. Manual Discharge Measurements and Levelling Surveys at GL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	13-Jun-12			
Time at Site (24 hr)	Start Time:	3:20:00 PM	End Time:	5:10:00 PM
Personnel	Eli, Coby			
Station Cordinates	Easting	Northing	Elevation	
	430,772E	7,279,016N	275m	
Weather Conditions	Above Zero	Partly Cloudy		

Transducer Information			
PT Model	PS98i	Serial #	2818014
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	1151	Memory Free	31956 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	0.934	100.934		100.000	
BM 4			0.718	100.216	
WL			1.533	**99.401**	
PT			2.332	98.602	
BM 5			0.409	100.525	
BM 5	0.444	100.969			
PT			2.369	98.600	
WL			1.567	**99.402**	
BM 4			0.753	100.216	
BM 3			0.970	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.218	100.216	-0.002	
BM 5	100.527	100.525	-0.002	
PT	98.584	98.582	-0.002	

Summary	
Stage (m)	99.402
Discharge (m^3/s)	0.384
Pressure Transducer Reading (m)	0.820
Pressure Transducer Elevation (m)	98.582

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	15:30	End	16:15	Location	1m downstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flomate			
Flow Meter Type	Flomate			Instrument Serial #		2004405			
Stage (m)	Start	Reading	0.819	Time	15:30				
	End	Reading	0.819	Time	16:15				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	19.15	0.00	0.00	0.01	0			0.000	0.0
	19.30	0.16	0.15	0.03	0.02			0.001	0.1
	19.50	0.18	0.20	0.04	0.1			0.004	0.9
	19.70	0.16	0.20	0.03	0.16			0.005	1.3
	19.90	0.18	0.20	0.04	0.2			0.007	1.9
	20.10	0.13	0.20	0.03	0.23			0.006	1.6
	20.30	0.08	0.20	0.02	0.22			0.004	0.9
	20.50	0.07	0.20	0.01	0.25			0.003	0.9
	20.70	0.12	0.20	0.02	0.3			0.007	1.9
	20.90	0.66	0.20	0.12	0.35			0.040	10.5
	21.05	0.64	0.15	0.10	0.34			0.033	8.5
	21.20	0.60	0.15	0.09	0.32			0.029	7.5
	21.35	0.60	0.15	0.09	0.32			0.029	7.5
	21.50	0.60	0.15	0.09	0.29			0.026	6.8
	21.65	0.54	0.15	0.08	0.23			0.019	4.9
	21.80	0.61	0.15	0.11	0.29			0.031	8.1
	22.00	0.48	0.20	0.10	0.26			0.025	6.5
	22.20	0.46	0.20	0.10	0.24			0.025	6.5
	22.45	0.46	0.25	0.12	0.25			0.029	7.5
	22.70	0.36	0.25	0.09	0.14			0.013	3.3
	22.95	0.33	0.25	0.08	0.24			0.020	5.2
	23.20	0.23	0.25	0.06	0.21			0.012	3.1
	23.45	0.16	0.25	0.04	0.2			0.008	2.1
	23.70	0.16	0.25	0.04	0.19			0.007	1.8
	23.90	0.16	0.20	0.02	0.14			0.003	0.7
LB	23.95	0.00	0.05	0.00	0			0.000	0.0
								0.384	**100.0**

General Notes
Gradiant from pool to below DS large riffle = 3.5%

Appendix 2-1. Manual Discharge Measurements and Levelling Surveys at GL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	6-Jul-12			
Time at Site (24 hr)	Start Time:	2:11:00 PM	End Time:	5:30:00 PM
Personnel	Eli H., Jacqueline			
Station Cordinates	Easting	Northing	Elevation	
	430772	7270016	275m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	281804
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	4456	Memory Free	30307
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	0.932	100.932		100.000	
BM 5			0.402	100.530	
BM 4			0.712	100.220	
PT			2.327	98.605	
WL			1.842	**99.090**	
TBM	2.418	100.830	2.520	98.412	
WL			1.743	**99.087**	
PT			2.227	98.603	
BM 4			0.613	100.217	
BM 5			0.303	100.527	
BM 3			0.830	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.218	100.219	0.001	
BM 5	100.527	100.529	0.002	
PT	98.584	98.595	0.011	

Summary	
Stage (m)	99.089
Discharge (m^3/s)	0.0842
Pressure Transducer Reading (m)	0.494
Pressure Transducer Elevation (m)	98.595

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	14:16	End	14:58	Location	1.5m Downstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612			
Stage (m)	Start	Reading	0.494	Time	14:16				
	End	Reading	0.494	Time	14:58				

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
LB	0.70	0.00	0.00	0.00	0.00	0.00		0.000	0.0
	0.78	0.05	0.02	0.08	0.00	0.04		0.000	0.1
	0.85	0.10	0.03	0.07	0.00	0.10		0.000	0.3
	0.95	0.15	0.05	0.10	0.00	0.15		0.001	0.8
	1.05	0.15	0.05	0.10	0.00	0.20		0.001	1.1
	1.15	0.20	0.06	0.10	0.01	0.18		0.001	1.3
	1.25	0.27	0.08	0.10	0.01	0.15		0.001	1.5
	1.35	0.31	0.09	0.10	0.01	0.23		0.002	2.6
	1.45	0.40	0.12	0.10	0.01	0.30		0.004	4.3
on rock	1.55	0.15	0.05	0.10	0.00	0.22		0.001	1.2
on rock	1.65	0.15	0.05	0.10	0.00	0.18		0.001	1.0
	1.75	0.20	0.06	0.10	0.01	0.18		0.001	1.3
	1.85	0.35	0.11	0.10	0.01	0.24		0.003	3.0
	1.95	0.56	0.17	0.10	0.01	0.27		0.003	4.1
	2.00	0.75	0.23	0.05	0.02	0.23		0.004	4.7
	2.10	0.90	0.27	0.10	0.03	0.21		0.006	6.8
	2.20	1.00	0.30	0.10	0.02	0.20		0.005	5.4
	2.25	1.10	0.34	0.05	0.02	0.25		0.004	5.0
	2.30	1.15	0.35	0.05	0.02	0.25		0.004	5.2
	2.35	1.20	0.37	0.05	0.02	0.38		0.007	8.3
	2.40	1.29	0.39	0.05	0.02	0.45		0.009	10.5
	2.45	1.30	0.40	0.05	0.02	0.44		0.009	10.4
	2.50	1.35	0.41	0.05	0.02	0.36		0.007	8.8
	2.55	1.30	0.40	0.05	0.02	0.33		0.007	7.8
	2.60	1.30	0.40	0.05	0.02	0.13		0.002	2.4
Rrock overhang	2.63	1.40	0.43	0.03	0.01	0.12		0.002	2.1
RB	2.67	0.00	0.00	0.04	0.01	0.00		0.000	0.0
Total Q								**0.0842**	**100.0**

General Notes
Gradiant = 2%. Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-1. Manual Discharge Measurements and Levelling Surveys at GL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	10-Aug-12			
Time at Site (24 hr)	Start Time:	11:41:00 AM	End Time:	1:00:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	430772	7270016	275m	
Weather Conditions	Cloudy, windy			

Transducer Information			
PT Model	PS98i	Serial #	281804
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	9490	Memory Free	27790
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	1.087	101.087		100.000	
BM 5			0.560	100.527	
BM 4			0.868	100.219	
PT			2.488	98.599	
WL			2.433	**98.654**	
TBM	2.577	101.163	2.501	98.586	
WL			2.511	**98.652**	
PT			2.565	98.598	
BM 4			0.945	100.218	
BM 5			0.635	100.528	
BM 3			1.162	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.218	100.219	0.001	
BM 5	100.527	100.528	0.001	
PT	98.584	98.587	0.003	

Summary	
Stage (m)	98.653
Discharge (m^3/s)	0.00452
Pressure Transducer Reading (m)	0.066
Pressure Transducer Elevation (m)	98.587

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	12:30	End	13:15	Location	10m Downstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042				
Stage (m)	Start	Reading	0.066	Time	12:30					
	End	Reading	0.066	Time	13:15					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
LB	0.91	0.00	0.00	0.00	0.00	0		0.000	0.0
	0.96	0.10	0.03	0.05	0.00	0.07		0.000	2.1
	1.00	0.31	0.09	0.04	0.00	0.19		0.001	17.9
	1.05	0.56	0.17	0.05	0.01	0.12		0.001	22.6
	1.10	0.50	0.15	0.05	0.01	0.16		0.001	21.6
	1.13	0.22	0.07	0.03	0.00	0.16		0.000	5.9
	1.15	0.21	0.06	0.02	0.00	0.14		0.000	6.9
	1.20	0.21	0.06	0.05	0.00	0.12		0.000	8.5
	1.25	0.43	0.13	0.05	0.01	0.07		0.000	10.1
	1.30	0.43	0.13	0.05	0.01	0.05		0.000	7.2
	1.35	0.42	0.13	0.05	0.01	0.04		0.000	5.7
	1.40	0.21	0.06	0.05	0.00	-0.02		0.000	-1.4
	1.45	0.20	0.06	0.05	0.00	-0.03		0.000	-2.0
	1.50	0.22	0.07	0.05	0.00	-0.03		0.000	-2.2
	1.55	0.29	0.09	0.05	0.00	-0.03		0.000	-2.9
RB	1.60	0.00	0.00	0.05	0.00	0		0.000	0.0
Total Q								**0.00452**	**100.0**

General Notes
Gradiant = 2%. Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-1. Manual Discharge Measurements and Levelling Surveys at GL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H1			
Stream Name	Goose Neck			
Date Monitored	7-Sep-12			
Time at Site (24 hr)	Start Time:	10:53:00 AM	End Time:	12:00:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	430772	7270016	275m	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	281804
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	13508	Memory Free	25780
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 3	2.581	102.581		100.000	
BM 5			2.365	100.216	
BM 4			2.057	100.524	
PT			3.985	98.596	
WL			3.917	**98.664**	
TBM	3.843	102.516	3.908	98.673	
WL			3.853	**98.663**	
PT			3.918	98.598	
BM 4			1.991	100.525	
BM 5			2.300	100.216	
BM 3			2.519	99.997	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 4	100.218	100.216	-0.002	
BM 5	100.527	100.525	-0.002	
PT	98.584	98.578	-0.006	

Summary	
Stage (m)	98.664
Discharge (m^3/s)	0.00652
Pressure Transducer Reading (m)	0.086
Pressure Transducer Elevation (m)	98.578

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	10:53	End	12:00	Location	20m Downstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Swoffer 2100			
Flow Meter Type	Swoffer			Instrument Serial #					
Stage (m)	Start	Reading	0.085	Time	10:53				
	End	Reading	0.086	Time	12:00				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.62	0.00	0.00	0.00	0			0.000	0.0
	0.67	0.07	0.05	0.00	0			0.000	0.0
	0.73	0.07	0.06	0.00	0.01			0.000	0.7
	0.80	0.06	0.07	0.00	0.01			0.000	0.6
	0.85	0.08	0.05	0.00	0.01			0.000	0.6
	0.90	0.13	0.05	0.01	0.02			0.000	1.6
	0.93	0.12	0.03	0.00	0.12			0.001	7.7
	0.97	0.12	0.04	0.00	0.15			0.001	8.3
	0.99	0.15	0.02	0.00	0.15			0.001	8.6
	1.02	0.08	0.03	0.00	0.17			0.000	7.3
	1.06	0.06	0.04	0.00	0.19			0.001	7.9
	1.11	0.08	0.05	0.00	0.2			0.001	11.0
	1.15	0.19	0.04	0.01	0.12			0.001	14.0
	1.19	0.19	0.04	0.01	0.13			0.001	15.2
	1.23	0.17	0.04	0.01	0.1			0.001	9.1
	1.26	0.07	0.03	0.00	0.16			0.000	6.0
	1.30	0.02	0.04	0.00	0.13			0.000	1.4
	1.33	0.00	0.03	0.00	0			0.000	0.0
Total Q								**0.00652**	**100.0**

General Notes
Gradiant = 2%

Appendix 2-2. Manual Discharge Measurements and Levelling Surveys at GL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	5-Jun-12			
Time at Site (24 hr)	**Start Time:**	8:45:00 AM	**End Time:**	1:45:00 PM
Personnel	Eli, Coby			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	428,746E	7,271,567N	287m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	**Serial #**	2818013
Gain	3.52168	**Offset**	0
Status	O.k.	**Battery**	100%
# of Records	0	**Memory Free**	32535 readings
Date Serviced	n/a	**Crest Gauges**	No

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM-01	1.351	101.351		100.000	
BM-02			1.612	99.739	
WL			1.614	**99.737**	
PT			1.924	99.427	Top of PVC
BM-03			1.576	99.775	
BM-03	1.544	101.319			
PT			1.892	99.427	
WL			1.583	**99.736**	
BM-02			1.580	99.739	
BM-01			1.318	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM-02	99.746	99.739	-0.007	
BM-03	99.792	99.775	-0.017	
PT	99.427	99.427	0.000	

Summary	
Stage (m)	99.737
Discharge (m^3/s)	No Discharge Measurement on this date
Pressure Transducer Reading (m)	0.339
Pressure Transducer Elevation (m)	99.398

Discharge Measurement - Mid-Section Method

Time (24 hr)	**Start**	10:25	**End**	12:36	**Location**	2m downstream of PT		
Method	Velocity-area (Mid-section)			**Instrument Model**				
Flow Meter Type				**Instrument Serial #**				
Stage (m)	**Start**	**Reading**		**Time**				
	End	**Reading**		**Time**				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	18.00	0.00	0.00	0.01					
Grass	18.25	0.07	0.25	0.04					
Grass	19.00	0.07	0.75	0.06					
Grass	20.00	0.11	1.00	0.12					
Grass	21.15	0.22	1.15	0.14					
	21.30	0.32	0.15	0.07					
	21.60	0.45	0.30	0.19					
	22.13	0.48	0.53	0.30					
	22.85	0.46	0.72	0.20					
	23.00	0.42	0.15	0.08					
Grass	23.21	0.32	0.21	0.06					
Grass	23.40	0.16	0.19	0.10					
Grass	24.50	0.20	1.10	0.21					
Grass	25.50	0.16	1.00	0.16					
Grass	26.50	0.18	1.00	0.18					
Grass	27.50	0.10	1.00	0.10					
Grass	28.50	0.04	1.00	0.04					
RB	29.35	0.00	0.85	0.02					
Total Q									

General Notes

Flow mate not operational on June 5, 2012.

Appendix 2-2. Manual Discharge Measurements and Levelling Surveys at GL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	12-Jun-12			
Time at Site (24 hr)	Start Time:	3:00:00 PM	End Time:	4:30:00 PM
Personnel	Eli, Coby			
Station Cordinates	Easting	Northing	Elevation	
	428,746E	7,271,567N	287m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	2818013
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	1036	Memory Free	32014 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM-01	1.236	101.236		100.000	
BM-02			1.502	99.734	
WL			1.557	**99.679**	
PT			1.805	99.431	error
BM-03			1.481	99.755	
BM-03	1.445	101.200			
PT			1.776	99.424	checked, ok
WL			1.523	**99.677**	
BM-02			1.466	99.734	
BM-01			1.202	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM-02	99.746	99.734	-0.012	
BM-03	99.792	99.755	-0.037	
PT	99.427	99.424	-0.003	

Summary	
Stage (m)	99.678
Discharge (m^3/s)	0.116
Pressure Transducer Reading (m)	0.281
Pressure Transducer Elevation (m)	99.397

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:15	End	16:05	Location	~40m upstream from PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flomate				
Flow Meter Type	Flo-mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.28	Time	15:15					
	End	Reading	0.281	Time	16:05					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.35	0.00	0.00	0.01	0			0.000	0.0
	0.40	0.23	0.05	0.01	0.05			0.001	0.5
	0.45	0.22	0.05	0.01	0.32			0.004	3.0
	0.50	0.22	0.05	0.01	0.39			0.004	3.7
	0.55	0.22	0.05	0.01	0.4			0.004	3.8
	0.60	0.23	0.05	0.01	0.44			0.005	4.3
	0.65	0.23	0.05	0.01	0.48			0.006	4.7
	0.70	0.23	0.05	0.01	0.44			0.005	4.3
	0.75	0.24	0.05	0.01	0.42			0.005	4.3
	0.80	0.23	0.05	0.01	0.51			0.006	5.0
	0.85	0.25	0.05	0.01	0.52			0.007	5.6
	0.90	0.23	0.05	0.01	0.49			0.006	4.8
	0.95	0.23	0.05	0.01	0.51			0.006	5.0
	1.00	0.23	0.05	0.01	0.49			0.006	4.8
	1.05	0.22	0.05	0.01	0.51			0.006	4.8
	1.10	0.22	0.05	0.01	0.49			0.005	4.6
	1.15	0.24	0.05	0.01	0.48			0.006	4.9
	1.20	0.23	0.05	0.01	0.45			0.005	4.4
	1.25	0.22	0.05	0.01	0.45			0.005	4.2
	1.30	0.24	0.05	0.01	0.43			0.005	4.4
	1.35	0.24	0.05	0.01	0.42			0.005	4.3
	1.40	0.22	0.05	0.01	0.39			0.004	3.7
	1.45	0.22	0.05	0.01	0.37			0.004	3.5
	1.50	0.22	0.05	0.01	0.33			0.004	3.1
	1.55	0.21	0.05	0.01	0.29			0.003	2.6
	1.60	0.16	0.05	0.01	0.22			0.001	1.2
	1.63	0.00	0.03	0.00	0			0.000	0.0
Total Q								**0.116**	**100.0**

General Notes

Appendix 2-2. Manual Discharge Measurements and Levelling Surveys at GL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	6-Jul-12			
Time at Site (24 hr)	Start Time:	9:30:00 AM	End Time:	1:16:00 PM
Personnel	Eli H., Jacqueline			
Station Cordinates	Easting	Northing	Elevation	
	428746	7271567	287	
Weather Conditions	Mix of Sun and Cloud			

Transducer Information			
PT Model	PS98i	Serial #	2818013
Gain	3.52168	Offset	0
Status	OK	Battery	97%
# of Records	4460	Memory Free	30304
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 1	1.112	101.112		100.000	
BM 2			1.368	99.744	
BM 3			1.332	99.780	
PT			1.678	99.434	error
WL			1.511	**99.601**	
TBM	1.589	101.069	1.632	99.480	
WL			1.469	**99.600**	
PT			1.639	99.430	checked, correct
BM 3			1.290	99.779	
BM 2			1.326	99.743	
BM 1			1.070	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 2	99.746	99.744	-0.002	
BM 3	99.792	99.780	-0.013	
PT	99.427	99.430	0.003	

Summary	
Stage (m)	99.601
Discharge (m^3/s)	0.0270
Pressure Transducer Reading (m)	0.189
Pressure Transducer Elevation (m)	99.412

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	9:48	End	10:34	Location					
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612				
Stage (m)	Start	Reading	0.19	Time	9:48					
	End	Reading	0.189	Time	10:34					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	0.80	0.00	0.00	0.00	0.00	0.00		0.000	0.0
Moss	0.90	0.15	0.05	0.10	0.00	0.12		0.000	1.7
	0.97	0.35	0.11	0.07	0.01	0.15		0.001	4.1
	1.04	0.40	0.12	0.07	0.01	0.18		0.002	5.7
	1.11	0.40	0.12	0.07	0.01	0.15		0.001	5.4
	1.20	0.40	0.12	0.09	0.01	0.16		0.001	5.4
	1.26	0.40	0.12	0.06	0.01	0.16		0.001	4.3
	1.32	0.55	0.17	0.06	0.01	0.17		0.002	6.3
	1.38	0.55	0.17	0.06	0.01	0.17		0.002	6.3
	1.44	0.50	0.15	0.06	0.01	0.16		0.002	5.9
On Rock	1.51	0.30	0.09	0.07	0.01	0.14		0.001	3.3
On Rock	1.58	0.30	0.09	0.07	0.01	0.12		0.001	2.8
	1.65	0.50	0.15	0.07	0.01	0.11		0.001	4.3
	1.72	0.40	0.12	0.07	0.01	0.12		0.001	3.8
	1.79	0.60	0.18	0.07	0.01	0.12		0.002	5.7
	1.86	0.70	0.21	0.07	0.01	0.12		0.002	6.6
	1.93	0.70	0.21	0.07	0.01	0.12		0.002	6.6
	2.00	0.50	0.15	0.07	0.01	0.12		0.001	4.7
	2.07	0.50	0.15	0.07	0.01	0.10		0.001	3.9
	2.14	0.50	0.15	0.07	0.01	0.12		0.001	4.7
	2.21	0.50	0.15	0.07	0.01	0.11		0.001	4.3
	2.28	0.45	0.14	0.07	0.01	0.07		0.001	2.1
Grass	2.33	0.45	0.14	0.05	0.01	0.03		0.000	0.9
Grass	2.40	0.40	0.12	0.07	0.01	0.01		0.000	0.4
	2.50	0.30	0.09	0.10	0.01	0.01		0.000	0.4
LB	2.65	0.00	0.00	0.15	0.01	0.00		0.000	0.0
Total Q								**0.0270**	**100.0**

General Notes
Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-2. Manual Discharge Measurements and Levelling Surveys at GL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	10-Aug-12			
Time at Site (24 hr)	Start Time:	2:20:00 PM	End Time:	4:00:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	428746	7271567	287	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2818013
Gain	3.52168	Offset	0
Status	OK	Battery	97%
# of Records	9528	Memory Free	27771
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 1	1.191	101.191		100.000	
BM 2			1.446	99.745	
BM 3			1.411	99.780	
PT			1.758	99.433	
WL			1.661	**99.530**	
TBM	1.624	101.134	1.681	99.510	
WL			1.603	**99.531**	
PT			1.701	99.433	
BM 3			1.353	99.781	
BM 2			1.388	99.746	
BM 1			1.133	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 2	99.746	99.746	-0.001	
BM 3	99.792	99.781	-0.011	
PT	99.427	99.433	0.006	

Summary	
Stage (m)	99.531
Discharge (m^3/s)	0.00127
Pressure Transducer Reading (m)	0.122
Pressure Transducer Elevation (m)	99.408

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	14:34	End	15:12	Location					
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042				
Stage (m)	Start	Reading	0.123	Time	14:34					
	End	Reading	0.122	Time	15:12					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	0.40	0.00	0.00	0.00	0.00	0		0.000	0.0
	0.45	0.10	0.03	0.05	0.00	0.04		0.000	4.8
	0.50	0.12	0.04	0.05	0.00	0.07		0.000	10.1
	0.55	0.21	0.06	0.05	0.00	0.05		0.000	12.6
	0.60	0.21	0.06	0.05	0.00	0.07		0.000	17.7
	0.65	0.21	0.06	0.05	0.00	0.11		0.000	27.8
	0.70	0.15	0.05	0.05	0.00	0.06		0.000	10.8
	0.75	0.15	0.05	0.05	0.00	0.03		0.000	5.4
	0.80	0.12	0.04	0.05	0.00	0.03		0.000	10.8
LB	1.00	0.00	0.00	0.20	0.00	0		0.000	0.0
Total Q								0.00127	100.0

General Notes
Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-2. Manual Discharge Measurements and Levelling Surveys at GL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H2			
Stream Name	Llama Lake Outflow			
Date Monitored	7-Sep-12			
Time at Site (24 hr)	Start Time:	8:45:00 AM	End Time:	10:45:00 AM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	428746	7271567	287	
Weather Conditions	Cloudy, recent rain			

Transducer Information			
PT Model	PS98i	Serial #	2818013
Gain	3.52168	Offset	0
Status	OK	Battery	97%
# of Records	13526	Memory Free	25771
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 1	1.151	101.151		100.000	
BM 2			1.402	99.749	
BM 3			1.374	99.777	
PT			1.724	99.427	
WL			1.612	**99.539**	
TBM	1.551	101.082	1.620	99.531	
WL			1.546	**99.536**	
PT			1.658	99.424	
BM 3			1.307	99.775	
BM 2			1.336	99.746	
BM 1			1.085	99.997	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 2	99.746	99.748	0.002	
BM 3	99.792	99.776	-0.016	
PT	99.427	99.426	-0.002	

Summary	
Stage (m)	99.538
Discharge (m^3/s)	0.00151
Pressure Transducer Reading (m)	0.136
Pressure Transducer Elevation (m)	99.402

Discharge Measurement - Mid-Section Method											
Time (24 hr)	Start	8:50	End	9:20	Location						
Method	Velocity-area (Mid-section)			Instrument Model	Swoffer 2100						
Flow Meter Type	Swoffer			Instrument Serial #							
Stage (m)	Start	Reading	0.135	Time	8:50						
	End	Reading	0.136	Time	9:20						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.32	0.00	0.00	0.00	0			0.000	0.0
	1.39	0.10	0.07	0.01	0.01			0.000	4.3
	1.45	0.10	0.06	0.00	0.04			0.000	12.0
	1.48	0.10	0.03	0.00	0.06			0.000	12.0
	1.51	0.07	0.03	0.00	0.04			0.000	6.5
	1.55	0.07	0.04	0.00	0.1			0.000	16.3
	1.58	0.06	0.03	0.00	0.2			0.000	23.9
	1.61	0.06	0.03	0.00	0.14			0.000	25.1
RB	1.67	0.00	0.06	0.00	0			0.000	0.0
Total Q								**0.00151**	**100.0**

General Notes

Appendix 2-3. Manual Discharge Measurements and Levelling Surveys at GL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	7-Jun-12			
Time at Site (24 hr)	Start Time:	3:30:00 PM	End Time:	5:40:00 PM
Personnel	Eli, Coby			
Station Cordinates	Easting	Northing	Elevation	
	432,891	7,269,919		
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	2818016
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	1	Memory Free	32535 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 17	1.506	101.506		100.000	
BM 18			1.367	100.139	
PT			2.603	98.903	
WL			1.671	**99.835**	
BM19			1.475	100.031	
BM19	1.394	101.425			
PT			2.523	98.902	
WL			1.586	**99.839**	
BM18			1.286	100.139	
BM17			1.425	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.139	0.002	
BM19	100.042	100.031	-0.011	
PT	98.902	99.369	0.467	

Summary	
Stage (m)	99.837
Discharge (m^3/s)	0.335
Pressure Transducer Reading (m)	0.981
Pressure Transducer Elevation (m)	98.856

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start		End		Location	10m upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type	Flo-mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.981	Time	16:00					
	End	Reading	0.981	Time	17:00					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	18.22	0.00	0.00	0.00	0			0.000	0.0
	18.30	0.06	0.08	0.01	0.05			0.000	0.1
	18.40	0.11	0.10	0.01	0.08			0.001	0.3
	18.50	0.18	0.10	0.02	0.11			0.002	0.6
	18.60	0.20	0.10	0.02	0.08			0.002	0.5
	18.70	0.20	0.10	0.02	0.21			0.004	1.3
	18.80	0.27	0.10	0.03	0.37			0.010	3.0
	18.90	0.28	0.10	0.03	0.43			0.012	3.6
	19.00	0.33	0.10	0.03	0.53			0.017	5.2
	19.10	0.36	0.10	0.04	0.49			0.018	5.3
	19.20	0.41	0.10	0.04	0.6			0.025	7.3
	19.30	0.43	0.10	0.04	0.59			0.025	7.6
	19.40	0.45	0.10	0.04	0.58			0.026	7.8
	19.50	0.42	0.10	0.04	0.6			0.025	7.5
	19.60	0.44	0.10	0.04	0.61			0.027	8.0
	19.70	0.46	0.10	0.05	0.65			0.030	8.9
	19.80	0.47	0.10	0.05	0.67			0.031	9.4
	19.90	0.46	0.10	0.05	0.74			0.034	10.2
	20.00	0.40	0.10	0.04	0.61			0.024	7.3
	20.10	0.36	0.10	0.04	0.39			0.014	4.2
	20.20	0.29	0.10	0.03	0.16			0.005	1.4
	20.30	0.24	0.10	0.02	0.09			0.002	0.6
	20.40	0.20	0.10	0.02	0.05			0.001	0.3
	20.50	0.19	0.10	0.02	0			0.000	0.0
	20.60	0.18	0.10	0.03	-0.03			-0.001	-0.2
LB	20.80	0.00	0.20	0.00	0			0.000	0.0
Total Q								**0.335**	**100.0**

General Notes
Plain grass bed with deep boulder pool. Small riffle 20m downstream.

Appendix 2-3. Manual Discharge Measurements and Levelling Surveys at GL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	13-Jun-12			
Time at Site (24 hr)	Start Time:	10:25:00 AM	End Time:	11:50:00 AM
Personnel	Eli H., Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	432,891	7,269,919		
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	2818016
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	830	Memory Free	32116 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 17	1.622	101.622		100.000	
BM 18			1.482	100.140	
PT			2.709	98.913	error, on clamp
WL			1.876	**99.746**	
BM19			1.588	100.034	Az
BM19	1.561	101.595			175.000
PT			2.690	98.905	
WL			1.846	**99.749**	272.000
BM18			1.454	100.141	139.000
BM17			1.594	100.001	129.000

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.141	0.004	
BM19	100.042	100.034	-0.008	
PT	98.902	98.905	0.003	

Summary	
Stage (m)	99.748
Discharge (m^3/s)	0.0503
Pressure Transducer Reading (m)	0.889
Pressure Transducer Elevation (m)	98.859

Discharge Measurement - Mid-Section Method											
Time (24 hr)	Start	10:33	End	11:08	Location	15m upstream of PT					
Method	Velocity-area (Mid-section)				Instrument Model	Flowmate					
Flow Meter Type	Flo-mate				Instrument Serial #	2004405					
Stage (m)	Start	Reading	0.888		Time	10:33					
	End	Reading	0.889		Time	11:08					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.66	0.00	0.00	0.00	0			0.000	0.0
	0.75	0.07	0.09	0.01	-0.01			0.000	-0.1
	0.85	0.14	0.10	0.01	0			0.000	0.0
	0.90	0.18	0.05	0.01	0.01			0.000	0.3
	1.00	0.26	0.10	0.03	0.05			0.001	2.6
	1.10	0.25	0.10	0.03	0.1			0.003	5.0
	1.20	0.26	0.10	0.03	0.12			0.003	6.2
	1.30	0.26	0.10	0.03	0.12			0.003	6.2
	1.40	0.28	0.10	0.03	0.13			0.004	7.2
	1.50	0.28	0.10	0.03	0.15			0.004	8.3
	1.60	0.30	0.10	0.03	0.14			0.004	8.3
	1.70	0.34	0.10	0.03	0.15			0.005	10.1
	1.80	0.34	0.10	0.03	0.15			0.005	10.1
	1.90	0.34	0.10	0.03	0.17			0.006	11.5
	2.00	0.34	0.10	0.03	0.16			0.005	10.8
	2.10	0.30	0.10	0.03	0.15			0.005	8.9
	2.20	0.22	0.10	0.02	0.08			0.002	3.5
	2.30	0.14	0.10	0.01	0.04			0.001	1.1
	2.40	0.10	0.10	0.01	0			0.000	0.0
	2.50	0.06	0.10	0.01	-0.01			0.000	-0.1
LB	2.60	0.00	0.10	0.00	0			0.000	0.0
Total Q								**0.0503**	**100.0**

General Notes
Gradiant = 1.5%

Appendix 2-3. Manual Discharge Measurements and Levelling Surveys at GL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	9-Jul-12			
Time at Site (24 hr)	Start Time:	1:50:00 PM	End Time:	5:45:00 PM
Personnel	Eli H., Yasser A.			
Station Cordinates	Easting	Northing	Elevation	
	432,891	7,269,919		
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	2818016
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	4595	Memory Free	30230
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 17	1.677	101.677		100.000	
BM 18			1.520	100.157	
BM 19			1.623	100.054	
PT			2.754	98.923	
WL			2.002	**99.675**	
TBM	1.687	101.622	1.742	99.935	
WL			1.942	**99.680**	
PT			2.698	98.924	
BM 19			1.568	100.054	
BM 18			1.462	100.160	
BM 17			1.619	100.003	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.159	0.022	
BM 19	100.042	100.054	0.012	
PT	98.902	98.924	0.022	

Summary	
Stage (m)	99.678
Discharge (m^3/s)	0.0167
Pressure Transducer Reading (m)	0.795
Pressure Transducer Elevation (m)	98.883

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	14:02	End	14:45	Location	15m upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flomate				
Flow Meter Type	Flo-mate			Instrument Serial #		2007612				
Stage (m)	Start	Reading	0.796	Time	14:02					
	End	Reading	0.795	Time	14:45					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	0.98	0.00	0.00	0.00	0.00	0.00		0.000	0.0
	1.05	0.32	0.10	0.07	0.01	0.00		0.000	0.0
	1.10	0.50	0.15	0.05	0.01	0.01		0.000	0.5
	1.17	0.68	0.21	0.07	0.01	0.01		0.000	0.9
	1.24	0.80	0.24	0.07	0.02	0.01		0.000	1.0
	1.31	0.90	0.27	0.07	0.02	0.03		0.001	3.4
	1.38	0.95	0.29	0.07	0.02	0.04		0.001	4.9
	1.45	0.96	0.29	0.07	0.02	0.04		0.001	4.9
	1.52	0.95	0.29	0.07	0.02	0.05		0.001	6.1
	1.59	0.90	0.27	0.07	0.02	0.06		0.001	6.9
	1.66	0.80	0.24	0.07	0.02	0.07		0.001	7.1
	1.73	0.81	0.25	0.07	0.02	0.07		0.001	7.2
	1.80	0.87	0.27	0.07	0.02	0.06		0.001	6.7
	1.87	0.90	0.27	0.07	0.02	0.07		0.001	8.0
	1.94	0.90	0.27	0.07	0.02	0.07		0.001	8.0
	2.01	0.92	0.28	0.07	0.02	0.05		0.001	5.9
	2.08	0.96	0.29	0.07	0.02	0.06		0.001	7.4
	2.15	0.93	0.28	0.07	0.02	0.05		0.001	5.9
	2.22	0.90	0.27	0.07	0.02	0.05		0.001	5.7
	2.29	0.67	0.20	0.07	0.01	0.06		0.001	5.1
	2.36	0.60	0.18	0.07	0.01	0.03		0.000	2.3
	2.43	0.54	0.16	0.07	0.01	0.03		0.000	1.9
	2.49	0.20	0.06	0.06	0.00	0.00		0.000	0.0
LB	2.53	0.00	0.00	0.04	0.00	0.00		0.000	0.0
Total Q								**0.0167**	**100.0**

General Notes
Gradiant = 1.5%. Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-3. Manual Discharge Measurements and Levelling Surveys at GL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	15-Aug-12			
Time at Site (24 hr)	Start Time:	10:05:00 AM	End Time:	1:00:00 PM
Personnel	Eli H., Cenling X			
Station Cordinates	Easting	Northing	Elevation	
	432,891	7,269,919		
Weather Conditions	Above Zero	Partly Cloudy		

Transducer Information			
PT Model	PS98i	Serial #	2818016
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	9900	Memory Free	55276
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 17	1.780	101.780		100.000	
BM 18			1.627	100.153	
BM 19			1.728	100.052	
PT			2.845	98.935	
WL			2.212	**99.568**	
TBM	2.779	101.714	2.845	98.935	
WL			2.148	**99.566**	
PT			2.779	98.935	
BM 19			1.661	100.053	
BM 18			1.562	100.152	
BM 17			1.713	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.153	0.016	
BM 19	100.042	100.053	0.011	
PT	98.902	98.935	0.033	

Summary	
Stage (m)	99.567
Discharge (m^3/s)	No Flow
Pressure Transducer Reading (m)	0.680
Pressure Transducer Elevation (m)	98.887

Discharge Measurement - Mid-Section Method						
Time (24 hr)	Start	N/A	End	N/A	Location	N/A
Method	No Flow			Instrument Model		
Flow Meter Type				Instrument Serial #		
Stage (m)	Start	Reading	0.68	Time	N/A	No Flow on August 15th
	End	Reading	0.68	Time	N/A	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
NO FLOW									

Appendix 2-3. Manual Discharge Measurements and Levelling Surveys at GL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	GL-H3			
Stream Name	Inflow to GL			
Date Monitored	9-Sep-12			
Time at Site (24 hr)	Start Time:	3:45:00 PM	End Time:	5:00:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	432,891	7,269,919		
Weather Conditions	Above Zero	Partly Cloudy		

Transducer Information			
PT Model	PS98i	Serial #	2818016
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	13535	Memory Free	25759
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 17	1.739	101.739		100.000	BM 17
BM 18			1.600	100.139	BM 18
BM 19			1.695	100.044	BM 19
PT			2.800	98.939	
WL			2.098	**99.641**	
TBM	1.661	101.641	1.759	99.980	
WL			2.001	**99.640**	
PT			2.701	98.940	
BM 19			1.597	100.044	BM 19
BM 18			1.502	100.139	BM 18
BM 17			1.641	100.000	BM 17

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 18	100.137	100.139	0.002	
BM 19	100.042	100.044	0.002	
PT	98.902	98.940	0.038	

Summary	
Stage (m)	99.641
Discharge (m^3/s)	0.00352
Pressure Transducer Reading (m)	0.748
Pressure Transducer Elevation (m)	98.893

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:58	End	16:30	Location	15m US of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Swoffer				
Flow Meter Type	Swoffer			Instrument Serial #						
Stage (m)	Start	Reading	0.748	Time	15:58					
	End	Reading	0.748	Time	16:30					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.42	0.00	0.00	0.00	0			0.000	0.0
	0.45	0.03	0.03	0.00	0			0.000	0.0
	0.50	0.07	0.05	0.00	0.01			0.000	1.0
	0.55	0.01	0.05	0.00	0.01			0.000	0.2
	0.60	0.12	0.05	0.01	0.01			0.000	1.7
	0.65	0.14	0.05	0.01	0.06			0.000	11.9
	0.70	0.14	0.05	0.01	0.07			0.000	13.9
	0.75	0.12	0.05	0.01	0.06			0.000	10.2
	0.80	0.12	0.05	0.01	0.04			0.000	6.8
	0.85	0.10	0.05	0.01	0.07			0.000	10.0
	0.90	0.08	0.05	0.00	0.07			0.000	8.0
	0.95	0.07	0.05	0.00	0.08			0.000	8.0
	1.00	0.06	0.05	0.00	0.07			0.000	6.0
	1.05	0.07	0.05	0.00	0.05			0.000	5.0
	1.10	0.09	0.05	0.00	0.06			0.000	7.7
	1.15	0.10	0.05	0.01	0.05			0.000	7.1
	1.20	0.11	0.05	0.01	0.01			0.000	1.6
	1.25	0.07	0.05	0.00	0.01			0.000	1.0
	1.30	0.07	0.05	0.00	0			0.000	0.0
	1.35	0.04	0.05	0.00	0			0.000	0.0
LB	1.40	0.00	0.05	0.00	0			0.000	0.0
Total Q								**0.00352**	**100.0**

General Notes

Appendix 2-4a. ADCP Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	6-Jun-12			
Time at Site (24 hr)	**Start Time:**	8:45	**End Time:**	15:00
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PS98i	**Serial #**	2718019
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	1	**Memory Free**	32530
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	0.808	100.808		100.000	
BM 7			1.270	99.538	
PT			2.296	98.512	
WL			1.375	**99.433**	
BM 6	1.259	100.860	1.207	99.601	
WL			1.427	**99.433**	
PT			2.349	98.511	
BM 7			1.322	99.538	
BM 8			0.861	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	99.539	99.538	-0.001	BM 8
BM 6	99.603	99.601	-0.002	BM 7
PT	98.512	98.512	0.000	BM 6

Discharge Measurement ADCP								
Time (24 hr)		**Start**	10:17	**End**	13:51	**Location**	~15m Upstream of station	
Method		Velocity-area (ADCP)				**Water Temp (ADCP)(°C)**	4	
Flow Meter Type		ADCP				**Water Temp (Therm) (°C)**		
Instrument Model		SteamPro				**Mean Discharge Q (m^3/s)**	19.3	
Instrument Serial#						**Error (Std Dev in m^3/s)**	0.36	
Stage (m)	**Start**	**Reading**	0.955	**Time**	**10:17**	**Mean % of Q Measured**	71.5	
	End	**Reading**	0.952	**Time**	**13:51**			
File Location		N:\833 Sabina\833-002 Back River\833-002-02 WaterResources-Hydrology\Data and Documentation\Flow Measurements\						
		2012\ADCP\June\PL-H1_060612\PL-H1_060612						

Transect #	Discharge Q (m^3/s)						% Q Measured	% Bad	
	Top	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**		**Ensembles**	**Bins**
2	1.931	13.733	3.609	0.058	0.085	19.415	70.7	30	0
3	1.865	13.246	3.494	0.086	0.075	18.766	70.6	27	0
4	1.750	14.191	3.216	0.069	0.069	19.296	73.5	32	0
5	1.915	13.930	3.578	0.090	0.077	19.591	71.1	29	0
Mean	**1.87**	**13.78**	**3.47**	**0.08**	**0.08**	**19.27**	71.5	**29.5**	**0.0**

General Notes

High percentage of bad ensembles is due to bouldery bottom of channel. Have selected transects based on lowest values for % bad bins and similar measured channel width.
Rejected Transect #1 due to larger width and missing data near left bank. Rejected transect 6 due to high number of %bad ensembles.

Summary

Stage (m)	99.433		
Discharge (m^3/s)	19.267		
Pressure Transducer Reading (m)	0.953		
Pressure Transducer Elevation (m)	98.480		

Appendix 2-4a. ADCP Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	14-Jun-12			
Time at Site (24 hr)	**Start Time:**	8:45	**End Time:**	11:30
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PS98i	**Serial #**	2718019
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	1143	**Memory Free**	31960
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	1.009	101.009		100.000	
BM 7			1.471	99.538	
PT			2.501	98.508	error
WL			1.855	**99.154**	
BM 6	1.345	100.947	1.407	99.602	
WL			1.793	**99.154**	
PT			2.435	98.512	checked, ok
BM 7			1.408	99.539	
BM 8			0.947	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	99.539	99.539	-0.001	
BM 6	99.603	99.602	-0.001	
PT	98.512	98.510	-0.002	

Discharge Measurement ADCP								
Time (24 hr)		**Start**	10:17	**End**	13:51	**Location**	~15m Upstream of station	
Method		Velocity-area (ADCP)				**Water Temp (ADCP)(°C)**	3.31	
Flow Meter Type		ADCP				**Water Temp (Therm) (°C)**		
Instrument Model		SteamPro				**Mean Discharge Q (m^3/s)**	6.9	
Instrument Serial#						**Error (Std Dev in m^3/s)**	0.23	
Stage (m)	**Start**	**Reading**	0.955	**Time**	**10:17**	**Mean % of Q Measured**	71.0	
	End	**Reading**	0.952	**Time**	**13:51**			
File Location		N:\833 Sabina\833-002 Back River\833-002-02 WaterResources-Hydrology\Data and Documentation\Flow Measurements\						
		2012\ADCP\June\PL-H1_140612\PL-H1_140612						

Transect #	Discharge Q (m^3/s)						% Q Measured	% Bad	
	Top	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**		**Ensembles**	**Bins**
15	0.75	5.07	1.26	0.05	0.05	7.18	70.6	35	1
16	0.70	4.89	1.27	0.03	0.05	6.94	70.5	39	1
17	0.71	4.99	1.17	0.03	0.06	6.96	71.8	36	1
22	0.68	4.70	1.17	0.03	0.04	6.62	71.0	23	1
Mean	**0.7**	**4.9**	**1.2**	**0.0**	**0.0**	**6.9**	**71.0**	**33.3**	**1.0**

General Notes

High percentage of bad ensembles is due to bouldery nature of the channel bottom. Values chosen based on lowest number of bad ensembles

Summary			
Stage (m)	99.154		
Discharge (m^3/s)	6.922		
Pressure Transducer Reading (m)	0.674		
Pressure Transducer Elevation (m)	98.480		

Appendix 2-4a. ADCP Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	14-Jul-12			
Time at Site (24 hr)	**Start Time:**	10:20	**End Time:**	16:30
Personnel	Eli H., Craig H., Kaitlin G.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PS98i	**Serial #**	2718019
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	5473	**Memory Free**	29799
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	1.006	101.006		100.000	BM 8
BM 7			1.469	99.537	BM 7
BM 6			1.405	99.601	BM 6
PT			2.498	98.508	
WL			2.187	**98.819**	
TBM	2.145	101.049	2.102	98.904	
WL			2.231	**98.818**	
PT			2.541	98.508	
BM 6			1.447	99.602	BM 6
BM 7			1.511	99.538	BM 7
BM 8			1.048	100.001	BM 8

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**		**Difference (m)**	**Notes**
BM 7	99.539	99.538		-0.002	
BM 6	99.603	99.602		-0.002	
PT	98.512	98.508		-0.004	

Discharge Measurement ADCP								
Time (24 hr)		**Start**	10:17	**End**	13:51	**Location**	~15m Upstream of station	
Method		Velocity-area (ADCP)				**Water Temp (ADCP)(°C)**	14	
Flow Meter Type		ADCP				**Water Temp (Therm) (°C)**		
Instrument Model		SteamPro				**Mean Discharge Q (m^3/s)**	1.7	
Instrument Serial#						**Error (Std Dev in m^3/s)**	0.40	
Stage (m)	**Start**	**Reading**	0.326	**Time**	**10:45**	**Mean % of Q Measured**	0.0	
	End	**Reading**	0.325	**Time**	**14:15**			
File Location		N:\833 Sabina\833-002 Back River\833-002-02 WaterResources-Hydrology\Data and Documentation\Flow Measurements\						
		2012\ADCP\July\PL-H1_140712\PL-H1_140712						

Transect #	**Discharge Q (m^3/s)**						**% Q Measured**	**% Bad**	
	Top	**Mid**	**Bottom**	**Left**	**Right**	**Total Q**		**Ensembles**	**Bins**
13	0.342	0.874	0.426	0.161	0.187	1.990	43.920	2	8
15	0.510	0.581	0.399	0.033	-0.100	1.423	40.829	3	7
16	0.175	0.688	0.286	-0.047	0.008	1.110	61.982	3	6
18	0.334	0.980	0.526	-0.246	0.037	1.631	60.086	2	7
19	0.303	0.648	0.376	-0.297	0.180	1.210	53.554	1	8
Mean	**0.33**	**0.75**	**0.40**	**-0.08**	**0.06**	**1.47**	**52.07**	**2.20**	**7.20**

General Notes

Measured values varied significantly due to low flow conditions. Also used flow-mate on this date in order compare values further upstream.

Summary	
Stage (m)	98.819
Discharge (m^3/s)	1.473
Pressure Transducer Reading (m)	0.326
Pressure Transducer Elevation (m)	98.493

Appendix 2-4b. Manual Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	15-Jul-12			
Time at Site (24 hr)	Start Time:	9:25:00 AM	End Time:	12:00:00 PM
Personnel				
Station Cordinates	Easting	Northing	Elevation	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2718019
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	29730	Memory Free	5612
Date Serviced	N/A	Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 8	0.994	100.994		100.000	
BM 7			1.456	99.538	
BM 6			1.393	99.601	
PT			2.486	98.508	
WL			2.185	**98.809**	
TBM	2.089	100.920	2.163	98.831	
WL			2.112	**98.808**	
PT			2.410	98.510	
BM 6			1.320	99.600	
BM 7			1.383	99.537	
BM 8			0.921	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	99.539	99.538	-0.002	
BM 6	99.603	99.601	-0.002	
PT	98.512	98.509	-0.003	

Summary	
Stage (m)	98.809
Discharge (m^3/s)	1.051
Pressure Transducer Reading (m)	0.316
Pressure Transducer Elevation (m)	98.493

Discharge Measurement - Mid-Section Method (continued on following page)												
Time (24 hr)	Start	9:30	End	11:15	Location	200m Upstream of PT						
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000						
Flow Meter Type	Flo-Mate			Instrument Serial #								
Stage (m)	Start	Reading	0.316	Time	9:30							
	End	Reading	0.316	Time	11:15							

	Station	Depth	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	2.40	0.00	0.00	0.00	0.02	0.00			0.000	0.0
	2.55	0.70	0.21	0.15	0.05	-0.01			-0.001	-0.1
	2.90	0.20	0.06	0.35	0.04	0.02			0.001	0.1
	4.00	1.32	0.40	1.10	0.42	0.10			0.042	4.0
	5.00	1.00	0.30	1.00	0.30	0.15			0.046	4.3
	6.00	0.91	0.28	1.00	0.28	0.04			0.011	1.1
	7.00	0.20	0.06	1.00	0.06	0.12			0.007	0.7
	8.00	0.46	0.14	1.00	0.14	0.18			0.025	2.4
	9.00	0.41	0.12	1.00	0.12	0.11			0.014	1.3
	10.00	0.76	0.23	1.00	0.23	0.16			0.037	3.5
	11.00	0.41	0.12	1.00	0.12	0.27			0.034	3.2
	12.00	0.66	0.20	1.00	0.20	0.17			0.034	3.3
	13.00	0.62	0.19	1.00	0.19	0.12			0.023	2.2
	14.00	0.78	0.24	1.00	0.18	0.06			0.011	1.0
	14.50	0.70	0.21	0.50	0.11	0.09			0.010	0.9
	15.00	0.00	0.00	0.50	0.00	0.00			0.000	0.0
	15.50	0.58	0.18	0.50	0.09	0.05			0.004	0.4
	16.00	0.22	0.07	0.50	0.05	0.14			0.007	0.7
	17.00	0.39	0.12	1.00	0.11	0.00			0.000	0.0
	17.90	1.50	0.46	0.90	0.46	0.02			0.009	0.9
	19.00	0.49	0.15	1.10	0.16	0.03			0.005	0.4
	20.00	0.51	0.16	1.00	0.16	0.02			0.003	0.3
	21.00	1.51	0.46	1.00	0.46	0.04			0.018	1.8
	22.00	2.32	0.71	1.00	0.71	0.06			0.042	4.0
	23.00	2.18	0.66	1.00	0.50	0.17			0.085	8.1
	23.50	1.19	0.36	0.50	0.18	0.28			0.051	4.8
	24.00	2.00	0.61	0.50	0.30	0.29			0.088	8.4
	24.50	2.03	0.62	0.50	0.31	0.33			0.102	9.7
cont'd								**0.709**	**0.7**	**67.4**

General Notes
ADCP Measurement taken previous day. At location of measurement may have missed some flow due to bouldery nature of channel.

Appendix 2-4b. Manual Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	15-Jul-12			
Time at Site (24 hr)	Start Time:	9:25:00 AM	End Time:	12:00:00 PM
Personnel				
Station Cordinates	Easting	Northing	Elevation	
	436094	7279939		
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2718019
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	29730	Memory Free	5612
Date Serviced	N/A	Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (completed)											
Time (24 hr)	Start	9:30	End	11:15	Location	200m Upstream of PT					
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000					
Flow Meter Type	Flo-Mate			Instrument Serial #							
Stage (m)	Start	Reading	0.316	Time	9:30						
	End	Reading	0.316	Time	11:15						
cont'd	Station	Depth	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q	
Notes	(m)	(ft)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%	
	25.00	2.30	0.70	0.0	0.35	0.22			0.077	7.3	
	25.50	1.71	0.52	0.5	0.26	0.16			0.042	4.0	
	26.00	2.20	0.67	0.5	0.50	0.12			0.060	5.7	
	27.00	2.17	0.66	1.0	0.66	0.13			0.086	8.2	
	28.00	1.57	0.48	1.0	0.48	0.06			0.029	2.7	
	29.00	0.61	0.19	1.0	0.19	0.05			0.009	0.9	
	30.00	1.06	0.32	1.0	0.24	0.11			0.027	2.5	
	30.50	0.66	0.20	0.5	0.10	0.10			0.010	1.0	
	31.00	0.30	0.09	0.5	0.05	0.05			0.002	0.2	
LB	31.50	0.00	0.00	0.5	0.02	0.00			0.000	0.0	
Total Q									1.051	32.6	

General notes

Appendix 2-4b. Manual Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	13-Aug-12			
Time at Site (24 hr)	**Start Time:**	10:15:00 AM	**End Time:**	4:00:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	436094	7279939		
Weather Conditions	cloudy, cool			

Transducer Information			
PT Model	PS98i	**Serial #**	2718019
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	9793	**Memory Free**	27639
Date Serviced	N/A	**Crest Gauges**	no

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 8	0.932	100.932		100.000	
BM 7			1.395	99.537	
BM 6			1.331	99.601	
PT			2.427	98.505	
WL			2.308	**98.624**	
TBM	2.160	100.878	2.214	98.718	
WL			2.255	**98.623**	
PT			2.372	98.506	
BM 6			1.277	99.601	
BM 7			1.340	99.538	
BM 8			0.877	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 7	99.539	99.538	-0.002	
BM 6	99.603	99.601	-0.002	
PT	98.512	98.506	-0.007	

Summary	
Stage (m)	98.624
Discharge (m^3/s)	0.316
Pressure Transducer Reading (m)	0.132
Pressure Transducer Elevation (m)	98.492

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	10:30	**End**	14:00	**Location**	400m Upstream of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2006042			
Stage (m)	**Start**	**Reading**	0.133	**Time**	10:30				
	End	**Reading**	0.132	**Time**	14:00				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	2.00	0.00	0.00	0.03	0			0.000	0.0
	2.20	0.27	0.20	0.07	0.16			0.011	3.5
	2.50	0.50	0.30	0.15	0.15			0.023	7.2
	2.80	0.56	0.30	0.14	0.13			0.018	5.7
	3.00	0.50	0.20	0.10	0.13			0.013	4.1
	3.20	0.61	0.20	0.12	0.14			0.017	5.4
	3.40	0.65	0.20	0.13	0.12			0.016	4.9
	3.60	0.64	0.20	0.13	0.14			0.018	5.7
	3.80	0.62	0.20	0.12	0.2			0.025	7.9
	4.00	0.58	0.20	0.12	0.24			0.028	8.8
	4.20	0.49	0.20	0.10	0.28			0.027	8.6
	4.40	0.40	0.20	0.08	0.28			0.022	7.0
	4.60	0.40	0.20	0.08	0.24			0.019	6.0
	4.80	0.32	0.20	0.06	0.34			0.022	6.9
	5.00	0.38	0.20	0.08	0.19			0.014	4.6
Behind Rock	5.20	0.40	0.20	0.08	0.09			0.007	2.3
Behind Rock	5.40	0.32	0.20	0.06	0			0.000	0.0
Behind Rock	5.60	0.23	0.20	0.05	0.02			0.001	0.3
Behind Rock	5.80	0.24	0.20	0.05	0.01			0.000	0.2
	6.00	0.18	0.20	0.04	0.13			0.005	1.5
	6.20	0.18	0.20	0.04	0.26			0.010	3.0
	6.40	0.14	0.20	0.03	0.28			0.008	2.4
	6.60	0.20	0.20	0.04	0.2			0.008	2.5
	6.80	0.15	0.20	0.03	0.13			0.004	1.3
	7.00	0.12	0.20	0.02	0.01			0.000	0.1
	7.20	0.03	0.20	0.00	0.18			0.001	0.2
LB	7.25	0.00	0.05	0.00	0			0.000	0.0
Total Q								**0.316**	100.0

General Notes
Prefered location for manual flow measurement under low flow conditions (further upstream than July). Still likely to be significant underground flow due to large boulders in the channel.

Appendix 2-4b. Manual Discharge Measurements and Levelling Surveys at PL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H1			
Stream Name	Propeller Outflow			
Date Monitored	8-Sep-12			
Time at Site (24 hr)	Start Time:	9:00:00 AM	End Time:	4:00:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	436094	7279939		
Weather Conditions	cloudy			

Transducer Information			
PT Model	PS98i	Serial #	2718019
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	13555	Memory Free	25757
Date Serviced	N/A	Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 8	1.508	101.508		100.000	
BM 7			1.971	99.537	
BM 6			1.908	99.600	
PT			3.016	98.492	
WL			2.944	**98.564**	
TBM	2.843	101.436	2.915	98.593	
WL			2.874	**98.562**	
PT			2.945	98.491	
BM 6			1.836	99.600	
BM 7			1.900	99.536	
BM 8			1.437	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 7	99.539	99.537	-0.003	
BM 6	99.603	99.600	-0.003	
PT	98.512	98.492	-0.020	

Summary	
Stage (m)	98.563
Discharge (m^3/s)	0.116
Pressure Transducer Reading (m)	0.0703
Pressure Transducer Elevation (m)	98.493

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:00	End	16:00	Location	400m Upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Swoffer 2100				
Flow Meter Type	Swoffer			Instrument Serial #						
Stage (m)	Start	Reading	0.070	Time	15:00					
	End	Reading	0.070	Time	16:00					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	1.24	0.00	0.00	0.00	0			0.000	0.0
	1.30	0.10	0.06	0.01	0.02			0.000	0.1
	1.40	0.10	0.10	0.02	0.06			0.001	0.9
	1.65	0.16	0.25	0.04	0.01			0.000	0.3
	1.90	0.07	0.25	0.02	0.02			0.000	0.3
	2.15	0.10	0.25	0.03	0.01			0.000	0.2
	2.40	0.20	0.25	0.05	0.01			0.001	0.4
	2.65	0.15	0.25	0.03	0.06			0.002	1.6
	2.80	0.11	0.15	0.02	0.02			0.000	0.3
	3.00	0.34	0.20	0.05	0.07			0.004	3.1
	3.10	0.48	0.10	0.06	0.18			0.011	9.3
	3.25	0.50	0.15	0.08	0.21			0.016	13.6
	3.40	0.51	0.15	0.08	0.24			0.018	15.8
	3.55	0.62	0.15	0.09	0.11			0.010	8.8
	3.70	0.62	0.15	0.09	0.18			0.017	14.4
	3.85	0.63	0.15	0.09	0.09			0.009	7.3
	4.00	0.62	0.15	0.11	0.06			0.007	5.6
	4.20	0.55	0.20	0.11	0.05			0.006	4.7
	4.40	0.42	0.20	0.08	0.05			0.004	3.6
	4.60	0.40	0.20	0.08	0.06			0.005	4.1
	4.80	0.41	0.20	0.08	0.05			0.004	3.5
	5.00	0.43	0.20	0.08	0.01			0.001	0.6
	5.15	0.40	0.15	0.04	0.01			0.000	0.3
	5.20	0.19	0.05	0.01	0.06			0.001	0.7
LB	5.30	0.00	0.10	0.01	0			0.000	0.0
Total Q								**0.116**	100.0

General Notes

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	12-Jun-12			
Time at Site (24 hr)	**Start Time:**	11:45:00 AM	**End Time:**	3:00:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1	**Memory Free**	524139 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 04	1.366	101.366		100.000	
BM 45			1.519	99.847	
PT			2.026	99.340	
WL			1.597	**99.769**	
BM 46	1.189	101.343	1.212	100.154	
WL			1.573	**99.770**	
PT			2.000	99.343	
BM 45			1.495	99.848	
BM 04			1.342	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 45	99.869	99.848	-0.022	est. from 2011
BM 46	100.177	100.154	-0.023	est. from 2011
PT	99.342	99.342	-0.001	From install date

Summary	
Stage (m)	99.770
Discharge (m^3/s)	3.456
Pressure Transducer Reading (m)	0.445
Pressure Transducer Elevation (m)	99.325

Discharge Measurement - Mid-Section Method											
Time (24 hr)	**Start**	12:31	**End**	14:00	**Location**	~20m Dowstream of station					
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000					
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405					
Stage (m)	**Start**	**Reading**	0.446	**Time**	12:31						
	End	**Reading**	0.445	**Time**	14:00						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	17.90	0.00	0.00	0.06	0			0.000	0.0
	18.25	0.32	0.35	0.34	0.06			0.020	0.6
	20.00	0.25	1.75	0.41	0.19			0.078	2.3
	21.55	0.10	1.55	0.10	0.05			0.005	0.1
Rocks	22.00	0.00	0.45	0.00	0			0.000	0.0
	23.00	0.16	1.00	0.24	0.07			0.017	0.5
	25.00	0.17	2.00	0.34	0.14			0.048	1.4
	27.00	0.16	2.00	0.32	0.29			0.093	2.7
	29.00	0.21	2.00	0.42	0.3			0.126	3.6
	31.00	0.18	2.00	0.36	0.13			0.047	1.4
	33.00	0.20	2.00	0.40	0.4			0.160	4.6
	35.00	0.29	2.00	0.58	0.32			0.186	5.4
	37.00	0.28	2.00	0.56	0.33			0.185	5.3
	39.00	0.34	2.00	0.68	0.31			0.211	6.1
	41.00	0.39	2.00	0.78	0.37			0.289	8.4
	43.00	0.34	2.00	0.68	0.36			0.245	7.1
	45.00	0.30	2.00	0.60	0.29			0.174	5.0
DS of Rocks	47.00	0.44	2.00	0.88	0.15			0.132	3.8
	49.00	0.32	2.00	0.64	0.29			0.186	5.4
	51.00	0.34	2.00	0.68	0.33			0.224	6.5
	53.00	0.30	2.00	0.60	0.37			0.222	6.4
	55.00	0.22	2.00	0.44	0.34			0.150	4.3
	57.00	0.30	2.00	0.60	0.33			0.198	5.7
	59.00	0.24	2.00	0.48	0.32			0.154	4.4
	61.00	0.16	2.00	0.32	0.3			0.096	2.8
	63.00	0.22	2.00	0.44	0.13			0.057	1.7
	65.00	0.22	2.00	0.44	0.16			0.070	2.0
	67.00	0.12	2.00	0.24	0.11			0.026	0.8
	69.00	0.20	2.00	0.37	0.15			0.056	1.6
	70.70	0.17	1.70	0.15	0.02			0.003	0.1
LB	70.78	0.00	0.08	0.01	0			0.000	0.0
Total Q								**3.456**	**100.0**

General Notes

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	16-Jun-12			
Time at Site (24 hr)	**Start Time:**	2:15:00 PM	**End Time:**	4:30:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	588	**Memory Free**	523551 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 04	1.407	101.407		100.000	
BM 45			1.555	99.852	
PT			2.066	99.341	
WL			1.700	**99.707**	
BM 46	1.213	101.370	1.250	100.157	
WL			1.662	**99.708**	
PT			2.031	99.339	
BM 45			1.520	99.850	
BM 04			1.371	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 45	99.869	99.851	-0.018	est. from 2011
BM 46	100.177	100.157	-0.020	est. from 2011
PT	99.342	99.340	-0.002	From install date

Summary	
Stage (m)	99.708
Discharge (m^3/s)	1.731
Pressure Transducer Reading (m)	0.394
Pressure Transducer Elevation (m)	99.314

Discharge Measurement - Mid-Section Method											
Time (24 hr)	**Start**	14:38	**End**	15:30	**Location**	~20m Dowstream of station					
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000					
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405					
Stage (m)	**Start**	**Reading**	0.395	**Time**	14:38						
	End	**Reading**	0.395	**Time**	15:30						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	18.80	0.00	0.00	0.03	0			0.000	0.0
	19.15	0.16	0.35	0.04	0			0.000	0.0
	19.30	0.18	0.15	0.12	0.04			0.005	0.3
	20.50	0.15	1.20	0.19	0.04			0.008	0.4
	21.80	0.13	1.30	0.12	0.04			0.005	0.3
Rock Island	22.40	0.00	0.60	0.00	0			0.000	0.0
Rock Island	23.40	0.00	0.00	0.00	0.00			0.000	0.0
	23.87	0.10	1.47	0.13	0.04			0.005	0.3
	26.00	0.08	2.13	0.17	0.03			0.005	0.3
	28.00	0.10	2.00	0.20	0.12			0.024	1.4
	30.00	0.18	2.00	0.36	0.15			0.054	3.1
	32.00	0.15	2.00	0.30	0.1			0.030	1.7
	34.00	0.14	2.00	0.28	0.30			0.084	4.9
	36.00	0.27	2.00	0.54	0.24			0.130	7.5
	38.00	0.26	2.00	0.52	0.15			0.078	4.5
	40.00	0.30	2.00	0.60	0.27			0.162	9.4
	42.00	0.25	2.00	0.50	0.26			0.130	7.5
	44.00	0.24	2.00	0.48	0.32			0.154	8.9
	46.00	0.41	2.00	0.82	0.17			0.139	8.1
	48.00	0.33	2.00	0.66	0.09			0.059	3.4
	50.00	0.28	2.00	0.56	0.17			0.095	5.5
	52.00	0.26	2.00	0.52	0.26			0.135	7.8
	54.00	0.27	2.00	0.54	0.19			0.103	5.9
	56.00	0.17	2.00	0.34	0.21			0.071	4.1
	58.00	0.24	2.00	0.48	0.19			0.091	5.3
	60.00	0.25	2.00	0.50	0.14			0.070	4.0
	62.00	0.16	2.00	0.32	0.11			0.035	2.0
	64.00	0.19	2.00	0.38	0.06			0.023	1.3
	66.00	0.10	2.00	0.20	0.1			0.020	1.2
	68.00	0.05	2.00	0.10	0.04			0.004	0.2
	70.00	0.18	2.00	0.29	0.02			0.006	0.3
	71.20	0.26	1.20	0.21	0.03			0.006	0.4
LB	71.60	0.00	0.40	0.05	0			0.000	0.0
Total Q								**1.731**	**100.0**

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	7-Jul-12			
Time at Site (24 hr)	**Start Time:**	8:30:00 AM	**End Time:**	2:00:00 PM
Personnel	Eli H., Rebecca K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	3.0V
# of Records	3578	**Memory Free**	520561
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 4	1.453	101.453		100.000	
BM 45			1.598	99.855	
BM 46			1.282	100.171	
PT			2.109	99.344	
WL			1.857	**99.596**	
TBM	1.807	101.403	1.857	99.596	
WL			1.807	**99.596**	
PT			2.060	99.343	
BM 46			1.233	100.170	
BM 45			1.548	99.855	
BM 4			1.403	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 45	99.869	99.855	-0.014	est. from 2011
BM 46	100.177	100.171	-0.007	est. from 2011
PT	99.342	99.344	0.002	From install date

Summary	
Stage (m)	99.596
Discharge (m^3/s)	0.668
Pressure Transducer Reading (m)	0.275
Pressure Transducer Elevation (m)	99.321

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	**Start**	9:00	**End**	10:03	**Location**	15m Downstream of PT		
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000		
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612		
Stage (m)	**Start**	**Reading**	0.275	**Time**	9:00	Reading values converted from psi to mH20		
	End	**Reading**	0.274	**Time**	10:03	(mH20=psi/1.422)		

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
RB	1.50	0.00	0.00	0.00	0.01	0		0.000	0.0
	1.70	0.30	0.09	0.20	0.03	0.01		0.000	0.0
	2.15	0.31	0.09	0.45	0.04	0.05		0.002	0.3
	2.60	0.10	0.03	0.45	0.02	0.01		0.000	0.0
	3.15	0.31	0.09	0.55	0.05	0.02		0.001	0.1
	3.65	0.60	0.18	0.50	0.08	0.01		0.001	0.1
	4.00	0.25	0.08	0.35	0.02	0.01		0.000	0.0
Island RB	4.30	0.00	0.00	0.30	0.00	0		0.000	0.0
Island LB	7.90	0.00	0.00	3.60	0.00	0		0.000	0.0
	8.00	0.37	0.11	0.10	0.02	0.09		0.002	0.2
Rocks	8.20	0.19	0.06	0.20	0.01	0.02		0.000	0.0
Rocks	8.30	0.00	0.00	0.10	0.00	0		0.000	0.0
	9.25	0.00	0.00	0.95	0.00	0		0.000	0.0
	9.35	0.25	0.08	0.10	0.03	0.11		0.003	0.5
	10.00	0.20	0.06	0.65	0.08	0.1		0.008	1.2
	12.00	0.22	0.07	2.00	0.09	0.03		0.003	0.4
	12.70	0.40	0.12	0.70	0.12	0.14		0.017	2.6
DS of Boulder	14.00	0.60	0.18	1.30	0.30	0.1		0.030	4.5
	16.00	0.15	0.05	2.00	0.09	0.15		0.014	2.1
	18.00	0.32	0.10	2.00	0.20	0.18		0.035	5.3
	20.00	0.61	0.19	2.00	0.37	0.18		0.067	10.0
	22.00	0.77	0.23	2.00	0.47	0.06		0.028	4.2
	24.00	0.48	0.15	2.00	0.29	0.24		0.070	10.5
	26.00	0.70	0.21	2.00	0.43	0.2		0.085	12.8
	28.00	0.45	0.14	2.00	0.27	0.15		0.041	6.2
	30.00	0.55	0.17	2.00	0.34	0.09		0.030	4.5
	32.00	0.70	0.21	2.00	0.43	0.11		0.047	7.0
	34.00	0.45	0.14	2.00	0.27	0.16		0.044	6.6
								0.529	**79.2**

General Notes

Gradiant = 1%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	7-Jul-12			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	2:00:00 PM
Personnel	Eli H., Rebecca K.			
Station Cordinates	Easting	Northing	Elevation	
	435007	7272014	266m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	Serial #	21221023
Gain	N/A	Offset	N/A
Status	Active	Battery	3.0V
# of Records	3578	Memory Free	520561
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes	

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (completed)										
Time (24 hr)	Start	9:00	End	10:03	Location	15m Downstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612				
Stage (m)	Start	Reading	0.275	Time	9:00	Reading values converted from psi to mH20				
	End	Reading	0.274	Time	10:03	(mH20=psi/1.422)				

cont'd	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
	36.00	0.60	0.18	2.00	0.37	0.1		0.037	5.5
	38.00	0.29	0.09	2.00	0.18	0.17		0.030	4.5
	40.00	0.53	0.16	2.00	0.32	0.07		0.023	3.4
	42.00	0.45	0.14	2.00	0.27	0.04		0.011	1.6
Behind Rock	44.00	0.33	0.10	2.00	0.17	0.05		0.008	1.2
	45.30	0.20	0.06	1.30	0.05	0.1		0.005	0.7
Rocks	45.50	0.00	0.00	0.20	0.00	0		0.000	0.0
Rocks	46.80	0.00	0.00	1.30	0.00	0		0.000	0.0
	46.90	0.20	0.06	0.10	0.01	0.11		0.001	0.2
	47.10	0.22	0.07	0.20	0.01	0.09		0.001	0.1
Rocks	47.20	0.00	0.00	0.10	0.00	0		0.000	0.0
Rocks	48.10	0.00	0.00	0.90	0.00	0		0.000	0.0
	48.30	0.26	0.08	0.20	0.03	0.07		0.002	0.3
	48.75	0.19	0.06	0.45	0.02	0.09		0.002	0.2
	48.90	0.00	0.00	0.15	0.00	0		0.000	0.0
	50.50	0.00	0.00	1.60	0.00	0		0.000	0.0
	50.80	0.41	0.12	0.30	0.11	0.07		0.008	1.2
	52.30	0.41	0.12	1.50	0.16	0.02		0.003	0.5
	53.30	0.30	0.09	1.00	0.07	0.14		0.010	1.4
LB	53.80	0.00	0.00	0.50	0.02	0		0.000	0.0
Total Q								0.668	100.0

General Notes

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	11-Aug-12			
Time at Site (24 hr)	**Start Time:**	8:30:00 AM	**End Time:**	11:00:00 AM
Personnel	Eli H., Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266m	
Weather Conditions	Cloudy, Cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	3.0V
# of Records	8616	**Memory Free**	515523
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 4	1.449	101.449		100.000	
BM 45			1.592	99.857	
BM 46			1.280	100.169	
PT			2.107	99.342	
WL			1.968	**99.481**	
TBM	1.859	101.382	1.926	99.523	
WL			1.902	**99.480**	
PT			2.040	99.342	
BM 46			1.213	100.169	
BM 45			1.527	99.855	
BM 4			1.382	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 45	99.869	99.856	-0.013	est. from 2011
BM 46	100.177	100.169	-0.008	est. from 2011
PT	99.342	99.342	0.000	From install date

Summary	
Stage (m)	99.481
Discharge (m^3/s)	0.042
Pressure Transducer Reading (m)	0.160
Pressure Transducer Elevation (m)	99.321

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	8:44	**End**	9:46	**Location**	80m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2006042				
Stage (m)	**Start**	**Reading**	0.159	**Time**	8:44	Channel very bouldery.				
	End	**Reading**	0.16	**Time**	9:46	Low flow near edges could not be measured				

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
LB	8.00	0.00	0.00	0.00	0.01	0		0.000	0.0
	8.15	0.42	0.13	0.15	0.04	0.04		0.001	3.3
	8.55	0.23	0.07	0.40	0.03	0.08		0.002	5.3
	8.95	0.21	0.06	0.40	0.03	0.02		0.001	1.2
Behind Rock	9.35	0.31	0.09	0.40	0.03	0.05		0.001	3.4
	9.55	0.48	0.15	0.20	0.02	0.05		0.001	2.2
Rock	9.60	0.00	0.00	0.05	0.00	0		0.000	0.0
Rock	10.00	0.00	0.00	0.40	0.00	0		0.000	0.0
	10.10	0.66	0.20	0.10	0.05	0.06		0.003	7.2
	10.50	0.20	0.06	0.40	0.02	0.05		0.001	2.9
	10.90	0.70	0.21	0.40	0.09	0.09		0.008	18.3
	11.30	0.45	0.14	0.40	0.04	0.1		0.004	9.8
	11.50	0.30	0.09	0.20	0.02	0.12		0.002	5.2
	11.70	0.60	0.18	0.20	0.04	0.09		0.003	7.8
	11.90	0.51	0.16	0.20	0.03	0.04		0.001	3.0
	12.10	0.42	0.13	0.20	0.04	0.03		0.001	2.7
	12.50	0.41	0.12	0.40	0.05	0.03		0.001	3.6
	12.90	0.22	0.07	0.40	0.03	0.02		0.001	1.3
	13.30	0.13	0.04	0.40	0.02	0.05		0.001	1.9
	13.70	0.20	0.06	0.40	0.02	0.05		0.001	2.9
	14.10	0.10	0.03	0.40	0.01	0.3		0.003	6.5
Rock	14.30	0.00	0.00	0.20	0.00	0		0.000	0.0
behind rock	14.50	0.10	0.03	0.20	0.00	0		0.000	0.0
Rocks	14.60	0.00	0.00	0.10	0.00	0		0.000	0.0
Rocks	15.30	0.00	0.00	0.70	0.00	0		0.000	0.0
	15.55	0.10	0.03	0.25	0.00	0.27		0.001	2.9
Rocks	15.60	0.00	0.00	0.05	0.00	0		0.000	0.0
Rocks	16.20	0.00	0.00	0.60	0.00	0		0.000	0.0
	16.50	0.20	0.06	0.30	0.02	0.17		0.004	8.6
RB	16.90	0.00	0.00	0.40	0.01	0		0.000	0.0
								0.042	**100.0**

General Notes
Gradiant = 1%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-5. Manual Discharge Measurements and Levelling Surveys at PL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	PL-H2			
Stream Name	Goose Lake Outflow			
Date Monitored	13-Sep-12			
Time at Site (24 hr)	**Start Time:**	12:35:00 PM	**End Time:**	4:30:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	435007	7272014	266m	
Weather Conditions	Cloudy, Cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221023
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	3.0V
# of Records	13392	**Memory Free**	510747
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 4	1.221	101.221		100.000	
BM 45			1.379	99.842	
BM 46			1.058	100.163	
PT			1.900	99.321	
WL			1.690	**99.531**	
TBM	1.679	101.139	1.761	99.460	
WL			1.610	**99.529**	
PT			1.817	99.322	
BM 46			0.975	100.164	
BM 45			1.297	99.842	
BM 4			1.139	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 45	99.869	99.842	-0.027	est. from 2011
BM 46	100.177	100.164	-0.014	est. from 2011
PT	99.342	99.322	-0.020	From install date

Summary	
Stage (m)	99.530
Discharge (m^3/s)	0.172
Pressure Transducer Reading (m)	0.224
Pressure Transducer Elevation (m)	99.306

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	12:41	**End**	13:20	**Location**	15m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007529				
Stage (m)	**Start**	**Reading**	0.222	**Time**	12:41	Channel very bouldery.				
	End	**Reading**	0.223	**Time**	13:20	Low flow near edges could not be measured				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.00	0.00	0.00	0.02	0			0.000	0.0
	1.00	0.04	1.00	0.05	0.01			0.001	0.3
	2.50	0.08	1.50	0.12	0.02			0.002	1.4
	4.00	0.04	1.50	0.06	0.02			0.001	0.7
	5.50	0.04	1.50	0.06	0.03			0.002	1.0
	7.00	0.12	1.50	0.18	0.07			0.013	7.3
	8.50	0.16	1.50	0.24	0.07			0.017	9.8
	10.00	0.07	1.50	0.11	0.04			0.004	2.4
	11.50	0.18	1.50	0.27	0.06			0.016	9.4
	13.00	0.11	1.50	0.17	0.11			0.018	10.5
	14.50	0.12	1.50	0.18	0.08			0.014	8.4
	16.00	0.16	1.50	0.24	0.09			0.022	12.5
	17.50	0.03	1.50	0.05	0.02			0.001	0.5
	19.00	0.14	1.50	0.21	0.04			0.008	4.9
	20.50	0.16	1.50	0.24	0.03			0.007	4.2
	22.00	0.14	1.50	0.21	0.04			0.008	4.9
	23.50	0.07	1.50	0.11	0.06			0.006	3.7
	25.00	0.16	1.50	0.24	0.02			0.005	2.8
	26.50	0.10	1.50	0.15	0.04			0.006	3.5
	28.00	0.06	1.50	0.09	0.03			0.003	1.6
	29.50	0.12	1.50	0.18	0.06			0.011	6.3
	31.00	0.10	1.50	0.14	0.01			0.001	0.8
	32.30	0.14	1.30	0.11	0.05			0.005	3.0
	32.50	0.00	0.20	0.00	0			0.000	0.0
	32.90	0.00	0.40	0.00	0			0.000	0.0
	33.00	0.10	0.10	0.02	0			0.000	0.0
	33.30	0.02	0.30	0.01	0.02			0.000	0.1
	34.00	0.00	0.70	0.01	0			0.000	0.0
Total Q								**0.172**	100.0

General Notes
Distance from middle of PT to top of conduit = 1.9cm

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	9-Jun-12			
Time at Site (24 hr)	Start Time:	1:20:00 PM	End Time:	
Personnel	Eli H, Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	432744	7271610	267	
Weather Conditions	Cloudy			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	ok	Battery	100%
# of Records	0	Memory Free	32535
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 5	1.256	101.256		100.000	
BM 47			1.332	99.924	
PT			1.944	99.312	
WL			1.475	**99.781**	
BM 49	1.277	101.300	1.233	100.023	
WL			1.520	**99.780**	
PT			1.993	99.307	
BM 47			1.377	99.923	
BM 5			1.301	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.925	99.924	-0.001	
BM 49	100.038	100.023	-0.015	
PT	99.312	99.310	-0.002	

Summary	
Stage (m)	99.781
Discharge (m^3/s)	1.827
Pressure Transducer Reading (m)	0.484
Pressure Transducer Elevation (m)	99.297

Discharge Measurement - Mid-Section Method (continued on following page)										
Time (24 hr)	Start		End		Location	Braid 1, 60m downstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type				Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.48	Time	13:54	Braid 1				
	End	Reading		Time						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	22.95	0.00	0.00	0.02	0			0.000	0.0
	23.10	0.21	0.15	0.06	0.15			0.009	0.5
	23.50	0.16	0.40	0.06	0.31			0.020	1.1
	23.90	0.13	0.40	0.05	0.42			0.022	1.2
	24.30	0.21	0.40	0.08	0.34			0.029	1.6
	24.70	0.08	0.40	0.03	0.15			0.005	0.3
	25.10	0.13	0.40	0.05	0.09			0.005	0.3
	25.50	0.15	0.40	0.06	0.32			0.019	1.1
	25.90	0.20	0.40	0.08	0.29			0.023	1.3
	26.30	0.36	0.40	0.14	0.21			0.030	1.7
	26.70	0.13	0.40	0.05	0.26			0.012	0.6
	27.00	0.19	0.30	0.06	0.3			0.017	0.9
	27.30	0.35	0.30	0.11	0.25			0.026	1.4
	27.60	0.30	0.30	0.09	0.38			0.034	1.9
	27.90	0.28	0.30	0.08	0.41			0.034	1.9
	28.20	0.33	0.30	0.10	0.37			0.037	2.0
	28.50	0.33	0.30	0.10	0.41			0.041	2.2
	28.80	0.38	0.30	0.11	0.41			0.047	2.6
	29.10	0.28	0.30	0.08	0.39			0.033	1.8
	29.40	0.28	0.30	0.08	0.49			0.041	2.3
	29.70	0.30	0.30	0.09	0.5			0.045	2.5
	30.00	0.37	0.30	0.11	0.41			0.046	2.5
	30.30	0.25	0.30	0.08	0.51			0.038	2.1
	30.60	0.20	0.30	0.06	0.25			0.015	0.8
	30.90	0.16	0.30	0.03	0.09			0.003	0.1
LB	30.95	0.00	0.05	0.08	0			0.000	0.0
Total Q (braid 1)								**0.629**	**34.4**

General Notes
Channel was braided, both braids were measured. Sum of total Qs is the total discharge
Meter would not zero, values were offset by -.03

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	9-Jun-12			
Time at Site (24 hr)	Start Time:	1:20:00 PM	End Time:	
Personnel	Eli H, Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	432744	7271610	267	
Weather Conditions	Cloudy			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	ok	Battery	100%
# of Records	0	Memory Free	32535
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Jun-12			
Time at Site (24 hr)	Start Time:	2:45:00 PM	End Time:	5:15:00 PM
Personnel	Eli H, Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Cloudy, windy, cold			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	ok	Battery	100%
# of Records	727	Memory Free	32168
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 5	1.344	101.344		100.000	
BM 47			1.407	99.937	
PT			2.025	99.319	
WL			1.624	**99.720**	Wavey conditions
BM 49	1.270	101.313	1.301	100.043	
WL			1.592	**99.721**	Wavey conditions
PT			1.992	99.321	
BM 47			1.375	99.938	
BM 5			1.312	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.925	99.938	0.013	
BM 49	100.038	100.043	0.005	
PT	99.312	99.320	0.008	

Summary	
Stage (m)	99.721
Discharge (m^3/s)	0.841
Pressure Transducer Reading (m)	0.438
Pressure Transducer Elevation (m)	99.283

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	Start	13:54	End	15:30	Location	Braid 1, 60m downstream of station	
Method	Velocity-area (Mid-section)			Instrument Model		Flomate	
Flow Meter Type				Instrument Serial #			
Stage (m)	Start	Reading	0.48	Time	13:54	Braid 1	
	End	Reading		Time			

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	19.70	0.00	0.00	0.00	0			0.000	0.0
	19.76	0.08	0.06	0.02	0.23			0.004	0.4
	20.10	0.14	0.34	0.05	0.03			0.001	0.2
	20.45	0.11	0.35	0.04	0.23			0.009	1.1
	20.80	0.10	0.35	0.04	0.11			0.004	0.5
	21.15	0.22	0.35	0.08	0.12			0.009	1.1
	21.50	0.14	0.35	0.05	0.07			0.003	0.4
	21.85	0.10	0.35	0.04	0.14			0.005	0.6
	22.20	0.20	0.35	0.07	0.15			0.011	1.2
	22.55	0.24	0.35	0.08	0.19			0.016	1.9
	22.90	0.35	0.35	0.12	0.06			0.007	0.9
	23.25	0.24	0.35	0.08	0.1			0.008	1.0
	23.60	0.23	0.35	0.08	0.26			0.021	2.5
	23.95	0.38	0.35	0.13	0.25			0.033	4.0
	24.30	0.46	0.35	0.16	0.08			0.013	1.5
	24.65	0.34	0.35	0.12	0.27			0.032	3.8
	25.00	0.18	0.35	0.06	0.31			0.020	2.3
	25.35	0.25	0.35	0.09	0.17			0.015	1.8
	25.70	0.26	0.35	0.09	0.35			0.032	3.8
	26.05	0.26	0.35	0.09	0.27			0.025	2.9
	26.40	0.17	0.35	0.06	0.29			0.017	2.1
	26.75	0.18	0.35	0.06	0.24			0.015	1.8
	27.10	0.10	0.35	0.02	0.12			0.002	0.3
LB	27.15	0.00	0.05	0.00	0			0.000	0.0
Total Q (braid 1)								**0.302**	**35.9**

General Notes

Channel was braided, both braids were measured. Sum of total Qs is the total discharge
Gradiant = 2%

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Jun-12			
Time at Site (24 hr)	Start Time:	2:45:00 PM	End Time:	5:15:00 PM
Personnel	Eli H, Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Cloudy, windy, cold			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	ok	Battery	100%
# of Records	727	Memory Free	32168
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (complete)										
Time (24 hr)	Start	13:54	End	15:30	Location	Braid 2, 60m downstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flomate 2000				
Flow Meter Type				Instrument Serial #		2004405				
Stage (m)	Start	Reading		Time						
	End	Reading	0.484	Time	15:30					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.10	0.05	0.00	0.24	0.11			0.026	3.1
	1.60	0.32	1.50	0.48	0.01			0.005	0.6
	3.10	0.07	1.50	0.11	0.14			0.015	1.7
	4.60	0.12	1.50	0.12	0.03			0.004	0.4
	5.10	0.22	0.50	0.22	0.02			0.004	0.5
	6.60	0.05	1.50	0.06	0.02			0.001	0.1
	7.60	0.40	1.00	0.40	0.14			0.056	6.7
	8.60	0.26	1.00	0.26	0.11			0.029	3.4
	9.60	0.26	1.00	0.26	0.1			0.026	3.1
	10.60	0.26	1.00	0.26	0.16			0.042	4.9
	11.60	0.23	1.00	0.23	0.22			0.051	6.0
	12.60	0.23	1.00	0.23	0.2			0.046	5.5
	13.60	0.24	1.00	0.24	0.16			0.038	4.6
	14.60	0.21	1.00	0.21	0.19			0.040	4.7
	15.60	0.16	1.00	0.16	0.17			0.027	3.2
	16.60	0.21	1.00	0.21	0.19			0.040	4.7
	17.60	0.17	1.00	0.17	0.14			0.024	2.8
	18.60	0.17	1.00	0.17	0.12			0.020	2.4
	19.60	0.20	1.00	0.25	0.14			0.035	4.2
	21.10	0.06	1.50	0.10	0.03			0.003	0.3
	22.80	0.05	1.70	0.08	0.05			0.004	0.4
	24.10	0.06	1.30	0.05	0.07			0.004	0.4
	24.60	0.00	0.50	0.02	0			0.000	0.0
LB									
Total Q (braid 2)								0.539	64.1

Genreral Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	13-Jul-12			
Time at Site (24 hr)	Start Time:	8:40:00 AM	End Time:	1:15:00 PM
Personnel	Eli H, Fraser T.			
Station Cordinates	Easting	Northing	Elevation	
	432744	7271610	267	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	4864	Memory Free	30104
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 5	1.609	101.609		100.000	
BM 47			1.686	99.923	
BM 49			1.561	100.048	
PT			2.282	99.327	
WL			1.962	**99.647**	
TBM	1.765	101.555	1.819	99.790	
WL			1.907	**99.648**	
PT			2.227	99.328	
BM 49			1.505	100.050	
BM 47			1.630	99.925	
BM 5			1.552	100.003	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.925	99.924	-0.001	
BM 49	100.038	100.049	0.011	
PT	99.312	99.328	0.015	

Summary	
Stage (m)	99.648
Discharge (m^3/s)	0.131
Pressure Transducer Reading (m)	0.340
Pressure Transducer Elevation (m)	99.307

Discharge Measurement - Mid-Section Method (continued on following page)							
Time (24 hr)	Start	8:43	End	10:15	Location	Braid 1, 60m downstream of station	
Method	Velocity-area (Mid-section)			Instrument Model		Flomate 2000	
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612	
Stage (m)	Start	Reading	0.339	Time	8:43	Braid 1	
	End	Reading		Time			

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	3.50	0.00	0.00	0.00	0.00	0		0.000	0.0
	3.60	0.10	0.03	0.10	0.00	0.03		0.000	0.1
Hole	3.80	0.68	0.21	0.20	0.04	0.07		0.003	2.2
behind rock	4.00	0.26	0.08	0.20	0.02	0.01		0.000	0.1
	4.20	0.20	0.06	0.20	0.01	0.07		0.001	0.7
	4.40	0.30	0.09	0.20	0.02	0.06		0.001	0.8
	4.60	0.15	0.05	0.20	0.01	0.12		0.001	0.8
	4.80	0.48	0.15	0.20	0.03	0.1		0.003	2.2
	5.00	0.41	0.12	0.20	0.02	0.13		0.003	2.5
	5.20	0.40	0.12	0.20	0.02	0.12		0.003	2.2
	5.40	0.33	0.10	0.20	0.02	0.12		0.002	1.8
	5.60	0.52	0.16	0.20	0.03	0.2		0.006	4.8
	5.80	0.92	0.28	0.20	0.06	0.03		0.002	1.4
	6.05	0.56	0.17	0.25	0.04	0.14		0.006	4.6
	6.30	0.27	0.08	0.25	0.02	0.22		0.005	3.5
	6.55	0.64	0.20	0.25	0.05	0.12		0.006	4.5
	6.80	0.61	0.19	0.25	0.05	0.14		0.007	5.0
rock	7.05	0.00	0.00	0.25	0.00	0		0.000	0.0
	7.30	0.33	0.10	0.25	0.03	0.27		0.007	5.2
	7.55	0.33	0.10	0.25	0.03	0.02		0.001	0.4
	7.80	0.23	0.07	0.25	0.02	0.07		0.001	0.9
	8.05	0.32	0.10	0.25	0.02	0.29		0.007	5.4
	8.30	0.30	0.09	0.25	0.02	0.05		0.001	0.9
	8.55	0.24	0.07	0.25	0.01	0.02		0.000	0.2
eddy	8.65	0.25	0.08	0.10	0.01	-0.02		0.000	-0.1
LB	8.72	0.00	0.00	0.07	0.00	0		0.000	0.0
Total Q (braid 1)								**0.0657**	**50.2**

General Notes
Channel was braided, both braids were measured. Sum of total Qs is the total discharge
Gradiant = 1%. Imperial Rod was used. Depths converted from ft to m (1ft = 0.3048m)

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	13-Jul-12			
Time at Site (24 hr)	Start Time:	8:40:00 AM	End Time:	1:15:00 PM
Personnel	Eli H, Fraser T.			
Station Cordinates	Easting	Northing	Elevation	
	432744	7271610	267	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	4864	Memory Free	30104
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes	

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (complete)										
Time (24 hr)	Start	8:43	End	10:15	Location	Braid 2, 60m downstream of station				
Method	Velocity-area (Mid-section)				Instrument Model	Flomate 2000				
Flow Meter Type	Flo-Mate				Instrument Serial #	2007612				
Stage (m)	Start	Reading			Time		Braid 2			
	End	Reading	0.34		Time	10:15				

	Station	Depth		Distance	Area	Velocity @60%	Cal. velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	1.70	0.00	0.00	0.00	0.00	0		0.000	0.0
	1.80	0.15	0.05	0.10	0.01	0.07		0.000	0.4
	2.00	0.15	0.05	0.20	0.01	0.05		0.000	0.2
rock	2.05	0.00	0.00	0.05	0.00	0		0.000	0.0
rock	2.50	0.00	0.00	0.45	0.00	0		0.000	0.0
	2.62	0.60	0.18	0.12	0.03	0		0.000	0.0
	2.85	0.36	0.11	0.23	0.03	0.01		0.000	0.2
	3.10	0.35	0.11	0.25	0.03	0.25		0.007	5.1
	3.35	0.22	0.07	0.25	0.01	0.03		0.000	0.3
rocks	3.45	0.00	0.00	0.10	0.00	0		0.000	0.0
rocks	5.10	0.00	0.00	1.65	0.00	0		0.000	0.0
	9.25	0.20	0.06	4.15	0.14	0		0.000	0.0
	9.60	0.32	0.10	0.35	0.07	0.02		0.001	1.0
	10.60	0.35	0.11	1.00	0.11	0.05		0.005	4.1
rock	11.60	0.00	0.00	1.00	0.00	0		0.000	0.0
	12.10	0.41	0.12	0.50	0.09	0.02		0.002	1.4
	13.10	0.41	0.12	1.00	0.12	0.03		0.004	2.9
	14.10	0.50	0.15	1.00	0.15	0.06		0.009	7.0
	15.10	0.32	0.10	1.00	0.10	0.07		0.007	5.2
	16.10	0.40	0.12	1.00	0.12	0.04		0.005	3.7
	17.10	0.48	0.15	1.00	0.15	0.07		0.010	7.8
	18.10	0.70	0.21	1.00	0.21	0.01		0.002	1.6
	19.10	0.25	0.08	1.00	0.08	0.02		0.002	1.2
	20.10	0.56	0.17	1.00	0.17	0.05		0.009	6.5
	21.10	0.20	0.06	1.00	0.06	0.01		0.001	0.5
	22.10	0.23	0.07	1.00	0.07	0		0.000	0.0
	23.10	0.50	0.15	1.00	0.10	0.01		0.001	0.8
	23.40	0.10	0.03	0.30	0.01	0.01		0.000	0.0
LB	23.50	0.00	0.00	0.10	0.00	0		0.000	0.0
Total Q (braid 2)								**0.0653**	**49.8**

General Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Aug-12			
Time at Site (24 hr)	**Start Time:**	10:00:00 AM	**End Time:**	2:20:00 PM
Personnel	Eli H, Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432744E	7271610N	267	
Weather Conditions	Mix of Sun + Cloud			

Transducer Information			
PT Model	P598i	**Serial #**	2718023
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	9484	**Memory Free**	55650
Date Serviced		**Crest Gauges**	no

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 5	1.596	101.596		100.000	
BM 47			1.674	99.922	
BM 49			1.560	100.036	
PT			2.270	99.326	
WL			2.036	**99.560**	
TBM	1.978	101.626	1.948	99.648	
WL			2.065	**99.561**	
PT			2.302	99.324	
BM 49			1.589	100.037	
BM 47			1.705	99.921	
BM 5			1.626	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.925	99.922	-0.003	
BM 49	100.038	100.037	-0.001	
PT	99.312	99.325	0.013	

Summary	
Stage (m)	99.561
Discharge (m^3/s)	0.034
Pressure Transducer Reading (m)	0.264
Pressure Transducer Elevation (m)	99.297

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	**Start**	10:45	**End**	11:40	**Location**	Braid 1, 20m downstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flomate 2000	
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2006042	
Stage (m)	**Start**	**Reading**	0.257	**Time**	10:45	Braid 1	
	End	**Reading**		**Time**			

					Velocity (m/s)				
	Station	**Depth**	**Distance**	**Area**				**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	2.50	0.00	0.00	0.00	0			0.000	0.0
	2.60	0.03	0.10	0.00	0.01			0.000	0.1
	2.70	0.03	0.10	0.00	0.03			0.000	0.3
Rock	2.80	0.00	0.10	0.00	0			0.000	0.0
Rock	3.10	0.00	0.30	0.00	0			0.000	0.0
	3.30	0.06	0.20	0.01	0.07			0.001	2.6
	3.50	0.08	0.20	0.02	0			0.000	0.0
	3.70	0.06	0.20	0.01	0.03			0.000	1.1
	3.90	0.14	0.20	0.03	0.01			0.000	0.8
	4.10	0.19	0.20	0.04	0.09			0.003	9.8
	4.30	0.37	0.20	0.07	0.06			0.004	12.8
	4.50	0.20	0.20	0.04	0.13			0.005	15.1
	4.70	0.40	0.20	0.08	0.05			0.004	11.6
	4.90	0.31	0.20	0.06	0.03			0.002	5.4
	5.10	0.34	0.20	0.05	0.05			0.003	7.5
	5.20	0.05	0.10	0.01	0.04			0.000	0.8
	5.40	0.06	0.20	0.01	-0.01			0.000	-0.4
	5.60	0.03	0.20	0.01	0.01			0.000	0.2
	5.80	0.03	0.20	0.01	-0.01			0.000	-0.2
	6.00	0.09	0.20	0.01	0			0.000	0.0
LB (1st channel)	6.10	0.00	0.10	0.00	0			0.000	0.0
Q (this table)								**0.0231**	**67.4**

General Notes

Channel was braided, both braids were measured. Sum of total Qs is the total discharge
Gradiant = 1%. Imperial Rod was used. Depths converted from ft to m (1ft = 0.3048m)

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Aug-12			
Time at Site (24 hr)	Start Time:	10:00:00 AM	End Time:	2:20:00 PM
Personnel	Eli H, Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Mix of Sun + Cloud			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	9484	Memory Free	55650
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (complete)										
Time (24 hr)	Start	8:43	End	10:15	Location	Braid 2, 60m downstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612				
Stage (m)	Start	Reading		Time		Braid 2				
	End	Reading	0.34	Time	10:15					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	12.00	0.00	0.00	0.00	0			0.000	0.0
	12.05	0.03	0.05	0.00	0.07			0.000	0.6
	12.20	0.06	0.15	0.01	0.08			0.001	2.5
	12.40	0.05	0.20	0.01	0.02			0.000	0.4
	12.50	0.00	0.10	0.00	0			0.000	0.0
	14.30	0.00	1.80	0.00	0			0.000	0.0
	14.40	0.03	0.10	0.00	0.05			0.000	0.7
	14.60	0.08	0.20	0.02	0.03			0.001	1.7
	14.90	0.12	0.30	0.02	0.08			0.002	5.6
	15.00	0.00	0.10	0.00	0			0.000	0.0
	15.35	0.09	0.35	0.02	0.12			0.002	6.2
	15.40	0.18	0.05	0.02	0.06			0.001	3.2
	15.55	0.00	0.15	0.00	0			0.000	0.0
	16.00	0.00	0.45	0.00	0			0.000	0.0
	16.10	0.11	0.10	0.02	0.07			0.001	3.3
	16.30	0.00	0.20	0.00	0			0.000	0.0
	16.50	0.06	0.20	0.01	0.11			0.001	3.1
	16.60	0.07	0.10	0.01	0.12			0.001	3.5
	16.80	0.00	0.20	0.00	0			0.000	0.0
	17.10	0.03	0.30	0.01	0			0.000	0.0
	17.30	0.05	0.20	0.01	0.03			0.000	0.8
	17.50	0.05	0.20	0.01	0.04			0.000	1.1
	17.70	0.00	0.20	0.00	0			0.000	0.0
	17.90	0.03	0.20	0.01	0			0.000	0.0
LB	18.20	0.00	0.30	0.00	0			0.000	0.0
Q (this table)								0.0111	32.6

General Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	10-Sep-12			
Time at Site (24 hr)	Start Time:	2:00:00 PM	End Time:	4:30:00 PM
Personnel	Eli H, Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Cloud, cool			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK/ Stopped	Battery	100%
# of Records	65534	Memory Free	0
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 5	1.407	101.407		100.000	
BM 47			1.485	99.922	
BM 49			1.369	100.038	
PT			2.087	99.320	
WL			1.855	**99.552**	
TBM	1.918	101.323	2.002	99.405	
WL			1.772	**99.551**	
PT			2.003	99.320	
BM 49			1.283	100.040	
BM 47			1.399	99.924	
BM 5			1.322	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 47	99.925	99.923	-0.002	
BM 49	100.038	100.039	0.001	
PT	99.312	99.320	0.008	

Summary	
Stage (m)	99.552
Discharge (m^3/s)	0.0295
Pressure Transducer Reading (m)	0.249
Pressure Transducer Elevation (m)	99.303

Discharge Measurement - Mid-Section Method (continued on following page)									
Time (24 hr)	Start	14:25	End	15:37	Location	Braid 1, 20m downstream of station			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529			
Stage (m)	Start	Reading	0.249	Time	14:25				
	End	Reading		Time					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	4.10	0.00	0.00	0.01	0			0.000	0.0
	4.25	0.12	0.15	0.02	0.03			0.001	1.8
	4.40	0.13	0.15	0.03	0.02			0.001	2.0
	4.70	0.14	0.30	0.03	0.06			0.002	5.7
Rock	4.80	0.00	0.10	0.00	0			0.000	0.0
Rock	5.20	0.00	0.40	0.00	0			0.000	0.0
	5.35	0.14	0.15	0.02	0.09			0.002	6.4
	5.50	0.26	0.15	0.03	0.13			0.004	14.3
	5.60	0.24	0.10	0.02	0.12			0.003	9.7
	5.70	0.19	0.10	0.02	0.12			0.002	7.7
	5.80	0.20	0.10	0.03	0.12			0.004	12.2
	6.00	0.16	0.20	0.04	0.06			0.002	8.1
	6.30	0.06	0.30	0.02	0.06			0.001	3.7
	6.60	0.10	0.30	0.03	0			0.000	0.0
Rock	6.85	0.00	0.25	0.00	0			0.000	0.0
Rock	8.35	0.00	1.50	0.00	0			0.000	0.0
	8.40	0.01	0.05	0.00	0.05			0.000	0.2
	8.55	0.02	0.15	0.00	0.03			0.000	0.2
Rocks	8.60	0.00	0.05	0.00	0			0.000	0.0
Rocks	13.00	0.00	4.40	0.00	0			0.000	0.0
	13.05	0.04	0.05	0.00	0.17			0.001	2.3
	13.20	0.02	0.15	0.00	0			0.000	0.0
Rock	13.40	0.00	0.20	0.00	0			0.000	0.0
Rock	15.70	0.00	2.30	0.00	0			0.000	0.0
	15.75	0.04	0.05	0.00	0.04			0.000	0.5
	15.90	0.11	0.15	0.02	0.04			0.001	2.6
	16.10	0.06	0.20	0.01	0.07			0.001	2.8
	16.30	0.05	0.20	0.01	0.02			0.000	0.7
Q (this table)								**0.0239**	**81.0**

General Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	10-Sep-12			
Time at Site (24 hr)	Start Time:	2:00:00 PM	End Time:	4:30:00 PM
Personnel	Eli H, Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Cloud, cool			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK/ Stopped	Battery	100%
# of Records	65534	Memory Free	0
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes	

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (complete)										
Time (24 hr)	Start	8:43	End	10:15	Location	Braid 2, 60m downstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flomate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529				
Stage (m)	Start	Reading		Time						
	End	Reading	0.249	Time	15:37					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	16.50	0.18	0.20	0.03	0.08			0.002	7.3
Rock	16.60	0.00	0.10	0.00	0			0.000	0.0
Rock	17.10	0.00	0.50	0.00	0			0.000	0.0
	17.20	0.09	0.10	0.01	0.11			0.001	3.4
Rock	17.30	0.00	0.10	0.00	0			0.000	0.0
	17.55	0.05	0.25	0.01	0.01			0.000	0.3
	17.65	0.05	0.10	0.01	0.03			0.000	0.9
	17.90	0.12	0.25	0.03	0.02			0.001	1.8
Rock	18.10	0.00	0.20	0.00	0			0.000	0.0
	18.30	0.03	0.20	0.01	0			0.000	0.0
	18.45	0.06	0.15	0.01	0.08			0.001	2.0
	18.55	0.14	0.10	0.02	0.04			0.001	2.4
	18.70	0.07	0.15	0.01	0.01			0.000	0.4
	18.85	0.06	0.15	0.01	0.02			0.000	0.6
	19.00	0.05	0.15	0.01	0			0.000	0.0
LB	19.20	0.00	0.20	0.00	0			0.000	0.0
Q (this table)								0.00563	19.0

General Notes

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Sep-12			
Time at Site (24 hr)	**Start Time:**	8:40:00 AM	**End Time:**	10:20:00 AM
Personnel	Eli H, Chris H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432744E	7271610N	267	
Weather Conditions	Sunny, cool			

Transducer Information			
PT Model	P598i	**Serial #**	2718023
Gain	3.52168	**Offset**	0
Status	OK/ Stopped	**Battery**	100%
# of Records	542	**Memory Free**	32258
Date Serviced		**Crest Gauges**	no

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 5	1.415	101.415		100.000	
BM 47			1.492	99.923	
BM 49			1.378	100.037	
PT			2.098	99.317	
WL			1.869	**99.546**	
TBM	2.057	101.353	2.119	99.296	
WL			1.807	**99.546**	
PT			2.037	99.316	
BM 49			1.316	100.037	
BM 47			1.432	99.921	
BM 5			1.353	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 47	99.925	99.922	-0.003	
BM 49	100.038	100.037	-0.001	
PT	99.312	99.317	0.005	

Summary	
Stage (m)	99.546
Discharge (m^3/s)	0.0456
Pressure Transducer Reading (m)	0.246
Pressure Transducer Elevation (m)	99.300

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	**Start**	8:42	**End**	9:52	**Location**	Braid 1, 20m downstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate 2000	
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007529	
Stage (m)	**Start**	**Reading**	0.243	**Time**	8:42		
	End	**Reading**		**Time**			

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	1.50	0.00	0.00	0.00	0			0.000	0.0
	1.60	0.06	0.10	0.01	0.05			0.000	0.8
	1.75	0.06	0.15	0.01	0.04			0.000	0.8
Rock above water	1.90	0.00	0.15	0.00	0			0.000	0.0
	2.20	0.04	0.30	0.01	0.02			0.000	0.4
	2.35	0.22	0.15	0.03	0.03			0.001	2.2
	2.50	0.18	0.15	0.03	0.07			0.002	4.1
	2.65	0.33	0.15	0.05	0.1			0.005	10.8
	2.80	0.41	0.15	0.06	0.07			0.004	9.4
	2.95	0.42	0.15	0.06	0.06			0.004	8.3
	3.10	0.31	0.15	0.05	0.08			0.004	8.2
	3.25	0.32	0.15	0.05	0.04			0.002	4.2
	3.40	0.42	0.15	0.06	0.03			0.002	4.1
	3.55	0.26	0.15	0.04	0.05			0.002	4.3
	3.70	0.07	0.15	0.01	0.03			0.000	0.6
Right Channel LB	3.80	0.00	0.10	0.00	0			0.000	0.0
Left Channel RB	10.40	0.00	6.60	0.00	0			0.000	0.0
	10.45	0.08	0.05	0.01	0.02			0.000	0.4
	10.65	0.12	0.20	0.02	0.05			0.001	2.0
Rock above water	10.75	0.00	0.10	0.00	0			0.000	0.0
Rock above water	10.80	0.00	0.05	0.00	0			0.000	0.0
	11.90	0.06	1.10	0.04	0.04			0.002	3.8
	12.25	0.03	0.35	0.01	0.02			0.000	0.5
	12.60	0.12	0.35	0.04	0.07			0.003	6.0
	12.90	0.17	0.30	0.05	0.03			0.002	3.4
	13.20	0.08	0.30	0.02	0.01			0.000	0.5
	13.50	0.12	0.30	0.04	0.02			0.001	1.8
	13.90	0.14	0.40	0.05	0.05			0.002	5.4
Q (this table)								**0.0374**	**82.0**

General Notes

Distance from middle of PT to top of pipe = 1.6cm

Appendix 2-6. Manual Discharge Measurements and Levelling Surveys at GI-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	GI-H1			
Stream Name	Giraffe Outlet			
Date Monitored	14-Sep-12			
Time at Site (24 hr)	Start Time:	8:40:00 AM	End Time:	10:20:00 AM
Personnel	Eli H, Chris H.			
Station Cordinates	Easting	Northing	Elevation	
	432744E	7271610N	267	
Weather Conditions	Sunny, cool			

Transducer Information			
PT Model	P598i	Serial #	2718023
Gain	3.52168	Offset	0
Status	OK/ Stopped	Battery	100%
# of Records	542	Memory Free	32258
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method(Complete)										
Time (24 hr)	Start	8:42	End	9:52	Location	Braid 2, 20m downstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529				
Stage (m)	Start	Reading		Time						
	End	Reading	0.246	Time	9:52					

continued	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	14.20	0.20	0.30	0.06	0.02			0.001	2.6
	14.50	0.20	0.30	0.06	0.01			0.001	1.3
	14.80	0.08	0.30	0.02	0.07			0.002	3.7
	15.10	0.11	0.30	0.03	0.06			0.002	4.3
	15.40	0.06	0.30	0.02	0.04			0.001	1.6
	15.70	0.05	0.30	0.02	0.04			0.001	1.3
	16.00	0.09	0.30	0.02	0.04			0.001	2.2
	16.25	0.10	0.25	0.02	0.03			0.000	1.0
LB	16.30	0.00	0.05	0.00	0			0.000	0.0
Q (this table)								0.00822	18.0

General Notes

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	South of Goose			
Date Monitored	6-Jun-12			
Time at Site (24 hr)	Start Time:	3:10:00 PM	End Time:	5:30:00 PM
Personnel	Eli, Coby			
Station Cordinates	Easting	Northing	Elevation	
	432,091	7,269,573	293m	
Weather Conditions	Above 20C	Sunny		

Transducer Information			
PT Model	PS98i	Serial #	2714003
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	1	Memory Free	32530 readings
Date Serviced	n/a	Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 14	1.108	101.108		100.000	
BM 15			1.182	99.926	
PT			2.141	98.967	
WL			1.729	**99.379**	
BM 16			1.116	99.992	
BM 16	1.066	101.058			
WL			1.679	99.379	
PT			2.090	**98.968**	
BM 15			1.132	99.926	
BM 14			1.057	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.915	99.926	0.011	
BM 16	99.984	99.992	0.008	
PT	98.968	98.968	-0.001	

Summary	
Stage (m)	99.379
Discharge (m^3/s)	Not Measured
Pressure Transducer Reading (m)	0.440
Pressure Transducer Elevation (m)	98.939

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:55	End	16:40	Location	10m downstream of PT				
Method	No Discharge measurement			Instrument Model						
Flow Meter Type				Instrument Serial #						
Stage (m)	Start	Reading	0.437	Time	15:55					
	End	Reading	0.439	Time	16:40					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	18.43	0.00	0.00	0.01					
	18.55	0.09	0.12	0.01					
	18.70	0.15	0.15	0.03					
	18.90	0.14	0.20	0.02					
	19.00	0.17	0.10	0.02					
	19.15	0.13	0.15	0.02					
	19.30	0.17	0.15	0.03					
	19.45	0.17	0.15	0.03					
	19.60	0.15	0.15	0.02					
	19.75	0.12	0.15	0.02					
	19.90	0.07	0.15	0.01					
LB	19.95	0.00	0.05	0.00					
Total Q									

General Notes
Small low energy ephemeral stream. Bed of grass covering boulders, muddy. Vegetated tundra banks. Gradient looking from above riffle above PT =2%. Flow meter not operational.

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	South of Goose			
Date Monitored	13-Jun-12			
Time at Site (24 hr)	**Start Time:**	0-Jan-00	**End Time:**	0-Jan-00
Personnel	Eli, Coby			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	432,091	7,269,573	293m	
Weather Conditions	Above Zero	Partly Cloudy		

Transducer Information			
PT Model	PS98i	**Serial #**	7-Sep-30
Gain	3-Jan-00	**Offset**	0-Jan-00
Status	O.k.	**Battery**	100%
# of Records	22-Aug-02	**Memory Free**	32048 readings
Date Serviced	n/a	**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 14	1.158	101.158		100.000	
BM 15			1.234	99.924	
PT			2.190	98.968	
WL			1.850	**99.308**	
BM 16			1.167	99.991	**Az**
BM 16	1.131	101.122			335.000
WL			1.815	99.307	
PT			2.155	**98.967**	132.000
BM 15			1.198	99.924	217.000
BM 14			1.123	99.999	247.000

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 15	99.915	99.924	0.009	
BM 16	99.984	99.991	0.007	
PT	98.968	98.968	-0.001	

Summary	
Stage (m)	99.308
Discharge (m^3/s)	0.00675
Pressure Transducer Reading (m)	0.361
Pressure Transducer Elevation (m)	98.946

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**		**End**		**Location**	10m downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**	Flo-mate 2000					
Flow Meter Type	Flo-mate			**Instrument Serial #**	14-Nov-87					
Stage (m)	**Start**	**Reading**	0-Jan-00	**Time**	15:55					
	End	**Reading**	0-Jan-00	**Time**	16:40					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	0.56	0.00	0.00	0.00	0			0.0000	0.0
Grass/eddy	0.64	0.08	0.08	0.00	0.07			0.0003	5.0
Grass/Eddy	0.68	0.10	0.04	0.01	0			0.0000	0.0
Eddy	0.74	0.19	0.06	0.01	-0.01			-0.0001	-1.7
Eddy	0.80	0.18	0.06	0.01	-0.01			-0.0001	-1.5
Eddy	0.85	0.18	0.05	0.01	-0.01			-0.0001	-1.3
Eddy	0.90	0.19	0.05	0.01	-0.01			-0.0001	-1.4
	0.95	0.18	0.05	0.01	0.01			0.0001	1.3
	1.00	0.18	0.05	0.01	0.02			0.0002	2.7
	1.05	0.19	0.05	0.01	0.02			0.0002	2.8
Grass	1.10	0.14	0.05	0.01	0.06			0.0004	6.2
Grass	1.15	0.13	0.05	0.01	0.07			0.0005	6.7
Grass	1.20	0.12	0.05	0.01	0.13			0.0008	11.6
Grass	1.25	0.13	0.05	0.01	0.06			0.0004	5.8
Grass	1.30	0.14	0.05	0.01	0.17			0.0012	17.6
Grass	1.35	0.12	0.05	0.01	0.16			0.0010	14.2
Grass	1.40	0.11	0.05	0.01	0.2			0.0011	16.3
Grass	1.45	0.10	0.05	0.01	0.12			0.0006	8.9
Grass	1.50	0.09	0.05	0.00	0.08			0.0004	5.3
Grass	1.55	0.08	0.05	0.00	0.02			0.0001	1.4
LB	1.62	0.00	0.07	0.00	0			0.0000	0.0
Total Q								**0.00675**	**100.0**

General Notes
Gradiant = 1.5%

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information					
Project Name	Back River				
Station Identification	EL-H1				
Stream Name	South of Goose				
Date Monitored	17-Jun-12				
Time at Site (24 hr)	Start Time:	12:44:00 PM	End Time:	1:30:00 PM	
Personnel	E. Heyman, C. Hall				
Station Cordinates	Easting	Northing	Elevation		
	432,091	7,269,573	293m		
Weather Conditions	Sunny				

Transducer Information					
PT Model		PS98i	Serial #		2714003
Gain		3.52168	Offset		0
Status		Active	Battery		100%
# of Records		1565	Memory Free		31749
Date Serviced			Crest Gauges		N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 14	1.154	101.154		100.000	
BM 15			1.234	99.920	error
PT			2.186	98.968	
WL			1.875	**99.279**	
BM 16	1.148	101.139	1.163	99.991	
WL			1.860	**99.279**	
PT			2.171	98.968	
BM 15			1.214	99.925	checked, correct
BM 14			1.139	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.915	99.925	0.010	
BM 16	99.984	99.991	0.007	
PT	98.968	98.968	0.000	

Summary	
Stage (m)	99.279
Discharge (m^3/s)	0.00263
Pressure Transducer Reading (m)	0.336
Pressure Transducer Elevation (m)	98.943

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	10:11	End	11:03	Location	10m downstream of pressure transducer			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-mate 2000			
Flow Meter Type	Flo-mate			Instrument Serial #		2004405			
Stage (m)	Start	Reading	0.336	Time	16:13				
	End	Reading	0.336	Time	17:32				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.37	0.00	0.00	0.00	0			0.0000	0.0
	0.43	0.08	0.06	0.00	0.19			0.0006	23.1
	0.45	0.09	0.02	0.00	0.31			0.0007	26.6
	0.48	0.07	0.03	0.00	0.41			0.0009	32.8
	0.51	0.04	0.03	0.00	0.23			0.0005	17.5
LB	0.58	0.00	0.07	0.00	0			0.0000	0.0
Total Q								**0.00263**	**100.0**

General Notes

Gradiant = 2%

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	Echo Lake Outflow			
Date Monitored	9-Jul-12			
Time at Site (24 hr)	Start Time:	11:00:00 AM	End Time:	1:30:00 PM
Personnel	E. Heyman, Yasser A.			
Station Cordinates	Easting	Northing	Elevation	
	432,091	7,269,573	293m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	Serial #	2714003
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	4723	Memory Free	30173
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 14	0.906	100.906		100.000	
BM 15			0.988	99.918	
BM 16			0.908	99.998	
PT			1.917	98.989	
WL			1.700	**99.206**	
TBM	1.527	100.862	1.571	99.335	
WL			1.654	**99.208**	
PT			1.875	98.987	
BM 16			0.863	99.999	
BM15			0.946	99.916	
BM 14			0.862	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.915	99.917	0.002	
BM 16	99.984	99.999	0.015	
PT	98.968	98.988	0.020	

Summary	
Stage (m)	99.207
Discharge (m^3/s)	No Flow
Pressure Transducer Reading (m)	0.239
Pressure Transducer Elevation (m)	98.968

Discharge Measurement - Mid-Section Method						
Time (24 hr)	Start	11:11	End	11:11	Location	N/A
Method				Instrument Model		N/A
Flow Meter Type	N/A			Instrument Serial #		N/A
Stage (m)	Start	Reading	0.239	Time	11:11	No Flow on this date
	End	Reading	0.239	Time	11:11	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
No Flow									

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	Echo Lake Outflow			
Date Monitored	14-Aug-12			
Time at Site (24 hr)	Start Time:	2:38:00 PM	End Time:	4:00:00 PM
Personnel	E. Heyman, Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	432,091	7,269,573	293m	
Weather Conditions	Mix of Sun and Cloud, cool			

Transducer Information			
PT Model	PS98i	Serial #	2714003
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	9928	Memory Free	27571
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 14	1.087	101.087		100.000	
BM 15			1.157	99.930	
BM 16			1.086	100.001	
PT			2.077	99.010	
WL			1.915	**99.172**	
TBM	1.717	101.003	1.801	99.286	
WL			1.831	**99.172**	
PT			1.994	99.009	
BM 16			1.002	100.001	
BM15			1.071	99.932	
BM 14			1.003	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.915	99.931	0.016	
BM 16	99.984	100.001	0.017	
PT	98.968	99.010	0.041	

Summary	
Stage (m)	99.172
Discharge (m^3/s)	No Flow
Pressure Transducer Reading (m)	0.182
Pressure Transducer Elevation (m)	98.990

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	N/A	End	N/A	Location	N/A
Method				Instrument Model		N/A
Flow Meter Type	N/A			Instrument Serial #		N/A
Stage (m)	Start	Reading	0.182	Time	14:45	No Flow on August 14th
	End	Reading	0.182	Time	14:45	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
No Flow									

Appendix 2-7. Manual Discharge Measurements and Levelling Surveys at EL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	EL-H1			
Stream Name	Echo Lake Outflow			
Date Monitored	7-Sep-12			
Time at Site (24 hr)	Start Time:	2:25:00 PM	End Time:	4:30:00 PM
Personnel	E. Heyman, Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	432,091	7,269,573	293m	
Weather Conditions	Mix of Sun and Cloud			

Transducer Information			
PT Model	PS98i	Serial #	2714003
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	13384	Memory Free	25833
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 14	1.253	101.253		100.000	
BM 15			1.324	99.929	
BM 16			1.276	99.977	
PT			2.248	99.005	
WL			1.924	**99.329**	
TBM	1.885	101.192	1.946	99.307	
WL			1.863	**99.329**	
PT			2.189	99.003	
BM 16			1.215	99.977	
BM15			1.263	99.929	
BM 14			1.194	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 15	99.915	99.929	0.014	
BM 16	99.984	99.977	-0.007	
PT	98.968	99.004	0.036	

Summary	
Stage (m)	99.329
Discharge (m^3/s)	0.00818
Pressure Transducer Reading (m)	0.335
Pressure Transducer Elevation (m)	98.994

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	14:30	End	14:04	Location	10m DS of station			
Method	Velocity-area (Mid-section)			Instrument Model		Swoffer			
Flow Meter Type	Swoffer			Instrument Serial #					
Stage (m)	Start	Reading	0.336	Time	14:30				
	End	Reading	0.335	Time	15:04				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.65	0.00	0.00	0.00	0			0.0000	0.0
	0.70	0.04	0.05	0.00	0.01			0.0000	0.3
	0.77	0.16	0.07	0.01	0.06			0.0007	8.2
	0.84	0.17	0.07	0.01	0.08			0.0007	9.1
	0.88	0.18	0.04	0.01	0.09			0.0006	7.9
	0.92	0.18	0.04	0.01	0.11			0.0008	9.7
	0.96	0.12	0.04	0.00	0.12			0.0006	7.0
	1.00	0.11	0.04	0.00	0.18			0.0008	9.7
	1.04	0.10	0.04	0.00	0.13			0.0005	6.4
	1.08	0.10	0.04	0.00	0.12			0.0005	5.9
	1.12	0.09	0.04	0.00	0.17			0.0006	7.5
	1.16	0.08	0.04	0.00	0.16			0.0005	6.3
	1.20	0.09	0.04	0.00	0.18			0.0006	7.9
	1.24	0.07	0.04	0.00	0.18			0.0005	6.2
	1.28	0.06	0.04	0.00	0.17			0.0004	5.0
	1.32	0.06	0.04	0.00	0.09			0.0002	3.0
LB	1.37	0.00	0.05	0.00	0			0.0000	0.0
Total Q								**0.00818**	**100.0**

General Notes
No Flow on this date

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B Outflow			
Date Monitored	9-Jun-12			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	
Personnel	Eli H, Coby H			
Station Cordinates	Easting	Northing	Elevation	
	442573E	7257794N		
Weather Conditions	Cloudy, light snow			

Transducer Information			
PT Model	PS98i	Serial #	2809011
Gain	3.52168	Offset	0
Status	logging	Battery	100%
# of Records	0	Memory Free	32535
Date Serviced		Crest Gauges	

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 10	1.219	101.219		100.000	
BM 44			1.248	99.971	
				101.219	
PT			1.965	99.254	
WL			1.585	**99.634**	
BM 48	1.040	101.161	1.098	100.121	
WL			1.524	**99.637**	
PT			1.910	99.251	
				101.161	
BM 44			1.189	99.972	
BM 10			1.160	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.972	0.009	
BM 48	100.118	100.121	0.003	
PT	99.253	99.253	-0.001	

Summary	
Stage (m)	99.636
Discharge (m^3/s)	Not Measured
Pressure Transducer Reading (m)	0.405
Pressure Transducer Elevation (m)	99.231

Discharge Measurement - Mid-Section Method											
Time (24 hr)	Start	9:25	End	10:58	Location	~2m upstream from PT					
Method				Instrument Model		N/A					
Flow Meter Type	N/A			Instrument Serial #		N/A					
Stage (m)	Start	Reading	0.402	Time	9:25	Velocity not measured on this date					
	End	Reading	0.405	Time	10:58						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	17.90	0.00	0.00	0.04					
Grass	18.50	0.13	0.60	0.07					
Grass	19.00	0.14	0.50	0.07					
Grass	19.50	0.17	0.50	0.09					
Grass	20.00	0.15	0.50	0.06					
Grass	20.30	0.21	0.30	0.08					
	20.75	0.27	0.45	0.13					
	21.25	0.33	0.50	0.17					
	21.75	0.39	0.50	0.20					
	22.25	0.34	0.50	0.17					
	22.75	0.37	0.50	0.14					
Grass	23.00	0.29	0.25	0.11					
Grass	23.50	0.20	0.50	0.10					
Grass	24.00	0.17	0.50	0.09					
Grass	24.50	0.20	0.50	0.10					
Grass	25.00	0.22	0.50	0.11					
Grass	25.50	0.16	0.50	0.08					
Grass	26.00	0.15	0.50	0.08					
Grass	26.50	0.13	0.50	0.07					
Grass	27.00	0.12	0.50	0.06					
Grass	27.50	0.10	0.50	0.05					
Grass	28.00	0.07	0.50	0.04					
Grass	28.50	0.07	0.50	0.04					
RB	29.20	0.00	0.70	0.02					
Total Q									

General Notes
Flomate not operational

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B Outflow			
Date Monitored	14-Jun-12			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	
Personnel	Eli H, Coby H			
Station Cordinates	Easting	Northing	Elevation	
	442573E	7257794N		
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2809011
Gain	3.52168	Offset	0
Status	logging	Battery	100%
# of Records	741	Memory Free	32161
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 10	1.194	101.194		100.000	
BM 44			1.230	99.964	
PT			1.965	99.229	
WL			1.635	**99.559**	
BM 48	1.050	101.162	1.082	100.112	
WL			1.605	**99.557**	
PT			1.936	99.226	
BM 44			1.198	99.964	
BM 10			1.159	100.003	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.964	0.002	
BM 48	100.118	100.112	-0.006	
PT	99.253	99.228	-0.026	

Summary	
Stage (m)	99.558
Discharge (m^3/s)	0.113
Pressure Transducer Reading (m)	0.356
Pressure Transducer Elevation (m)	99.202

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	9:25	End	10:58	Location	~2m upstream from PT				
Method	Surface Velocity Estimation			Instrument Model		Flo-Mate 200				
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.402	Time	9:25					
	End	Reading	0.405	Time	10:58					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	19.40	0.00	0.00	0.00	0			0.000	0.0
Grass, no flow	19.50	0.06	0.10	0.02	0			0.000	0.0
Grass, no flow	20.00	0.06	0.50	0.03	0			0.000	0.0
Grass	20.40	0.12	0.40	0.04	0.02			0.001	0.6
Grass	20.60	0.12	0.20	0.03	0.16			0.004	4.0
Grass	20.80	0.14	0.20	0.03	0.14			0.004	3.7
	21.00	0.15	0.20	0.04	0.13			0.005	4.4
	21.20	0.19	0.20	0.04	0.17			0.006	5.4
	21.40	0.18	0.20	0.03	0.14			0.005	4.2
	21.60	0.17	0.20	0.04	0.14			0.005	4.7
	21.80	0.19	0.20	0.04	0.07			0.003	2.2
	22.00	0.18	0.20	0.04	0.1			0.004	3.2
	22.20	0.18	0.20	0.04	0.23			0.008	7.4
	22.40	0.16	0.20	0.03	0.13			0.004	3.7
	22.60	0.18	0.20	0.04	0.17			0.006	5.4
	22.80	0.18	0.20	0.04	0.11			0.004	3.5
	23.00	0.20	0.20	0.04	0.19			0.008	6.8
	23.20	0.22	0.20	0.04	0.16			0.007	6.3
	23.40	0.22	0.20	0.04	0.17			0.007	6.6
	23.60	0.24	0.20	0.04	0.17			0.006	5.4
	23.70	0.22	0.10	0.03	0.1			0.003	2.9
Grass	23.90	0.16	0.20	0.06	0.09			0.006	5.1
Grass	24.50	0.11	0.60	0.08	0.1			0.008	6.8
Grass	25.30	0.08	0.80	0.06	0.07			0.004	3.7
Grass	26.00	0.08	0.70	0.06	0.03			0.002	1.5
Grass	26.70	0.06	0.70	0.06	0.04			0.003	2.2
RB	28.10	0.00	1.40	0.04	0			0.000	0.0
Total Q								**0.113**	**100.0**

General Notes
Flomate not operational

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B Outflow			
Date Monitored	17-Jun-12			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	12:15:00 PM
Personnel	Eli H, Coby H			
Station Cordinates	Easting	Northing	Elevation	
	442573E	7257794N		
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2809011
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	1147	Memory Free	31958
Date Serviced		Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 10	1.276	101.276		100.000	
BM 44			1.320	99.956	error
PT			2.058	99.218	
WL			1.764	**99.512**	
BM 48	1.132	101.237	1.171	100.105	
WL			1.725	**99.512**	
PT			2.020	99.217	
BM 44			1.251	99.986	checked, correct
BM 10			1.236	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.986	0.024	
BM 48	100.118	100.105	-0.013	
PT	99.253	99.218	-0.035	

Summary	
Stage (m)	99.512
Discharge (m^3/s)	0.0127
Pressure Transducer Reading (m)	0.318
Pressure Transducer Elevation (m)	99.194

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	9:25	End	10:58	Location	~2m upstream from PT				
Method	Surface Velocity Estimation			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.402	Time	9:25					
	End	Reading	0.405	Time	10:58					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	20.90	0.00	0.00	0.01	0			0.000	0.0
Grass	21.10	0.10	0.20	0.03	-0.04			-0.001	-8.7
	21.45	0.13	0.35	0.03	-0.01			0.000	-2.3
	21.55	0.16	0.10	0.02	0.04			0.001	6.3
	21.70	0.15	0.15	0.03	0.02			0.001	4.2
	21.85	0.18	0.15	0.02	0.03			0.001	5.3
	21.95	0.18	0.10	0.02	0.05			0.001	7.9
	22.05	0.20	0.10	0.02	0.04			0.001	6.0
	22.15	0.19	0.10	0.02	0.02			0.000	3.1
	22.25	0.20	0.10	0.02	0.01			0.000	1.5
	22.35	0.19	0.10	0.02	0.02			0.000	2.8
Grass	22.45	0.18	0.10	0.02	-0.02			0.000	-2.8
	22.55	0.20	0.10	0.02	0.01			0.000	1.6
	22.65	0.20	0.10	0.02	0.02			0.000	3.1
	22.75	0.20	0.10	0.02	0.02			0.000	3.1
	22.85	0.20	0.10	0.02	0.06			0.001	9.4
	22.95	0.20	0.10	0.02	0.06			0.001	9.4
	23.05	0.18	0.10	0.02	0.11			0.002	15.6
	23.15	0.19	0.10	0.02	0.08			0.002	12.0
	23.25	0.20	0.10	0.02	0.05			0.001	7.9
	23.35	0.20	0.10	0.02	0.08			0.002	12.6
	23.45	0.20	0.10	0.02	0.04			0.001	7.9
	23.60	0.19	0.15	0.04	-0.02			-0.001	-6.0
RB	23.85	0.00	0.25	0.02	0			0.000	0.0
Total Q								**0.0127**	**100.0**

General Notes

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B outflow			
Date Monitored	7-Jul-12			
Time at Site (24 hr)	**Start Time:**	3:45:00 PM	**End Time:**	5:40:00 PM
Personnel	Eli H., Rebecca K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	442573	7257796	275m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PS98i	**Serial #**	2809011
Gain	3.52168	**Offset**	0
Status	OK	**Battery**	100%
# of Records	4070	**Memory Free**	30495
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 10	1.274	101.274		100.000	
BM 44			1.320	99.954	
BM 48			1.172	100.102	
PT			2.058	99.216	
WL			1.831	**99.443**	
TBM	0.491	101.187	0.578	100.696	
WL			1.743	**99.444**	
PT			1.969	99.218	
BM 48			1.082	100.105	
BM 44			1.233	99.954	
BM 10			1.186	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 44	99.962	99.954	-0.008	
BM 48	100.118	100.104	-0.014	
PT	99.253	99.217	-0.036	

Summary	
Stage (m)	99.444
Discharge (m^3/s)	0.0099
Pressure Transducer Reading (m)	0.245
Pressure Transducer Elevation (m)	99.199

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	15:48	**End**	16:19	**Location**	Above PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612			
Stage (m)	**Start**	**Reading**	0.244	**Time**	15:48				
	End	**Reading**	0.245	**Time**	16:19				

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
LB	0.62	0.00	0.00	0.00	0.00	0		0.0000	0.0
eddy/swamp	0.70	0.15	0.05	0.08	0.01	0.01		0.0001	0.5
	0.85	0.25	0.08	0.15	0.01	0		0.0000	0.0
	1.00	0.30	0.09	0.15	0.02	0		0.0000	0.0
	1.30	0.40	0.12	0.30	0.04	0		0.0000	0.0
	1.60	0.60	0.18	0.30	0.05	0		0.0000	0.0
	1.90	0.85	0.26	0.30	0.05	0.01		0.0005	5.2
	2.00	0.76	0.23	0.10	0.02	0.05		0.0009	8.8
	2.05	0.72	0.22	0.05	0.01	0.05		0.0005	5.6
	2.10	0.70	0.21	0.05	0.01	0.06		0.0006	6.5
	2.15	0.70	0.21	0.05	0.01	0.01		0.0001	1.1
	2.20	0.70	0.21	0.05	0.01	0.06		0.0006	6.5
	2.25	0.75	0.23	0.05	0.01	0.05		0.0006	5.8
	2.30	0.70	0.21	0.05	0.01	0.04		0.0004	4.3
	2.35	0.70	0.21	0.05	0.01	0.06		0.0006	6.5
	2.40	0.60	0.18	0.05	0.01	0.07		0.0006	6.5
	2.45	0.60	0.18	0.05	0.01	0.08		0.0007	7.4
	2.50	0.51	0.16	0.05	0.01	0.07		0.0005	5.5
	2.55	0.51	0.16	0.05	0.01	0.07		0.0005	5.5
	2.60	0.50	0.15	0.05	0.01	0.07		0.0005	5.4
	2.65	0.47	0.14	0.05	0.01	0.05		0.0004	3.6
	2.70	0.45	0.14	0.05	0.01	0.07		0.0007	7.3
	2.80	0.41	0.12	0.10	0.01	0.06		0.0007	7.6
	2.90	0.30	0.09	0.10	0.01	0.02		0.0002	1.9
	3.00	0.25	0.08	0.10	0.01	-0.01		-0.0001	-1.3
RB	3.25	0.00	0.00	0.25	0.01	0		0.0000	0.0
Total Q								**0.0099**	**100.0**

General Notes
Gradiant = <1%. radiant= 2%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B outflow			
Date Monitored	8-Nov-12			
Time at Site (24 hr)	Start Time:	11:10:00 AM	End Time:	12:45:00 PM
Personnel	Eli H., Cenling X			
Station Cordinates	Easting	Northing	Elevation	
	442573	7257796	275m	
Weather Conditions	Rain			

Transducer Information			
PT Model	PS98i	Serial #	2809011
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	9086	Memory Free	56095
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey

Stn	BS	HI	FS	Elevation	Notes
BM 10	1.198	101.198		100.000	
BM 44			1.235	99.963	
BM 48			1.083	100.115	
PT			2.006	99.192	Difficult to find due to mud
WL			1.845	**99.353**	
TBM	0.630	101.264	0.564	100.634	
WL			1.912	**99.352**	
PT			2.080	99.184	use average
BM 48			1.151	100.113	
BM 44			1.302	99.962	
BM 10			1.265	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.963	0.000	
BM 48	100.118	100.114	-0.004	
PT	99.253	99.188	-0.065	

Summary	
Stage (m)	99.353
Discharge (m^3/s)	No Flow
Pressure Transducer Reading (m)	0.167
Pressure Transducer Elevation (m)	99.186

Discharge Measurement - Mid-Section Method

Time (24 hr)	Start	N/A	End	N/A	Location	NO FLOW
Method	NO FLOW			Instrument Model		
Flow Meter Type				Instrument Serial #		
Stage (m)	Start	Reading	N/A	Time	N/A	NO FLOW on August 11th 2012
	End	Reading	N/A	Time	N/A	

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
NO FLOW									

Appendix 2-8. Manual Discharge Measurements and Levelling Surveys at REFB-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFB-H1			
Stream Name	Reference Lake B outflow			
Date Monitored	13-Sep-12			
Time at Site (24 hr)	Start Time:	9:20:00 AM	End Time:	12:20:00 PM
Personnel	Eli H., Chris H.			
Station Cordinates	Easting	Northing	Elevation	
	442573	7257796	275m	
Weather Conditions	Cloudy, windy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2809011
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	13828	Memory Free	25371
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 10	1.467	101.467		100.000	
BM 44			1.497	99.970	
BM 48			1.367	100.100	
PT			2.320	99.147	error
WL			2.071	**99.396**	
TBM	2.078	101.553	1.992	99.475	
WL			2.161	**99.392**	
PT			2.401	99.152	checked, ok
BM 48			1.453	100.100	
BM 44			1.586	99.967	
BM 10			1.553	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 44	99.962	99.969	0.007	
BM 48	100.118	100.100	-0.018	
PT	99.253	99.152	-0.101	

Summary	
Stage (m)	99.394
Discharge (m^3/s)	0.00202
Pressure Transducer Reading (m)	0.237
Pressure Transducer Elevation (m)	99.157

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	9:38	End	9:57	Location	Above PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529			
Stage (m)	Start	Reading	0.238	Time	9:38				
	End	Reading	0.238	Time	9:52				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.88	0.00	0.00	0.00	0			0.0000	0.0
	0.90	0.06	0.02	0.00	0.01			0.0000	1.8
	1.00	0.12	0.10	0.01	0			0.0000	0.0
	1.10	0.16	0.10	0.02	0.01			0.0002	7.9
	1.20	0.16	0.10	0.02	0.01			0.0002	7.9
	1.30	0.16	0.10	0.02	0.01			0.0002	7.9
	1.40	0.16	0.10	0.02	0.01			0.0002	7.9
	1.50	0.17	0.10	0.02	0.01			0.0002	8.4
	1.60	0.17	0.10	0.02	0.01			0.0002	8.4
	1.70	0.16	0.10	0.02	0.01			0.0002	7.9
	1.80	0.16	0.10	0.02	0			0.0000	0.0
	1.90	0.16	0.10	0.02	0.01			0.0002	7.9
	2.00	0.16	0.10	0.02	0.01			0.0002	7.9
	2.10	0.16	0.10	0.02	0			0.0000	0.0
	2.20	0.16	0.10	0.02	0			0.0000	0.0
	2.30	0.10	0.10	0.01	0.02			0.0002	9.9
	2.40	0.10	0.10	0.01	0.01			0.0001	5.0
	2.50	0.09	0.10	0.01	0.01			0.0001	4.5
	2.60	0.07	0.10	0.01	0.01			0.0001	3.5
	2.70	0.06	0.10	0.01	0.01			0.0001	3.0
	2.80	0.05	0.10	0.01	0			0.0000	0.0
	2.90	0.03	0.10	0.00	0			0.0000	0.0
RB	3.00	0.00	0.10	0.00	0			0.0000	0.0
Total Q								**0.00202**	**100.0**

General Notes
Gradiant = <1%. Distance from middle of PT to survey point on conduit = 1.5cm. PT Bumped at 9:40 --> dropped 0.010m

Appendix 2-9. Manual Discharge Measurements and Levelling Surveys at WL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	7-Jun-12			
Time at Site (24 hr)	Start Time:	8:20:00 AM	End Time:	2:30:00 PM
Personnel	Eli H, Coby H			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2809027
Gain	3.52168	Offset	0
Status	logging	Battery	100%
# of Records	0	Memory Free	32535
Date Serviced	N/A	Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.322	100.322		100.000	
BM 1			1.085	99.237	
PT			2.513	97.809	
WL			1.556	**98.766**	
BM 2	0.332	100.261	0.393	99.929	
WL			1.496	**98.765**	
PT			2.454	97.807	
BM 1			1.024	99.237	
BM 12			0.260	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.207	99.237	0.030	
BM 2	99.917	99.929	0.012	
PT	97.808	97.808	0.000	

Summary	
Stage (m)	98.766
Discharge (m^3/s)	1.743
Pressure Transducer Reading (m)	0.991
Pressure Transducer Elevation (m)	97.775

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	13:15	End	14:30	Location	5m upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flomate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.989	Time	13:15					
	End	Reading	0.989	Time	14:30					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	17.84	0.00	0.00	0.01	0.00			0.000	0.0
Grass	17.98	0.12	0.14	0.01	-0.06			-0.001	0.0
eddy	18.05	0.18	0.07	0.01	0.00			0.000	0.0
eddy	18.13	0.42	0.08	0.04	-0.05			-0.002	-0.1
	18.26	0.52	0.13	0.10	0.01			0.001	0.1
	18.50	0.66	0.24	0.24	0.07			0.017	1.0
	19.00	0.90	0.50	0.45		0.13	0.07	0.045	2.6
	19.50	0.99	0.50	0.50		0.18	0.10	0.069	4.0
	20.00	1.10	0.50	0.55		0.22	0.11	0.091	5.2
	20.50	1.18	0.50	0.59		0.19	0.11	0.089	5.1
	21.00	1.24	0.50	0.62		0.25	0.14	0.121	6.9
faster @ depth	21.50	1.22	0.50	0.61		0.22	0.25	0.143	8.2
	22.00	1.22	0.50	0.61		0.26	0.19	0.137	7.9
	22.50	1.21	0.50	0.61		0.29	0.20	0.148	8.5
	23.00	1.19	0.50	0.60		0.29	0.28	0.170	9.7
	23.50	1.16	0.50	0.58		0.31	0.24	0.160	9.2
	24.00	1.10	0.50	0.55		0.33	0.27	0.165	9.5
	24.50	1.05	0.50	0.53		0.27	0.29	0.147	8.4
	25.00	0.88	0.50	0.44		0.27	0.23	0.110	6.3
	25.50	0.78	0.50	0.39		0.20	0.18	0.074	4.3
	26.00	0.63	0.50	0.32	0.16			0.050	2.9
	26.50	0.62	0.50	0.29	0.02			0.006	0.3
	26.95	0.55	0.45	0.18	0.01			0.002	0.1
	27.14	0.44	0.19	0.11	0.01			0.001	0.1
RB	27.45	0.00	0.31	0.07	0.00			0.000	0.0
Total Q								1.743	100.0

General Notes
Gradiant = <1%

Appendix 2-9. Manual Discharge Measurements and Levelling Surveys at WL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	13-Jun-12			
Time at Site (24 hr)	Start Time:	12:40:00 PM	End Time:	2:30:00 PM
Personnel	Eli H, Coby H			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PS98i	Serial #	2809027
Gain	3.52168	Offset	0
Status	O.k.	Battery	100%
# of Records	884	Memory Free	32089
Date Serviced	N/A	Crest Gauges	no

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.275	100.275		100.000	
BM 1			1.034	99.241	
PT			2.477	97.798	
WL			1.603	**98.672**	error
BM 2	0.390	100.321	0.344	99.931	
WL			1.642	**98.679**	checked, correct
PT			2.521	97.800	
BM 1			1.079	99.242	
BM 12			0.321	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.207	99.242	0.035	
BM 2	99.917	99.931	0.014	
PT	97.808	97.799	-0.009	

Summary	
Stage (m)	98.679
Discharge (m^3/s)	1.069
Pressure Transducer Reading (m)	0.912
Pressure Transducer Elevation (m)	97.767

Discharge Measurement - Mid-Section Method							
Time (24 hr)	Start	12:48	End	14:00	Location		
Method	Velocity-area (Mid-section)			Instrument Model		Flomate 2000	
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405	
Stage (m)	Start	Reading	0.913	Time	12:48		
	End	Reading	0.912	Time	14:00		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	19.30	0.00	0.00	0.00	0			0.000	0.0
Grass	19.40	0.08	0.10	0.01	-0.01			0.000	0.0
Grass	19.55	0.13	0.15	0.02	0.07			0.002	0.1
	19.75	0.48	0.20	0.11	0.11			0.012	1.1
	20.00	0.64	0.25	0.21	0.13			0.027	2.5
	20.40	0.68	0.40	0.27	0.13			0.035	3.3
	20.80	0.76	0.40	0.30		0.16	0.10	0.040	3.7
	21.20	0.83	0.40	0.33		0.14	0.09	0.038	3.6
	21.60	0.89	0.40	0.36		0.14	0.16	0.053	5.0
	22.00	1.00	0.40	0.40		0.15	0.10	0.050	4.7
	22.40	1.08	0.40	0.43		0.16	0.17	0.071	6.7
	22.80	1.12	0.40	0.45		0.18	0.13	0.069	6.5
	23.20	1.14	0.40	0.46		0.18	0.13	0.071	6.6
	23.60	1.14	0.40	0.46		0.22	0.14	0.082	7.7
	24.00	1.10	0.40	0.44		0.17	0.15	0.070	6.6
	24.40	1.07	0.40	0.43		0.19	0.14	0.071	6.6
	24.80	1.02	0.40	0.41		0.18	0.17	0.071	6.7
	25.20	1.04	0.40	0.42		0.16	0.17	0.069	6.4
	25.60	0.99	0.40	0.40		0.12	0.15	0.053	5.0
	26.00	0.95	0.40	0.38		0.14	0.15	0.055	5.2
	26.40	0.92	0.40	0.37		0.14	0.17	0.057	5.3
	26.80	0.85	0.40	0.26		0.12	0.13	0.032	3.0
	27.00	0.88	0.20	0.20		0.12	0.11	0.023	2.1
	27.25	0.54	0.25	0.14	0.11			0.015	1.4
	27.50	0.16	0.25	0.03	0.1			0.003	0.3
RB	27.60	0.00	0.10	0.01	0			0.000	
Total Q								**1.069**	**100.0**

General Notes
Gradiant = <1%

Appendix 2-9. Manual Discharge Measurements and Levelling Surveys at WL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	5-Jul-12			
Time at Site (24 hr)	Start Time:	3:23:00 PM	End Time:	5:50:00 PM
Personnel	Eli H., Merle K.			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2809027
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	4069	Memory Free	30500
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.049	100.049		100.000	
BM 1			0.821	99.228	
BM 2			0.110	99.939	
PT			2.249	97.800	
WL			1.679	**98.370**	
TBM	1.301	100.098	1.252	98.797	
WL			1.728	**98.370**	
PT			2.298	97.800	
BM 2			0.161	99.937	
BM 1			0.870	99.228	
BM 12			0.100	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.207	99.228	0.021	
BM 2	99.917	99.938	0.021	
PT	97.808	97.800	-0.008	

Summary	
Stage (m)	98.370
Discharge (m^3/s)	0.1894
Pressure Transducer Reading (m)	0.601
Pressure Transducer Elevation (m)	97.769

Discharge Measurement - Mid-Section Method												
Time (24 hr)	Start	15:34	End	16:43	Location	1 m Downstream of Station						
Method	Velocity-area (Mid-section)				Instrument Model	Flo-Mate 2000						
Flow Meter Type	Flo-Mate				Instrument Serial #	2007612						
Stage (m)	Start	Reading	0.602	Time	15:34							
	End	Reading	0.601	Time	16:43							

	Station	Depth	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.10	0.00	0.00	0.00	0.01	0			0.000	0.0
	1.20	0.35	0.11	0.10	0.02	0			0.000	0.0
	1.50	0.90	0.27	0.30	0.08	-0.01			-0.001	-0.4
	1.80	1.25	0.38	0.30	0.11	0.01			0.001	0.6
	2.10	1.45	0.44	0.30	0.13	0.02			0.003	1.4
	2.40	1.65	0.50	0.30	0.15	0.03			0.005	2.4
	2.70	1.70	0.52	0.30	0.16	0.03			0.005	2.5
	3.00	1.95	0.59	0.30	0.18	0.03			0.005	2.8
	3.30	2.10	0.64	0.30	0.19	0.03			0.006	3.0
	3.60	2.25	0.69	0.30	0.21	0.04			0.008	4.3
	3.90	2.55	0.78	0.30	0.23		0.03	0.04	0.008	4.3
	4.20	2.60	0.79	0.30	0.24		0.04	0.04	0.010	5.0
	4.50	2.60	0.79	0.30	0.24		0.04	0.04	0.010	5.0
	4.80	2.55	0.78	0.30	0.23		0.04	0.04	0.009	4.9
	5.10	2.50	0.76	0.30	0.23		0.03	0.04	0.008	4.2
	5.40	2.40	0.73	0.30	0.22	0.05			0.011	5.8
	5.70	2.40	0.73	0.30	0.22	0.05			0.011	5.8
	6.00	2.30	0.70	0.30	0.21	0.05			0.011	5.6
	6.30	2.25	0.69	0.30	0.21	0.05			0.010	5.4
	6.60	2.30	0.70	0.30	0.21	0.05			0.011	5.6
	6.90	2.35	0.72	0.30	0.21	0.05			0.011	5.7
	7.20	2.30	0.70	0.30	0.21	0.05			0.011	5.6
	7.50	2.15	0.66	0.30	0.20	0.05			0.010	5.2
	7.80	2.10	0.64	0.30	0.19	0.04			0.008	4.1
	8.10	2.00	0.61	0.30	0.18	0.05			0.009	4.8
	8.40	2.05	0.62	0.30	0.19	0.05			0.009	4.9
	8.70	1.05	0.32	0.30	0.07	0.04			0.003	1.5
	8.85	0.30	0.09	0.15	0.01	0			0.000	0.0
RB	9.00	0.00	0.00	0.15	0.01	0			0.000	0.0
Total Q									**0.189**	**100.0**

General Notes
Gradiant = 1%. Depth values measured in ft and converted to m (1ft = 0.3048m)

Appendix 2-9. Manual Discharge Measurements and Levelling Surveys at WL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	11-Aug-12			
Time at Site (24 hr)	Start Time:	3:10:00 PM	End Time:	5:00:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2809027
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	9395	Memory Free	27838
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.210	100.210		100.000	
BM 1			0.968	99.242	
BM 2			0.255	99.955	
PT			2.396	97.814	
WL			1.947	**98.263**	
TBM	1.955	100.176	1.989	98.221	
WL			1.916	**98.260**	
PT			2.365	97.811	
BM 2		0.936	0.220	99.956	
BM 1			0.936	99.240	
BM 12			0.174	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.207	99.241	0.034	
BM 2	99.917	99.956	0.038	
PT	97.808	97.813	0.004	

Summary	
Stage (m)	98.262
Discharge (m^3/s)	0.0494
Pressure Transducer Reading (m)	0.477
Pressure Transducer Elevation (m)	97.785

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	15:22	End	15:56	Location	5m Downstream of Station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042				
Stage (m)	Start	Reading	0.477	Time	15:22					
	End	Reading	0.477	Time	15:56					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
LB	1.70	0.00	0.00	0.00	0.07	0		0.000	0.0
	2.00	1.45	0.44	0.30	0.15	0		0.000	0.0
	2.40	1.90	0.58	0.40	0.23	-0.01		-0.002	-4.7
	2.80	1.99	0.61	0.40	0.24	0.01		0.002	4.9
	3.20	2.10	0.64	0.40	0.26	0		0.000	0.0
	3.60	2.12	0.65	0.40	0.26	0.01		0.003	5.2
	4.00	2.17	0.66	0.40	0.26	0.02		0.005	10.7
	4.40	2.14	0.65	0.40	0.26	0.01		0.003	5.3
	4.80	2.11	0.64	0.40	0.26	0.02		0.005	10.4
	5.20	2.15	0.66	0.40	0.26	0.01		0.003	5.3
	5.60	2.20	0.67	0.40	0.27	0.01		0.003	5.4
	6.00	2.22	0.68	0.40	0.27	0.02		0.005	11.0
	6.40	2.12	0.65	0.40	0.26	0.02		0.005	10.5
	6.80	2.10	0.64	0.40	0.26	0.02		0.005	10.4
	7.20	2.05	0.62	0.40	0.25	0.01		0.002	5.1
	7.60	2.00	0.61	0.40	0.24	0.02		0.005	9.9
	8.00	1.85	0.56	0.40	0.23	0.01		0.002	4.6
	8.40	1.70	0.52	0.40	0.21	0.01		0.002	4.2
	8.80	1.62	0.49	0.40	0.20	0		0.000	0.0
	9.20	1.10	0.34	0.40	0.12	0.01		0.001	2.4
	9.50	0.31	0.09	0.30	0.02	-0.01		0.000	-0.5
RB	9.70	0.00	0.00	0.20	0.01	0		0.000	0.0
RB									
Total Q								0.0494	100.0

General Notes
Gradiant = 1%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-9. Manual Discharge Measurements and Levelling Surveys at WL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	WL-H1			
Stream Name	Wolf Outflow			
Date Monitored	14-Sep-12			
Time at Site (24 hr)	Start Time:	10:40:00 AM	End Time:	5:00:00 PM
Personnel	Eli H., Chris H.			
Station Cordinates	Easting	Northing	Elevation	
	434269	7269719		
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2809027
Gain	3.52168	Offset	0
Status	OK	Battery	100%
# of Records	14271	Memory Free	25401
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 12	0.104	100.104		100.000	
BM 1			0.871	99.233	
BM 2			0.143	99.961	
PT			2.300	97.804	
WL			1.807	**98.297**	
TBM	2.410	100.159	2.355	97.749	
WL			1.862	**98.297**	
PT			2.352	97.807	
BM 2		0.924	0.199	99.960	
BM 1			0.924	99.235	
BM 12			0.161	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 1	99.207	99.234	0.027	
BM 2	99.917	99.961	0.043	
PT	97.808	97.806	-0.003	

Summary	
Stage (m)	98.297
Discharge (m^3/s)	0.0508
Pressure Transducer Reading (m)	0.515
Pressure Transducer Elevation (m)	97.782

Discharge Measurement - Mid-Section Method											
Time (24 hr)	Start	10:P45	End	12:00	Location	5m Downstream of Station					
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000					
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529					
Stage (m)	Start	Reading	0.514	Time	10:45						
	End	Reading	0.514	Time	12:00						

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.85	0.00	0.00	0.00	0			0.000	0.0
	1.90	0.07	0.05	0.01	0			0.000	0.0
	2.15	0.19	0.25	0.05	0.01			0.000	0.9
	2.40	0.22	0.25	0.06	0.02			0.001	2.2
	2.65	0.29	0.25	0.07	0.02			0.001	2.9
	2.90	0.32	0.25	0.08	0.02			0.002	3.2
	3.15	0.34	0.25	0.09	0.02			0.002	3.3
	3.40	0.36	0.25	0.09	0.03			0.003	5.3
	3.65	0.40	0.25	0.10	0.03			0.003	5.9
	3.90	0.44	0.25	0.11	0.03			0.003	6.5
	4.15	0.48	0.25	0.12	0.03			0.004	7.1
	4.40	0.52	0.25	0.13	0.04			0.005	10.2
	4.65	0.52	0.25	0.13	0.04			0.005	10.2
	4.90	0.53	0.25	0.13	0.04			0.005	10.4
	5.15	0.40	0.25	0.10	0.03			0.003	5.9
	5.40	0.38	0.25	0.10	0.03			0.003	5.6
	5.65	0.42	0.25	0.11	0.02			0.002	4.1
	5.90	0.40	0.25	0.10	0.03			0.003	5.9
	6.15	0.36	0.25	0.08	0.02			0.002	3.2
	6.35	0.35	0.20	0.09	0.02			0.002	3.4
	6.65	0.32	0.30	0.09	0.02			0.002	3.5
	6.90	0.34	0.25	0.06	0			0.000	0.0
	7.00	0.08	0.10	0.01	0.01			0.000	0.2
RB	7.10	0.00	0.10	0.00	0			0.000	0.0
RB									
Total Q								0.0508	100.0

General Notes
Gradiant = 1%. Distance from middle of PT to survey point on conduit = 1.65cm

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Northeast inflow to Big Lake			
Date Monitored	12-Jun-12			
Time at Site (24 hr)	Start Time:	8:30:00 AM	End Time:	11:00:00 AM
Personnel	Eli H., Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	429044	7268478	301	
Weather Conditions				

Transducer Information			
PT Model	PS98i	Serial #	2714017
Gain	N/A	Offset	N/A
Status	OK, logging	Battery	100%
# of Records	1	Memory Free	32530 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 52	1.197	101.197		100.000	
BM 53			1.253	99.944	
PT			1.747	99.450	
WL			1.442	**99.755**	
BM 54	1.199	101.119	1.277	99.920	
WL			1.365	**99.754**	
PT			1.670	99.449	
BM 53			1.174	99.945	
BM 52			1.117	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	99.945	99.945		
BM 54	99.920	99.920		
PT	99.450	99.450		

Summary	
Stage (m)	99.755
Discharge (m^3/s)	0.0569
Pressure Transducer Reading (m)	0.338
Pressure Transducer Elevation (m)	99.417

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	9:30	End	10:18	Location	~10m Upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.339	Time	9:30					
	End	Reading	0.339	Time	10:18					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.12	0.00	0.00	0.00	0			0.000	0.0
	0.14	0.06	0.02	0.00	0.04			0.000	0.1
	0.19	0.11	0.05	0.01	0.19			0.001	2.0
	0.25	0.14	0.06	0.01	0.28			0.002	3.8
	0.30	0.15	0.05	0.01	0.31			0.002	4.1
	0.35	0.17	0.05	0.01	0.31			0.003	4.6
	0.40	0.18	0.05	0.01	0.32			0.003	5.1
	0.45	0.18	0.05	0.01	0.32			0.003	5.1
	0.50	0.18	0.05	0.01	0.35			0.003	5.5
	0.55	0.20	0.05	0.01	0.37			0.004	6.5
	0.60	0.20	0.05	0.01	0.43			0.004	7.6
	0.65	0.19	0.05	0.01	0.49			0.005	8.2
	0.70	0.19	0.05	0.01	0.49			0.005	8.2
	0.75	0.21	0.05	0.01	0.48			0.005	8.9
	0.80	0.22	0.05	0.01	0.44			0.005	8.5
	0.85	0.23	0.05	0.01	0.43			0.005	8.7
	0.90	0.23	0.05	0.01	0.38			0.004	7.7
	0.95	0.23	0.05	0.01	0.33			0.003	6.0
	0.99	0.22	0.04	0.01	-0.03			0.000	-0.5
LB	1.04	0.10	0.05	0.01	0			0.000	0.0
Total Q								**0.0569**	**100.0**

General Notes

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Northeast inflow to Big Lake			
Date Monitored	16-Jun-12			
Time at Site (24 hr)	**Start Time:**	12:15:00 PM	**End Time:**	2:00:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429044	7268478	301	
Weather Conditions				

Transducer Information			
PT Model	PS98i	**Serial #**	2714017
Gain	N/A	**Offset**	N/A
Status	OK, logging	**Battery**	100%
# of Records	594	**Memory Free**	32234 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 52	1.180	101.180		100.000	BM 52
BM 53			1.237	99.943	BM 53
PT			1.740	99.440	
WL			1.478	**99.702**	
BM 54	1.246	101.164	1.262	99.918	BM 54
WL			1.464	**99.700**	
PT			1.724	99.440	
BM 53			1.222	99.942	BM 53
BM 52			1.164	100.000	BM 52

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	99.945	99.943	-0.002	
BM 54	99.920	99.918	-0.002	
PT	99.450	99.440	-0.010	

Summary	
Stage (m)	99.701
Discharge (m^3/s)	0.0213
Pressure Transducer Reading (m)	0.293
Pressure Transducer Elevation (m)	99.408

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	12:28	**End**	13:15	**Location**	~10m Upstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405				
Stage (m)	**Start**	**Reading**	0.292	**Time**	12:28					
	End	**Reading**	0.293	**Time**	13:15					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.47	0.00	0.00	0.00	0			0.000	0.0
eddy	0.52	0.12	0.05	0.01	-0.02			0.000	-0.5
	0.56	0.12	0.04	0.01	0.02			0.000	0.6
	0.62	0.13	0.06	0.01	0.03			0.000	1.1
	0.68	0.16	0.06	0.01	0.04			0.000	1.8
	0.74	0.16	0.06	0.01	0.07			0.001	3.2
	0.80	0.14	0.06	0.01	0.10			0.001	4.0
	0.86	0.14	0.06	0.01	0.10			0.001	4.0
	0.92	0.15	0.06	0.01	0.12			0.001	5.1
	0.98	0.16	0.06	0.01	0.14			0.001	6.3
	1.04	0.18	0.06	0.01	0.14			0.002	7.1
	1.10	0.16	0.06	0.01	0.13			0.001	5.9
	1.16	0.16	0.06	0.01	0.13			0.001	5.9
	1.22	0.17	0.06	0.01	0.09			0.001	4.3
	1.28	0.18	0.06	0.01	0.11			0.001	5.6
	1.34	0.20	0.06	0.01	0.11			0.001	6.2
	1.40	0.20	0.06	0.01	0.13			0.002	7.3
	1.46	0.22	0.06	0.01	0.14			0.002	8.7
	1.52	0.21	0.06	0.01	0.16			0.002	9.5
	1.58	0.24	0.06	0.01	0.15			0.002	10.2
	1.64	0.24	0.06	0.02	0.05			0.001	4.0
LB	1.72	0.00	0.08	0.01	0			0.000	0.0
Total Q								**0.0213**	**100.0**

General Notes

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Northeast inflow to Big Lake			
Date Monitored	13-Jul-12			
Time at Site (24 hr)	**Start Time:**	1:57:00 PM	**End Time:**	5:30:00 PM
Personnel	Eli H., Fraser T.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429044	7268478	301	
Weather Conditions	Mix of Sun and Cloud			

Transducer Information			
PT Model	PS98i	**Serial #**	2714017
Gain	N/A	**Offset**	N/A
Status	OK, logging	**Battery**	100%
# of Records	4492	**Memory Free**	30288 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 52	1.215	101.215		100.000	
BM 53			1.282	99.933	
BM 54			1.317	99.898	
PT			1.762	99.453	
WL			1.604	**99.611**	
TBM	1.568	101.255	1.528	99.687	
WL			1.644	**99.611**	
PT			1.800	99.455	
BM 54			1.358	99.897	
BM 53			1.321	99.934	
BM 52			1.252	100.003	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	99.945	99.934	-0.011	
BM 54	99.920	99.898	-0.022	
PT	99.450	99.454	0.005	

Summary	
Stage (m)	99.611
Discharge (m^3/s)	0.00840
Pressure Transducer Reading (m)	0.195
Pressure Transducer Elevation (m)	99.416

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	14:08	**End**	14:52	**Location**	~10m Upstream of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612			
Stage (m)	**Start**	**Reading**	0.196	**Time**	14:08				
	End	**Reading**	0.195	**Time**	14:52				

	Station	Depth		Distance	Area	Velocity @ 60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	0.57	0.00	0.00	0.00	0.00	0.00		0.000	0.0
	0.61	0.34	0.10	0.04	0.00	-0.01		0.000	-0.6
	0.66	0.36	0.11	0.05	0.01	0.00		0.000	0.0
	0.71	0.38	0.12	0.05	0.01	0.01		0.000	0.7
	0.76	0.40	0.12	0.05	0.01	0.01		0.000	0.7
	0.81	0.46	0.14	0.05	0.01	0.01		0.000	0.8
	0.86	0.48	0.15	0.05	0.01	0.01		0.000	0.9
	0.91	0.44	0.13	0.05	0.01	0.02		0.000	1.6
	0.96	0.44	0.13	0.05	0.01	0.04		0.000	3.2
	1.01	0.49	0.15	0.05	0.01	0.05		0.000	4.4
	1.06	0.50	0.15	0.05	0.01	0.07		0.001	6.4
	1.11	0.48	0.15	0.05	0.01	0.07		0.001	6.1
	1.16	0.49	0.15	0.05	0.01	0.07		0.001	6.2
	1.21	0.51	0.16	0.05	0.01	0.08		0.001	7.4
	1.26	0.52	0.16	0.05	0.01	0.08		0.001	7.5
	1.31	0.52	0.16	0.05	0.01	0.07		0.001	6.6
	1.36	0.52	0.16	0.05	0.01	0.07		0.001	6.6
	1.41	0.50	0.15	0.05	0.01	0.07		0.001	6.4
	1.46	0.51	0.16	0.05	0.01	0.06		0.000	5.6
	1.51	0.52	0.16	0.05	0.01	0.06		0.000	5.7
	1.56	0.54	0.16	0.05	0.01	0.05		0.000	4.9
	1.61	0.51	0.16	0.05	0.01	0.06		0.000	5.6
	1.66	0.51	0.16	0.05	0.01	0.06		0.000	5.6
	1.71	0.53	0.16	0.05	0.01	0.06		0.000	5.2
	1.75	0.53	0.16	0.04	0.01	0.03		0.000	2.6
LB	1.80	0.00	0.00	0.05	0.00	0.00		0.000	0.0
Total Q								**0.00840**	**100.000**

General Notes
Imperial Rod used. Depth values converted from ft. to m. (1ft = 0.3048)

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Northeast inflow to Big Lake			
Date Monitored	10-Aug-12			
Time at Site (24 hr)	**Start Time:**	8:30:00 AM	**End Time:**	10:30:00 AM
Personnel	Eli H., Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	429044	7268478	301	
Weather Conditions	Rainy and Cool			

Transducer Information			
PT Model	PS98i	**Serial #**	2714017
Gain	N/A	**Offset**	N/A
Status	OK, logging	**Battery**	100%
# of Records	8493	**Memory Free**	28287 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 52	1.093	101.093		100.000	
BM 53			1.113	99.980	error
BM 54			1.192	99.901	
PT			1.628	99.465	
WL			1.506	**99.587**	
TBM	1.500	101.022	1.571	99.522	
WL			1.436	**99.586**	
PT			1.556	99.466	
BM 54			1.119	99.903	
BM 53			1.083	99.939	checked, ok
BM 52			1.022	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 53	99.945	99.939	-0.005	
BM 54	99.920	99.902	-0.018	
PT	99.450	99.466	0.016	

Summary	
Stage (m)	99.587
Discharge (m^3/s)	0.00106
Pressure Transducer Reading (m)	0.149
Pressure Transducer Elevation (m)	99.438

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	8:56	**End**	9:55	**Location**	~15m Upstream of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2006042			
Stage (m)	**Start**	**Reading**	0.149	**Time**	8:56	Stream very low flow and narrow,			
	End	**Reading**	0.149	**Time**	9:55	unable to record 20 measurements			

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
LB	1.12	0.00	0.00	0.00	0.00	0		0.000	0.0
	1.16	0.10	0.03	0.04	0.00	-0.03		0.000	-3.4
	1.20	0.41	0.12	0.04	0.00	0		0.000	0.0
	1.24	0.41	0.12	0.04	0.00	0.02		0.000	9.4
	1.28	0.40	0.12	0.04	0.01	0.03		0.000	15.5
	1.33	0.33	0.10	0.05	0.01	0.06		0.000	28.4
	1.38	0.35	0.11	0.05	0.00	0.07		0.000	31.6
	1.42	0.37	0.11	0.04	0.00	0.05		0.000	18.6
	1.45	0.39	0.12	0.03	0.00	0		0.000	0.0
RB	1.46	0.00	0.00	0.01	0.00	0		0.000	0.0
Total Q								**0.00106**	**100.0**

General Notes
Used 2nd measurement because flow was too low at first location (lots of 0.00s). Imperial Rod was used, depth values converted from ft. to m (1ft = 0.3048m).

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Northeast inflow to Big Lake			
Date Monitored	15-Aug-12			
Time at Site (24 hr)	Start Time:	12:00:00 PM	End Time:	3:00:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	429044	7268478	301	
Weather Conditions	Cloudy, coldl			

Transducer Information			
PT Model	PS98i	Serial #	2714017
Gain	N/A	Offset	N/A
Status	OK	Battery	100%
# of Records	9236	Memory Free	27916 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 52	1.288	101.288		100.000	
BM 53			1.348	99.940	
BM 54			1.383	99.905	
PT			1.820	99.468	
WL			1.668	**99.620**	
TBM	1.733	101.417	1.604	99.684	
WL			1.800	**99.617**	
PT			1.948	99.469	
BM 54			1.513	99.904	
BM 53			1.478	99.939	
BM 52			1.417	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	99.945	99.940	-0.005	
BM 54	99.920	99.905	-0.016	
PT	99.450	99.469	0.019	

Summary	
Stage (m)	99.619
Discharge (m^3/s)	0.00308
Pressure Transducer Reading (m)	0.178
Pressure Transducer Elevation (m)	99.441

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	12:45	End	13:15	Location	~7m Upstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042			
Stage (m)	Start	Reading	0.178	Time	12:45				
	End	Reading	0.178	Time	13:15				

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
LB	0.85	0.00	0.00	0.00	0.00	0		0.000	0.0
	0.90	0.19	0.06	0.05	0.00	0		0.000	0.0
	0.95	0.30	0.09	0.05	0.00	0.02		0.000	2.7
	0.99	0.30	0.09	0.04	0.00	0.04		0.000	4.8
	1.03	0.30	0.09	0.04	0.00	0.06		0.000	7.1
	1.07	0.30	0.09	0.04	0.00	0.06		0.000	6.2
	1.10	0.25	0.08	0.03	0.00	0.09		0.000	7.8
	1.14	0.25	0.08	0.04	0.00	0.1		0.000	11.1
	1.19	0.25	0.08	0.05	0.00	0.12		0.000	13.4
	1.23	0.25	0.08	0.04	0.00	0.1		0.000	9.9
	1.27	0.25	0.08	0.04	0.00	0.07		0.000	6.9
	1.31	0.25	0.08	0.04	0.00	0.06		0.000	5.9
	1.35	0.24	0.07	0.04	0.00	0.05		0.000	4.8
	1.39	0.24	0.07	0.04	0.00	0.06		0.000	5.7
	1.43	0.22	0.07	0.04	0.00	0.05		0.000	4.4
	1.47	0.22	0.07	0.04	0.00	0.04		0.000	3.5
	1.51	0.22	0.07	0.04	0.00	0.04		0.000	3.5
	1.55	0.21	0.06	0.04	0.00	0.03		0.000	2.5
	1.59	0.20	0.06	0.04	0.00	0.01		0.000	0.8
	1.63	0.20	0.06	0.04	0.00	0		0.000	0.0
	1.67	0.15	0.05	0.04	0.00	-0.01		0.000	-1.0
RB	1.76	0.00	0.00	0.09	0.00	0		0.000	0.0
Total Q								**0.00308**	**100.0**

General Notes
Imperial Rod used. Depth values converted from ft. to m. (1ft = 0.3048)

Appendix 2-10. Manual Discharge Measurements and Levelling Surveys at BL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H1			
Stream Name	Big Lake inflow			
Date Monitored	10-Sep-12			
Time at Site (24 hr)	Start Time:	9:00:00 AM	End Time:	11:00:00 AM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	429044	7268478	301	
Weather Conditions	Cloudy, coldl			

Transducer Information			
PT Model	PS98i	Serial #	2714017
Gain	N/A	Offset	N/A
Status	OK	Battery	100%
# of Records	12958	Memory Free	26054
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 52	1.472	101.472		100.000	
BM 53			1.532	99.940	
BM 54			1.562	99.910	
PT			2.001	99.471	
WL			1.788	**99.684**	
TBM	1.853	101.407	1.918	99.554	
WL			1.723	**99.684**	
PT			1.933	99.474	
BM 54			1.497	99.910	
BM 53			1.469	99.938	
BM 52			1.409	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 53	99.945	99.939	-0.006	
BM 54	99.920	99.910	-0.010	
PT	99.450	99.473	0.023	

Summary	
Stage (m)	99.684
Discharge (m^3/s)	0.00871
Pressure Transducer Reading (m)	0.242
Pressure Transducer Elevation (m)	99.442

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	9:12	End	9:52	Location	~7m Upstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Swoffer 2100				
Flow Meter Type	Swoffer			Instrument Serial #						
Stage (m)	Start	Reading	0.242	Time	9:12					
	End	Reading	0.242	Time	9:52					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.40	0.00	0.00	0.00	0			0.000	0.0
	0.45	0.11	0.05	0.01	0.01			0.000	0.6
	0.50	0.20	0.05	0.01	0.01			0.000	1.1
	0.55	0.20	0.05	0.01	0.02			0.000	2.3
	0.60	0.20	0.05	0.01	0.06			0.001	6.9
	0.65	0.20	0.05	0.01	0.07			0.001	8.0
	0.70	0.19	0.05	0.01	0.05			0.000	5.5
	0.75	0.20	0.05	0.01	0.05			0.001	5.7
	0.80	0.18	0.05	0.01	0.05			0.000	5.2
	0.85	0.18	0.05	0.01	0.05			0.000	5.2
	0.90	0.20	0.05	0.01	0.08			0.001	7.4
	0.93	0.20	0.03	0.01	0.1			0.001	5.7
	0.95	0.18	0.02	0.00	0.07			0.000	2.9
	0.97	0.18	0.02	0.00	0.11			0.000	5.7
	1.00	0.19	0.03	0.01	0.08			0.000	5.2
	1.03	0.20	0.03	0.01	0.1			0.001	5.7
	1.05	0.19	0.02	0.00	0.07			0.000	3.1
	1.07	0.20	0.02	0.01	0.1			0.001	5.7
	1.10	0.19	0.03	0.01	0.07			0.000	4.6
	1.13	0.20	0.03	0.01	0.07			0.000	4.0
	1.15	0.18	0.02	0.01	0.07			0.000	5.1
	1.20	0.19	0.05	0.01	0.02			0.000	2.2
	1.25	0.18	0.05	0.01	0.01			0.000	1.0
	1.30	0.18	0.05	0.01	0.01			0.000	1.0
	1.35	0.17	0.05	0.01	0.01			0.000	1.5
	1.45	0.17	0.10	0.02	0			0.000	0.0
	1.55	0.16	0.10	0.01	-0.01			0.000	-1.4
	1.60	0.17	0.05	0.01	0			0.000	0.0
RB	1.62	0.00	0.02	0.00	0			0.000	0.0
Total Q								**0.00871**	**100.0**

General Notes

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Swan Drainage Outflow			
Date Monitored	8-Jun-12			
Time at Site (24 hr)	**Start Time:**	9:00:00 AM	**End Time:**	3:30:00 PM
Personnel	Eli, Coby			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424087	7265274	276m	
Weather Conditions	Sunny, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221025
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1	**Memory Free**	524138 readings
Date Serviced	N/A	**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 70	1.113	101.113		100.000	
BM 71			1.172	99.941	
PT			2.935	98.178	
WL			1.889	**99.224**	
BM 72	1.431	101.039	1.505	99.608	
WL			1.817	**99.222**	
PT			2.861	98.178	
BM 71			1.099	99.940	
BM 70			1.039	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 71	99.941	99.941		Established June 8 2012
BM 72	99.608	99.608		Established June 8 2012
PT	98.178	98.178		Installed June 8 2

Summary	
Stage (m)	99.223
Discharge (m^3/s)	10.167
Pressure Transducer Reading (m)	1.067
Pressure Transducer Elevation (m)	98.156

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	11:34	**End**	13:29	**Location**	~30m DS of station				
Method	Velocity-area (Mid-section)			**Instrument Model**	Flo-Mate 2000					
Flow Meter Type	Flo-Mate			**Instrument Serial #**	2004405					
Stage (m)	**Start**	**Reading**	1.094	**Time**	11:34					
	End	**Reading**	1.067	**Time**	13:29					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	21.25	0.00	0.00	0.01	0			0.000	0.0
	21.50	0.08	0.25	0.05	0.04			0.002	0.0
	22.50	0.15	1.00	0.19	0.38			0.071	0.7
	24.00	0.36	1.50	0.34	0.43			0.147	1.4
	24.40	0.67	0.40	0.67	0.34			0.228	2.2
	26.00	0.40	1.60	0.62	0.5			0.310	3.0
	27.50	0.35	1.50	0.53	0.4			0.210	2.1
	29.00	0.37	1.50	0.56	0.49			0.272	2.7
	30.50	0.51	1.50	0.77	0.45			0.344	3.4
	32.00	0.54	1.50	0.81	0.54			0.437	4.3
	33.50	0.69	1.50	1.04	0.56			0.580	5.7
	35.00	0.70	1.50	1.05	0.71			0.746	7.3
	36.50	0.73	1.50	1.10	0.62			0.679	6.7
	38.00	0.71	1.50	0.89	0.65			0.577	5.7
	39.00	0.81	1.00	0.81		0.63	0.59	0.494	4.9
	40.00	0.88	1.00	0.88		0.59	0.52	0.488	4.8
	41.00	1.02	1.00	1.02		0.59	0.56	0.587	5.8
	42.00	1.06	1.00	1.06		0.58	0.42	0.530	5.2
	43.00	1.06	1.00	1.06		0.60	0.66	0.668	6.6
	44.00	1.18	1.00	0.86		0.62	0.54	0.496	4.9
	44.45	1.16	0.45	0.58		0.62	0.25	0.252	2.5
	45.00	0.82	0.55	0.84		0.64	0.63	0.534	5.2
	46.50	0.93	1.50	1.40		0.55	0.58	0.788	7.8
	48.00	0.81	1.50	1.22		0.53	0.46	0.601	5.9
	49.50	0.38	1.50	0.40	0.3			0.120	1.2
	50.11	0.14	0.61	0.06	0.09			0.005	0.1
	50.35	0.00	0.24	0.02	0			0.000	0.0
Total Q								**10.167**	**100.0**

General Notes
Gradiant = 1%

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Swan Drainage Outflow			
Date Monitored	16-Jun-12			
Time at Site (24 hr)	**Start Time:**	8:20:00 AM	**End Time:**	9:55:00 AM
Personnel	Eli, Coby			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424087	7265274	276m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221025
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1133	**Memory Free**	523006 readings
Date Serviced	N/A	**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 70	0.988	100.988		100.000	
BM 71			1.045	99.943	
PT			2.821	98.167	
WL			1.985	**99.003**	
BM 72	1.325	100.933	1.380	99.608	
WL			1.931	**99.002**	
PT			2.763	98.170	
BM 71			0.992	99.941	
BM 70			0.932	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 71	99.9405	99.942	-0.002	
BM 72	99.608	99.608	0.000	
PT	98.169	98.169	0.001	

Summary	
Stage (m)	99.003
Discharge (m^3/s)	3.983
Pressure Transducer Reading (m)	0.855
Pressure Transducer Elevation (m)	98.147

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	11:34	**End**	13:29	**Location**	~100m DS of station			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405			
Stage (m)	**Start**	**Reading**	0.857	**Time**	8:25				
	End	**Reading**	0.856	**Time**	9:26				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	18.90	0.00	0.00	0.01	0			0.000	0.0
	18.95	0.34	0.05	0.03	0.03			0.001	0.0
	19.05	0.33	0.10	0.16	0.1			0.016	0.4
	19.90	0.35	0.85	0.31	0.38			0.116	2.9
	20.80	0.35	0.90	0.32	0.25			0.079	2.0
	21.70	0.36	0.90	0.32	0.35			0.113	2.8
	22.60	0.38	0.90	0.34	0.32			0.109	2.7
	23.50	0.39	0.90	0.35	0.31			0.109	2.7
	24.40	0.40	0.90	0.36	0.43			0.155	3.9
	25.30	0.46	0.90	0.41	0.36			0.149	3.7
	26.20	0.41	0.90	0.37	0.38			0.140	3.5
	27.10	0.47	0.90	0.42	0.4			0.169	4.2
	28.00	0.52	0.90	0.47	0.46			0.215	5.4
	28.90	0.50	0.90	0.45	0.5			0.225	5.6
	29.80	0.52	0.90	0.47	0.12			0.056	1.4
	30.70	0.58	0.90	0.52	0.45			0.235	5.9
	31.60	0.70	0.90	0.63	0.56			0.353	8.9
	32.50	0.79	0.90	0.71		0.57	0.39	0.341	8.6
	33.40	0.78	0.90	0.70		0.60	0.53	0.397	10.0
	34.30	0.80	0.90	0.72		0.61	0.57	0.425	10.7
	35.20	0.68	0.90	0.46	0.62			0.285	7.1
	35.65	0.64	0.45	0.26	0.57			0.146	3.7
	36.00	0.36	0.35	0.24	0.59			0.143	3.6
	37.00	0.10	1.00	0.07	0.08			0.006	0.1
	37.45	0.00	0.45	0.00	0			0.000	0.0
Total Q								**3.983**	**100.0**

General Notes
Gradiant = 1%

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	8-Jul-12			
Time at Site (24 hr)	**Start Time:**	8:50:00 AM	**End Time:**	1:00:00 PM
Personnel	Eli H., Ian K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424087	7265274	276m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221025
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	3.0V%
# of Records	4304	**Memory Free**	519835
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 70	1.118	101.118		100.000	
BM 71			1.172	99.946	
BM 72			1.489	99.629	
PT			2.980	98.138	
WL			2.299	**98.819**	
TBM	2.694	101.068	2.744	98.374	
WL			2.249	**98.819**	
PT			2.928	98.140	
BM 72			1.436	99.632	
BM 71			1.119	99.949	
BM 70			1.066	100.002	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 71	99.9405	99.948	0.007	
BM 72	99.608	99.631	0.022	
PT	98.169	98.139	-0.030	

Summary	
Stage (m)	98.819
Discharge (m^3/s)	1.666
Pressure Transducer Reading (m)	0.667
Pressure Transducer Elevation (m)	98.152

Discharge Measurement - Mid-Section Method							
Time (24 hr)	**Start**	9:35	**End**	10:50	**Location**	~50m Downstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000	
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612	
Stage (m)	**Start**	**Reading**	0.667	**Time**	9:35	Reading values converted from psi to mH20	
	End	**Reading**	0.669	**Time**	10:50	(mH20=psi/1.422)	

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
LB	1.05	0.00	0.00	0.00	0.01	0.00		0.000	0.0
	1.25	0.25	0.08	0.20	0.04	0.05		0.002	0.1
	2.00	0.44	0.13	0.75	0.10	0.11		0.011	0.6
	2.70	0.50	0.15	0.70	0.11	0.20		0.021	1.3
	3.40	0.56	0.17	0.70	0.12	0.16		0.019	1.1
	4.10	0.59	0.18	0.70	0.13	0.19		0.024	1.4
On rock	4.80	0.32	0.10	0.70	0.07	0.20		0.014	0.8
	5.50	0.70	0.21	0.70	0.15	0.15		0.022	1.3
	6.20	0.76	0.23	0.70	0.16	0.19		0.031	1.8
	6.90	0.72	0.22	0.70	0.15	0.25		0.038	2.3
	7.60	0.80	0.24	0.70	0.17	0.21		0.036	2.2
	8.30	0.65	0.20	0.70	0.14	0.26		0.036	2.2
	9.00	0.95	0.29	0.70	0.20	0.25		0.051	3.0
	9.70	1.12	0.34	0.70	0.24	0.21		0.050	3.0
	10.40	1.05	0.32	0.70	0.22	0.25		0.056	3.4
	11.10	1.05	0.32	0.70	0.22	0.30		0.067	4.0
	11.80	1.44	0.44	0.70	0.31	0.21		0.065	3.9
	12.50	1.50	0.46	0.70	0.32	0.32		0.102	6.1
	13.20	1.33	0.41	0.70	0.28	0.31		0.088	5.3
On rock	13.90	0.29	0.09	0.70	0.06	0.37		0.023	1.4
	14.60	1.82	0.55	0.70	0.39	0.40		0.155	9.3
	15.30	2.15	0.66	0.70	0.29	0.42		0.124	7.4
	15.50	1.81	0.55	0.20	0.14	0.43		0.059	3.6
	15.80	1.62	0.49	0.30	0.15	0.42		0.062	3.7
	16.10	2.20	0.67	0.30	0.20	0.41		0.082	5.0
	16.40	1.95	0.59	0.30	0.30	0.42		0.125	7.5
	17.10	1.69	0.52	0.70	0.36	0.44		0.159	9.5
	17.80	1.48	0.45	0.70	0.20	0.40		0.081	4.9
	18.00	1.36	0.41	0.20	0.15	0.41		0.059	3.6
	18.50	0.30	0.09	0.50	0.04	0.07		0.003	0.2
RB	18.90	0.00	0.00	0.40	0.02	0.00		0.000	0.0
Total Q								**1.666**	**100.0**

General Notes
Gradiant = 2%. Imperial rod was used. Depths have been converted from ft to m (1ft=0.3048m)

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	14-Aug-12			
Time at Site (24 hr)	Start Time:	7:40:00 AM	End Time:	9:45:00 AM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	424087	7265274	276m	
Weather Conditions	Cloudy, cold			

Transducer Information			
PT Model	PT2X	Serial #	21221025
Gain	N/A	Offset	N/A
Status	Active	Battery	3.0V%
# of Records	9625	Memory Free	514514
Date Serviced		Crest Gauges	No

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 70	1.093	101.093		100.000	
BM 71			1.147	99.946	
BM 72			1.497	99.596	
PT			2.945	98.148	
WL			2.420	**98.673**	
TBM	2.470	101.103	2.460	98.633	
WL			2.430	**98.673**	
PT			2.955	98.148	
BM 72			1.500	99.603	
BM 71			1.158	99.945	
BM 70			1.104	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 71	99.9405	99.946	0.005	
BM 72	99.608	99.600	-0.008	
PT	98.169	98.148	-0.021	

Summary	
Stage (m)	98.673
Discharge (m^3/s)	0.339
Pressure Transducer Reading (m)	0.545
Pressure Transducer Elevation (m)	98.128

Discharge Measurement - Mid-Section Method												
Time (24 hr)	Start	7:48	End	8:50	Location	~50m Downstream of station						
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000						
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042						
Stage (m)	Start	Reading	0.54	Time	7:48							
	End	Reading	0.545	Time	8:50							

	Station	Depth		Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	1.30	0.00	0.00	0.00	0.01	0			0.000	0.0
	1.60	0.25	0.08	0.30	0.03	-0.01			0.000	-0.1
	2.00	0.50	0.15	0.40	0.11	0.01			0.001	0.3
	3.00	0.70	0.21	1.00	0.21	0.01			0.002	0.6
	4.00	0.90	0.27	1.00	0.27	0.04			0.011	3.2
	5.00	0.93	0.28	1.00	0.28	0.04			0.011	3.3
	6.00	1.05	0.32	1.00	0.32	0.05			0.016	4.7
	7.00	1.10	0.34	1.00	0.34	0.08			0.027	7.9
	8.00	1.05	0.32	1.00	0.32	0.07			0.022	6.6
	9.00	0.80	0.24	1.00	0.24	0.08			0.020	5.8
	10.00	1.60	0.49	1.00	0.49	0.07			0.034	10.1
	11.00	1.65	0.50	1.00	0.50	0.06			0.030	8.9
	12.00	1.05	0.32	1.00	0.32	0.08			0.026	7.6
	13.00	1.45	0.44	1.00	0.44	0.01			0.004	1.3
	14.00	1.50	0.46	1.00	0.46	0.05			0.023	6.7
	15.00	1.40	0.43	1.00	0.43	0.06			0.026	7.6
	16.00	1.22	0.37	1.00	0.37	0.02			0.007	2.2
	17.00	1.00	0.30	1.00	0.24	0.04			0.010	2.9
	17.60	1.60	0.49	0.60	0.29	0.01			0.003	0.9
	18.20	2.00	0.61	0.60	0.37	0.03			0.011	3.2
	18.80	2.35	0.72	0.60	0.43	0.02			0.009	2.5
	19.40	2.30	0.70	0.60	0.42	0.03			0.013	3.7
	20.00	2.68	0.82	0.60	0.49		0.04	0.01	0.012	3.6
	20.60	2.70	0.82	0.60	0.41		0.03	0.03	0.012	3.6
	21.00	1.64	0.50	0.40	0.20	0.01			0.002	0.6
	21.40	1.20	0.37	0.40	0.18	0.04			0.007	2.2
RB	22.00	0.00	0.00	0.60	0.11	0			0.000	0.0
Total Q									**0.339**	**100**

General Notes
Gradiant = 1.5%. Imperial rod was used. Depths have been converted from ft to m (1ft=0.3048m)

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	6-Sep-12			
Time at Site (24 hr)	**Start Time:**	3:00:00 PM	**End Time:**	4:30:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424087	7265274	276m	
Weather Conditions	Cloudy, windy			

Transducer Information			
PT Model	PT2X	**Serial #**	21221025
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	2.9V
# of Records	12980	**Memory Free**	511159
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 70	1.247	101.247		100.000	
BM 71			1.303	99.944	
BM 72			1.628	99.619	
PT			3.090	98.157	
WL			2.617	**98.630**	
TBM	2.562	101.162	2.647	98.600	
WL			2.529	**98.633**	
PT			3.003	98.159	
BM 72			1.543	99.619	
BM 71			1.219	99.943	
BM 70			1.162	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 71	99.9405	99.944	0.003	
BM 72	99.608	99.619	0.011	
PT	98.169	98.158	-0.011	

Summary	
Stage (m)	98.632
Discharge (m^3/s)	0.125
Pressure Transducer Reading (m)	0.486
Pressure Transducer Elevation (m)	98.145

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	14:58	**End**	15:56	**Location**	~50m Downstream of station			
Method	Velocity-area (Mid-section)			**Instrument Model**		Swoffer			
Flow Meter Type	Swoffer			**Instrument Serial #**					
Stage (m)	**Start**	**Reading**	0.49	**Time**	14:58				
	End	**Reading**	0.487	**Time**	15:56				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	3.50	0.00	0.00	0.00	0			0.000	0.0
	3.70	0.02	0.20	0.01	0			0.000	0.0
	4.10	0.11	0.40	0.04	0.16			0.007	5.3
	4.45	0.07	0.35	0.02	0.01			0.000	0.2
	4.80	0.07	0.35	0.02	0.13			0.003	2.6
	5.15	0.08	0.35	0.03	0.33			0.009	7.4
	5.50	0.12	0.35	0.04	0.23			0.010	7.7
	5.85	0.13	0.35	0.04	0.08			0.003	2.7
	6.15	0.12	0.30	0.04	0.17			0.007	5.3
	6.50	0.12	0.35	0.04	0.22			0.009	7.4
	6.85	0.08	0.35	0.03	0.19			0.005	4.3
	7.20	0.15	0.35	0.06	0.23			0.013	10.4
	7.60	0.10	0.40	0.04	0.09			0.003	2.7
	7.95	0.16	0.35	0.04	0.17			0.007	5.4
	8.10	0.12	0.15	0.02	0.17			0.004	2.9
	8.30	0.17	0.20	0.05	0.17			0.008	6.4
	8.65	0.10	0.35	0.04	0.19			0.007	5.3
	9.00	0.13	0.35	0.04	0.28			0.010	8.0
	9.20	0.11	0.20	0.03	0.17			0.005	4.1
	9.55	0.09	0.35	0.03	0.02			0.001	0.5
	9.90	0.07	0.35	0.03	0.28			0.007	5.9
	10.30	0.06	0.40	0.02	0.2			0.004	3.1
	10.55	0.10	0.25	0.03	0.12			0.003	2.4
RB	10.80	0.00	0.25	0.01	0			0.000	0.0
Total Q								**0.125**	**100.0**

General Notes
Gradiant = 1.5%

Appendix 2-11. Manual Discharge Measurements and Levelling Surveys at BL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H2			
Stream Name	Big Lake Outflow			
Date Monitored	9-Sep-12			
Time at Site (24 hr)	**Start Time:**	1:45:00 PM	**End Time:**	3:30:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	424087	7265274	276m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221025
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	2.9V
# of Records	13405	**Memory Free**	510734
Date Serviced		**Crest Gauges**	No

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 70	1.052	101.052		100.000	
BM 71			1.110	99.942	
BM 72			1.435	99.617	
PT			2.898	98.154	
WL			2.373	**98.679**	
TBM	2.589	101.167	2.474	98.578	
WL			2.488	**98.679**	
PT			3.012	98.155	
BM 72			1.550	99.617	
BM 71			1.227	99.940	
BM 70			1.169	99.998	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 71	99.9405	99.941	0.001	
BM 72	99.608	99.617	0.009	
PT	98.169	98.155	-0.014	

Summary	
Stage (m)	98.679
Discharge (m^3/s)	0.260
Pressure Transducer Reading (m)	0.541
Pressure Transducer Elevation (m)	98.138

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	13:44	**End**	14:32	**Location**	~50m Downstream of station				
Method	Velocity-area (Mid-section)			**Instrument Model**		Swoffer				
Flow Meter Type	Swoffer			**Instrument Serial #**						
Stage (m)	**Start**	**Reading**	0.542	**Time**	13:44					
	End	**Reading**	0.541	**Time**	14:32					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	1.50	0.00	0.00	0.01	0			0.000	0.0
	1.60	0.12	0.10	0.03	0.12			0.004	1.4
	2.00	0.20	0.40	0.08	0.18			0.014	5.5
	2.40	0.27	0.40	0.09	0.18			0.017	6.5
	2.70	0.25	0.30	0.08	0.27			0.020	7.8
	3.00	0.30	0.30	0.09	0.19			0.017	6.6
	3.30	0.22	0.30	0.07	0.17			0.011	4.3
	3.60	0.22	0.30	0.07	0.17			0.011	4.3
	3.90	0.15	0.30	0.05	0.26			0.012	4.5
	4.20	0.24	0.30	0.07	0.28			0.020	7.8
	4.50	0.20	0.30	0.06	0.28			0.017	6.5
	4.80	0.21	0.30	0.07	0.2			0.015	5.7
	5.20	0.19	0.40	0.08	0.19			0.014	5.6
	5.60	0.17	0.40	0.05	0.2			0.010	3.9
	5.80	0.21	0.20	0.04	0.24			0.010	3.9
On Rock	6.00	0.04	0.20	0.01	0.34			0.004	1.6
Behind Rock	6.40	0.16	0.40	0.05	0			0.000	0.0
	6.65	0.18	0.25	0.05	0.21			0.011	4.4
	7.00	0.16	0.35	0.06	0.01			0.001	0.2
	7.40	0.19	0.40	0.08	0.25			0.019	7.3
	7.80	0.17	0.40	0.07	0.22			0.015	5.8
	8.20	0.17	0.40	0.07	0.18			0.012	4.7
	8.60	0.07	0.40	0.03	0.16			0.004	1.7
	9.00	0.04	0.40	0.02	0.01			0.000	0.1
	9.40	0.02	0.40	0.00	0			0.000	0.0
LB	9.45	0.00	0.05	0.00	0			0.000	0.0
Total Q								**0.260**	**100.0**

General Notes
Gradiant = 1.5%

Appendix 2-12. Manual Discharge Measurements and Levelling Surveys at BL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H3			
Stream Name	Swan OF			
Date Monitored	8-Jun-12			
Time at Site (24 hr)	**Start Time:**	4:30:00 PM	**End Time:**	6:30:00 PM
Personnel	E. Heyman, C. Hall			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	423,467E	7,264,998N	258m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain		**Offset**	
Status	Active, Logging	**Battery**	100%
# of Records	1	**Memory Free**	524.138
Date Serviced		**Crest Gauges**	

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 81	1.653	101.653		100.000	
WL			1.486	**100.167**	**Error**
TBM	1.119	101.708	1.064	100.589	Station Rebar
WL			1.535	**100.173**	**Checked and Correct**
BM 81			1.709	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 81	100.000	100.000		
TBM		100.589		Station Rebar
PT		Not Surveyed		

Summary	
Stage (m)	100.173
Discharge (m^3/s)	0.969
Pressure Transducer Reading (m)	1.300
Pressure Transducer Elevation (m)	98.873

Discharge Measurement - Mid-Section Method											
Time (24 hr)	**Start**		**End**		**Location**	10m downstream of pressure transducer					
Method	Velocity-area (Mid-section)			**Instrument Model**	Flomate 2000						
Flow Meter Type	Flo-mate			**Instrument Serial #**	2004405						
Stage (m)	**Start**	**Reading**	1.299	**Time**	16:13						
	End	**Reading**	1.300	**Time**	17:32						

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	1.29	0.00	0.00	0.00	0			0.000	0.0
	1.35	0.07	0.06	0.01	0.06			0.000	0.0
	1.44	0.12	0.09	0.01	0.07			0.001	0.1
	1.47	0.63	0.03	0.03	0.3			0.010	1.1
	1.55	0.65	0.08	0.06	0.46			0.027	2.8
	1.65	0.62	0.10	0.06	0.46			0.029	2.9
	1.75	0.60	0.10	0.06	0.63			0.038	3.9
	1.85	0.58	0.10	0.06	0.78			0.045	4.7
	1.95	0.55	0.10	0.05	0.94			0.052	5.3
	2.05	0.60	0.10	0.07	1.06			0.073	7.5
	2.18	0.60	0.13	0.06	1.1			0.066	6.8
	2.25	0.59	0.07	0.06	1.08			0.061	6.2
	2.37	0.53	0.12	0.05	1			0.053	5.5
	2.45	0.55	0.08	0.05	1.12			0.055	5.7
	2.55	0.57	0.10	0.06	1.12			0.064	6.6
	2.65	0.52	0.10	0.05	1.12			0.058	6.0
	2.75	0.51	0.10	0.05	1.09			0.056	5.7
	2.85	0.50	0.10	0.05	1.05			0.053	5.4
	2.95	0.58	0.10	0.06	0.93			0.054	5.6
	3.05	0.57	0.10	0.06	0.88			0.050	5.2
	3.15	0.53	0.10	0.05	0.78			0.041	4.3
	3.25	0.59	0.10	0.06	0.69			0.041	4.2
	3.35	0.59	0.10	0.05	0.45			0.023	2.3
	3.42	0.58	0.07	0.04	0.43			0.017	1.8
	3.49	0.16	0.07	0.01	0.15			0.002	0.2
	3.55	0.08	0.06	0.00	0.32			0.001	0.1
	3.59	0.06	0.04	0.00	0.08			0.000	0.0
RB	3.68	0.00	0.09	0.00	0			0.000	0.0
Total Q								**0.969**	**100.0**

General Notes

Appendix 2-12. Manual Discharge Measurements and Levelling Surveys at BL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H3			
Stream Name	Swan OF			
Date Monitored	16-Jun-12			
Time at Site (24 hr)	**Start Time:**	10:10:00 AM	**End Time:**	11:50:00 AM
Personnel	E. Heyman, C. Hall			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	423,467E	7,264,998N	258m	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain		**Offset**	
Status	Active	**Battery**	100%
# of Records	1121	**Memory Free**	523018
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 81	1.608	101.608		100.000	
BM 82			1.910	99.698	
PT			2.701	98.907	
WL			1.694	**99.914**	
BM 83	1.835	101.645	1.798	99.810	
WL			1.734	**99.911**	
PT			2.740	98.905	
BM 82			1.948	99.697	
BM 81			1.645	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 82	99.698	99.698		Established June 16 2012
BM 83	99.810	99.810		Established June 16 2012
PT	98.906	98.906		Installed June 16 2012

Summary	
Stage (m)	99.913
Discharge (m^3/s)	0.232
Pressure Transducer Reading (m)	1.033
Pressure Transducer Elevation (m)	98.880

Discharge Measurement - Mid-Section Method											
Time (24 hr)	**Start**	10:11	**End**	11:03	**Location**	10m downstream of pressure transducer					
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-mate 2000					
Flow Meter Type	Flo-mate			**Instrument Serial #**		2004405					
Stage (m)	**Start**	**Reading**	1.032	**Time**	16:13						
	End	**Reading**	1.033	**Time**	17:32						

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.55	0.00	0.00	0.01	0.28			0.002	0.7
undercut	0.58	0.37	0.03	0.02	0.38			0.008	3.3
	0.66	0.42	0.08	0.03	0.39			0.013	5.6
	0.74	0.40	0.08	0.03	0.44			0.014	6.1
	0.82	0.40	0.08	0.03	0.46			0.015	6.3
	0.90	0.44	0.08	0.04	0.44			0.015	6.7
	0.98	0.42	0.08	0.03	0.45			0.015	6.5
	1.06	0.42	0.08	0.03	0.44			0.015	6.4
	1.14	0.43	0.08	0.03	0.47			0.016	7.0
	1.22	0.43	0.08	0.03	0.47			0.016	7.0
	1.30	0.30	0.08	0.02	0.48			0.012	5.0
	1.38	0.30	0.08	0.02	0.47			0.011	4.9
	1.46	0.29	0.08	0.02	0.49			0.011	4.9
	1.54	0.30	0.08	0.02	0.45			0.011	4.7
	1.62	0.30	0.08	0.02	0.43			0.010	4.4
	1.70	0.31	0.08	0.02	0.29			0.007	3.1
	1.78	0.38	0.08	0.03	0.34			0.010	4.5
	1.86	0.34	0.08	0.03	0.37			0.010	4.3
	1.94	0.30	0.08	0.02	0.32			0.008	3.3
	2.02	0.30	0.08	0.02	0.32			0.008	3.3
undercut	2.10	0.36	0.08	0.02	0.2			0.005	2.0
grass	2.15	0.05	0.05	0.00	0.08			0.000	0.1
RB	2.20	0.00	0.05	0.00	0			0.000	0.0
Total Q								**0.232**	**100.0**

General Notes
Gradiant = 2%

Appendix 2-12. Manual Discharge Measurements and Levelling Surveys at BL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H3			
Stream Name	Swan OF			
Date Monitored	8-Jul-12			
Time at Site (24 hr)	**Start Time:**	1:15:00 PM	**End Time:**	5:20:00 PM
Personnel	E. Heyman, Ian K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	423,467E	7,264,998N	258m	
Weather Conditions	Mix of sun and cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	4303	**Memory Free**	519836
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 81	1.822	101.822		100.000	
BM 82			2.119	99.703	
BM 83			1.988	99.834	
PT			2.882	98.940	
WL			2.042	**99.780**	
TBM	2.459	101.761	2.520	99.302	
WL			1.982	**99.779**	
PT			2.823	98.938	
BM 83			1.928	99.833	
BM 82			2.060	99.701	
BM 81			1.762	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 82	99.698	99.702	0.004	
BM 83	99.810	99.834	0.024	
PT	98.906	98.939	0.033	

Summary	
Stage (m)	99.780
Discharge (m^3/s)	0.06044
Pressure Transducer Reading (m)	0.867
Pressure Transducer Elevation (m)	98.913

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	14:05	**End**	14:38	**Location**	15m Dowstream of Station				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flomate 2000				
Flow Meter Type	Flomate			**Instrument Serial #**		2007612				
Stage (m)	**Start**	**Reading**	0.866	**Time**	14:05	Reading values converted from psi to mH20				
	End	**Reading**	0.867	**Time**	14:38	(mH20=psi/1.422)				

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
RB	0.60	0.00	0.00	0.00	0.00	0.00		0.000	0.0
	0.66	0.43	0.13	0.06	0.01	0.15		0.001	2.0
	0.72	0.43	0.13	0.06	0.01	0.20		0.002	2.6
	0.78	0.48	0.15	0.06	0.01	0.21		0.002	3.1
	0.84	0.48	0.15	0.06	0.01	0.22		0.002	3.2
	0.90	0.43	0.13	0.06	0.01	0.14		0.001	1.8
	0.96	0.41	0.12	0.06	0.01	0.13		0.001	1.6
	1.02	0.41	0.12	0.06	0.01	0.16		0.001	2.0
	1.08	0.32	0.10	0.06	0.01	0.16		0.001	1.5
On Rock	1.14	0.30	0.09	0.06	0.01	0.19		0.001	1.7
On Rock	1.20	0.23	0.07	0.06	0.00	0.19		0.001	1.3
	1.26	0.33	0.10	0.06	0.01	0.21		0.001	2.1
	1.32	0.38	0.12	0.06	0.01	0.23		0.002	2.6
On Rock	1.38	0.25	0.08	0.06	0.00	0.23		0.001	1.7
On Rock	1.44	0.24	0.07	0.06	0.00	0.23		0.001	1.7
	1.50	0.41	0.12	0.06	0.01	0.22		0.002	2.7
	1.56	0.65	0.20	0.06	0.01	0.19		0.002	3.7
	1.62	0.60	0.18	0.06	0.01	0.24		0.003	4.4
	1.68	0.51	0.16	0.06	0.01	0.21		0.002	3.2
	1.74	0.63	0.19	0.06	0.01	0.37		0.004	7.1
	1.80	0.65	0.20	0.06	0.01	0.40		0.005	7.9
	1.86	0.65	0.20	0.06	0.01	0.42		0.005	8.3
	1.92	0.70	0.21	0.06	0.01	0.41		0.005	8.7
	1.98	0.77	0.23	0.06	0.01	0.40		0.006	9.3
	2.04	0.91	0.28	0.06	0.01	0.38		0.005	7.8
	2.07	0.92	0.28	0.03	0.01	0.38		0.005	7.9
LB	2.13	0.00	0.00	0.06	0.01	0.00		0.000	0.0
Total Q								**0.0604**	**100.0**

General Notes
Gradiant = 2%. Imperial Rod was used. Depths converted from ft to m (1ft = 0.3048m)

Appendix 2-12. Manual Discharge Measurements and Levelling Surveys at BL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H3			
Stream Name	Swan OF			
Date Monitored	11-Aug-12			
Time at Site (24 hr)	**Start Time:**	1:00:00 PM	**End Time:**	2:30:00 PM
Personnel	E. Heyman, Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	423,467E	7,264,998N	258m	
Weather Conditions	Mix of sun and cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	9197	**Memory Free**	514942
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 81	1.745	101.745		100.000	
BM 82			2.035	99.710	
BM 83			1.909	99.836	
PT			2.748	98.997	error
WL			1.959	**99.786**	
TBM	1.978	101.792	1.931	99.814	
WL			2.009	**99.783**	
PT			2.857	98.935	
BM 83			1.957	99.835	
BM 82			2.083	99.709	
BM 81			1.792	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 82	99.698	99.710	0.012	
BM 83	99.810	99.836	0.025	
PT	98.906	98.935	0.029	

Summary	
Stage (m)	99.785
Discharge (m^3/s)	0.0304
Pressure Transducer Reading (m)	0.873
Pressure Transducer Elevation (m)	98.912

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	13:14	**End**	13:42	**Location**	15m Dowstream of Station				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flomate 2000				
Flow Meter Type	Flomate			**Instrument Serial #**		2006042				
Stage (m)	**Start**	**Reading**	0.872	**Time**	13:14					
	End	**Reading**	0.873	**Time**	13:42					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
LB	0.90	0.00	0.00	0.00	0.00	0		0.000	0.0
	0.94	0.10	0.03	0.04	0.00	0.01		0.000	0.1
	1.02	0.67	0.20	0.08	0.02	0.1		0.002	5.4
	1.10	0.63	0.19	0.08	0.02	0.13		0.002	6.6
	1.18	0.63	0.19	0.08	0.02	0.2		0.003	10.1
	1.26	0.71	0.22	0.08	0.02	0.19		0.003	10.8
	1.34	0.62	0.19	0.08	0.02	0.15		0.002	7.5
	1.42	0.51	0.16	0.08	0.01	0.14		0.002	5.7
	1.50	0.51	0.16	0.08	0.01	0.07		0.001	2.9
	1.58	0.60	0.18	0.08	0.01	0.04		0.001	1.9
	1.66	0.58	0.18	0.08	0.01	0.15		0.002	7.0
	1.74	0.54	0.16	0.08	0.01	0.17		0.002	7.4
	1.82	0.58	0.18	0.08	0.01	0.13		0.002	6.0
	1.90	0.55	0.17	0.08	0.01	0.12		0.002	5.3
	1.98	0.45	0.14	0.08	0.01	0.13		0.001	4.7
	2.06	0.43	0.13	0.08	0.01	0.05		0.001	1.7
	2.14	0.51	0.16	0.08	0.01	0.07		0.001	2.9
	2.22	0.52	0.16	0.08	0.01	0.14		0.002	5.8
	2.30	0.51	0.16	0.08	0.01	0.13		0.002	5.3
	2.38	0.50	0.15	0.08	0.01	0.03		0.000	1.2
	2.46	0.50	0.15	0.08	0.01	0.03		0.000	0.9
	2.50	0.49	0.15	0.04	0.00	0.06		0.000	0.9
RB	2.52	0.00	0.00	0.02	0.00	0		0.000	0.0
Total Q								**0.0304**	**100.0**

General Notes
Gradiant = 2%. Gradiant = 2%. Imperial Rod was used. Depths converted from ft to m (1ft = 0.3048m)

Appendix 2-12. Manual Discharge Measurements and Levelling Surveys at BL-H3 in 2012

Site Information				
Project Name	Back River			
Station Identification	BL-H3			
Stream Name	Swan OF			
Date Monitored	9-Sep-12			
Time at Site (24 hr)	**Start Time:**	9:40:00 AM	**End Time:**	1:00:00 PM
Personnel	E. Heyman, Scott C.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	423,467E	7,264,998N	258m	
Weather Conditions	Sunny, fog			

Transducer Information			
PT Model	PT2X	**Serial #**	21221020
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	13351	**Memory Free**	510788
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 81	1.841	101.841		100.000	
BM 82			2.158	99.683	
BM 83			2.014	99.827	
PT			2.892	98.949	
WL			1.980	**99.861**	
TBM	2.062	101.755	2.148	99.693	
WL			1.893	**99.862**	
PT			2.806	98.949	
BM 83			1.930	99.825	
BM 82			2.072	99.683	
BM 81			1.755	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 82	99.698	99.683	-0.015	
BM 83	99.810	99.826	0.016	
PT	98.906	98.949	0.043	

Summary	
Stage (m)	99.862
Discharge (m^3/s)	0.0862
Pressure Transducer Reading (m)	0.940
Pressure Transducer Elevation (m)	98.922

Discharge Measurement - Mid-Section Method							
Time (24 hr)	**Start**	9:23	**End**	10:28	**Location**	15m Dowstream of Station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Swoffer 2100	
Flow Meter Type	Swoffer			**Instrument Serial #**			
Stage (m)	**Start**	**Reading**	0.940	**Time**	9:23	Under cut 0.05-0.15 (d=0.27m, v=0.01m/s)	
	End	**Reading**	0.940	**Time**	10:28		

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
LB	0.17	0.00	0.00	0.00	0			0.000	0.0
	0.20	0.27	0.03	0.01	0			0.000	0.0
	0.25	0.27	0.05	0.02	0.2			0.003	3.8
	0.32	0.26	0.07	0.02	0.2			0.003	3.9
	0.38	0.26	0.06	0.02	0.17			0.003	3.6
	0.46	0.26	0.08	0.02	0.27			0.005	6.1
	0.53	0.12	0.07	0.01	0.31			0.003	3.0
	0.60	0.07	0.07	0.00	0.32			0.002	1.8
	0.67	0.05	0.07	0.00	0.33			0.001	1.3
	0.74	0.06	0.07	0.00	0.4			0.002	1.9
	0.81	0.08	0.07	0.01	0.41			0.002	2.7
	0.88	0.10	0.07	0.01	0.4			0.003	3.2
	0.95	0.15	0.07	0.01	0.4			0.003	3.8
	0.99	0.23	0.04	0.01	0.31			0.004	4.5
	1.06	0.21	0.07	0.02	0.29			0.005	5.3
	1.14	0.17	0.08	0.01	0.29			0.004	4.6
	1.22	0.19	0.08	0.02	0.32			0.005	5.6
	1.30	0.25	0.08	0.02	0.36			0.008	8.9
	1.39	0.25	0.09	0.02	0.33			0.007	7.7
	1.46	0.23	0.07	0.01	0.25			0.004	4.3
	1.52	0.25	0.06	0.02	0.25			0.004	5.1
	1.60	0.25	0.08	0.02	0.17			0.003	3.9
RB	1.68	0.25	0.08	0.02	0.24			0.005	5.6
	1.76	0.15	0.08	0.01	0.23			0.003	3.2
	1.84	0.11	0.08	0.01	0.2			0.002	2.0
	1.92	0.11	0.08	0.01	0.18			0.002	1.8
	2.00	0.11	0.08	0.01	0.17			0.002	2.2
	2.12	0.00	0.12	0.01	0			0.000	0.0
Total Q								**0.0862**	**100.0**

General Notes
Gradiant = 2%

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	11-Jun-12			
Time at Site (24 hr)	**Start Time:**	10:00:00 AM	**End Time:**	4:30:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	396495	7335612	237	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221024
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1	**Memory Free**	524139 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 68	1.172	101.172		100.000	
BM 69			1.486	99.686	
PT			2.544	98.628	
WL			1.829	**99.343**	
BM 70	1.222	101.102	1.292	99.880	
WL			1.755	**99.347**	
PT			2.470	98.632	
BM 69			1.415	99.687	
BM 68			1.102	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 69	99.687	99.687		Established June 11 2012
BM 70	99.880	99.880		Established June 11 2012
PT	98.630	98.630		Installed June 11 2012

Summary	
Stage (m)	99.345
Discharge (m^3/s)	0.249
Pressure Transducer Reading (m)	0.750
Pressure Transducer Elevation (m)	98.595

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	**Start**	12:17	**End**	15:02	**Location**	~75m Dowstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000	
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405	
Stage (m)	**Start**	**Reading**	0.75	**Time**	12:17		
	End	**Reading**	0.748	**Time**	15:02		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	20.32	0.00	0.00	0.00	0			0.000	0.0
Grass	20.40	0.04	0.08	0.00	0.2			0.001	0.2
Grass	20.45	0.04	0.05	0.00	0.28			0.001	0.2
Grass	20.50	0.08	0.05	0.01	0.18			0.001	0.4
Grass	20.60	0.08	0.10	0.01	0.1			0.001	0.3
Grass	20.70	0.08	0.10	0.01	0.08			0.001	0.3
Grass	20.80	0.06	0.10	0.00	-0.01			0.000	0.0
Island RB	20.85	0.00	0.05	0.00	0			0.000	0.0
Island LB	22.60	0.00	1.75	0.00	0			0.000	0.0
	22.67	0.04	0.07	0.00	0.19			0.001	0.2
	22.75	0.04	0.08	0.00	0.32			0.001	0.5
	22.85	0.10	0.10	0.01	0.15			0.001	0.6
	22.95	0.07	0.10	0.01	0.38			0.003	1.1
	23.05	0.08	0.10	0.01	0.56			0.004	1.8
	23.15	0.15	0.10	0.02	0.29			0.004	1.7
	23.25	0.16	0.10	0.02	0.54			0.009	3.5
	23.35	0.15	0.10	0.02	0.45			0.007	2.7
On rock	23.45	0.08	0.10	0.01	0.78			0.006	2.5
On rock	23.55	0.05	0.10	0.01	0.45			0.002	0.9
	23.65	0.05	0.10	0.01	0.19			0.001	0.4
	23.75	0.06	0.10	0.01	0			0.000	0.0
Island RB	23.92	0.00	0.17	0.01	0			0.000	0.0
Island LB	25.15	0.00	1.23	0.00	0			0.000	0.0
	25.24	0.03	0.09	0.00	0.13			0.000	0.1
	25.30	0.05	0.06	0.00	0.13			0.001	0.2
	25.40	0.04	0.10	0.00	0.12			0.000	0.2
	25.50	0.04	0.10	0.00	0.19			0.001	0.3
	25.60	0.06	0.10	0.00	0.29			0.000	0.0
continued									

General Notes

WL location of rod may have changed slightly. PT difficult to get exact location on conduit, use average.

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	11-Jun-12			
Time at Site (24 hr)	Start Time:	10:00:00 AM	End Time:	4:30:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions				

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	100%
# of Records	1	Memory Free	524139 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes	

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (Continued)							
Time (24 hr)	Start	12:17	End	15:02	Location	~75m Dowstream of station	
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000	
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405	
Stage (m)	Start	Reading	0.75	Time	12:17		
	End	Reading	0.748	Time	15:02		

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	25.70	0.07	0.10	0.01	0.33			0.002	0.9
	25.80	0.07	0.10	0.01	0.17			0.001	0.5
	25.90	0.10	0.10	0.01	0.04			0.000	0.2
Island RB	26.00	0.00	0.10	0.01	0			0.000	0.0
Island LB	27.30	0.00	1.30	0.00	0			0.000	0.0
Grass	27.40	0.03	0.10	0.01	0.14			0.001	0.3
	27.65	0.04	0.25	0.01	0.02			0.000	0.1
	27.75	0.24	0.10	0.03	0.09			0.003	1.1
	27.90	0.21	0.15	0.03	0.2			0.006	2.5
	28.05	0.23	0.15	0.03	0.1			0.003	1.4
	28.20	0.32	0.15	0.05	0.09			0.004	1.7
	28.35	0.35	0.15	0.05	0.34			0.018	7.2
	28.50	0.23	0.15	0.03	0.33			0.011	4.6
	28.65	0.17	0.15	0.03	0.24			0.006	2.5
	28.80	0.32	0.15	0.05	0.16			0.008	3.1
	28.95	0.23	0.15	0.03	0.1			0.003	1.4
	29.10	0.09	0.15	0.01	0.29			0.003	1.3
	29.20	0.04	0.10	0.00	0.2			0.001	0.2
Rock RE	29.24	0.00	0.04	0.00	0			0.000	0.0
Rock LE	29.65	0.00	0.41	0.00	0			0.000	0.0
	29.70	0.08	0.05	0.01	0.06			0.000	0.1
	29.80	0.08	0.10	0.01	0.03			0.000	0.1
Island RB	29.95	0.00	0.15	0.01	0			0.000	0.0
Island LB	31.50	0.00	1.55	0.00	0			0.000	0.0
	31.60	0.06	0.10	0.01	0.05			0.000	0.2
	31.80	0.17	0.20	0.03	0.13			0.003	1.3
	31.90	0.20	0.10	0.02	0.17			0.003	1.4
	32.00	0.22	0.10	0.00	0.17			0.000	0.0
continued									

General Notes

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	11-Jun-12			
Time at Site (24 hr)	Start Time:	10:00:00 AM	End Time:	4:30:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions				

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	100%
# of Records	1	Memory Free	524139 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (completed)										
Time (24 hr)	Start	12:17	End	15:02	Location	~75m Dowstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405				
Stage (m)	Start	Reading	0.75	Time	12:17					
	End	Reading	0.748	Time	15:02					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
	32.10	0.24	0.10	0.04	0.18			0.006	2.6
	32.20	0.21	0.10	0.02	0.21			0.004	1.8
	32.30	0.32	0.20	0.02	0.09			0.002	0.9
	32.35	0.10	0.05	0.01	0.23			0.001	0.5
Island RB	32.40	0.00	0.05	0.00	0			0.000	0.0
Island LB	38.45	0.00	6.05	0.00	0			0.000	0.0
	38.55	0.05	0.10	0.01	0.22			0.002	0.7
	38.75	0.07	0.20	0.01	0.19			0.003	1.1
	38.95	0.08	0.20	0.02	0.12			0.003	1.1
	39.30	0.25	0.55	0.04	0.25			0.011	4.4
	39.30	0.19	0.35	0.00	0.21			0.001	0.2
Rock RE	39.33	0.00	0.03	0.00	0			0.000	0.0
Rock LE	39.80	0.00	0.47	0.00	0			0.000	0.0
	39.85	0.12	0.05	0.02	0.33			0.005	2.0
	40.05	0.15	0.20	0.03	0.35			0.011	4.2
	40.25	0.16	0.20	0.03	0.29			0.009	3.7
	40.45	0.09	0.20	0.02	0.31			0.006	2.2
	40.65	0.16	0.20	0.03	0.17			0.005	2.2
	40.85	0.20	0.20	0.04	0.39			0.016	6.3
	41.05	0.20	0.20	0.04	0.51			0.020	8.2
	41.25	0.18	0.20	0.04	0.38			0.014	5.5
	41.45	0.20	0.20	0.03	0.16			0.005	1.9
	41.55	0.18	0.10	0.01	0.07			0.001	0.4
LB	41.60	0.00	0.05	0.00	0			0.000	0.0
Total Q								0.249	100.000

General Notes

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	15-Jun-12			
Time at Site (24 hr)	**Start Time:**	9:10:00 AM	**End Time:**	11:50:00 AM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	396495	7335612	237	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221024
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	558	**Memory Free**	523581 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 68	1.223	101.223		100.000	
BM 69			1.536	99.687	
PT			2.600	98.623	
WL			1.914	**99.309**	
BM 70	1.291	101.170	1.344	99.879	
WL			1.860	**99.310**	
PT			2.549	98.621	
BM 69			1.484	99.686	
BM 68			1.170	100.000	
BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**		**Difference (m)**	**Notes**
BM 69	99.687	99.687		0.000	
BM 70	99.880	99.879		-0.001	
PT	98.630	98.622		-0.008	

Summary	
Stage (m)	99.310
Discharge (m^3/s)	0.143
Pressure Transducer Reading (m)	0.716
Pressure Transducer Elevation (m)	98.594

Discharge Measurement - Mid-Section Method (continued on following page)										
Time (24 hr)	**Start**	12:17	**End**	15:02	**Location**	~75m Dowstream of station				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405				
Stage (m)	**Start**	**Reading**	0.75	**Time**	12:17					
	End	**Reading**	0.748	**Time**	15:02					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	21.80	0.00	0.00	0.00	0			0.000	0.0
Grass	21.90	0.09	0.10	0.01	-0.01			0.000	-0.1
	22.10	0.17	0.20	0.03	0.03			0.001	0.7
	22.30	0.16	0.20	0.03	0.02			0.001	0.4
	22.50	0.14	0.20	0.03	0.07			0.002	1.4
	22.70	0.14	0.20	0.03	0.1			0.003	2.0
Behind shrubs	22.90	0.13	0.20	0.02	-0.02			0.000	-0.3
	23.01	0.11	0.11	0.02	0.03			0.001	0.5
	23.30	0.12	0.29	0.03	0.03			0.001	0.6
	23.50	0.14	0.20	0.03	0.03			0.001	0.6
	23.70	0.19	0.20	0.04	0.06			0.002	1.6
	23.90	0.08	0.20	0.02	0.17			0.003	1.9
	24.10	0.26	0.20	0.05	0.08			0.004	2.9
	24.30	0.38	0.20	0.08	0.07			0.005	3.7
	24.50	0.30	0.20	0.06	0.07			0.004	2.9
	24.70	0.31	0.20	0.06	0.05			0.003	2.2
	24.90	0.22	0.20	0.04	0.01			0.000	0.3
	25.05	0.14	0.15	0.02	0			0.000	0.0
Island RE	25.12	0.00	0.07	0.00	0			0.000	0.0
Island LE	27.00	0.00	1.88	0.01	0			0.000	0.0
	27.10	0.10	0.10	0.02	0.19			0.003	2.0
	27.30	0.14	0.20	0.03	0.22			0.006	4.3
	27.50	0.18	0.20	0.04	0.18			0.006	4.5
	27.70	0.19	0.20	0.04	0.22			0.008	5.8
	27.90	0.10	0.20	0.02	0.37			0.006	3.9
	28.00	0.10	0.10	0.01	0.2			0.002	1.4
	28.10	0.17	0.10	0.01	0.19			0.002	1.7
	28.15	0.04	0.05	0.00	0.38			0.000	0.0
continued									

General Notes
Gradiant= 2%

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	15-Jun-12			
Time at Site (24 hr)	Start Time:	9:10:00 AM	End Time:	11:50:00 AM
Personnel	Eli H., Coby H.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions				

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	100%
# of Records	558	Memory Free	523581 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary	
Stage (m)	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (completed)									
Time (24 hr)	Start	12:17	End	15:02	Location	~75m Dowstream of station			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2004405			
Stage (m)	Start	Reading	0.75	Time	12:17				
	End	Reading	0.748	Time	15:02				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
Island RE	28.20	0.00	0.05	0.00	0			0.000	0.0
Island LE	32.20	0.00	4.00	0.01	0			0.000	0.0
	32.30	0.24	0.10	0.02	0.08			0.001	1.0
	32.35	0.23	0.05	0.01	0.08			0.001	0.6
	32.40	0.23	0.05	0.01	0.01			0.000	0.1
	32.45	0.21	0.05	0.02	-0.01			0.000	-0.1
Island RE	32.55	0.00	0.10	0.01	0			0.000	0.0
Island LE	38.75	0.00	6.20	0.02	0			0.000	0.0
	38.95	0.20	0.20	0.04	0.23			0.008	5.6
	39.10	0.15	0.15	0.02	0.34			0.008	5.3
	39.25	0.05	0.15	0.01	0.2			0.001	1.0
	39.40	0.06	0.15	0.01	0.26			0.002	1.6
	39.55	0.14	0.15	0.02	0.19			0.004	2.8
	39.70	0.12	0.15	0.02	0.38			0.007	4.8
	39.85	0.11	0.15	0.02	0.41			0.007	4.7
	40.00	0.16	0.15	0.02	0.32			0.008	5.4
	40.15	0.18	0.15	0.03	0.25			0.007	4.7
	40.30	0.12	0.15	0.02	0.05			0.001	0.6
	40.45	0.18	0.15	0.03	0.21			0.006	4.0
	40.60	0.04	0.15	0.01	0.22			0.002	1.1
	40.80	0.10	0.20	0.02	0.37			0.006	4.5
	40.95	0.06	0.15	0.01	0.31			0.003	1.9
Behind rock	41.10	0.16	0.15	0.02	-0.03			-0.001	-0.5
	41.25	0.20	0.15	0.03	0.2			0.006	4.2
	41.40	0.10	0.15	0.01	0.16			0.002	1.4
	41.50	0.16	0.10	0.02	0.03			0.000	0.3
LB	41.60	0.00	0.10	0.01	0			0.000	0.0
Total Q								**0.143**	**100.000**

General Notes

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	10-Jul-12			
Time at Site (24 hr)	**Start Time:**	12:30:00 PM	**End Time:**	5:30:00 PM
Personnel	Eli H., Ryan K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	396495	7335612	237	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	**Serial #**	21221024
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	3.0V
# of Records	4177	**Memory Free**	519962 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 68	1.242	101.242		100.000	
BM 69			1.538	99.704	
BM 70			1.343	99.899	
PT			2.638	98.604	error
WL			2.029	**99.213**	
TBM	2.282	101.178	2.346	98.896	
WL			1.963	**99.215**	
PT			2.568	98.610	checked, ok
BM 70			1.281	99.897	
BM 69			1.477	99.701	
BM 68			1.181	99.997	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 69	99.687	99.703	0.016	
BM 70	99.880	99.898	0.018	
PT	98.630	98.610	-0.020	

Summary	
Stage (m)	99.214
Discharge (m^3/s)	0.0447
Pressure Transducer Reading (m)	0.643
Pressure Transducer Elevation (m)	98.571

Discharge Measurement - Mid-Section Method (continued on following page)

Time (24 hr)	**Start**	13:43	**End**	14:56	**Location**	~75m Dowstream of station	
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000	
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612	
Stage (m)	**Start**	**Reading**	0.645	**Time**	13:43		
	End	**Reading**	0.644	**Time**	14:56		

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	1.50	0.00	0.00	0.00	0.00	0		0.000	0.0
eddie	1.75	0.10	0.03	0.25	0.01	-0.03		0.000	-0.3
	1.83	0.15	0.05	0.08	0.00	0.05		0.000	0.4
	1.89	0.17	0.05	0.06	0.00	0.1		0.000	0.7
	1.95	0.23	0.07	0.06	0.01	0.14		0.001	1.8
behind rock	2.05	0.23	0.07	0.10	0.01	-0.03		0.000	-0.4
	2.10	0.20	0.06	0.05	0.00	-0.03		0.000	-0.3
	2.20	0.30	0.09	0.10	0.01	0.28		0.002	4.3
	2.25	0.25	0.08	0.05	0.00	0.09		0.000	0.8
	2.30	0.30	0.09	0.05	0.00	0.18		0.001	1.8
	2.35	0.30	0.09	0.05	0.00	0.19		0.001	1.9
	2.40	0.30	0.09	0.05	0.00	0.18		0.001	1.8
	2.45	0.25	0.08	0.05	0.00	0.37		0.001	3.2
	2.50	0.24	0.07	0.05	0.00	0.3		0.001	2.5
	2.55	0.20	0.06	0.05	0.00	0.23		0.001	1.6
	2.60	0.15	0.05	0.05	0.00	0.2		0.001	1.1
	2.66	0.10	0.03	0.06	0.00	0.15		0.000	0.7
island RB	2.73	0.00	0.00	0.07	0.00	0		0.000	0.0
Island LB	7.95	0.00	0.00	5.22	0.00	0		0.000	0.0
behind rock	8.00	0.34	0.10	0.05	0.00	-0.02		0.000	-0.1
	8.10	0.10	0.03	0.10	0.00	0.04		0.000	0.2
	8.15	0.10	0.03	0.05	0.00	0.09		0.000	0.8
	8.35	0.60	0.18	0.20	0.02	0.09		0.002	4.6
	8.40	0.49	0.15	0.05	0.01	0.12		0.001	2.0
	8.45	0.45	0.14	0.05	0.01	0.1		0.001	1.5
	8.50	0.35	0.11	0.05	0.01	0.24		0.001	2.9
	8.55	0.15	0.05	0.05	0.00	0.16		0.001	1.2
	8.65	0.15	0.05	0.10	0.00	0.02		0.000	0.0
continued									

General Notes

Gradiant= 1.5%. Gradiant= 2%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	10-Jul-12			
Time at Site (24 hr)	Start Time:	12:30:00 PM	End Time:	5:30:00 PM
Personnel	Eli H., Ryan K.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions	Sunny			

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	3.0V
# of Records	4177	Memory Free	519962 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM#	Established Elevation (m)	Mean Elevation (this date) (m)		Difference (m)	Notes

Summary	
Discharge (m^3/s)	
Pressure Transducer Reading (m)	
Pressure Transducer Elevation (m)	

Discharge Measurement - Mid-Section Method (completed)										
Time (24 hr)	Start	13:43	End	14:56	Location	~75m Dowstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612				
Stage (m)	Start	Reading	0.645	Time	13:43					
	End	Reading	0.644	Time	14:56					

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
	8.75	0.30	0.09	0.10	0.00	0.08		0.000	0.4
	8.80	0.63	0.19	0.05	0.00	0.29		0.001	3.0
	8.85	0.60	0.18	0.05	0.01	0.33		0.003	6.8
	8.90	0.54	0.16	0.05	0.01	0.22		0.003	5.7
	8.99	0.54	0.16	0.09	0.01	0.12		0.001	2.7
rock	9.02	0.00	0.00	0.03	0.00	0		0.000	0.0
rock	9.30	0.00	0.00	0.28	0.00	0		0.000	0.0
	9.34	0.32	0.10	0.04	0.00	0.23		0.000	0.0
Island RB	9.39	0.00	0.00	0.05	0.00	0		0.000	0.0
Island LB	19.03	0.00	0.00	9.64	0.00	0		0.000	0.0
	19.10	0.30	0.09	0.07	0.01	0.24		0.001	2.9
	19.15	0.55	0.17	0.05	0.01	0.29		0.004	8.2
	19.25	0.69	0.21	0.10	0.02	0.11		0.002	5.2
	19.35	0.67	0.20	0.10	0.02	0.09		0.002	4.1
	19.45	0.49	0.15	0.10	0.01	0.2		0.003	6.7
	19.55	0.40	0.12	0.10	0.01	0.27		0.003	7.4
	19.65	0.41	0.12	0.10	0.01	0.11		0.001	3.1
	19.75	0.41	0.12	0.10	0.01	0.1		0.001	2.8
	19.85	0.41	0.12	0.10	0.01	0.07		0.001	2.0
	19.95	0.45	0.14	0.10	0.01	0.08		0.001	2.5
	20.05	0.39	0.12	0.10	0.01	0.07		0.001	2.3
	20.20	0.15	0.05	0.15	0.01	-0.01		0.000	-0.2
LB	20.35	0.00	0.00	0.15	0.00	0		0.000	0.0
Total Q								0.0447	100.000

General Notes

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	12-Aug-12			
Time at Site (24 hr)	Start Time:	9:30:00 AM	End Time:	10:35:00 AM
Personnel	Eli H., Cenling X.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions	Cloudy, drizzle			

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	3.0V
# of Records	8912	Memory Free	515227 readings
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 68	1.430	101.430		100.000	
BM 69			1.728	99.702	
BM 70			1.532	99.898	
PT			2.870	98.560	
WL			2.326	**99.104**	
TBM	2.398	101.428	2.400	99.030	
WL			2.325	**99.103**	
PT			2.870	98.558	
BM 70			1.529	99.899	
BM 69			1.727	99.701	
BM 68			1.429	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 69	99.687	99.702	0.015	
BM 70	99.880	99.899	0.019	
PT	98.630	98.559	-0.071	

Summary	
Stage (m)	99.104
Discharge (m^3/s)	0.00207
Pressure Transducer Reading (m)	0.577
Pressure Transducer Elevation (m)	98.526

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	9:30	End	10:35	Location	~100m Dowstream of station			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2007612			
Stage (m)	Start	Reading	0.576	Time	9:30	Much of flow is underground and difficult to measure.			
	End	Reading	0.577	Time	10:35				

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	2.27	0.00	0.00	0.00	0.00	0		0.000	0.0
	2.38	0.10	0.03	0.11	0.00	-0.01		0.000	-1.3
	2.45	0.10	0.03	0.07	0.00	0		0.000	0.0
	2.50	0.15	0.05	0.05	0.00	0		0.000	0.0
	2.55	0.17	0.05	0.05	0.00	0.01		0.000	1.3
	2.60	0.33	0.10	0.05	0.01	0.04		0.000	9.7
	2.65	0.36	0.11	0.05	0.01	0.04		0.000	10.6
	2.70	0.44	0.13	0.05	0.01	0.04		0.000	13.0
	2.75	0.44	0.13	0.05	0.01	0.04		0.000	13.0
	2.80	0.58	0.18	0.05	0.01	0.04		0.000	17.1
	2.85	0.50	0.15	0.05	0.01	0.04		0.000	14.8
	2.90	0.50	0.15	0.05	0.01	0.02		0.000	7.4
	2.95	0.40	0.12	0.05	0.01	0.01		0.000	3.0
	3.00	0.20	0.06	0.05	0.00	0.01		0.000	1.5
	3.05	0.30	0.09	0.05	0.00	0.02		0.000	4.4
	3.10	0.30	0.09	0.05	0.00	0.03		0.000	6.6
Behind Rock	3.15	0.19	0.06	0.05	0.00	0		0.000	0.0
Behind Rock	3.20	0.20	0.06	0.05	0.00	-0.01		0.000	-1.0
LB	3.22	0.00	0.00	0.02	0.00	0		0.000	0.0
Total Q								**0.00207**	**100.0**

General Notes
Gradiant= 1.5%. Gradiant= 2%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-13. Manual Discharge Measurements and Levelling Surveys at REFC-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	REFC-H1			
Stream Name	Reference Lake C outflow			
Date Monitored	11-Sep-12			
Time at Site (24 hr)	Start Time:	12:26:00 PM	End Time:	3:30:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	396495	7335612	237	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PT2X	Serial #	21221024
Gain	N/A	Offset	N/A
Status	Active	Battery	3.0V
# of Records	13249	Memory Free	510891
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 68	1.269	101.269		100.000	
BM 69			1.567	99.702	
BM 70			1.371	99.898	
PT			2.720	98.549	
WL			2.220	**99.049**	
TBM	2.199	101.319	2.149	99.120	
WL			2.268	**99.051**	
PT			2.771	98.548	
BM 70			1.420	99.899	
BM 69			1.617	99.702	
BM 68			1.318	100.001	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 69	99.687	99.702	0.016	
BM 70	99.880	99.899	0.019	
PT	98.630	98.549	-0.081	

Summary	
Stage (m)	99.050
Discharge (m^3/s)	0.000388
Pressure Transducer Reading (m)	0.522
Pressure Transducer Elevation (m)	98.528

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	12:23	End	13:11	Location	~75m Dowstream of station				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529				
Stage (m)	Start	Reading	0.522	Time	12:23	Much of flow is underground and difficult to measure.				
	End	Reading	0.522	Time	13:11					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
LB	0.78	0.00	0.00	0.00	0			0.000	0.0
	0.80	0.01	0.02	0.00	0.01			0.000	0.8
	0.84	0.04	0.04	0.00	0.01			0.000	4.1
	0.88	0.02	0.04	0.00	0.01			0.000	2.1
	0.92	0.04	0.04	0.00	0.01			0.000	4.1
	0.96	0.03	0.04	0.00	0.01			0.000	3.1
	1.00	0.05	0.04	0.00	0.01			0.000	5.2
	1.04	0.14	0.04	0.00	0.01			0.000	10.8
	1.06	0.16	0.02	0.01	0.01			0.000	16.5
	1.12	0.07	0.06	0.00	0.01			0.000	9.0
	1.16	0.06	0.04	0.00	0.01			0.000	6.2
	1.20	0.08	0.04	0.00	0.01			0.000	8.2
	1.24	0.04	0.04	0.00	0.01			0.000	4.1
	1.28	0.07	0.04	0.00	0.01			0.000	7.2
	1.32	0.03	0.04	0.00	0.01			0.000	3.1
	1.36	0.06	0.04	0.00	0.01			0.000	6.2
	1.40	0.05	0.04	0.00	0.01			0.000	5.2
	1.44	0.01	0.04	0.00	0.01			0.000	1.0
	1.48	0.01	0.04	0.00	0.01			0.000	1.0
	1.52	0.02	0.04	0.00	0.01			0.000	2.1
	1.56	0.03	0.04	0.00	0			0.000	0.0
RB	1.60	0.00	0.04	0.00	0			0.000	0.0
Total Q								**0.00039**	**100.0**

General Notes
Gradiant= 1.5%

Appendix 2-14. Manual Discharge Measurements and Levelling Surveys at KL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	10-Jun-12			
Time at Site (24 hr)	**Start Time:**	2:00:00 PM	**End Time:**	4:45:00 PM
Personnel				
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	390592	7309400	310	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221019
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1	**Memory Free**	524139 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 85	0.981	100.981		100.000	
BM 86			0.856	100.125	
PT			2.892	98.089	
WL			1.927	**99.054**	
BM 87	1.331	100.958	1.354	99.627	
WL			1.903	**99.055**	
PT			2.869	98.089	
BM 86			0.833	100.125	
BM 85			0.958	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 86	100.125	100.125		Established June 10 2012
BM 87	99.627	99.627		Established June 10 2012
PT	98.089	98.089		Installed June 10 2012

Summary	
Stage (m)	99.055
Discharge (m^3/s)	1.267
Pressure Transducer Reading (m)	0.984
Pressure Transducer Elevation (m)	98.071

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	14:48	**End**	15:58	**Location**	12m Dowstream of PT, just above riffle			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405			
Stage (m)	**Start**	**Reading**	0.983	**Time**	14:48				
	End	**Reading**	0.984	**Time**	15:58				

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.60	0.00	0.00	0.00	0			0.000	0.0
Grass	0.65	0.08	0.05	0.01	0.12			0.001	0.1
Grass	0.80	0.14	0.15	0.01	0.44			0.006	0.4
Grass/Undercut	0.83	0.39	0.03	0.03	0.09			0.003	0.2
	0.95	0.36	0.12	0.05	0.75			0.036	2.9
	1.10	0.44	0.15	0.07	0.88			0.058	4.6
	1.25	0.45	0.15	0.07	0.82			0.055	4.4
	1.40	0.49	0.15	0.07	0.87			0.064	5.0
	1.55	0.49	0.15	0.07	0.94			0.069	5.5
	1.70	0.49	0.15	0.07	0.83			0.061	4.8
	1.85	0.58	0.15	0.09	0.84			0.073	5.8
	2.00	0.64	0.15	0.09	0.96			0.083	6.5
	2.12	0.65	0.12	0.08	1			0.078	6.2
	2.24	0.64	0.12	0.08	0.96			0.074	5.8
	2.36	0.60	0.12	0.07	1.04			0.075	5.9
	2.48	0.63	0.12	0.07	1.15			0.083	6.5
	2.60	0.65	0.12	0.08	1.05			0.079	6.3
	2.72	0.67	0.12	0.08	1.14			0.093	7.3
	2.85	0.56	0.13	0.09	1.24			0.108	8.5
	2.98	0.68	0.13	0.05	0.94			0.050	3.9
Grass	3.04	0.22	0.06	0.07	1			0.075	5.9
Grass	3.20	0.15	0.16	0.03	0.61			0.021	1.6
Grass	3.35	0.12	0.15	0.02	0.52			0.012	0.9
Grass	3.50	0.08	0.15	0.02	0.31			0.006	0.4
Grass	3.65	0.06	0.15	0.01	0.37			0.004	0.4
Grass	3.80	0.05	0.15	0.01	0.14			0.001	0.1
Grass	3.95	0.05	0.15	0.01	0.03			0.000	0.0
LB	4.05	0	0.10	0.00	0			0.000	0.0
Total Q								**1.267**	**100.0**

General Notes

Appendix 2-14. Manual Discharge Measurements and Levelling Surveys at KL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	15-Jun-12			
Time at Site (24 hr)	**Start Time:**	2:33:00 PM	**End Time:**	4:30:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	390592	7309400	310	
Weather Conditions				

Transducer Information			
PT Model	PT2X	**Serial #**	21221019
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	717	**Memory Free**	523422 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 85	1.008	101.008		100.000	
BM 86			0.884	100.124	
PT			2.921	98.087	
WL			2.066	**98.942**	
BM 87	1.369	100.997	1.380	99.628	
WL			2.054	**98.943**	
PT			2.908	98.089	
BM 86			0.870	100.127	
BM 85			0.997	100.000	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 86	100.125	100.126	0.000	
BM 87	99.627	99.628	0.001	
PT	98.089	98.088	-0.001	

Summary	
Stage (m)	98.943
Discharge (m^3/s)	0.719
Pressure Transducer Reading (m)	0.880
Pressure Transducer Elevation (m)	98.063

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	14:34	**End**	15:30	**Location**	20m Dowstream of PT, just above riffle			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405			
Stage (m)	**Start**	**Reading**	0.882	**Time**	14:34				
	End	**Reading**	0.88	**Time**	15:30				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	20.40	0.00	0.00	0.00	0			0.000	0.0
Grass	20.50	0.04	0.10	0.00	0.03			0.000	0.0
Grass	20.55	0.08	0.05	0.00	0.23			0.001	0.1
undercut	20.60	0.32	0.05	0.02	0.27			0.006	0.9
	20.70	0.35	0.10	0.03	0.55			0.019	2.7
	20.80	0.31	0.10	0.03	0.7			0.022	3.0
	20.90	0.36	0.10	0.04	0.62			0.022	3.1
	21.00	0.34	0.10	0.03	0.59			0.020	2.8
	21.10	0.31	0.10	0.03	0.66			0.020	2.8
	21.20	0.36	0.10	0.04	0.78			0.028	3.9
	21.30	0.40	0.10	0.04	0.71			0.028	3.9
	21.40	0.44	0.10	0.04	0.58			0.026	3.5
	21.50	0.44	0.10	0.04	0.58			0.026	3.5
	21.60	0.44	0.10	0.04	0.66			0.029	4.0
	21.70	0.48	0.10	0.05	0.72			0.035	4.8
	21.80	0.48	0.10	0.05	0.77			0.037	5.1
	21.90	0.51	0.10	0.05	0.79			0.040	5.6
	22.00	0.54	0.10	0.05	0.72			0.039	5.4
	22.10	0.46	0.10	0.05	0.84			0.039	5.4
	22.20	0.47	0.10	0.05	0.84			0.039	5.5
	22.30	0.48	0.10	0.05	0.89			0.043	5.9
	22.40	0.52	0.10	0.05	0.93			0.048	6.7
	22.50	0.51	0.10	0.05	0.93			0.047	6.6
	22.60	0.48	0.10	0.05	0.92			0.044	6.1
	22.70	0.45	0.10	0.03	0.91			0.031	4.3
	22.75	0.50	0.05	0.02	0.76			0.019	2.6
Grass	22.80	0.15	0.05	0.01	0.71			0.008	1.1
Grass	22.90	0.08	0.10	0.01	0.24			0.002	0.3
Grass	23.00	0.06	0.10	0.01	0.06			0.001	0.1
LB	23.20	0	0.20	0.01	0			0.000	0.0
Total Q								**0.719**	**100.0**

General Notes
gradiant = 2%

Appendix 2-14. Manual Discharge Measurements and Levelling Surveys at KL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	11-Jul-12			
Time at Site (24 hr)	**Start Time:**	3:10:00 PM	**End Time:**	5:30:00 PM
Personnel	Eli H., Ryan K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	390592	7309400	310	
Weather Conditions	Mix of Sun and Cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21221019
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	4466	**Memory Free**	519673 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 85	1.331	101.331		100.000	
BM 86			1.204	100.127	
BM 87			1.707	99.624	
PT			3.243	98.088	
WL			2.582	**98.749**	
TBM	1.647	101.364	1.614	99.717	
WL			2.618	**98.746**	
PT			3.277	98.087	
BM 85			1.738	99.626	
BM 86			1.239	100.125	
BM 87			1.365	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 86	100.125	100.126	0.001	
BM 87	99.627	99.625	-0.002	
PT	98.089	98.088	-0.001	

Summary	
Stage (m)	98.748
Discharge (m^3/s)	0.284
Pressure Transducer Reading (m)	0.682
Pressure Transducer Elevation (m)	98.066

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	15:15	**End**	15:57	**Location**	10m Dowstream of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612			
Stage (m)	**Start**	**Reading**	0.682	**Time**	15:15				
	End	**Reading**	0.682	**Time**	15:57				

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
RB	0.27	0.00	0.00	0.00	0.00	0		0.000	0.0
Grass	0.36	0.15	0.05	0.09	0.00	0		0.000	0.0
Grass	0.42	0.31	0.09	0.06	0.01	-0.01		0.000	0.0
Grass	0.50	0.64	0.20	0.08	0.01	0.12		0.001	0.5
	0.53	1.53	0.47	0.03	0.02	0.05		0.001	0.4
	0.60	1.65	0.50	0.07	0.04	0.12		0.005	1.8
	0.70	1.70	0.52	0.10	0.05	0.31		0.016	5.7
	0.80	1.70	0.52	0.10	0.05	0.32		0.017	5.8
	0.90	1.63	0.50	0.10	0.05	0.32		0.016	5.6
	1.00	1.60	0.49	0.10	0.05	0.3		0.015	5.2
	1.10	1.60	0.49	0.10	0.05	0.31		0.015	5.3
	1.20	1.59	0.48	0.10	0.05	0.28		0.014	4.8
	1.30	1.58	0.48	0.10	0.05	0.27		0.013	4.6
	1.40	1.53	0.47	0.10	0.05	0.27		0.013	4.4
	1.50	1.53	0.47	0.10	0.05	0.31		0.014	5.1
	1.60	1.50	0.46	0.10	0.05	0.3		0.014	4.8
	1.70	1.40	0.43	0.10	0.04	0.3		0.013	4.5
	1.80	1.43	0.44	0.10	0.04	0.28		0.012	4.3
	1.90	1.35	0.41	0.10	0.04	0.3		0.012	4.3
	2.00	1.29	0.39	0.10	0.04	0.29		0.011	4.0
	2.10	1.25	0.38	0.10	0.04	0.31		0.012	4.2
	2.20	1.22	0.37	0.10	0.04	0.3		0.011	3.9
	2.30	1.21	0.37	0.10	0.04	0.29		0.011	3.8
	2.40	1.22	0.37	0.10	0.04	0.3		0.011	3.9
	2.50	1.28	0.39	0.10	0.04	0.31		0.012	4.3
	2.60	1.32	0.40	0.10	0.04	0.28		0.011	4.0
	2.70	1.30	0.40	0.10	0.03	0.27		0.009	3.2
	2.77	1.10	0.34	0.07	0.02	0.23		0.005	1.6
Grass	2.82	0.20	0.06	0.05	0.00	0.03		0.000	0.0
LB	2.87	0.00	0	0.05	0.00	0		0.000	0.0
Total Q								**0.284**	**100.0**

General Notes
gradiant = 1%. Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-14. Manual Discharge Measurements and Levelling Surveys at KL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	12-Aug-12			
Time at Site (24 hr)	Start Time:	12:10:00 PM	End Time:	2:00:00 PM
Personnel	Eli H., Ryan K.			
Station Cordinates	Easting	Northing	Elevation	
	390592	7309400	310	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PT2X	Serial #	21221019
Gain	N/A	Offset	N/A
Status	Active	Battery	100%
# of Records	9056	Memory Free	515083
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 85	0.842	100.842		100.000	
BM 86			0.715	100.127	
BM 87			1.215	99.627	
PT			2.760	98.082	
WL			2.232	**98.610**	
TBM	2.079	100.769	2.152	98.690	
WL			2.156	**98.613**	
PT			2.689	98.080	
BM 85			1.143	99.626	
BM 86			0.642	100.127	
BM 87			0.771	99.998	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 86	100.125	100.127	0.002	
BM 87	99.627	99.627	-0.001	
PT	98.089	98.081	-0.008	

Summary	
Stage (m)	98.612
Discharge (m^3/s)	0.06040
Pressure Transducer Reading (m)	0.555
Pressure Transducer Elevation (m)	98.057

Discharge Measurement - Mid-Section Method									
Time (24 hr)	Start	12:30	End	13:20	Location	10m Dowstream of PT			
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			Instrument Serial #		2006042			
Stage (m)	Start	Reading	0.554	Time	12:30				
	End	Reading	0.555	Time	13:20				

	Station	Depth		Distance	Area	Velocity @60%	Cal. Velocity	Q	% of Total Q
Notes	(m)	(ft)	(m)	(m)	(m^2)	(m/s)	(m/s)	(m^3/s)	%
RB	0.24	0.00	0.00	0.00	0.00	0		0.000	0.0
	0.33	0.10	0.03	0.09	0.00	0.01		0.000	0.0
	0.35	1.00	0.30	0.02	0.02	0.02		0.000	0.6
	0.45	1.19	0.36	0.10	0.04	0.05		0.002	3.0
	0.55	1.29	0.39	0.10	0.04	0.1		0.004	6.5
	0.65	1.35	0.41	0.10	0.04	0.13		0.005	8.9
	0.75	1.34	0.41	0.10	0.04	0.13		0.005	8.8
	0.85	1.27	0.39	0.10	0.04	0.12		0.005	7.7
	0.95	1.27	0.39	0.10	0.04	0.09		0.003	5.8
	1.05	1.27	0.39	0.10	0.04	0.05		0.002	3.2
	1.15	1.23	0.37	0.10	0.04	0.07		0.003	4.3
	1.25	1.32	0.40	0.10	0.04	0.09		0.004	6.0
	1.35	1.30	0.40	0.10	0.04	0.1		0.004	6.6
	1.45	1.17	0.36	0.10	0.04	0.08		0.003	4.7
	1.55	1.22	0.37	0.10	0.04	0.03		0.001	1.8
	1.65	1.10	0.34	0.10	0.03	0.04		0.001	2.2
	1.75	0.97	0.30	0.10	0.03	0.03		0.001	1.5
	1.85	0.94	0.29	0.10	0.03	0.04		0.001	1.9
	1.95	0.91	0.28	0.10	0.03	0.08		0.002	3.7
	2.05	0.90	0.27	0.10	0.03	0.07		0.002	3.2
	2.15	0.89	0.27	0.10	0.03	0.07		0.002	3.1
	2.25	0.95	0.29	0.10	0.03	0.08		0.002	3.8
	2.35	0.95	0.29	0.10	0.03	0.11		0.003	5.3
	2.45	0.95	0.29	0.10	0.03	0.11		0.003	5.3
	2.55	0.93	0.28	0.10	0.02	0.06		0.001	2.3
	2.61	0.71	0.22	0.06	0.01	-0.01		0.000	-0.1
LB	2.63	0.00	0.00	0.02	0.00	0		0.000	0.0
Total Q								**0.0604**	**100.0**

General Notes

gradiant = 1%. Imperial Rod used. Depth values converted from ft. to m (1ft. = 0.3048m)

Appendix 2-14. Manual Discharge Measurements and Levelling Surveys at KL-H1 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H1			
Stream Name	Esker Pond outflow			
Date Monitored	12-Sep-12			
Time at Site (24 hr)	Start Time:	10:35:00 AM	End Time:	12:45:00 PM
Personnel	Eli H., Scott C.			
Station Cordinates	Easting	Northing	Elevation	
	390592	7309400	310	
Weather Conditions	Cloudy, light snow			

Transducer Information			
PT Model	PT2X	Serial #	21221019
Gain	N/A	Offset	N/A
Status	Active	Battery	100%
# of Records	13510	Memory Free	510629
Date Serviced		Crest Gauges	N/A

Hydrometric Leveling Survey					
Stn	BS	HI	FS	Elevation	Notes
BM 85	0.817	100.817		100.000	
BM 86			0.690	100.127	
BM 87			1.191	99.626	
PT			2.754	98.063	
WL			2.128	**98.689**	
TBM	2.611	100.755	2.673	98.144	
WL			2.068	**98.687**	
PT			2.693	98.062	
BM 85			1.128	99.627	
BM 86			0.628	100.127	
BM 87			0.755	100.000	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 86	100.125	100.127	0.002	
BM 87	99.627	99.627	-0.001	
PT	98.089	98.063	-0.026	

Summary	
Stage (m)	98.688
Discharge (m^3/s)	0.132
Pressure Transducer Reading (m)	0.646
Pressure Transducer Elevation (m)	98.042

Discharge Measurement - Mid-Section Method										
Time (24 hr)	Start	10:32	End	11:29	Location	7m Dowstream of PT				
Method	Velocity-area (Mid-section)			Instrument Model		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			Instrument Serial #		2007529				
Stage (m)	Start	Reading	0.645	Time	12:30					
	End	Reading	0.646	Time	13:20					

	Station	Depth	Distance	Area	Velocity (m/s)			Q	% of Total Q
Notes	(m)	(m)	(m)	(m^2)	60%	20%	80%	(m^3/s)	%
RB	0.30	0.00	0.00	0.00	0			0.000	0.0
	0.35	0.08	0.05	0.01	0.01			0.000	0.0
	0.44	0.42	0.09	0.03	0.06			0.002	1.4
	0.50	0.47	0.06	0.04	0.1			0.004	2.9
	0.60	0.49	0.10	0.05	0.13			0.006	4.8
	0.70	0.49	0.10	0.05	0.15			0.007	5.6
	0.80	0.49	0.10	0.05	0.15			0.007	5.6
	0.90	0.48	0.10	0.05	0.15			0.007	5.5
	1.00	0.47	0.10	0.05	0.16			0.008	5.7
	1.10	0.46	0.10	0.05	0.12			0.006	4.2
	1.20	0.46	0.10	0.05	0.13			0.006	4.5
	1.30	0.48	0.10	0.05	0.14			0.007	5.1
	1.40	0.48	0.10	0.05	0.15			0.007	5.5
	1.50	0.46	0.10	0.05	0.15			0.007	5.2
	1.60	0.44	0.10	0.04	0.12			0.005	4.0
	1.70	0.42	0.10	0.04	0.13			0.005	4.1
	1.80	0.39	0.10	0.04	0.14			0.005	4.1
	1.90	0.36	0.10	0.04	0.15			0.005	4.1
	2.00	0.36	0.10	0.04	0.15			0.005	4.1
	2.10	0.35	0.10	0.04	0.16			0.006	4.2
	2.20	0.34	0.10	0.03	0.15			0.005	3.9
	2.30	0.36	0.10	0.04	0.14			0.005	3.8
	2.40	0.38	0.10	0.04	0.14			0.005	4.0
	2.50	0.38	0.10	0.04	0.14			0.005	4.0
	2.60	0.37	0.10	0.03	0.13			0.004	2.7
	2.65	0.35	0.05	0.01	0.09			0.001	0.8
LB	2.67	0.00	0.02	0.00	0			0.000	0.0
Total Q								**0.132**	**100.0**

General Notes

Appendix 2-15. Manual Discharge Measurements and Levelling Surveys at KL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	10-Jun-12			
Time at Site (24 hr)	**Start Time:**	11:00:00 AM	**End Time:**	1:50:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	386687	7314673	337	
Weather Conditions	Clear, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	1	**Memory Free**	524138 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 73	1.484	101.484		100.000	
BM 74			1.636	99.848	
PT			2.420	99.064	
WL			1.849	**99.635**	
BM 78	0.690	101.422	0.752	100.732	
WL			1.786	**99.636**	
PT			2.358	99.064	
BM 74			1.575	99.847	
BM 73			1.421	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 74	99.848	99.848		Established June 10 2012
BM 78	100.732	100.732		Established June 10 2012
PT	99.064	99.064		Installed June 10 2012

Summary	
Stage (m)	99.636
Discharge (m^3/s)	0.497
Pressure Transducer Reading (m)	0.595
Pressure Transducer Elevation (m)	99.040

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	11:57	**End**	13:00	**Location**	~15m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405				
Stage (m)	**Start**	**Reading**	0.594	**Time**	11:57					
	End	**Reading**	0.595	**Time**	13:00					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	21.40	0.00	0.00	0.01	0			0.000	0.0
	21.60	0.07	0.20	0.02	0.04			0.001	0.2
	21.95	0.07	0.35	0.02	0.22			0.005	0.9
	22.20	0.22	0.25	0.07	0.4			0.026	5.3
	22.55	0.36	0.35	0.13	0.47			0.059	11.9
	22.90	0.29	0.35	0.10	0.46			0.047	9.4
	23.25	0.34	0.35	0.12	0.53			0.063	12.7
	23.60	0.39	0.35	0.14	0.39			0.053	10.7
	23.95	0.27	0.35	0.09	0.55			0.052	10.5
	24.30	0.33	0.35	0.12	0.43			0.050	10.0
	24.65	0.32	0.35	0.11	0.27			0.030	6.1
	25.00	0.39	0.35	0.14	0.21			0.029	5.8
	25.35	0.33	0.35	0.12	0.17			0.020	4.0
	25.70	0.37	0.35	0.13	0.13			0.017	3.4
	26.05	0.46	0.35	0.16	0.1			0.016	3.2
	26.40	0.47	0.35	0.16	0.08			0.013	2.6
Deep Pool, low flow	26.75	0.49	0.35	0.17	0.06			0.010	2.1
Deep Pool, low flow	27.10	0.56	0.35	0.20	0.02			0.004	0.8
Deep Pool, low flow	27.45	0.56	0.35	0.22	0.01			0.002	0.5
Deep Pool, low flow	27.90	0.64	0.45	0.30	0			0.000	0.0
Deep Pool, low flow	28.40	0.49	0.50	0.31	0			0.000	0.0
LB	29.15	0.00	0.75	0.18	0			0.000	0.0
Total Q								**0.497**	**100.0**

General Notes
Gradiant= 2.5%

Appendix 2-15. Manual Discharge Measurements and Levelling Surveys at KL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	15-Jun-12			
Time at Site (24 hr)	**Start Time:**	12:15:00 PM	**End Time:**	2:00:00 PM
Personnel	Eli H., Coby H.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	386687	7314673	337	
Weather Conditions	Mix Sun and Cloud, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	722	**Memory Free**	523417 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 73	1.510	101.510		100.000	
BM 74			1.667	99.843	
PT			2.452	99.058	
WL			1.929	**99.581**	
BM 78	0.741	101.469	0.782	100.728	
WL			1.890	**99.579**	
PT			2.413	99.056	
BM 74			1.625	99.844	
BM 73			1.470	99.999	

BM#	Established Elevation (m)	Mean Elevation (this date) (m)	Difference (m)	Notes
BM 74	99.848	99.844	-0.004	
BM 78	100.732	100.728	-0.004	
PT	99.064	99.057	-0.007	

Summary	
Stage (m)	99.580
Discharge (m^3/s)	0.271
Pressure Transducer Reading (m)	0.544
Pressure Transducer Elevation (m)	99.036

Discharge Measurement - Mid-Section Method									
Time (24 hr)	**Start**	12:29	**End**	13:34	**Location**	~15m Downstream of PT			
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000			
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2004405			
Stage (m)	**Start**	**Reading**	0.545	**Time**	12:29				
	End	**Reading**	0.544	**Time**	13:34				

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	20.00	0.00	0.00	0.01	0			0.000	0.0
Eddy	20.10	0.10	0.10	0.01	-0.01			0.000	0.0
	20.20	0.18	0.10	0.01	-0.03			0.000	-0.1
	20.25	0.20	0.05	0.02	0.05			0.001	0.4
	20.40	0.21	0.15	0.04	0.28			0.010	3.8
	20.60	0.36	0.20	0.06	0.1			0.006	2.3
	20.75	0.41	0.15	0.06	0.27			0.017	6.1
	20.90	0.41	0.15	0.07	0.3			0.022	7.9
	21.10	0.45	0.20	0.08	0.3			0.024	8.7
	21.25	0.37	0.15	0.06	0.36			0.023	8.6
	21.45	0.47	0.20	0.08	0.14			0.012	4.2
	21.60	0.44	0.15	0.08	0.03			0.002	0.9
	21.80	0.46	0.20	0.08	0.05			0.004	1.5
	21.95	0.38	0.15	0.07	0.16			0.011	3.9
	22.15	0.43	0.20	0.08	0.23			0.017	6.4
	22.30	0.42	0.15	0.07	0.29			0.021	7.9
	22.50	0.39	0.20	0.07	0.26			0.018	6.5
	22.65	0.38	0.15	0.07	0.16			0.011	3.9
Deep Pool, low flow	22.85	0.38	0.20	0.10	0.08			0.008	3.1
Deep Pool, low flow	23.20	0.39	0.35	0.14	0.02			0.003	1.0
Deep Pool, low flow	23.55	0.50	0.35	0.18	-0.02			-0.004	-1.3
Deep Pool, low flow	23.90	0.41	0.35	0.14	-0.02			-0.003	-1.1
Deep Pool, low flow	24.25	0.43	0.35	0.18	0			0.000	0.0
Deep Pool, low flow	24.75	0.49	0.50	0.25	0.03			0.015	5.4
Deep Pool, low flow	25.25	0.56	0.50	0.28	0.06			0.025	9.3
Deep Pool, low flow	25.75	0.57	0.50	0.21	0.09			0.015	5.5
Deep Pool, low flow	26.00	0.56	0.25	0.18	0.07			0.013	4.7
Deep Pool, low flow	26.40	0.16	0.40	0.06	0.07			0.001	0.5
Deep Pool, low flow	26.80	0.08	0.40	0.02	0.02			0.000	0.0
LB	26.95	0	0.15	0.00	0			0.000	0.0
Total Q								**0.271**	**100.0**

General Notes
Gradiant= 1.5%

Appendix 2-15. Manual Discharge Measurements and Levelling Surveys at KL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	12-Jul-12			
Time at Site (24 hr)	**Start Time:**	8:10:00 AM	**End Time:**	12:30:00 PM
Personnel	Eli H., Ryan K.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	386687	7314673	337m	
Weather Conditions	Mix Sun and Cloud			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	4585	**Memory Free**	519554 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 73	2.111	102.111		100.000	
BM 74			2.259	99.852	
BM 78			1.374	100.737	
PT			3.009	99.102	error
WL			2.601	**99.510**	
TBM	1.764	102.066	1.809	100.302	
WL			2.558	**99.508**	
PT			3.065	99.001	checked, ok
BM 78			1.331	100.735	
BM 74			2.215	99.851	
BM 73			2.063	100.003	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 74	99.848	99.852	0.004	
BM 78	100.732	100.736	0.004	
PT	99.064	99.001	-0.063	

Summary	
Stage (m)	99.509
Discharge (m^3/s)	0.179
Pressure Transducer Reading (m)	0.516
Pressure Transducer Elevation (m)	98.993

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	8:25	**End**	9:19	**Location**	~12m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007612				
Stage (m)	**Start**	**Reading**	0.518	**Time**	8:25					
	End	**Reading**	0.516	**Time**	9:19					

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
RB	2.40	0.00	0.00	0.00	0.00	0		0.000	0.0
eddy	2.50	0.10	0.03	0.10	0.00	-0.03		0.000	-0.1
	2.60	0.20	0.06	0.10	0.01	-0.03		0.000	-0.1
	2.70	0.15	0.05	0.10	0.01	0.05		0.000	0.2
	2.85	0.38	0.12	0.15	0.02	0.39		0.007	3.8
	3.00	0.50	0.15	0.15	0.02	0.48		0.011	6.3
	3.16	1.02	0.31	0.16	0.05	0.28		0.013	7.3
	3.30	1.07	0.33	0.14	0.05	0.21		0.010	5.5
	3.45	1.10	0.34	0.15	0.05	0.3		0.015	8.4
	3.60	1.16	0.35	0.15	0.05	0.08		0.004	2.4
behind rock	3.75	1.04	0.32	0.15	0.05	-0.02		-0.001	-0.5
behind rock	3.90	1.00	0.30	0.15	0.05	-0.02		-0.001	-0.5
behind rock	4.05	0.95	0.29	0.15	0.04	-0.03		-0.001	-0.7
	4.20	0.96	0.29	0.15	0.04	0.06		0.003	1.5
	4.35	1.00	0.30	0.15	0.05	0.15		0.007	3.8
	4.50	0.90	0.27	0.15	0.04	0.22		0.009	5.0
	4.65	0.98	0.30	0.15	0.06	0.13		0.008	4.3
	4.90	1.00	0.30	0.25	0.08	0.06		0.005	2.8
	5.20	0.73	0.22	0.30	0.07	0.08		0.005	3.0
	5.50	0.90	0.27	0.30	0.09	0.02		0.002	1.0
	5.85	1.02	0.31	0.35	0.11	0.07		0.008	4.2
	6.20	1.09	0.33	0.35	0.12	0.02		0.002	1.3
	6.55	0.95	0.29	0.35	0.10	0.07		0.007	4.0
	6.90	1.11	0.34	0.35	0.12	0.08		0.009	5.3
	7.25	1.35	0.41	0.35	0.14	0.08		0.012	6.4
	7.60	1.42	0.43	0.35	0.15	0.12		0.018	10.1
	7.95	1.40	0.43	0.35	0.15	0.11		0.016	9.2
	8.30	1.19	0.36	0.35	0.10	0.11		0.011	6.1
	8.50	1.15	0.35	0.20	0.11	0.19		0.022	12.1
	8.95	0.20	0.06	0.45	0.02	0.04		0.001	0.4
LB	9.15	0.00	0.00	0.20	0.00	0		0.000	0.0
Total Q								**0.179**	**100.0**

General Notes
Gradiant= 2%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-15. Manual Discharge Measurements and Levelling Surveys at KL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	12-Aug-12			
Time at Site (24 hr)	**Start Time:**	2:15:00 PM	**End Time:**	4:35:00 PM
Personnel	Eli H., Cenling X.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	386687	7314673	337m	
Weather Conditions	Cloudy, cool			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	9086	**Memory Free**	515053 readings
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 73	1.518	101.518		100.000	
BM 74			1.671	99.847	
BM 78			0.786	100.732	
PT			2.570	98.948	
WL			2.095	**99.423**	
TBM	0.763	101.420	0.861	100.657	
WL			1.999	**99.421**	
PT			2.472	98.948	
BM 78			0.688	100.732	
BM 74			1.573	99.847	
BM 73			1.421	99.999	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 74	99.848	99.847	0.000	
BM 78	100.732	100.732	0.000	
PT	99.064	98.948	-0.116	

Summary	
Stage (m)	99.422
Discharge (m^3/s)	0.0245
Pressure Transducer Reading (m)	0.493
Pressure Transducer Elevation (m)	98.929

Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	14:30	**End**	15:11	**Location**	~20m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2006042				
Stage (m)	**Start**	**Reading**	0.493	**Time**	14:30					
	End	**Reading**	0.493	**Time**	15:11					

	Station	**Depth**		**Distance**	**Area**	**Velocity @60%**	**Cal. Velocity**	**Q**	**% of Total Q**
Notes	**(m)**	**(ft)**	**(m)**	**(m)**	**(m^2)**	**(m/s)**	**(m/s)**	**(m^3/s)**	**%**
RB	3.20	0.00	0.00	0.00	0.00	0		0.000	0.0
pool/behind rocks	3.30	0.25	0.08	0.10	0.02	-0.01		0.000	-0.6
pool/behind rocks	3.60	0.10	0.03	0.30	0.01	0		0.000	0.0
pool/behind rocks	3.90	0.53	0.16	0.30	0.05	0		0.000	0.0
pool/behind rocks	4.20	0.63	0.19	0.30	0.06	0.01		0.001	2.4
	4.50	0.78	0.24	0.30	0.06	0.04		0.002	9.7
	4.70	0.70	0.21	0.20	0.04	0.05		0.002	8.7
	4.90	0.63	0.19	0.20	0.04	0.01		0.000	1.6
	5.10	0.64	0.20	0.20	0.05	0.02		0.001	4.0
	5.40	0.25	0.08	0.30	0.02	0.02		0.000	1.6
	5.60	0.50	0.15	0.20	0.03	0.02		0.001	2.5
	5.80	0.48	0.15	0.20	0.03	0.02		0.001	2.4
	6.00	0.52	0.16	0.20	0.03	0.02		0.001	2.6
	6.20	0.71	0.22	0.20	0.04	0		0.000	0.0
	6.40	0.80	0.24	0.20	0.05	0.01		0.000	2.0
	6.60	0.75	0.23	0.20	0.05	0.01		0.000	1.9
	6.80	0.60	0.18	0.20	0.04	0		0.000	0.0
	7.00	0.42	0.13	0.20	0.02	0		0.000	0.0
	7.15	0.64	0.20	0.15	0.03	0.02		0.001	2.4
	7.30	0.64	0.20	0.15	0.03	0.03		0.001	4.2
	7.50	0.75	0.23	0.20	0.05	0.03		0.001	5.6
	7.70	0.78	0.24	0.20	0.05	0.03		0.001	5.8
	7.90	0.80	0.24	0.20	0.05	0.02		0.001	4.0
	8.10	0.95	0.29	0.20	0.06	0.04		0.002	9.5
	8.30	1.00	0.30	0.20	0.06	0.03		0.002	7.5
	8.50	1.00	0.30	0.20	0.06	0.03		0.002	7.5
	8.70	0.90	0.27	0.20	0.05	0.04		0.002	9.0
	8.90	1.10	0.34	0.20	0.05	0.03		0.002	6.2
	9.00	1.00	0.30	0.10	0.04	0.02		0.001	3.1
	9.15	0.40	0.12	0.15	0.02	0.01		0.000	0.7
LB	9.30	0.00	0.00	0.15	0.01	0		0.000	0.0
Total Q								**0.0245**	**100.0**

General Notes
Gradiant= 2%. Depth values converted from ft. to m (1ft. = 0.3048m).

Appendix 2-15. Manual Discharge Measurements and Levelling Surveys at KL-H2 in 2012

Site Information				
Project Name	Back River			
Station Identification	KL-H2			
Stream Name	George Lake Outflow			
Date Monitored	12-Sep-12			
Time at Site (24 hr)	**Start Time:**	8:00:00 AM	**End Time:**	10:00:00 AM
Personnel	Eli H., Scott C.			
Station Cordinates	**Easting**	**Northing**	**Elevation**	
	386687	7314673	337m	
Weather Conditions	Mis of Sun and Cloud, Flurries			

Transducer Information			
PT Model	PT2X	**Serial #**	21221021
Gain	N/A	**Offset**	N/A
Status	Active	**Battery**	100%
# of Records	13512	**Memory Free**	510627
Date Serviced		**Crest Gauges**	N/A

Hydrometric Leveling Survey					
Stn	**BS**	**HI**	**FS**	**Elevation**	**Notes**
BM 73	1.861	101.861		100.000	
BM 74			2.012	99.849	
BM 78			1.127	100.734	
PT			2.925	98.936	
WL			2.425	**99.436**	
TBM	2.366	101.779	2.448	99.413	
WL			2.341	**99.438**	
PT			2.838	98.941	
BM 78			1.044	100.735	
BM 74			1.929	99.850	
BM 73			1.778	100.001	

BM#	**Established Elevation (m)**	**Mean Elevation (this date) (m)**	**Difference (m)**	**Notes**
BM 74	99.848	99.850	0.002	
BM 78	100.732	100.735	0.003	
PT	99.064	98.939	-0.125	

Summary	
Stage (m)	99.437
Discharge (m^3/s)	0.03738
Pressure Transducer Reading (m)	0.528
Pressure Transducer Elevation (m)	98.909

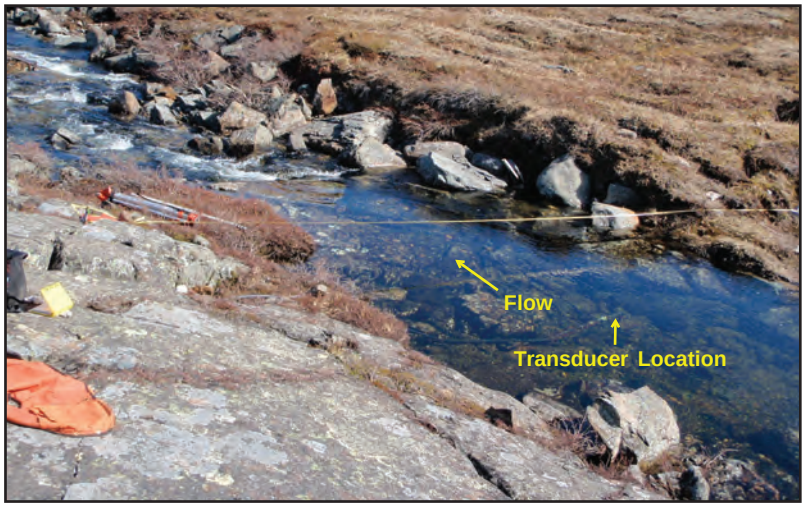
Discharge Measurement - Mid-Section Method										
Time (24 hr)	**Start**	8:04	**End**	9:15	**Location**	~15m Downstream of PT				
Method	Velocity-area (Mid-section)			**Instrument Model**		Flo-Mate 2000				
Flow Meter Type	Flo-Mate			**Instrument Serial #**		2007529				
Stage (m)	**Start**	**Reading**	0.527	**Time**	8:04					
	End	**Reading**	0.528	**Time**	9:15					

	Station	**Depth**	**Distance**	**Area**	**Velocity (m/s)**			**Q**	**% of Total Q**
Notes	**(m)**	**(m)**	**(m)**	**(m^2)**	**60%**	**20%**	**80%**	**(m^3/s)**	**%**
RB	16.60	0.00	0.00	0.00	0			0.000	0.0
	16.65	0.11	0.05	0.02	0			0.000	0.0
	16.90	0.06	0.25	0.01	0			0.000	0.0
	17.10	0.06	0.20	0.01	0			0.000	0.0
	17.20	0.24	0.10	0.04	0			0.000	0.0
	17.40	0.12	0.20	0.03	0.05			0.002	4.0
	17.70	0.29	0.30	0.02	0.04			0.001	2.3
	17.55	0.29	0.15	0.04	0.03			0.001	3.5
	18.00	0.27	0.45	0.10	0.01			0.001	2.7
	18.30	0.24	0.30	0.07	0			0.000	0.0
	18.60	0.13	0.30	0.04	0.05			0.002	5.2
	18.90	0.18	0.30	0.05	0.08			0.004	11.6
	19.20	0.20	0.30	0.06	0.04			0.002	6.4
	19.50	0.29	0.30	0.07	0			0.000	0.0
	19.70	0.26	0.20	0.05	0			0.000	0.0
	19.90	0.22	0.20	0.06	0.01			0.001	1.5
	20.20	0.22	0.30	0.07	0.01			0.001	1.8
	20.50	0.27	0.30	0.08	0.01			0.001	2.2
	20.80	0.30	0.30	0.09	0.02			0.002	4.8
	21.10	0.30	0.30	0.09	0.03			0.003	7.2
	21.40	0.31	0.30	0.08	0.04			0.003	8.3
	21.60	0.32	0.20	0.06	0.04			0.003	6.8
	21.80	0.32	0.20	0.06	0.05			0.003	8.6
	22.00	0.32	0.20	0.06	0.06			0.004	10.3
	22.20	0.38	0.20	0.08	0.04			0.003	8.1
	22.40	0.44	0.20	0.09	0.02			0.002	4.7
	22.60	0.16	0.20	0.02	0			0.000	0.0
LB	22.70	0.00	0.10	0.01	0			0.000	0.0
Total Q								**0.0374**	**100.0**

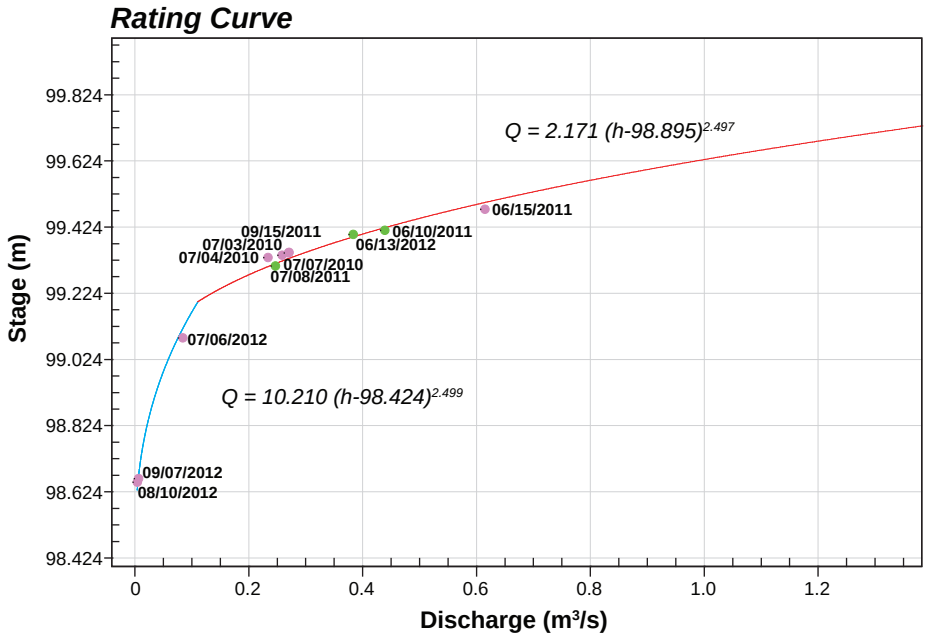
General Notes
Gradiant= 2%.

Appendix 3
Rating Curves

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GL-H1 from the left bank looking downstream and across the channel. The bed of this channel is composed of bedrock and the transducer is located in large pool upstream of a cascade section. The flow gauging section is indicated by the measuring tape. Photograph taken June 13, 2012.



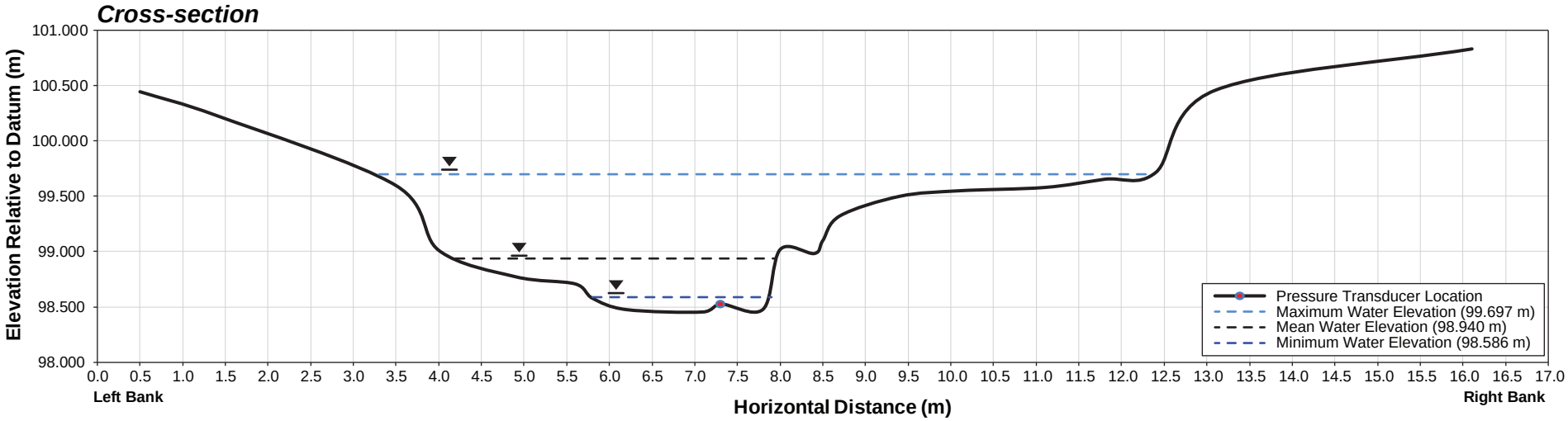


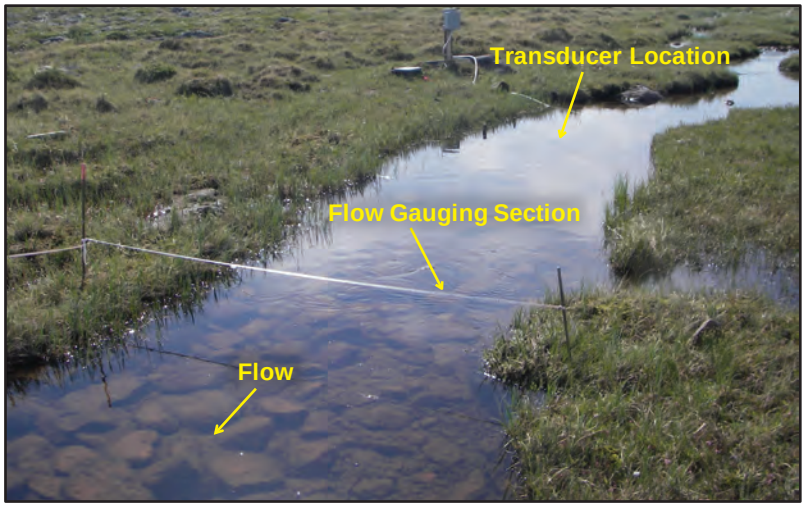
Figure A3.1

Sabina GOLD & SILVER CORP.

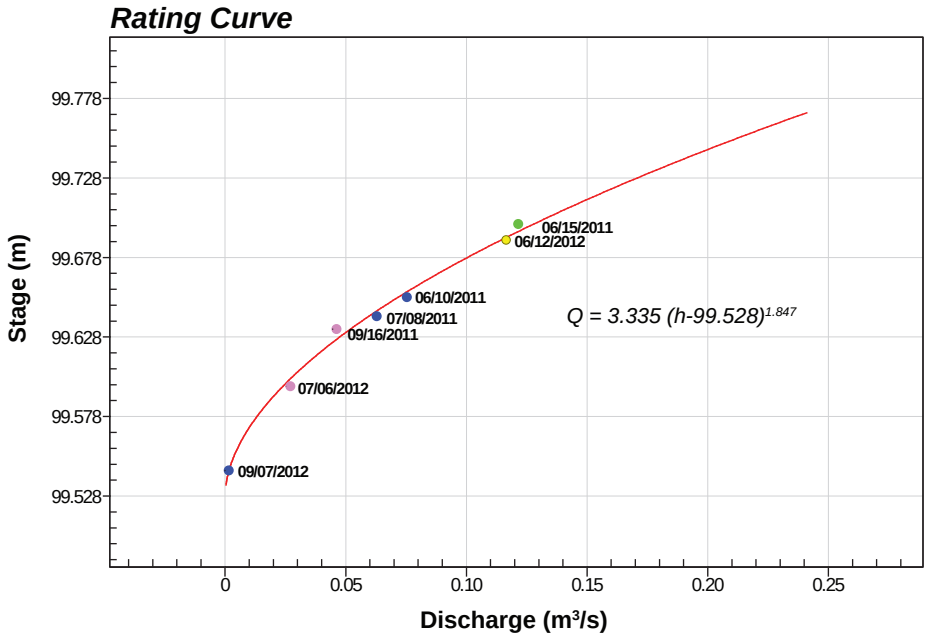
GL-H1 -Stage Discharge Rating Curve and Cross-Section
(Rating Period from July 7, 2010 -September 7, 2012)

Figure A3.1

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Upstream view of station GL-H3 with the flow gauging section in the foreground, downstream of the transducer location. The stream is narrow with very low flow velocities under most conditions and it floods onto the floodplain under high flow conditions. Photograph taken during mid-level flow conditions (July 6, 2012).



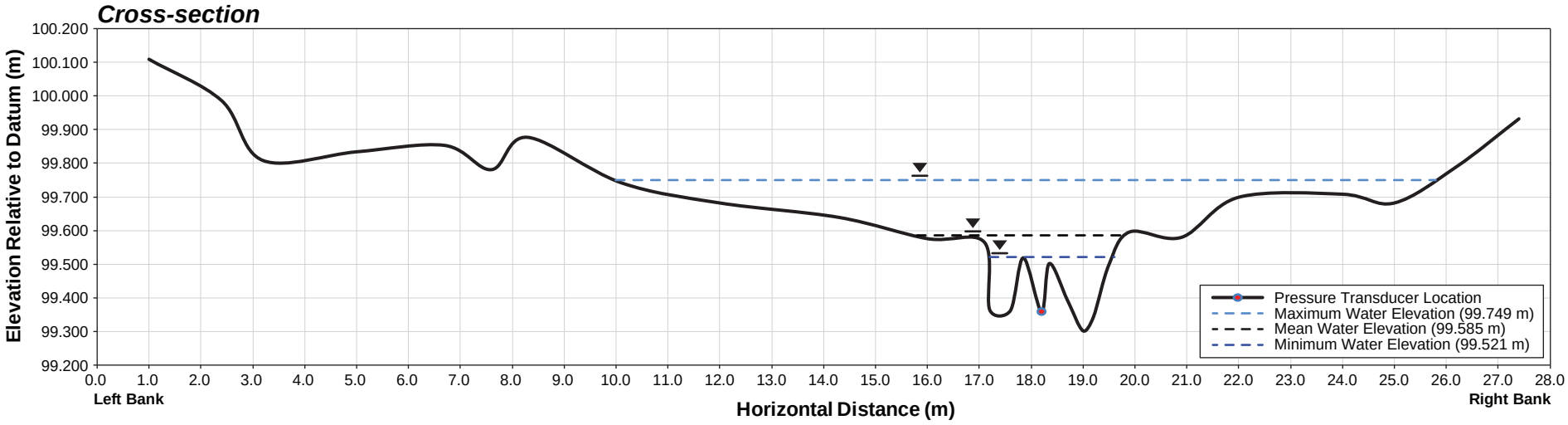


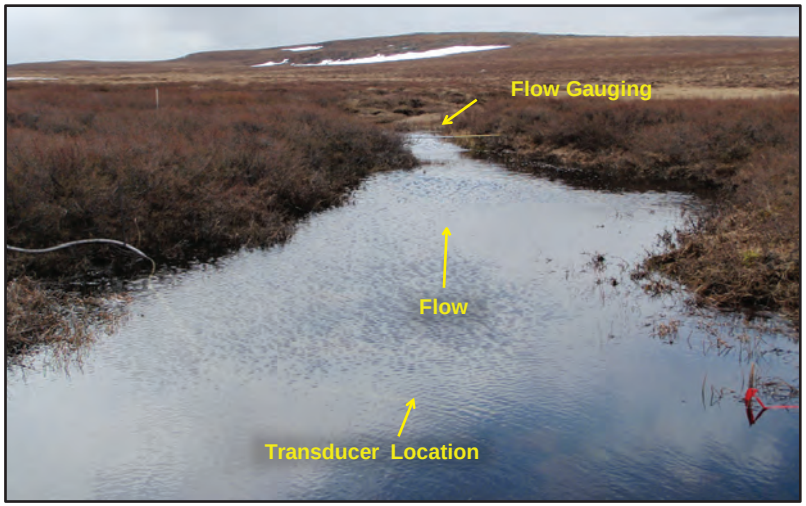
Figure A3-2

Sabina GOLD & SILVER CORP.

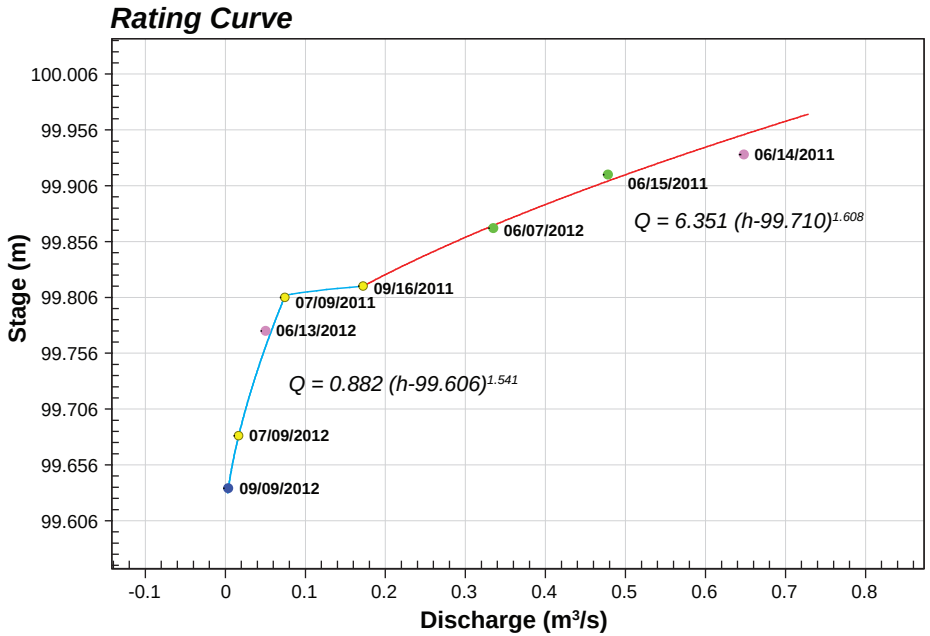
GL-H2 -Stage Discharge Rating Curve and Cross-Section
(Rating Period from June 10, 2011 -September 7, 2012)

Figure A3-2

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Upstream view of the monitored reach at station GL-H3. The transducer is located in a deep pool with the channel becoming much shallower upstream near the location of the flow gauging section. Photo taken June 13, 2012.



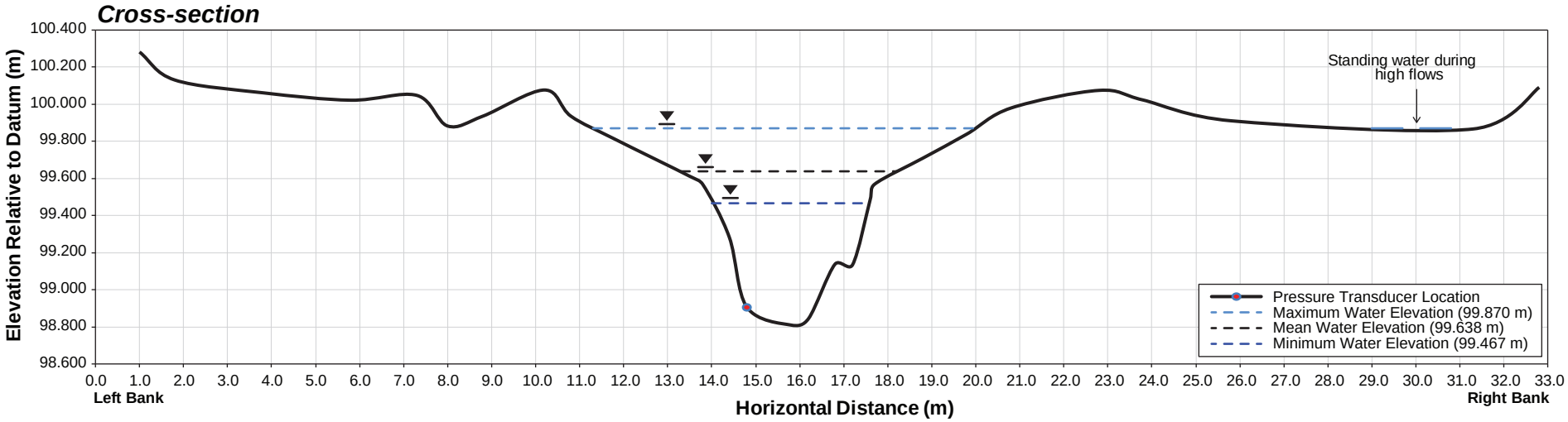


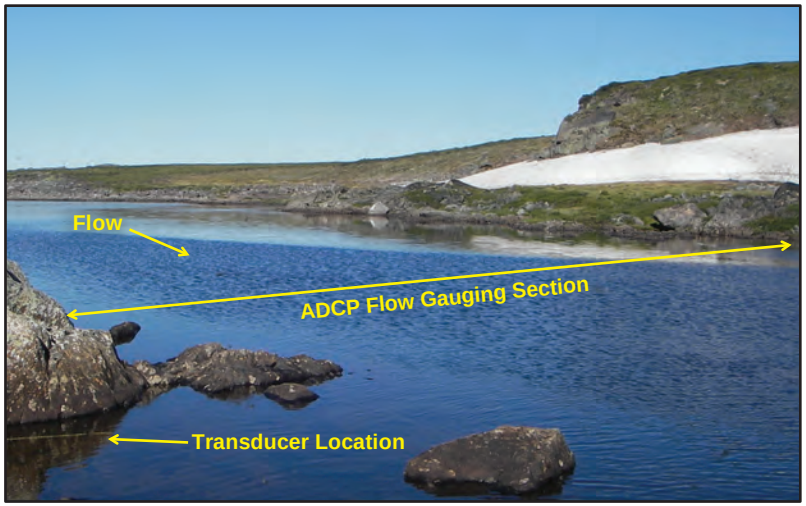
Figure A3-3

Sabina GOLD & SILVER CORP.

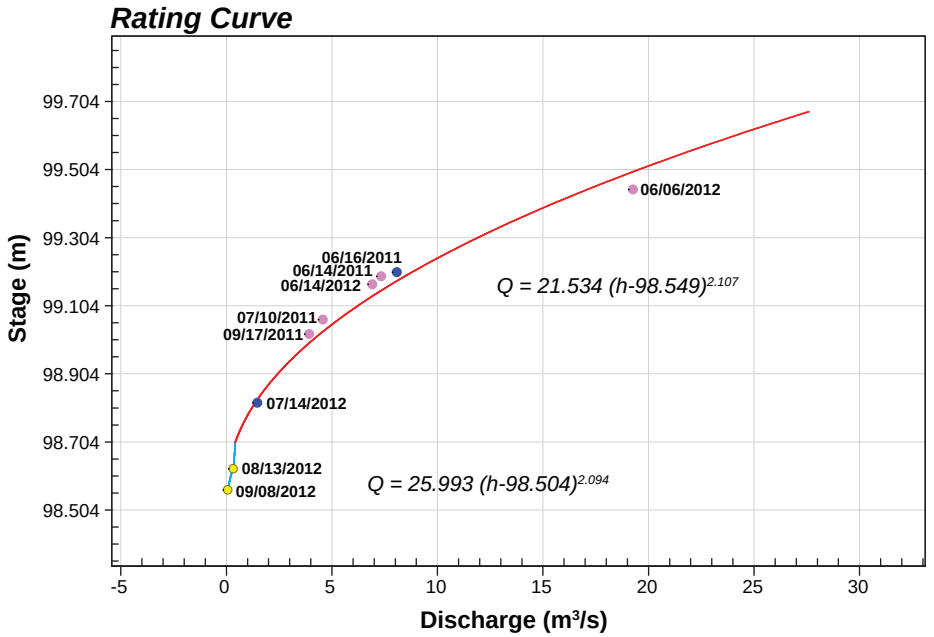
GL-H3 -Stage Discharge Rating Curve and Cross-Section
(Rating Period from July 7, 2011 -September 7, 2012)

Figure A3-3

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Upstream view of the flow gauging section at PL-H1 during July mid-flow conditions. The monitored reach is a low energy channel that is deep and wide with a bouldery bottom and bedrock banks. An ADCP was used at this location in order to measure discharge. Photograph taken July 15, 2012.



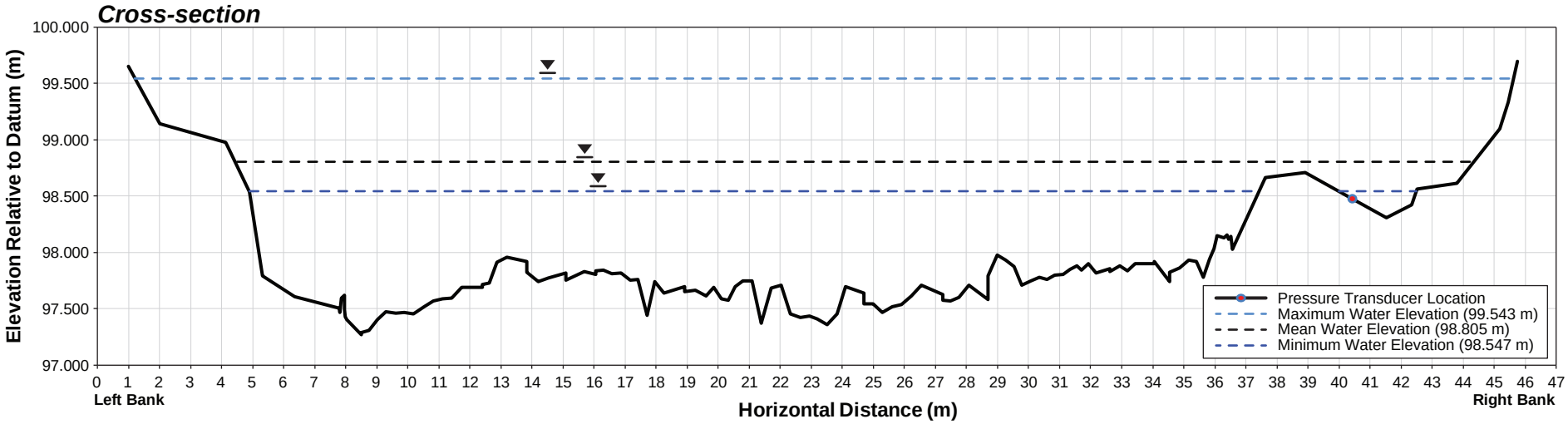


Figure A3-4

Sabina GOLD & SILVER CORP.

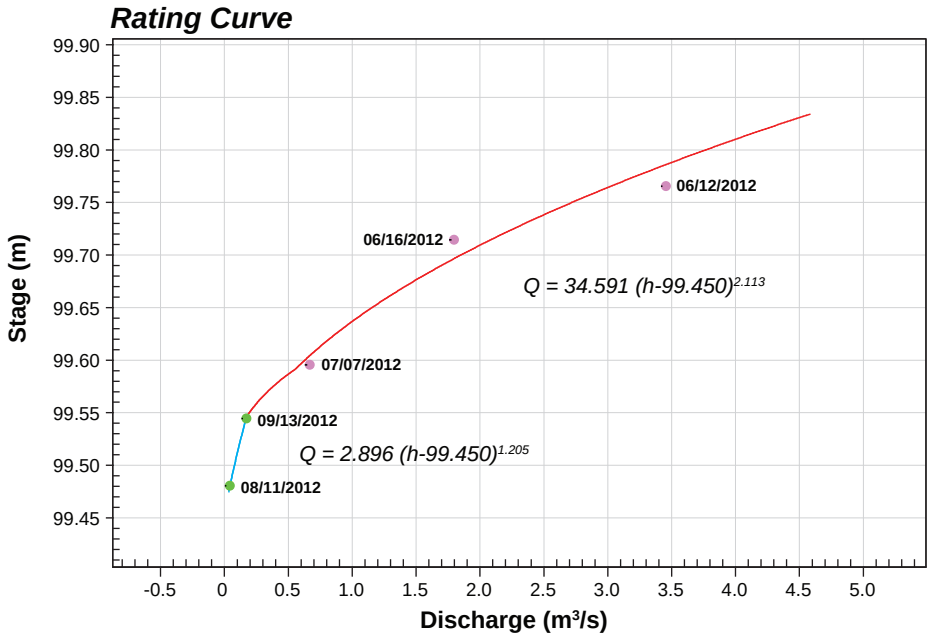
PL-H1 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 14, 2011 to September 8, 2012)

Figure A3-4

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PL-H2, looking downstream from the station. The monitored reach is approximately 55 m wide at this location during high flow conditions. The channel has a cobble/boulder bed substrate and is confined by low vegetated banks. Photograph taken on June 12, 2012.



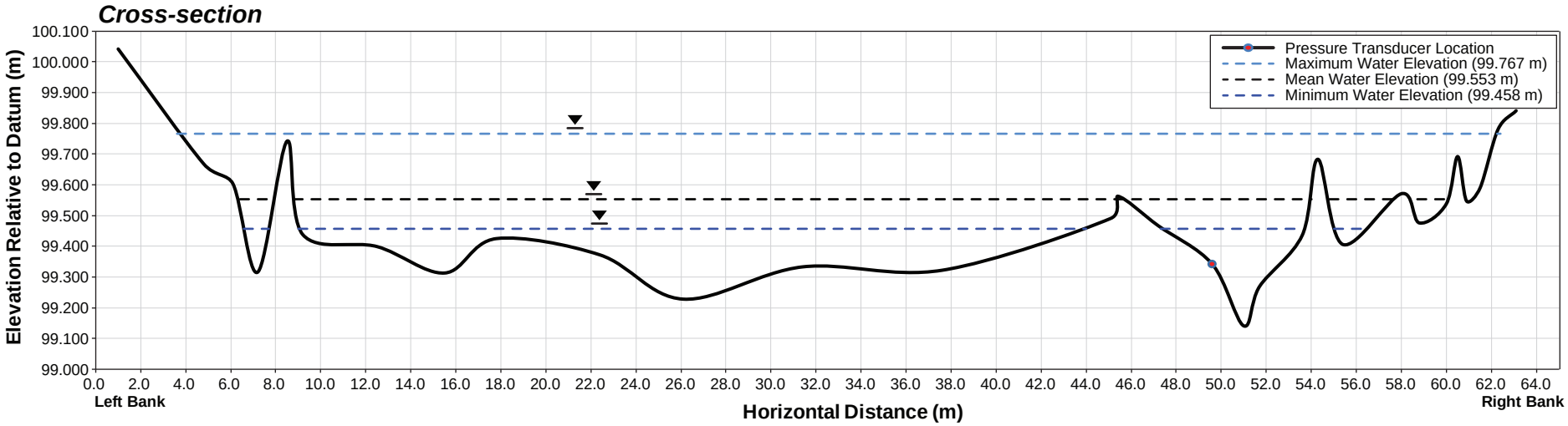


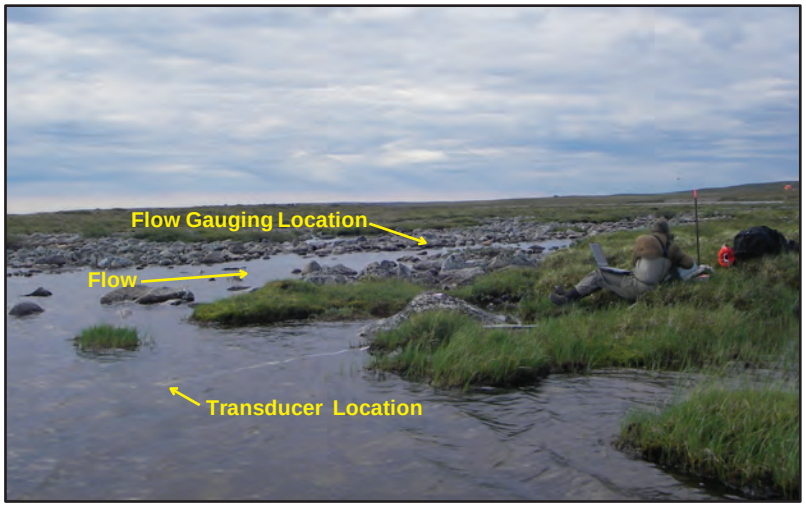
Figure A3-5

Sabina GOLD & SILVER CORP.

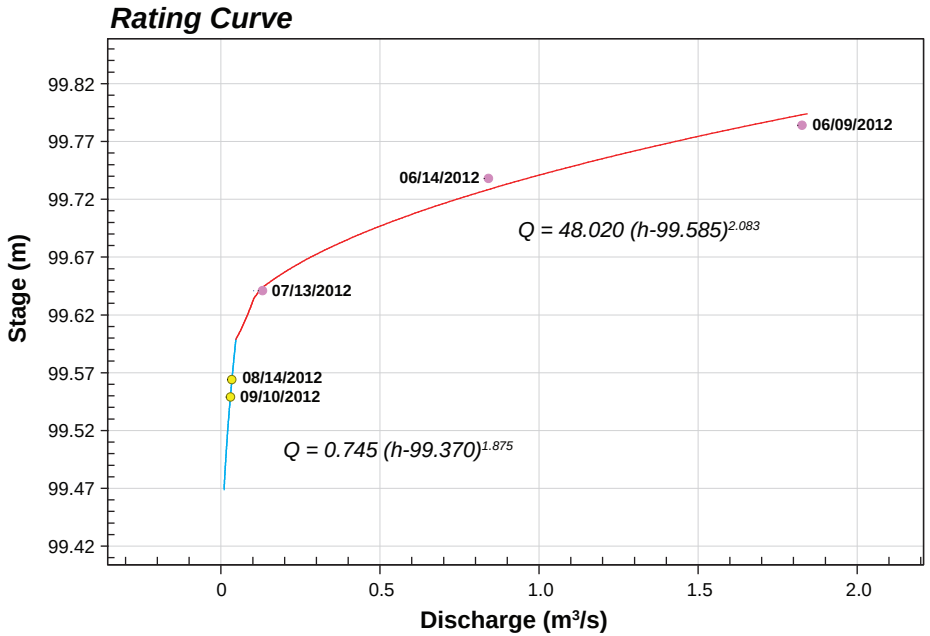
PL-H2 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 12 - September 12 2012)

Figure A3-5

Rescan Engineers & Scientists



Downstream view of station GI-H1. The transducer is located at the outflow of Giraffe lake with the flow gauging section shown further downstream. Note the bouldery nature of the channel. Photograph taken July 13, 2012.



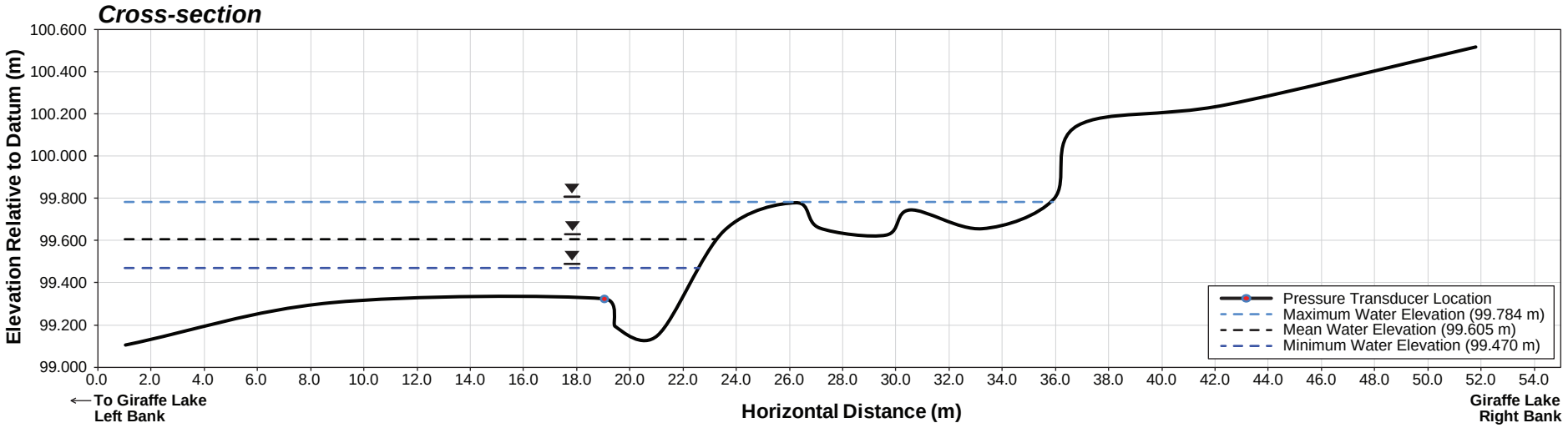


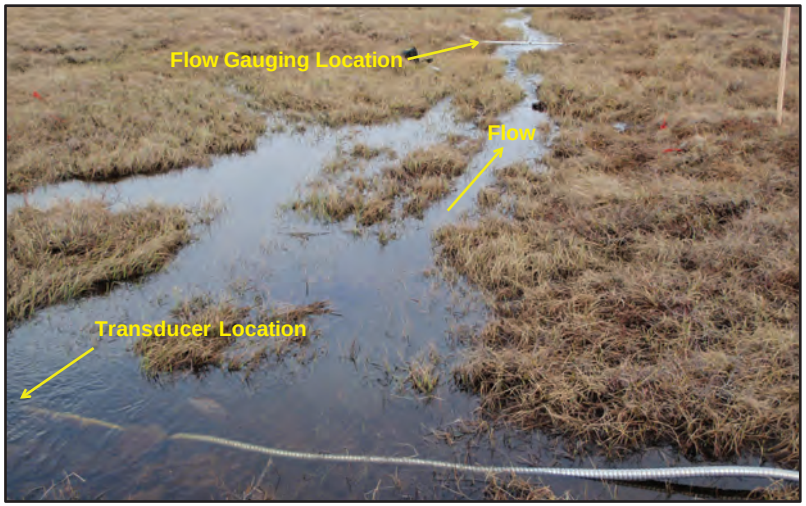
Figure A3-6

Sabina GOLD & SILVER CORP.

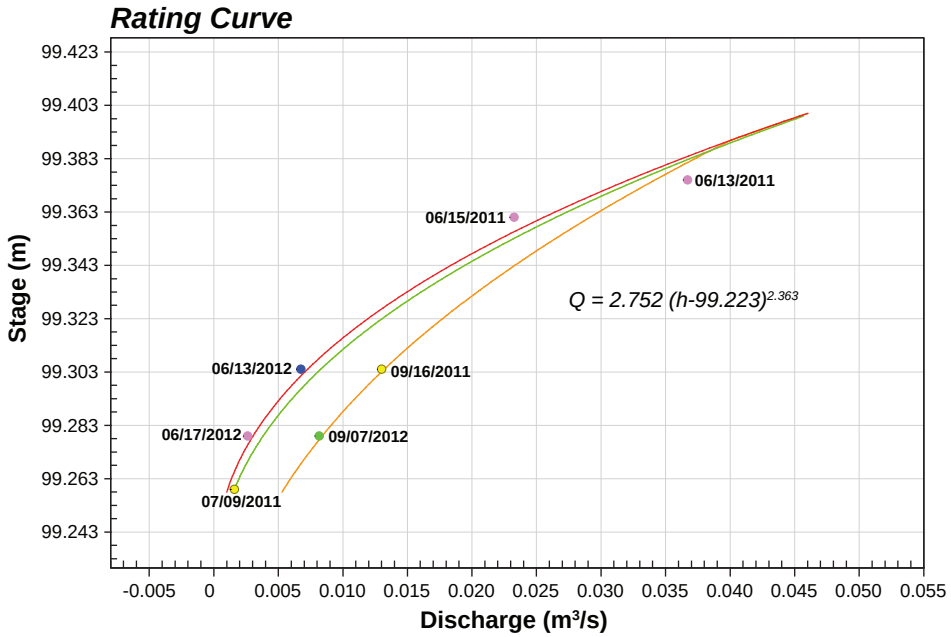
GI-H1 - Stage Discharge Rating Curve and Shoreline Profile
(Rating Period from June 9, 2012 - September 14, 2012)

Figure A3-6

Rescan Engineers & Scientists



Downstream view of station EL-H1 during freshet with the transducer location and flow gauging location shown. Note the the channel is ephemeral and flows over mostly grass. Photo taken June 13, 2012.



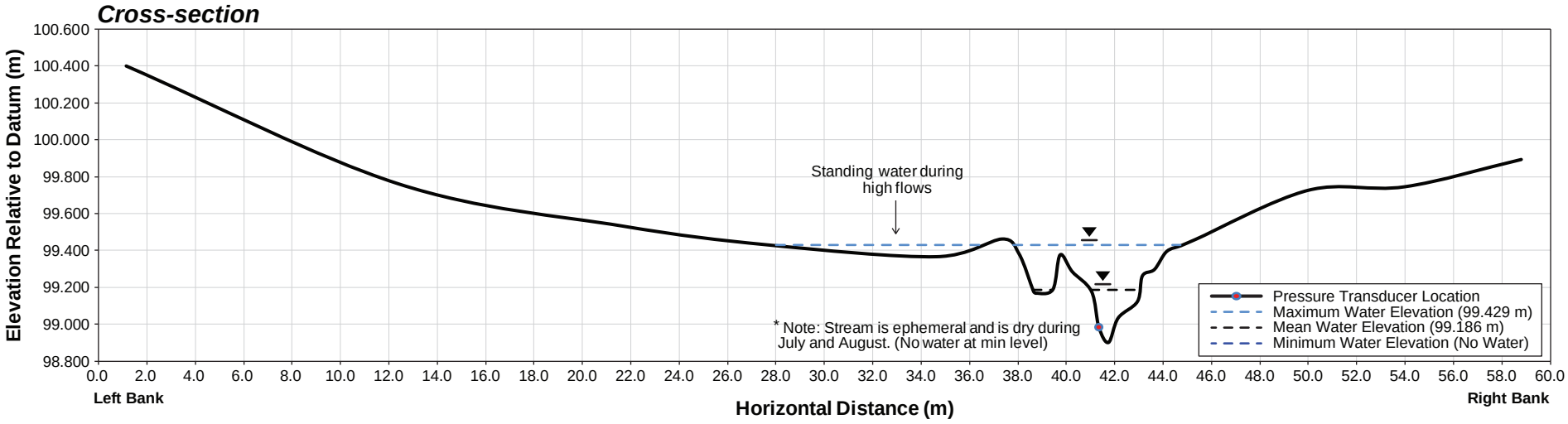


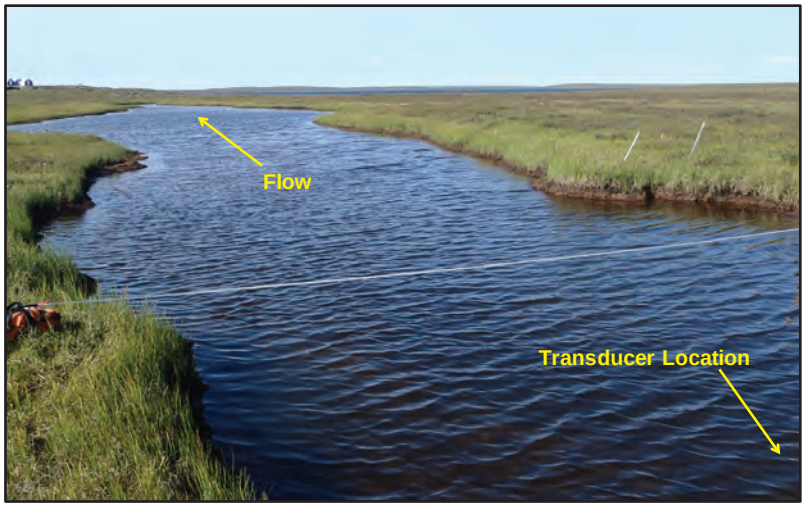
Figure A3-7

Sabina GOLD & SILVER CORP.

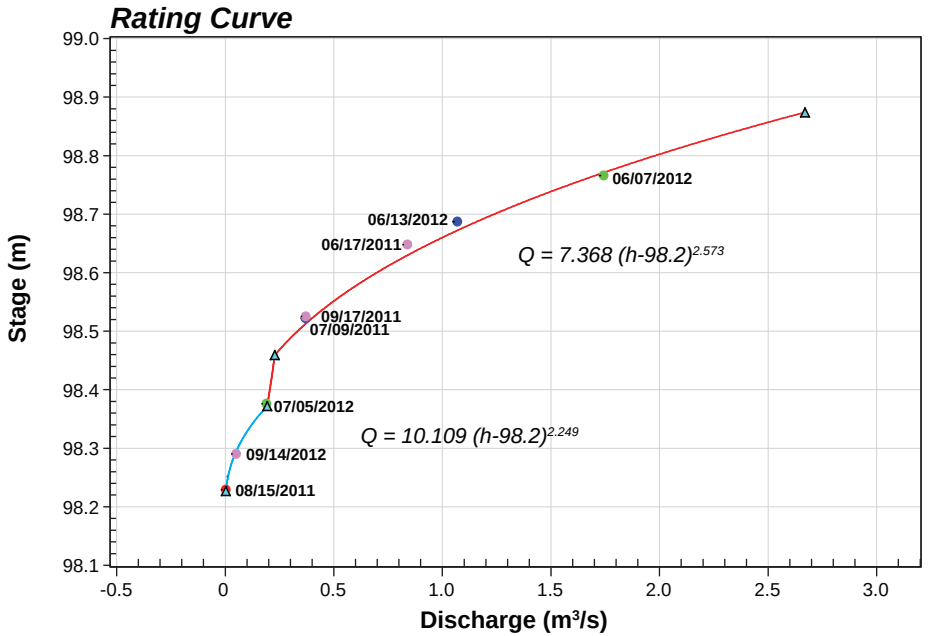
EL-H1 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 13, 2012 - September 7, 2012)

Figure A3-7

Rescan Engineers & Scientists



WL-H1, looking downstream along the monitored reach towards Goose Lake. Note that the channel is confined within its banks on this date. During high flow conditions the stream overflows the banks onto the adjacent floodplain, leading to a different relationship between low and high stage conditions. Photograph taken August 10, 2012.



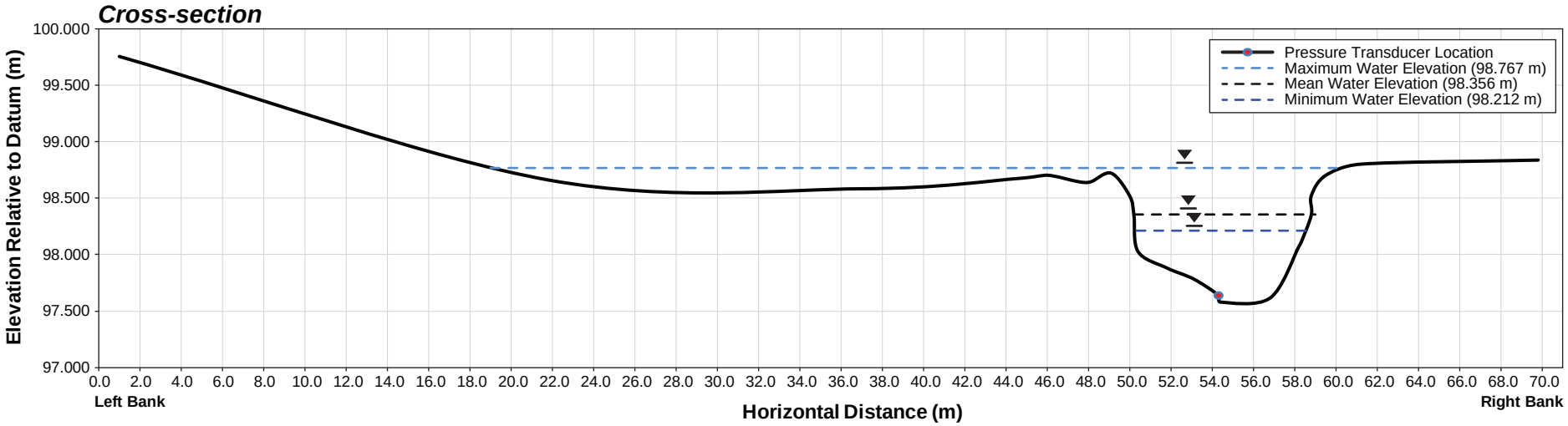


Figure A3-8

Sabina GOLD & SILVER CORP.

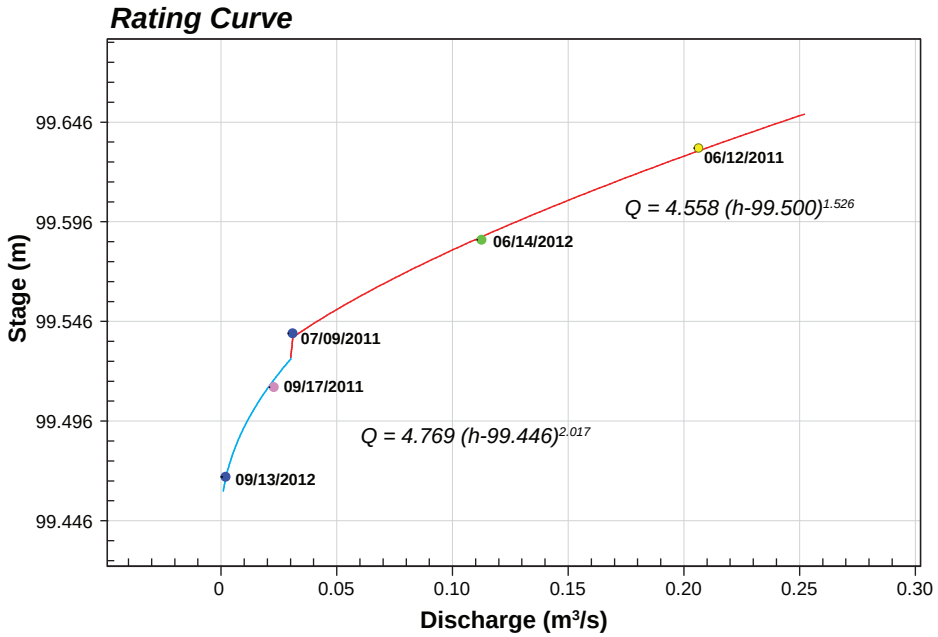
WL-H1 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 17, 2011 - September 14, 2012)

Figure A3-8

Rescan Engineers & Scientists



Downstream view of REFB-H1 during spring high flow conditions. Note that the channel is flowing through the grass banks. During low flow dry conditions there is no flow in the channel allowing for vegetation to grow on the bed. Photograph taken June 14, 2012.



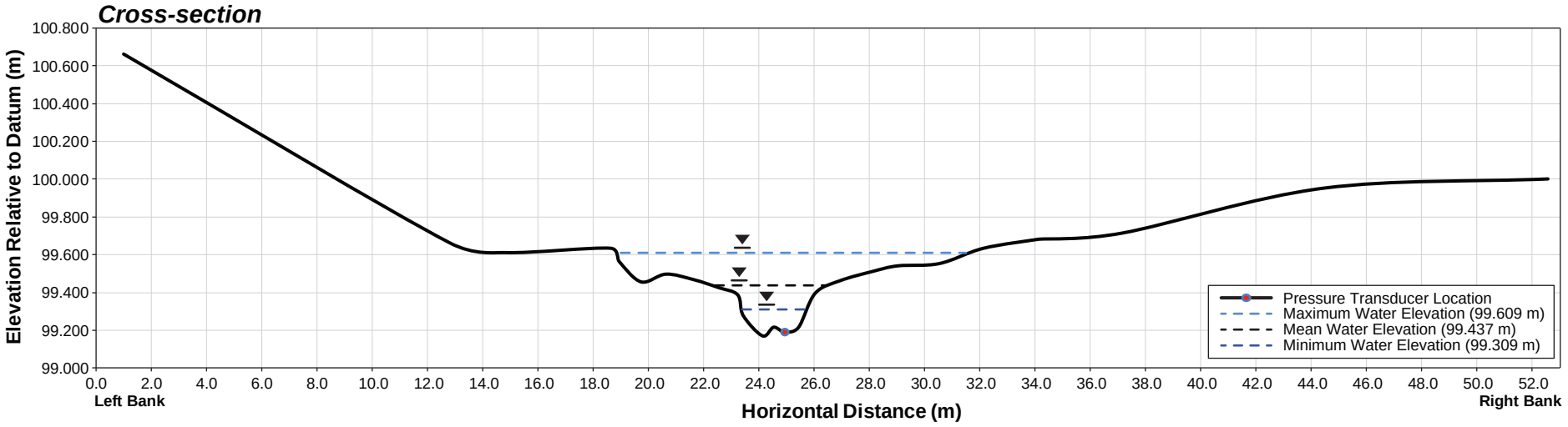


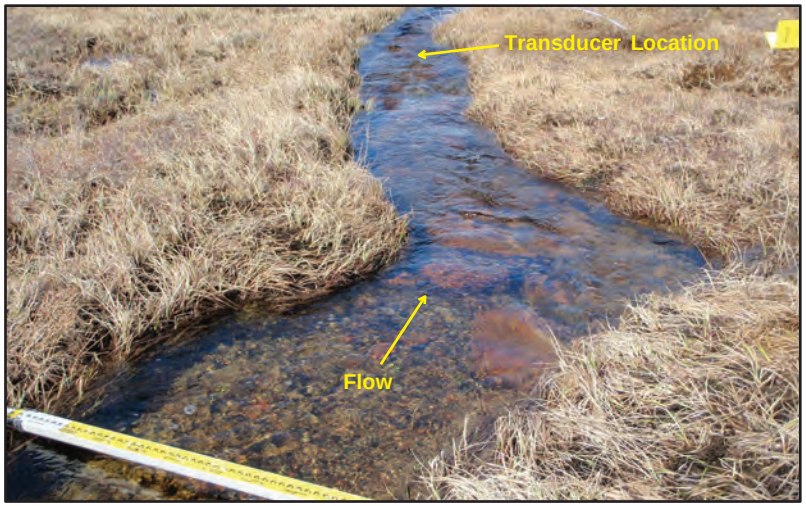
Figure A3-9

Sabina GOLD & SILVER CORP.

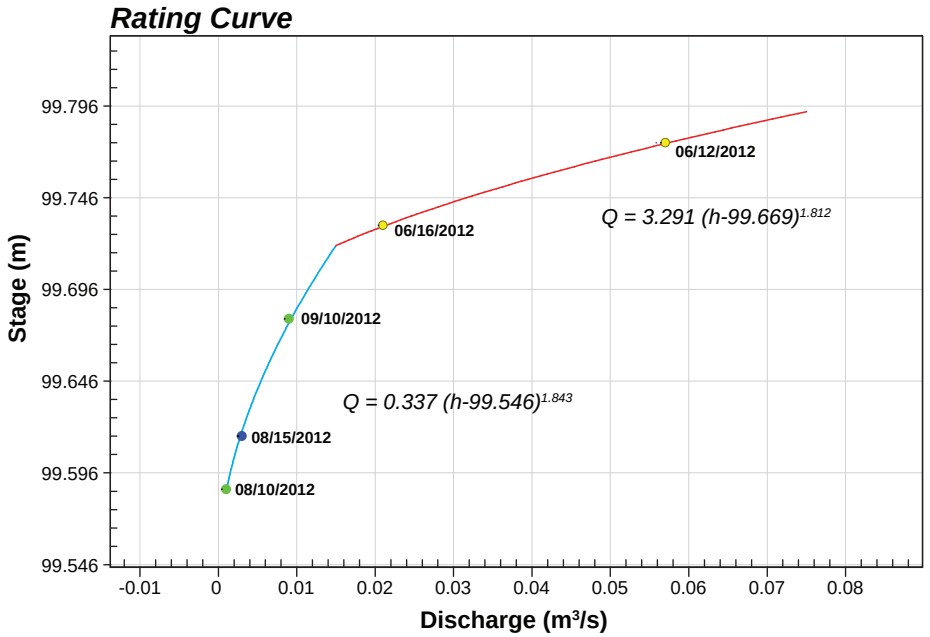
REFB-H1 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 12, 2011 to September 13, 2012)

Figure A3-9

Rescan Engineers & Scientists



BL-H1, looking downstream along the monitored reach. Note the water flowing through the grass along the edges of the channel. The rod across the channel indicates where mannual flow measurements were conducted. Photograph taken June 12, 2012.



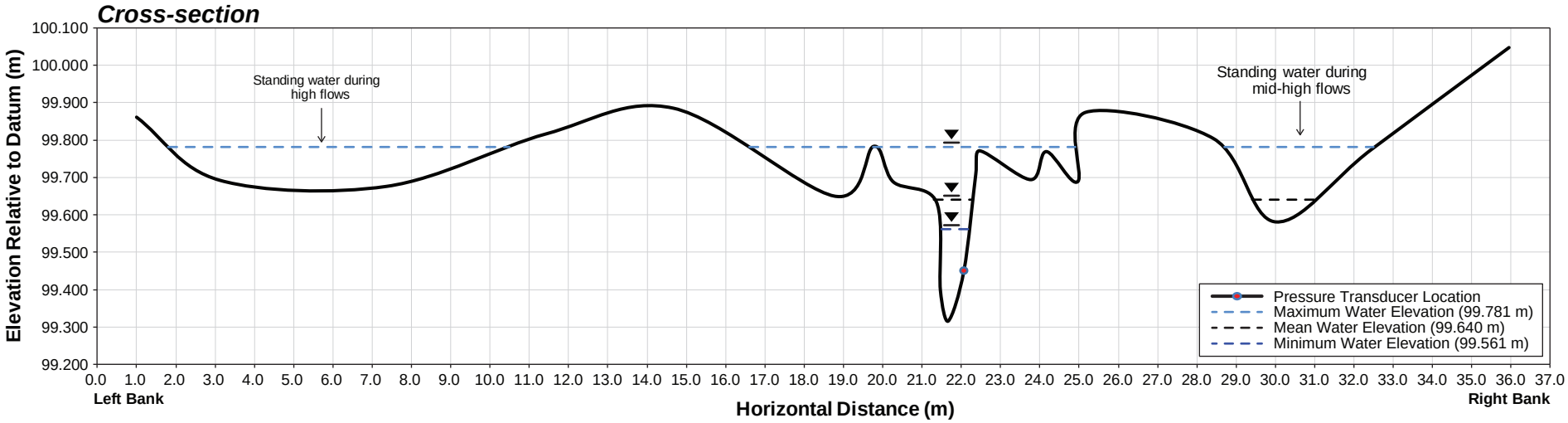


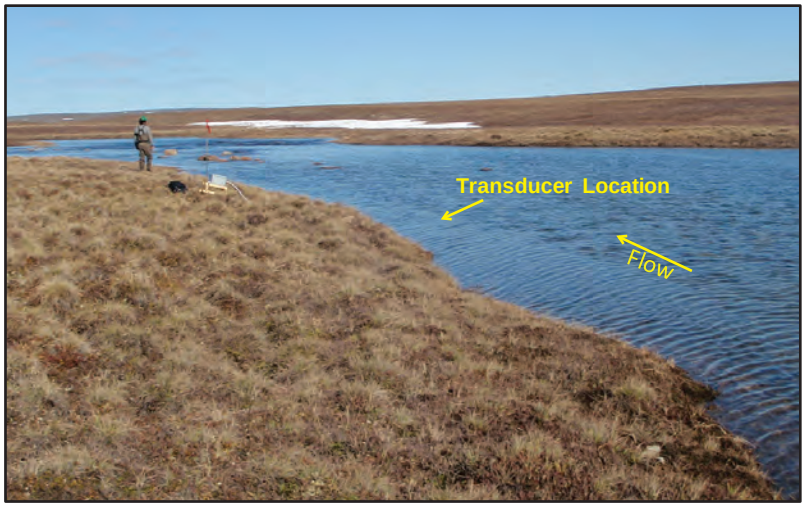
Figure A3-10

Sabina GOLD & SILVER CORP.

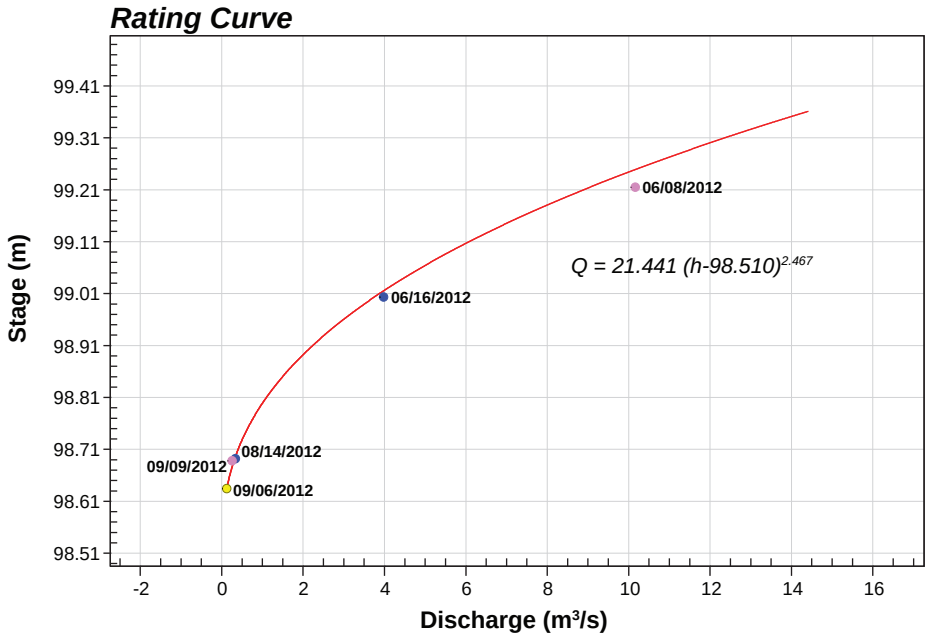
BL-H1 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 12 - September 9, 2012)

Figure A3-10

Rescan Engineers & Scientists



BL-H2 looking downstream along the monitored reach. Manual flow measurements were conducted near the transducer location in June and further downstream during low flow periods. Photograph taken June 12, 2012.



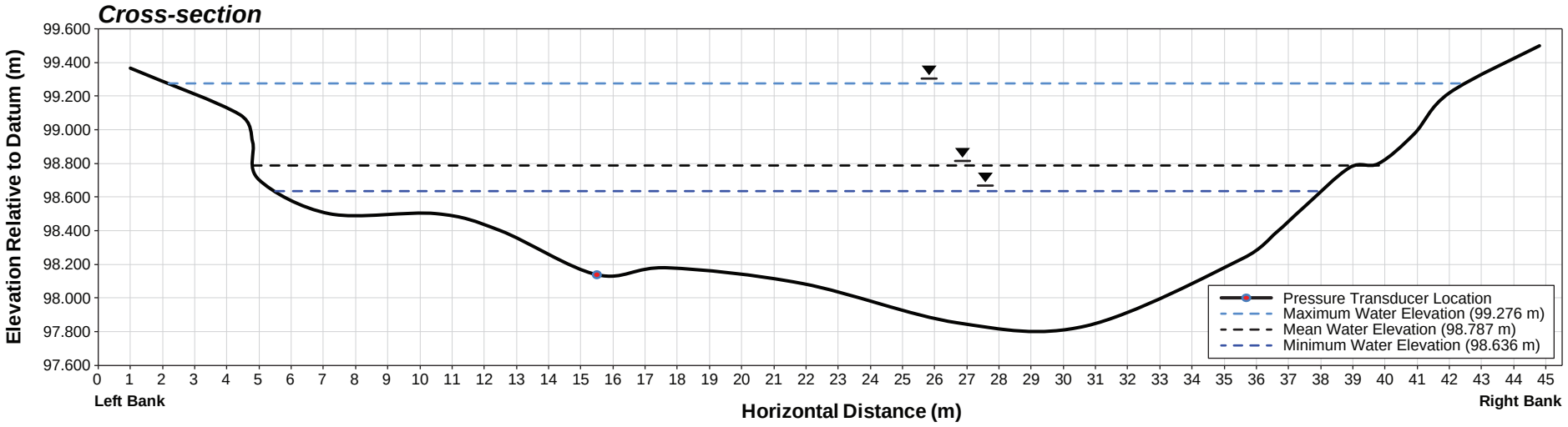


Figure A3-11

Sabina GOLD & SILVER CORP.

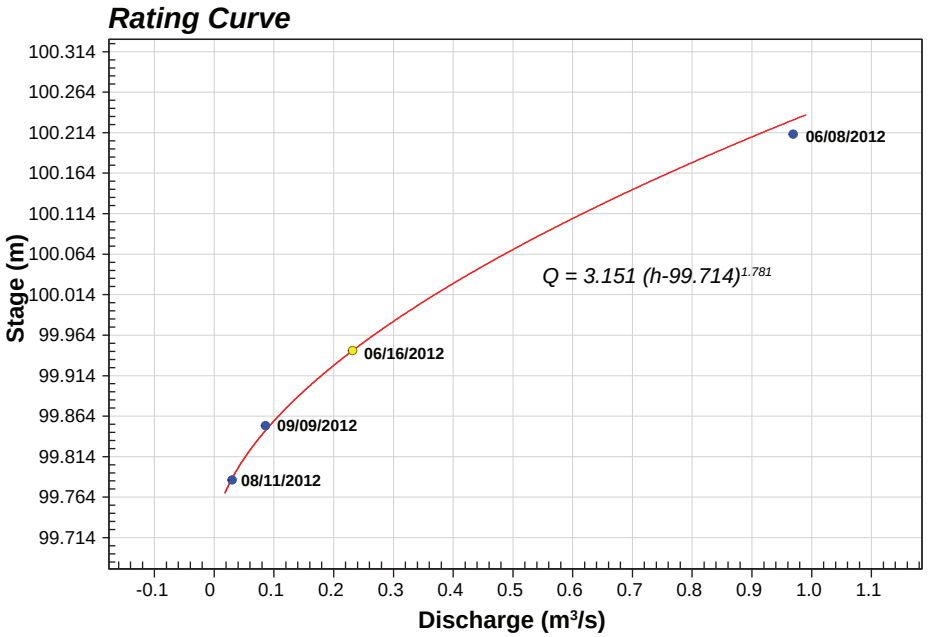
BL-H2 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 8 - September 9, 2012)

Figure A3-11

Rescan Engineers & Scientists



BL-H3, looking downstream along the monitored reach with the transducer location in the foreground. The rod across the channel indicates where manual flow measurements were conducted. Photograph taken June 12, 2012



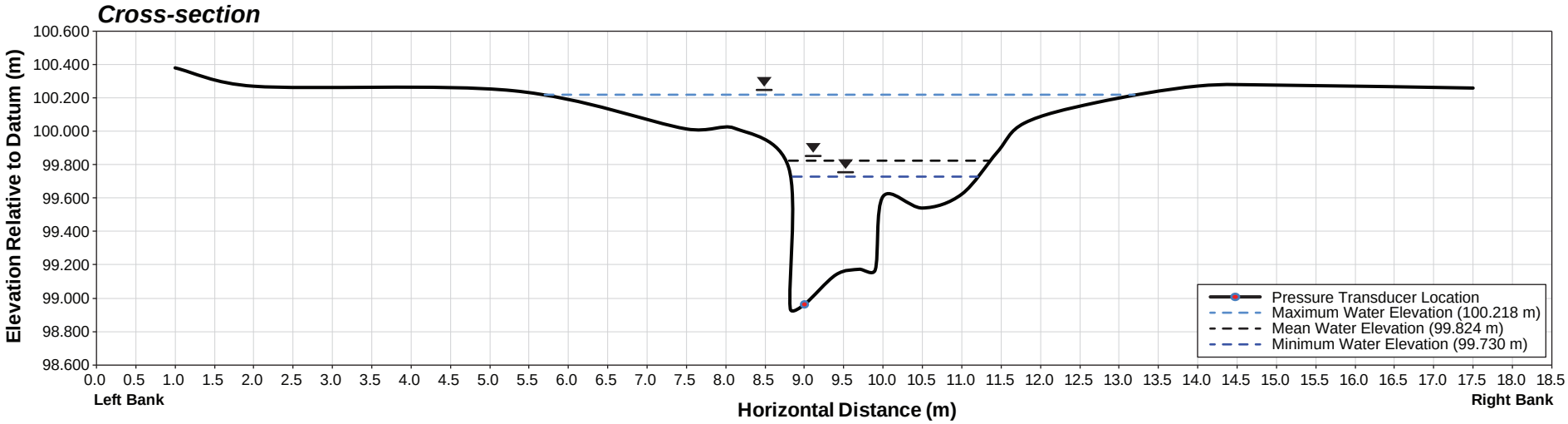


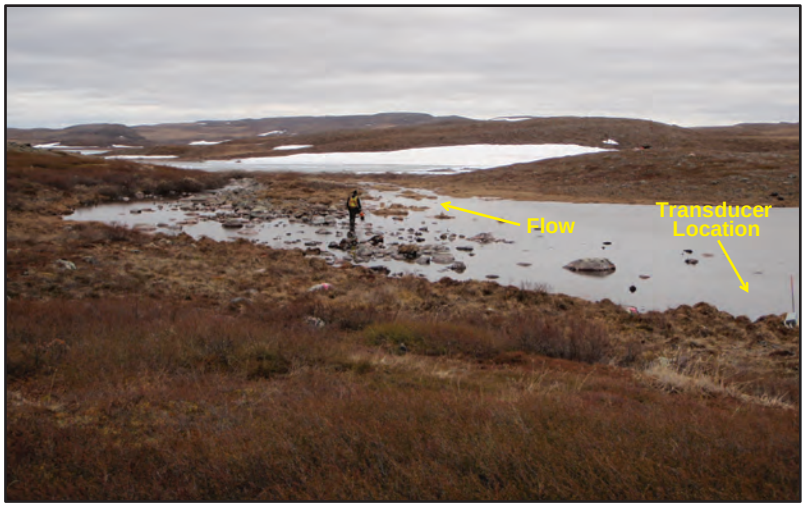
Figure A3-12

Sabina GOLD & SILVER CORP.

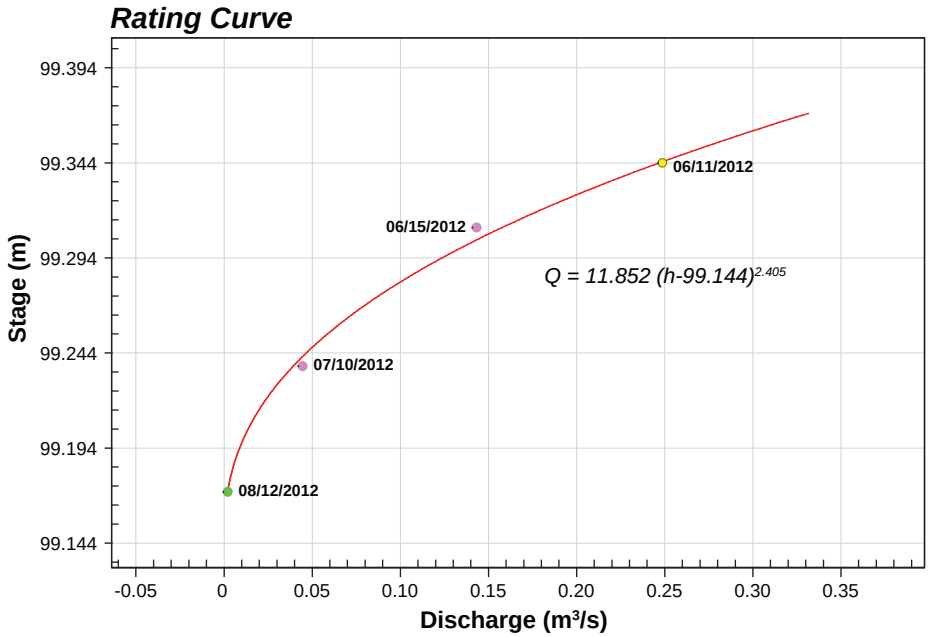
BL-H3 - Stage Discharge Rating Curve and Channel Geometry
(Rating Period from June 8 - September 9, 2012)

Figure A3-12

Rescan Engineers & Scientists



REFC-H1, looking downstream towards the monitored reach. The channel is characterized by vegetation and rocks with the flow splitting in two sections along its length. The pressure transducer is located in Reference Lake C near the outlet. Photograph taken June 11, 2012.



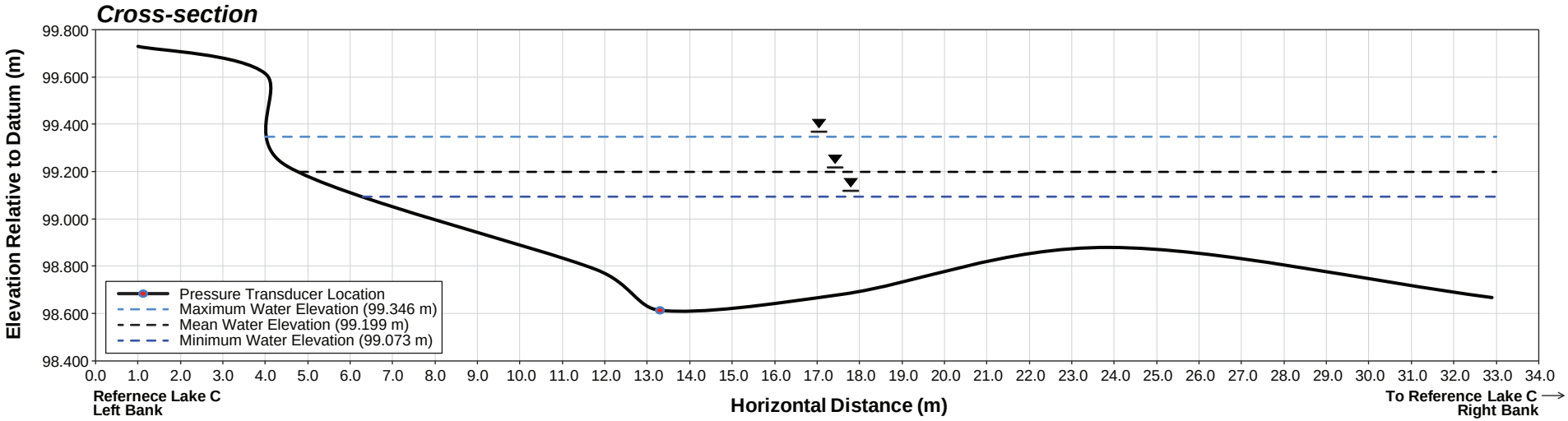


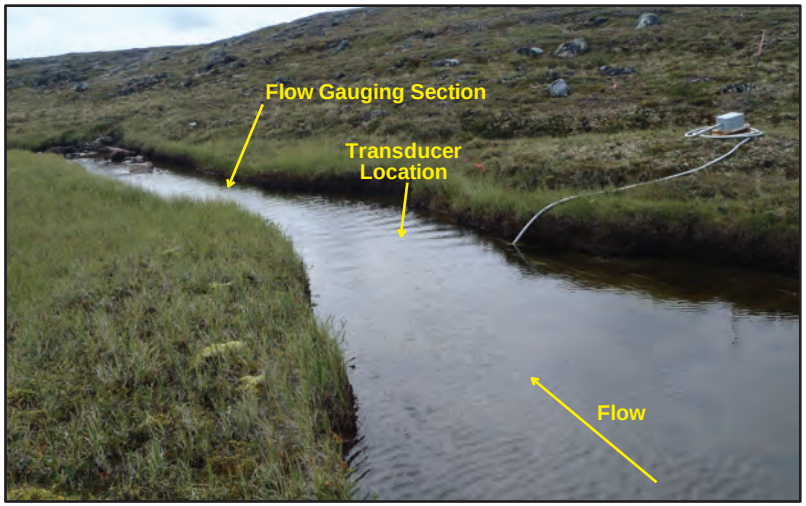
Figure A3-13

Sabina GOLD & SILVER CORP.

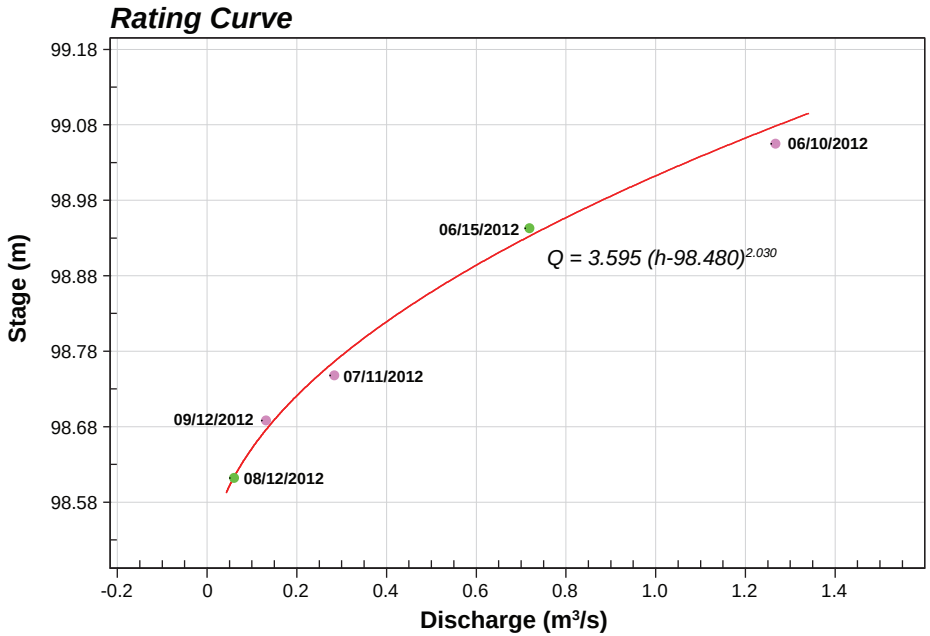
REFC-H1 - Stage Discharge Rating Curve and Shoreline Profile
(Rating Period from June 11 - September 11, 2012)

Figure A3-13

Rescan Engineers & Scientists



Downstream view of the flow gauging section at KL-H1 under low flow conditions. Note that during the freshet period water flows above the level of the grass banks. Photograph taken August 12, 2012.



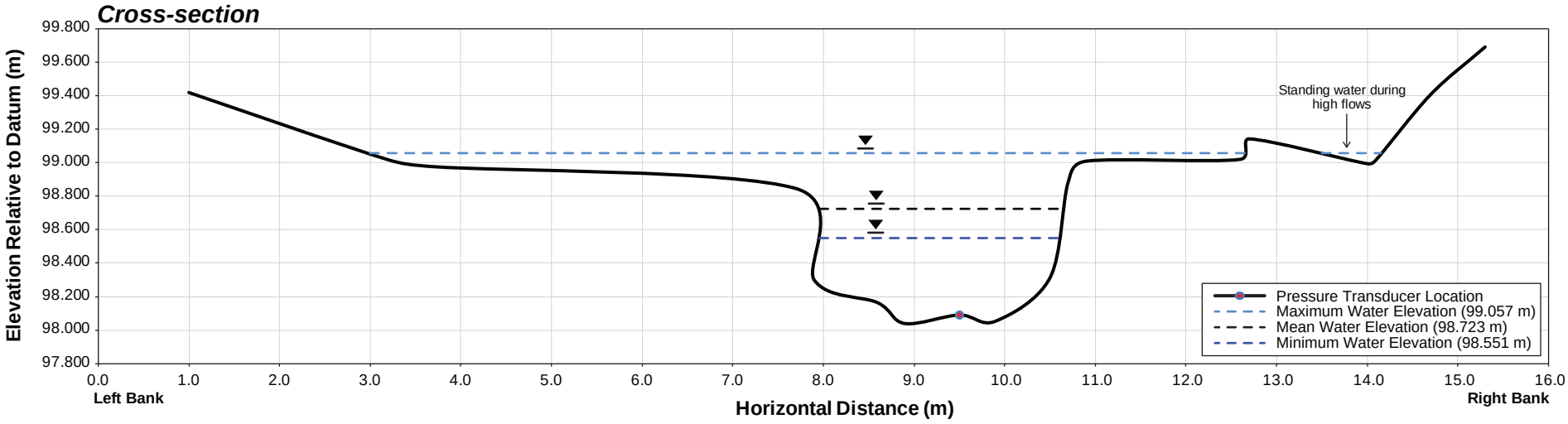


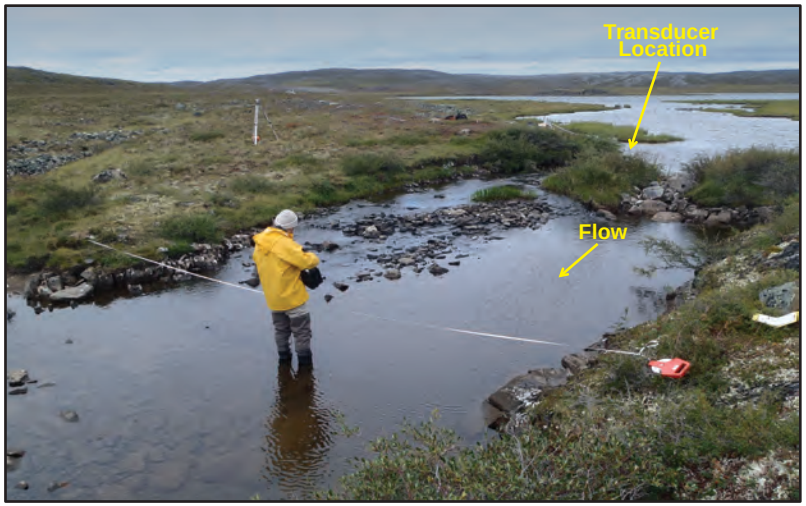
Figure A3-14

Sabina GOLD & SILVER CORP.

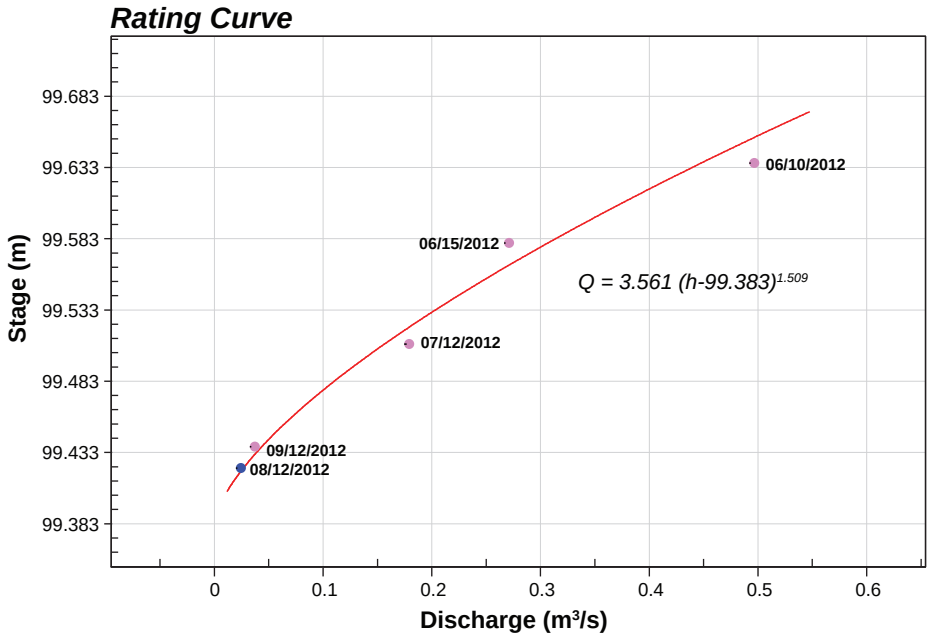
KL-H1 - Stage Discharge Rating Curve and Cross-Section
(Rating Period from June 10 - September 12, 2012)

Figure A3-14

Rescan Engineers & Scientists



Upstream view of station KL-H2 on George Lake outflow during a flow measurement. The pressure transducer is located in George Lake with the flow gauging section downstream of the outlet. Photograph taken August 12, 2012.



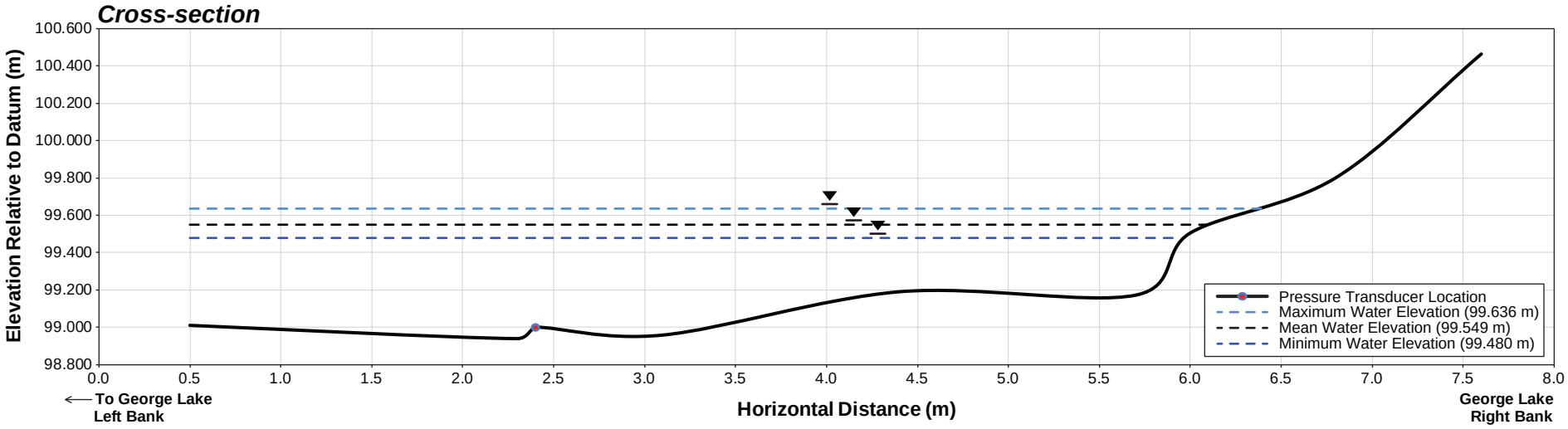


Figure A3-15

Sabina GOLD & SILVER CORP.

KL-H2 - Stage Discharge Rating Curve and Shoreline Profile
(Rating Period from June 10 - September 12, 2012)

Figure A3-15

Rescan Engineers & Scientists

Appendix 4
Daily Discharge Tables

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Appendix 4.1. Summary of Daily Discharge [Q] at Hydrometric Station GL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.275*	0.107	0.011	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.510*	0.101	0.010	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.416*	0.094	0.009	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.322*	0.085	0.008	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.227	0.079	0.007	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.133	0.074	0.006	0.000	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.029	0.069	0.005	0.005	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.853	0.065	0.005	*0.002*	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.714	0.062	0.004	*0.002*	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.604	0.062	0.004	*0.002*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.524	0.059	0.005	*0.002*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.464	0.061	0.005	*0.002*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.415	0.058	0.004	*0.002*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.370	0.055	0.004	*0.001*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.331	0.051	0.000	*0.001*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.294	0.046	0.000	*0.001*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.269	0.043	0.000	*0.001*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.249	0.040	0.000	*0.001*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.233	0.037	0.000	*0.001*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.238	0.034	0.000	*0.001*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.249	0.031	0.000	*0.001*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.228	0.028	0.000	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.202	0.026	0.000	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.182	0.024	0.000	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.173	0.023	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.155	0.023	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.132	0.021	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.115	0.019	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.109	0.016	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.009*	0.111	0.014	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.050*		0.013	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.002**	**0.504**	**0.049**	**0.003**	**0.001**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.050**	**1.510**	**0.107**	**0.011**	**0.005**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.109**	**0.013**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.061**	**15.128**	**1.518**	**0.087**	**0.025**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.2. Summary of Daily Discharge [Q] at Hydrometric Station GL-H2

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.052*	0.049	0.000	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.217*	0.044	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.212*	0.038	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.208*	0.033	0.000	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.203	0.028	0.000	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.198	0.024	0.000	0.000	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.197	0.021	0.000	0.001	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.181	0.018	0.000	*0.001*	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.164	0.015	0.000	*0.001*	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.144	0.015	0.000	*0.001*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.130	0.013	0.000	*0.001*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.116	0.013	0.000	*0.001*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.112	0.011	0.000	*0.001*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.105	0.009	0.000	*0.001*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.098	0.007	0.000	*0.001*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.095	0.006	0.000	*0.001*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.093	0.006	0.000	*0.001*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.092	0.005	0.000	*0.000*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.095	0.006	0.000	*0.000*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.098	0.006	0.000	*0.000*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.100	0.003	0.000	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.093	0.002	0.000	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.087	0.002	0.000	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.083	0.001	0.000	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.078	0.002	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.072	0.001	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.067	0.001	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.062	0.001	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.059	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.003*	0.055	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.013*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.119**	**0.012**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.013**	**0.217**	**0.049**	**0.000**	**0.001**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.052**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.016**	**3.567**	**0.382**	**0.001**	**0.011**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.3. Summary of Daily Discharge [Q] at Hydrometric Station GL-H3

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.110*	0.036	0.000	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.516*	0.033	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.479*	0.028	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.442*	0.025	0.000	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.404*	0.021	0.000	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.367*	0.018	0.000	0.001	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.330	0.017	0.000	0.000	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.293	0.017	0.000	0.003	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.230	0.018	0.000	0.004	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.159	0.021	0.000	*0.004*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.074	0.019	0.000	*0.004*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.065	0.017	0.000	*0.003*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.057	0.011	0.000	*0.003*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.047	0.007	0.000	*0.003*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.045	0.005	0.000	*0.003*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.040	0.002	0.000	*0.002*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.035	0.002	0.000	*0.002*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.031	0.001	0.000	*0.002*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.027	0.000	0.000	*0.002*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.035	0.000	0.000	*0.001*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.041	0.000	0.000	*0.001*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.044	0.000	0.000	*0.001*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.042	0.000	0.000	*0.001*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.043	0.000	0.000	*0.001*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.044	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.043	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.040	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.038	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.042	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.005*	0.042	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.023*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.140**	**0.010**	**0.000**	**0.001**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.023**	**0.516**	**0.036**	**0.000**	**0.004**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.027**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.030**	**4.207**	**0.299**	**0.000**	**0.042**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.4. Summary of Daily Discharge [Q] at Hydrometric Station PL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.504*	3.265	0.383	0.075	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*19.883*	3.081	0.377	0.002	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*19.151*	2.919	0.371	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*18.418*	2.721	0.366	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*17.685*	2.528	0.356	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	16.953	2.381	0.328	0.000	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	16.220	2.228	0.312	0.080	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	14.867	2.084	0.289	0.071	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	13.322	1.971	0.292	*0.062*	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	11.869	1.929	0.295	*0.053*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	10.625	1.760	0.325	*0.044*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	9.539	1.700	0.337	*0.035*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	8.605	1.528	0.319	*0.026*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.828	1.374	0.274	*0.017*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.211	1.266	0.207	*0.009*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.651	1.179	0.186	*0.000*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.153	1.114	0.164	*0.000*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.741	1.062	0.156	*0.000*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.438	0.930	0.161	*0.000*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.331	0.756	0.160	*0.000*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.211	0.721	0.136	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.956	0.694	0.111	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.686	0.599	0.094	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.530	0.516	0.083	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.396	0.547	0.072	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.170	0.480	0.030	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.960	0.440	0.068	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	3.752	0.415	0.100	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.005*	3.622	0.404	0.085	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.040*	3.485	0.396	0.078	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.315*		0.388	0.045		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.012**	**8.892**	**1.399**	**0.212**	**0.016**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.315**	**19.883**	**3.265**	**0.383**	**0.080**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**2.504**	**0.388**	**0.030**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.361**	**266.762**	**43.378**	**6.561**	**0.475**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.5. Summary of Daily Discharge [Q] at Hydrometric Station PL-H2

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.664*	0.960	0.053	0.103	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*4.224*	0.857	0.050	0.084	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*4.098*	0.799	0.048	0.084	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.973*	0.742	0.044	0.086	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.848*	0.692	0.008	0.089	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.722*	0.656	0.000	0.113	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.597*	0.601	0.000	0.129	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.472*	0.559	0.026	0.134	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.346*	0.486	0.000	0.134	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.221*	0.510	0.001	0.133	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*3.095*	0.423	0.043	0.108	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.970	0.378	0.062	0.113	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.845	0.323	0.068	*0.147*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.589	0.303	0.059	*0.147*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.320	0.260	0.053	*0.132*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.123	0.217	0.046	*0.117*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.958	0.182	0.056	*0.102*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.824	0.197	0.055	*0.087*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.725	0.153	0.060	*0.072*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.732	0.150	0.075	*0.057*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.683	0.142	0.066	*0.042*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.572	0.138	0.056	*0.027*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.498	0.123	0.050	*0.012*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.425	0.107	0.044	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.342	0.105	0.044	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.236	0.104	0.048	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.153	0.096	0.060	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.085	0.095	0.075	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.003*	1.067	0.081	0.068	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.016*	1.023	0.064	0.071	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.104*		0.056	0.095		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.004**	**2.348**	**0.341**	**0.048**	**0.075**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.104**	**4.224**	**0.960**	**0.095**	**0.147**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.664**	**0.056**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.124**	**70.432**	**10.559**	**1.483**	**2.253**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.6. Summary of Daily Discharge [Q] at Hydrometric Station GI-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.429*	0.515	0.020	0.031	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.541*	0.459	0.021	0.030	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.410*	0.396	0.020	0.030	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.280*	0.353	0.018	0.030	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.150*	0.310	0.022	0.030	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.020*	0.261	0.019	0.030	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.889*	0.231	0.013	0.030	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.759*	0.212	0.011	0.030	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.629	0.166	0.013	0.030	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.499	0.196	0.021	0.030	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.294	0.146	0.032	0.032	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.142	0.137	0.031	0.028	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.051	0.114	0.027	0.031	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.912	0.099	0.031	0.029	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.836	0.079	0.032	*0.026*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.787	0.061	0.032	*0.024*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.753	0.049	0.032	*0.021*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.720	0.068	0.032	*0.019*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.721	0.078	0.032	*0.017*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.724	0.098	0.032	*0.014*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.760	0.034	0.032	*0.012*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.736	0.032	0.032	*0.009*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.703	0.053	0.031	*0.007*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.705	0.023	0.031	*0.004*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.704	0.029	0.031	*0.002*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.642	0.032	0.031	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.602	0.038	0.031	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.572	0.035	0.031	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.573	0.025	0.031	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.012*	0.557	0.021	0.031	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.073*		0.020	0.031		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.003**	**1.137**	**0.141**	**0.027**	**0.019**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.073**	**2.541**	**0.515**	**0.032**	**0.032**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.429**	**0.020**	**0.011**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.087**	**34.098**	**4.370**	**0.834**	**0.577**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.7. Summary of Daily Discharge [Q] at Hydrometric Station EL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.027*	0.002	0.000	0.001	*0.002*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.100*	0.001	0.000	0.004	*0.002*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.090*	0.000	0.000	0.004	*0.001*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.079*	0.000	0.000	0.005	*0.001*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.069*	0.000	0.000	0.005	*0.001*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.058	0.000	0.000	0.004	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.048	0.000	0.000	0.009	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.036	0.000	0.000	*0.009*	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.028	0.000	0.000	*0.008*	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.021	0.000	0.000	*0.008*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.018	0.000	0.000	*0.008*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.016	0.000	0.000	*0.008*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.013	0.000	0.000	*0.007*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.010	0.000	0.000	*0.007*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.009	0.000	0.000	*0.007*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.008	0.000	0.000	*0.006*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.007	0.000	0.000	*0.006*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.006	0.000	0.000	*0.006*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.006	0.000	0.000	*0.005*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.010	0.000	0.000	*0.005*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.011	0.000	0.000	*0.005*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.009	0.000	0.000	*0.005*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.006	0.000	0.000	*0.004*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.005	0.000	0.000	*0.004*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.005	0.000	0.000	*0.004*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.003	0.000	0.000	*0.003*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.002	0.000	0.000	*0.003*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.001	0.000	0.000	*0.003*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.003	0.000	0.000	*0.002*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.002*	0.004	0.000	0.000	*0.002*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.007*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.023**	**0.000**	**0.000**	**0.005**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.007**	**0.100**	**0.002**	**0.000**	**0.009**	**0.002**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.000**	**0.000**	**0.001**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.010**	**0.703**	**0.003**	**0.000**	**0.156**	**0.006**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.8. Summary of Daily Discharge [Q] at Hydrometric Station WL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.359*	0.220	0.006	0.017	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*2.063*	0.215	0.005	0.016	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.986*	0.208	0.003	0.019	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.908*	0.202	0.001	0.020	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.831*	0.197	0.001	0.019	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.753*	0.193	0.000	0.020	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.676	0.187	0.000	0.055	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.598	0.180	0.000	0.049	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.504	0.167	0.000	0.055	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.409	0.182	0.008	0.054	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.326	0.161	0.016	0.053	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.247	0.144	0.012	0.043	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.167	0.113	0.009	0.052	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.082	0.090	0.009	0.045	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.002	0.077	0.007	*0.038*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.917	0.071	0.006	*0.032*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.822	0.073	0.007	*0.025*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.729	0.077	0.008	*0.018*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.652	0.060	0.009	*0.012*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.657	0.043	0.010	*0.005*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.584	0.029	0.008	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.486	0.028	0.007	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.433	0.027	0.006	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.402	0.016	0.006	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.356	0.022	0.006	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.302	0.019	0.006	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.250	0.019	0.013	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.225	0.014	0.014	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.231	0.010	0.012	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.011*	0.225	0.008	0.017	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.063*		0.007	0.015		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.002**	**0.973**	**0.099**	**0.007**	**0.021**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.063**	**2.063**	**0.220**	**0.017**	**0.055**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.225**	**0.007**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.076**	**29.181**	**3.060**	**0.229**	**0.644**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.9. Summary of Daily Discharge [Q] at Hydrometric Station REFB-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.067*	0.002	0.000	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.292*	0.001	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.272*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.251*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.231*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.211*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.190*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.170*	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.150	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.129	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.107	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.083	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.065	0.000	0.000	0.000	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.050	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.033	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.026	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.019	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.015	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.014	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.013	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.014	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.010	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.008	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.007	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.006	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.004	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.003	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.003	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.003	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.004*	0.003	0.000	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.015*		0.000	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.082**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.015**	**0.292**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.003**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.020**	**2.450**	**0.003**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.10. Summary of Daily Discharge [Q] at Hydrometric Station BL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.026*	0.009	0.000	0.006	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.095*	0.007	0.000	0.006	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.090*	0.006	0.000	0.006	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.085*	0.005	0.000	0.006	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.080*	0.004	0.000	0.007	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.075*	0.003	0.000	0.007	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.070*	0.004	0.000	0.010	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.065*	0.004	0.000	0.011	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.060*	0.003	0.000	0.012	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.055*	0.006	0.000	0.011	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.050*	0.005	0.001	*0.011*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.045	0.006	0.002	*0.010*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.040	0.004	0.003	*0.009*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.033	0.003	0.002	*0.008*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.029	0.002	0.003	*0.008*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.026	0.002	0.002	*0.007*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.023	0.002	0.003	*0.006*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.022	0.002	0.003	*0.006*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.022	0.002	0.003	*0.005*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.024	0.001	0.003	*0.004*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.022	0.001	0.003	*0.004*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.019	0.000	0.003	*0.003*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.016	0.000	0.003	*0.002*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.016	0.000	0.003	*0.002*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.014	0.000	0.003	*0.001*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.012	0.001	0.003	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.010	0.001	0.005	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.009	0.001	0.006	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.012	0.000	0.006	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.002*	0.011	0.000	0.007	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.007*		0.000	0.007		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.039**	**0.003**	**0.002**	**0.006**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.007**	**0.095**	**0.009**	**0.007**	**0.012**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.009**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.010**	**1.157**	**0.085**	**0.073**	**0.169**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.11. Summary of Daily Discharge [Q] at Hydrometric Station BL-H2

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.012*	1.776	0.281	0.254	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.028*	1.648	0.280	0.205	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.062*	1.523	0.251	0.226	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.138*	1.453	0.227	0.252	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.307*	1.368	0.316	0.246	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.686*	1.259	0.264	0.204	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.531*	1.188	0.206	0.163	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.632	1.151	0.190	0.121	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	9.568	1.089	0.209	0.079	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	7.694	1.217	0.279	*0.038*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	6.544	1.115	0.314	*0.000*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.486	1.019	0.292	*0.000*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	5.012	0.988	0.254	*0.000*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.843	0.928	0.307	*0.000*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	4.185	0.821	0.260	*0.000*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.724	0.722	0.204	*0.000*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.446	0.646	0.205	*0.000*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.176	0.758	0.221	*0.000*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	3.067	0.841	0.237	*0.000*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.825	0.820	0.306	*0.000*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.770	0.485	0.258	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.656	0.465	0.231	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.510	0.595	0.202	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.385	0.362	0.189	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.252	0.451	0.184	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	2.064	0.445	0.176	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.960	0.517	0.201	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	1.890	0.437	0.275	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	1.879	0.351	0.251	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.002*	1.848	0.313	0.347	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.006*		0.289	0.242		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**3.073**	**0.872**	**0.247**	**0.060**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.006**	**9.568**	**1.776**	**0.347**	**0.254**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.012**	**0.289**	**0.176**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.010**	**92.183**	**27.040**	**7.656**	**1.788**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.12. Summary of Daily Discharge [Q] at Hydrometric Station BL-H3

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.288*	0.087	0.000	0.066	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.595*	0.070	0.000	0.064	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.478*	0.055	0.000	0.061	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.361*	0.046	0.000	0.059	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.244*	0.038	0.000	0.059	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.128*	0.032	0.000	0.057	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.011*	0.026	0.000	0.084	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.894	0.024	0.000	0.094	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.777	0.025	0.000	0.095	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.608	0.055	0.025	*0.094*	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.488	0.049	0.029	*0.089*	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.401	0.042	0.029	*0.083*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.341	0.033	0.025	*0.077*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.294	0.028	0.024	*0.072*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.257	0.023	0.025	*0.066*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.227	0.014	0.027	*0.061*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.204	0.011	0.035	*0.055*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.184	0.023	0.040	*0.049*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.176	0.011	0.040	*0.044*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.188	0.002	0.040	*0.038*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.184	0.000	0.042	*0.033*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.167	0.000	0.040	*0.027*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.147	0.000	0.038	*0.021*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.138	0.000	0.037	*0.016*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.128	0.000	0.037	*0.010*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.111	0.000	0.036	*0.005*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.095	0.000	0.061	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.083	0.000	0.067	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.103	0.000	0.064	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.009*	0.107	0.000	0.072	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.052*		0.000	0.068		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.002**	**0.480**	**0.022**	**0.029**	**0.049**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.052**	**1.595**	**0.087**	**0.072**	**0.095**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.083**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.064**	**14.406**	**0.695**	**0.898**	**1.478**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.13. Summary of Daily Discharge [Q] at Hydrometric Station REFC-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.095*	0.069	0.002	0.000	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.440*	0.065	0.000	0.000	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.418*	0.060	0.000	0.000	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.396*	0.057	0.000	0.000	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.374*	0.053	0.000	0.000	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.352*	0.048	0.000	0.000	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.330*	0.045	0.000	0.000	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.308*	0.042	0.000	0.000	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.286*	0.039	0.000	0.000	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.264*	0.041	0.000	0.000	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.242	0.039	0.000	0.000	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.220	0.042	0.000	*0.000*	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.192	0.039	0.000	*0.000*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.171	0.036	0.000	*0.000*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.156	0.032	0.000	*0.000*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.144	0.028	0.000	*0.000*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.132	0.024	0.000	*0.000*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.122	0.025	0.000	*0.000*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.117	0.024	0.000	*0.000*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.115	0.021	0.000	*0.000*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.112	0.016	0.000	*0.000*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.107	0.015	0.000	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.100	0.015	0.000	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.099	0.009	0.000	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.095	0.008	0.000	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.090	0.008	0.000	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.085	0.008	0.000	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.081	0.006	0.000	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.077	0.005	0.000	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.005*	0.074	0.004	0.000	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.021*		0.003	0.000		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.193**	**0.030**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.021**	**0.440**	**0.069**	**0.002**	**0.000**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.074**	**0.003**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.026**	**5.795**	**0.924**	**0.004**	**0.000**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.14. Summary of Daily Discharge [Q] at Hydrometric Station KL-H1

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.310*	0.452	0.000	0.102	*0.101*	*0.021*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.740*	0.418	0.000	0.086	*0.098*	*0.018*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.666*	0.387	0.000	0.083	*0.096*	*0.016*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.592*	0.360	0.000	0.085	*0.093*	*0.013*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.518*	0.337	0.000	0.084	*0.091*	*0.011*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.444*	0.312	0.000	0.077	*0.088*	*0.008*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.370*	0.286	0.000	0.153	*0.085*	*0.006*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.296*	0.266	0.000	0.169	*0.083*	*0.003*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*1.222*	0.250	0.000	0.157	*0.080*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.148	0.264	0.005	0.153	*0.078*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	1.074	0.253	0.047	0.153	*0.075*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.943	0.252	0.056	0.150	*0.073*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.870	0.232	0.053	*0.147*	*0.070*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.819	0.211	0.053	*0.145*	*0.067*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.766	0.190	0.048	*0.142*	*0.065*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.714	0.168	0.006	*0.140*	*0.062*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.675	0.147	0.001	*0.137*	*0.060*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.653	0.147	0.000	*0.135*	*0.057*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.652	0.150	0.033	*0.132*	*0.055*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.674	0.148	0.086	*0.129*	*0.052*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.681	0.116	0.080	*0.127*	*0.049*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.629	0.096	0.069	*0.124*	*0.047*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.601	0.094	0.059	*0.122*	*0.044*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.604	0.070	0.054	*0.119*	*0.042*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.588	0.062	0.053	*0.116*	*0.039*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.557	0.060	0.052	*0.114*	*0.036*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.529	0.069	0.067	*0.111*	*0.034*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.506	0.061	0.100	*0.109*	*0.031*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.002*	0.495	0.043	0.103	*0.106*	*0.029*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.010*	0.483	0.000	0.124	*0.104*	*0.026*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.055*		0.000	0.110		*0.024*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.002**	**0.894**	**0.190**	**0.041**	**0.124**	**0.062**	**0.003**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.055**	**1.740**	**0.452**	**0.124**	**0.169**	**0.101**	**0.021**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.310**	**0.000**	**0.000**	**0.077**	**0.024**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.067**	**26.820**	**5.901**	**1.261**	**3.710**	**1.930**	**0.096**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 4.15. Summary of Daily Discharge [Q] at Hydrometric Station KL-H2

2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.132*	0.245	0.000	0.025	*0.000*	*0.000*	*0.000*
2	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.644*	0.236	0.000	0.022	*0.000*	*0.000*	*0.000*
3	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.618*	0.224	0.000	0.022	*0.000*	*0.000*	*0.000*
4	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.592*	0.214	0.000	0.024	*0.000*	*0.000*	*0.000*
5	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.567*	0.201	0.021	0.023	*0.000*	*0.000*	*0.000*
6	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.541*	0.189	0.025	0.018	*0.000*	*0.000*	*0.000*
7	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.515*	0.177	0.019	0.037	*0.000*	*0.000*	*0.000*
8	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.489*	0.169	0.014	0.040	*0.000*	*0.000*	*0.000*
9	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.464*	0.162	0.022	0.042	*0.000*	*0.000*	*0.000*
10	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.438	0.169	0.029	0.045	*0.000*	*0.000*	*0.000*
11	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.412	0.160	0.027	0.052	*0.000*	*0.000*	*0.000*
12	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.373	0.168	0.026	0.047	*0.000*	*0.000*	*0.000*
13	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.353	0.159	0.023	*0.041*	*0.000*	*0.000*	*0.000*
14	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.336	0.144	0.025	*0.036*	*0.000*	*0.000*	*0.000*
15	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.313	0.131	0.019	*0.031*	*0.000*	*0.000*	*0.000*
16	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.294	0.119	0.017	*0.026*	*0.000*	*0.000*	*0.000*
17	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.285	0.113	0.017	*0.021*	*0.000*	*0.000*	*0.000*
18	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.279	0.104	0.018	*0.016*	*0.000*	*0.000*	*0.000*
19	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.291	0.102	0.022	*0.011*	*0.000*	*0.000*	*0.000*
20	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.289	0.095	0.027	*0.006*	*0.000*	*0.000*	*0.000*
21	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.297	0.073	0.027	*0.001*	*0.000*	*0.000*	*0.000*
22	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.290	0.063	0.025	*0.000*	*0.000*	*0.000*	*0.000*
23	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.284	0.061	0.024	*0.000*	*0.000*	*0.000*	*0.000*
24	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.285	0.044	0.023	*0.000*	*0.000*	*0.000*	*0.000*
25	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.286	0.045	0.022	*0.000*	*0.000*	*0.000*	*0.000*
26	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.281	0.036	0.021	*0.000*	*0.000*	*0.000*	*0.000*
27	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.275	0.036	0.026	*0.000*	*0.000*	*0.000*	*0.000*
28	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	0.267	0.028	0.030	*0.000*	*0.000*	*0.000*	*0.000*
29	*0.000*	*0.000*	*0.000*	*0.000*	*0.001*	0.262	0.021	0.032	*0.000*	*0.000*	*0.000*	*0.000*
30	*0.000*		*0.000*	*0.000*	*0.006*	0.255	0.018	0.038	*0.000*	*0.000*	*0.000*	*0.000*
31	*0.000*		*0.000*		*0.027*		0.010	0.024		*0.000*		*0.000*
Mean	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.367**	**0.120**	**0.021**	**0.020**	**0.000**	**0.000**	**0.000**
Max	**0.000**	**0.000**	**0.000**	**0.000**	**0.027**	**0.644**	**0.245**	**0.038**	**0.052**	**0.000**	**0.000**	**0.000**
Min	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.132**	**0.010**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.034**	**11.006**	**3.716**	**0.645**	**0.587**	**0.000**	**0.000**	**0.000**

1. Estimated values are italicized

2. Values in red denote high uncertainty based on extrapolation of the rating curve beyond 1.5 times the greatest measured discharge

Appendix 5
Annual Hydrographs

Rescan™
Engineers and Scientists

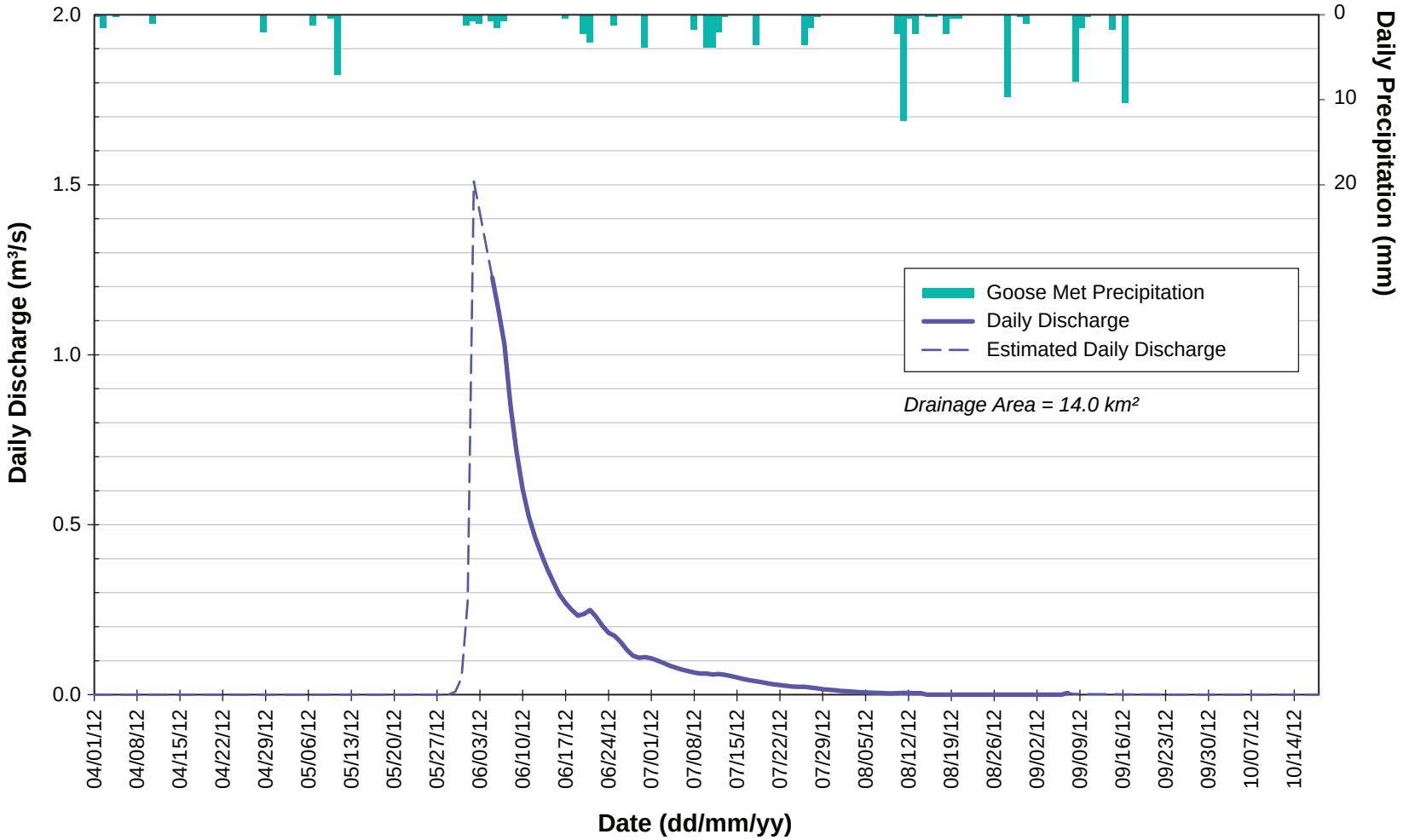


Figure A5-1

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-H1 Hydrometric Monitoring Station, 2012

Figure A5-1

Rescan™ Engineers & Scientists

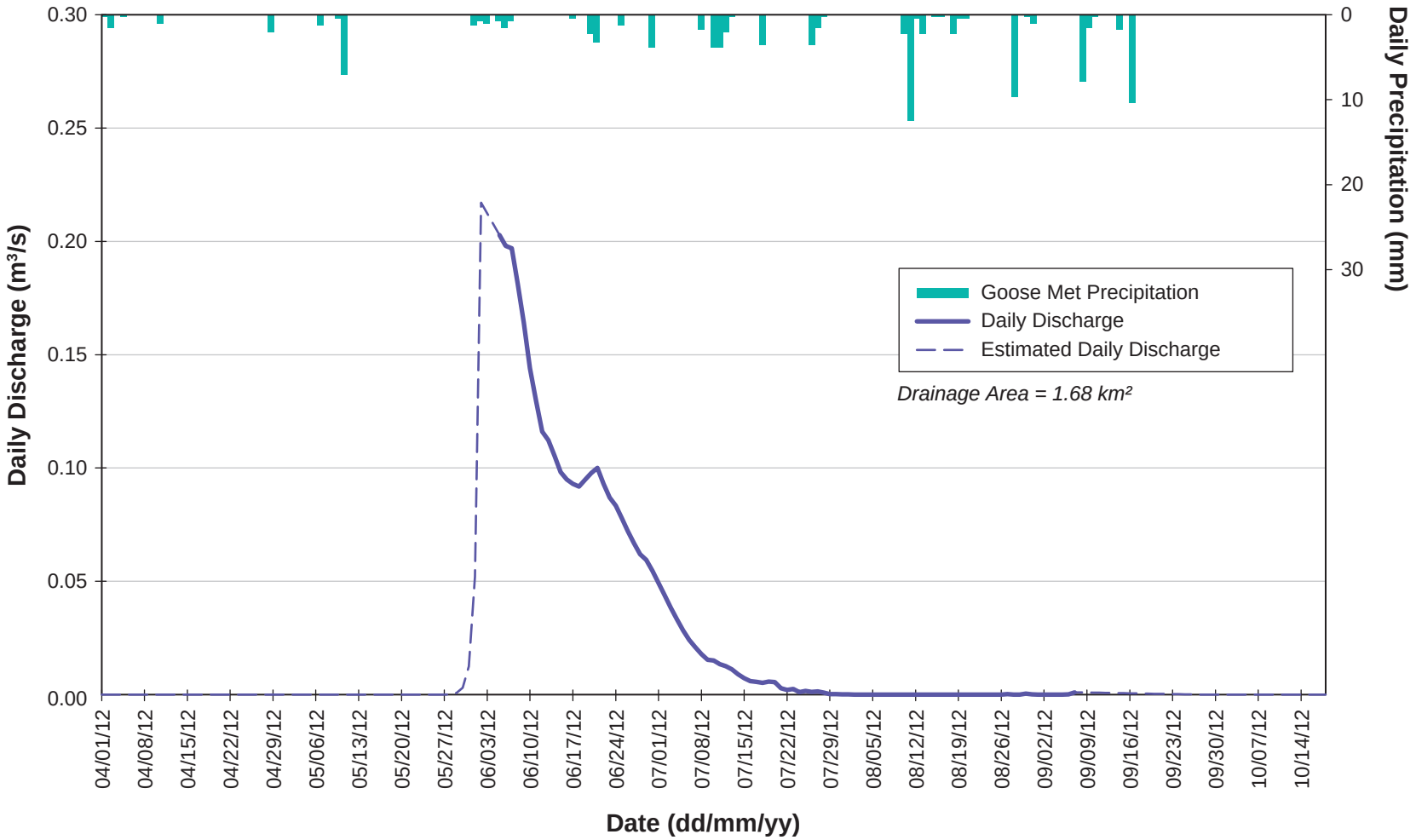


Figure A5-2

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-H2
Hydrometric Monitoring Station, 2012

Figure A5-2

Rescan™ Engineers & Scientists

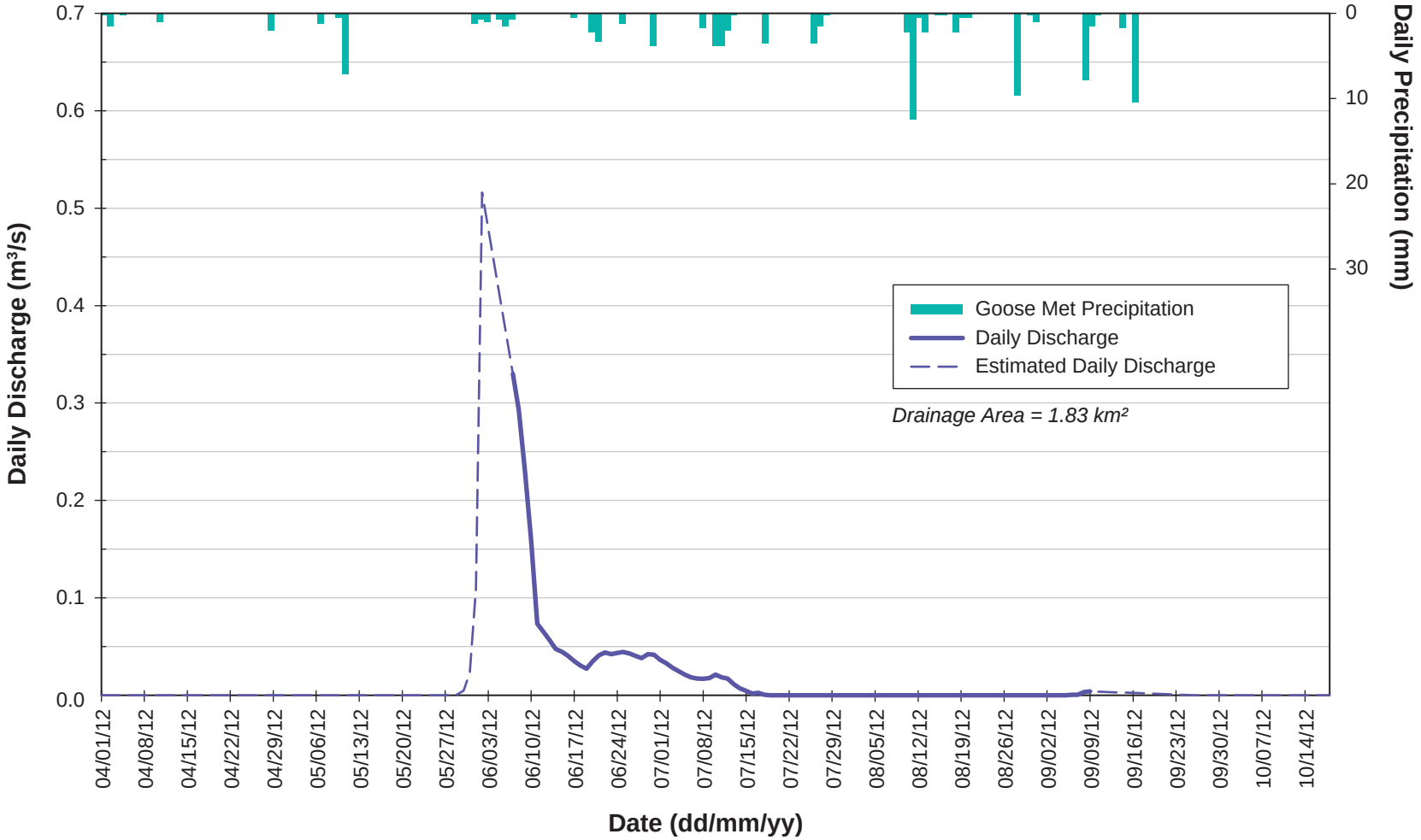


Figure A5-3

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GL-H3 Hydrometric Monitoring Station, 2012

Figure A5-3

Rescan™ Engineers & Scientists

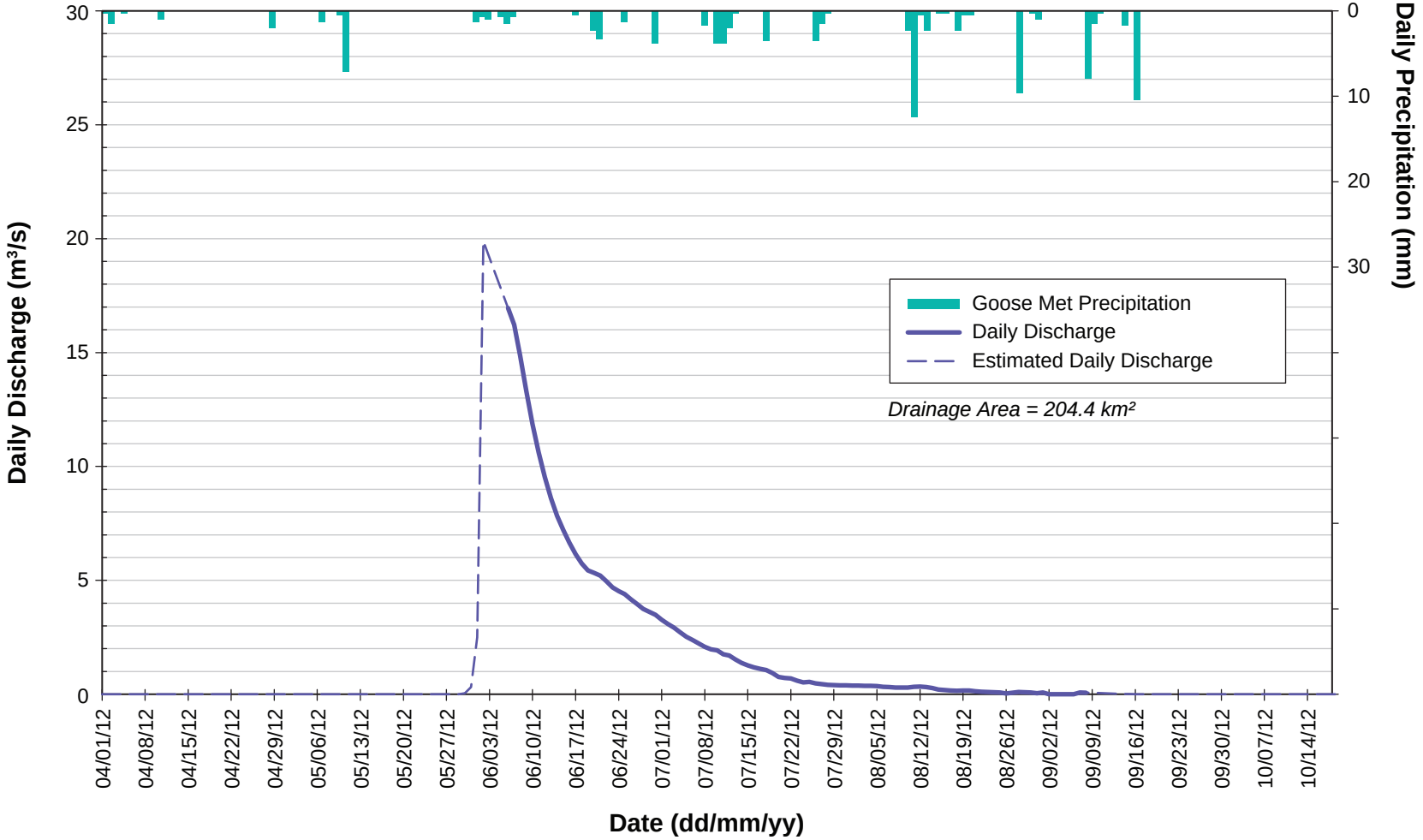


Figure A5-4

Sabina GOLD & SILVER CORP.

Annual Hydrograph at PL-H1
Hydrometric Monitoring Station, 2012

Figure A5-4

Rescan™ Engineers & Scientists

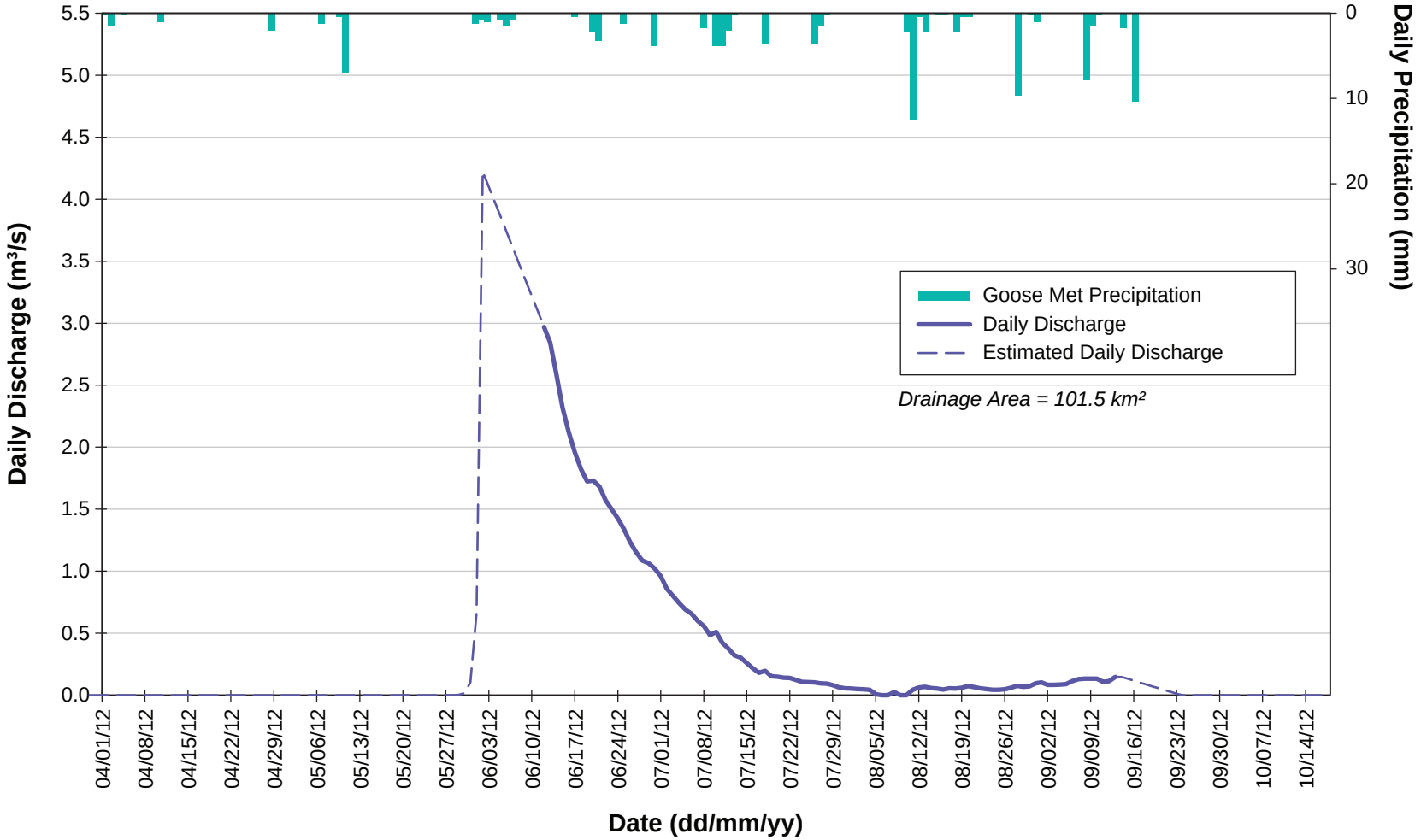


Figure A5-5

Sabina GOLD & SILVER CORP.

Annual Hydrograph at PL-H2
Hydrometric Monitoring Station, 2012

Figure A5-5

Rescan™ Engineers & Scientists

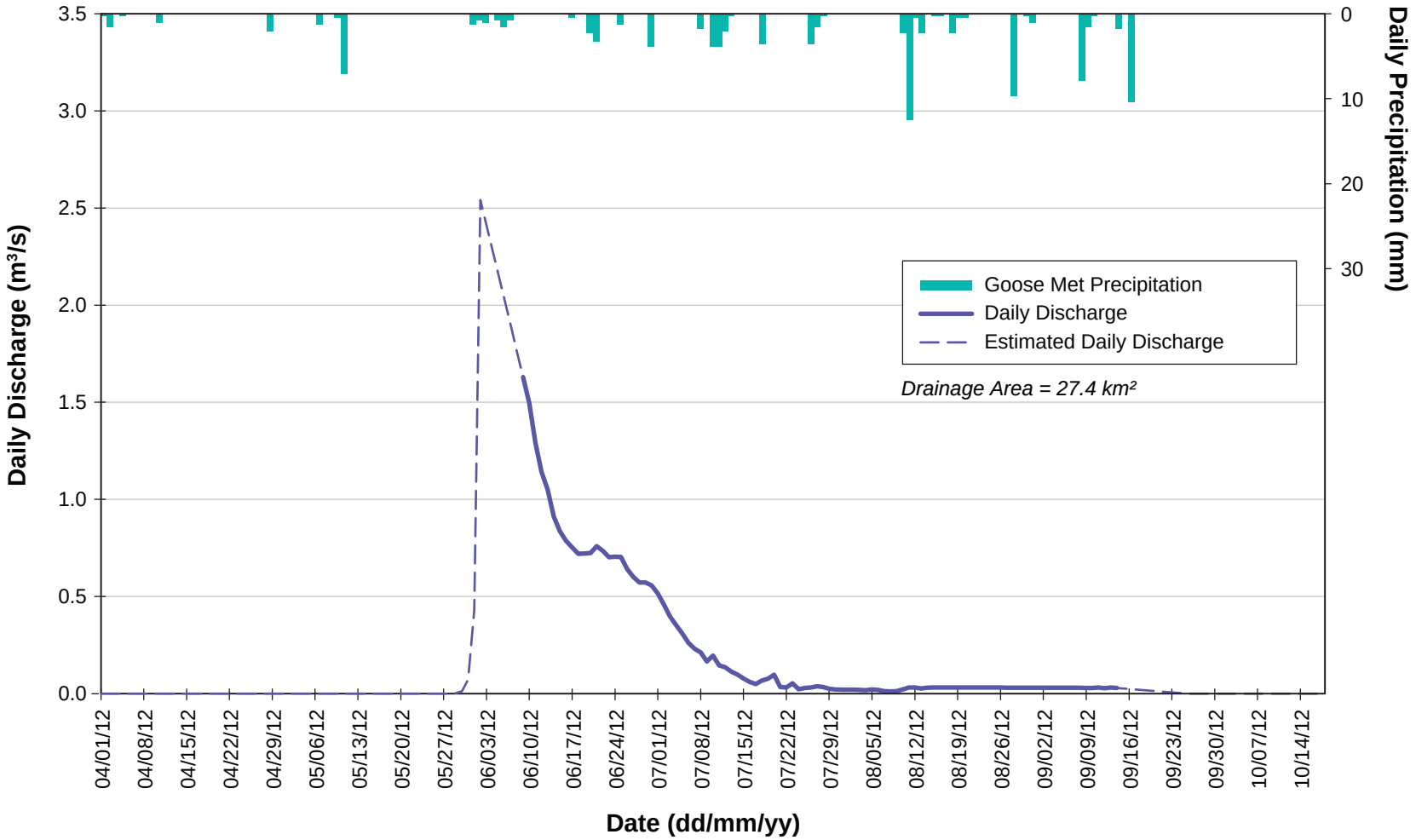


Figure A5-6

Sabina GOLD & SILVER CORP.

Annual Hydrograph at GI-H1 Hydrometric Monitoring Station, 2012

Figure A5-6

Rescan™ Engineers & Scientists

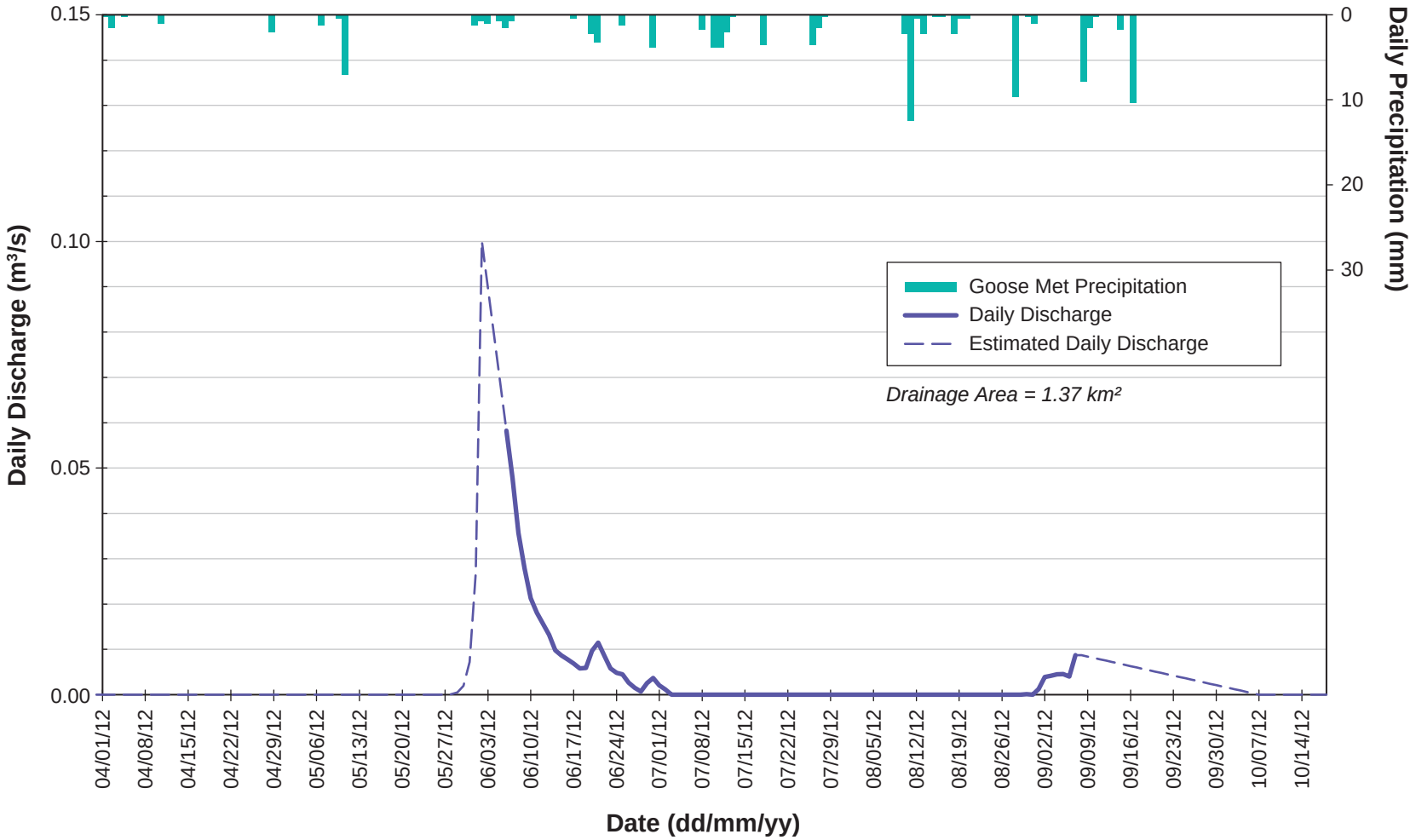


Figure A5-7

Sabina GOLD & SILVER CORP.

Annual Hydrograph at EL-H1 Hydrometric Monitoring Station, 2012

Figure A5-7

Rescan™ Engineers & Scientists

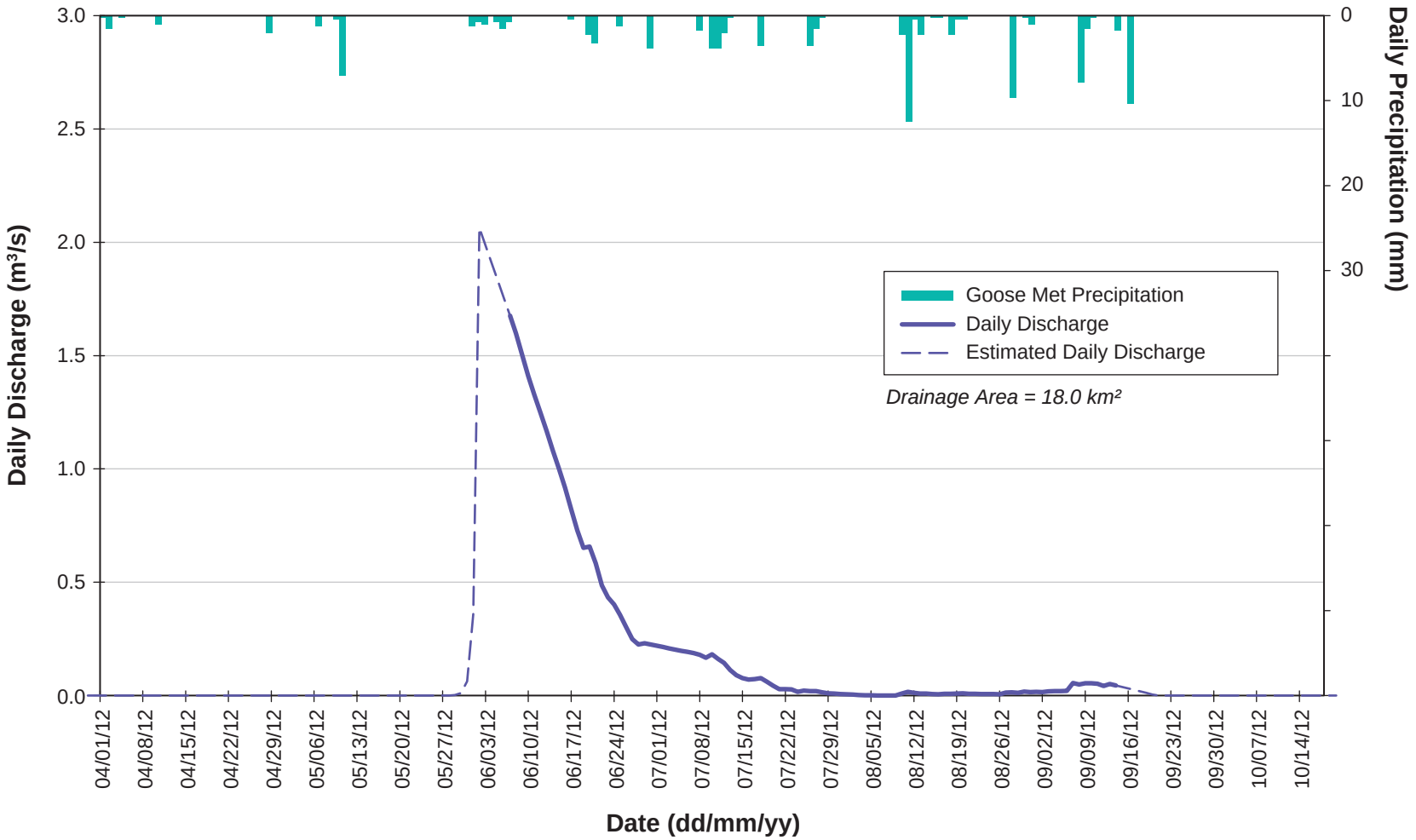


Figure A5-8

Sabina GOLD & SILVER CORP.

Annual Hydrograph at WL-H1
Hydrometric Monitoring Station, 2012

Figure A5-8

Rescan™ Engineers & Scientists

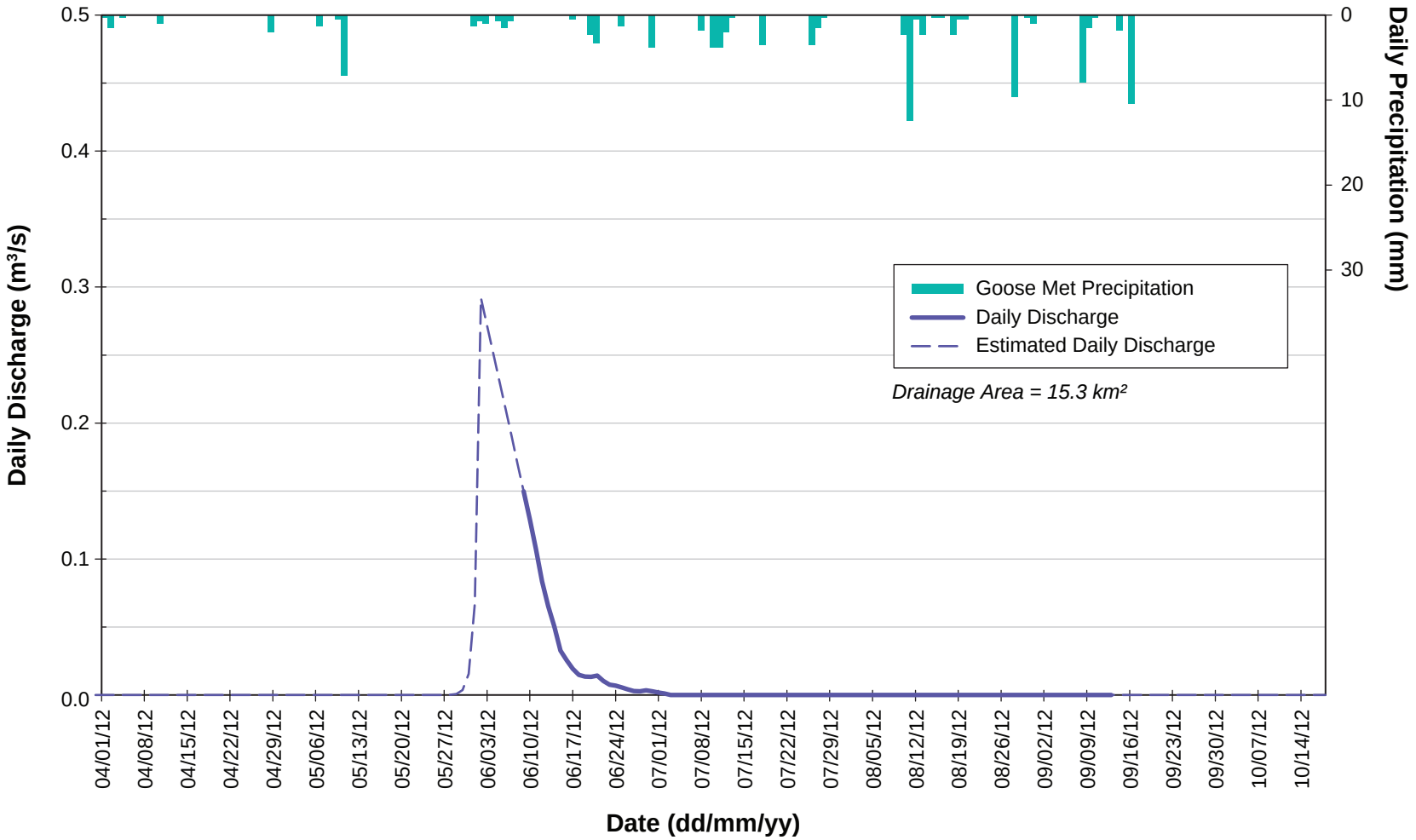


Figure A5-9

Sabina GOLD & SILVER CORP.

Annual Hydrograph at REFB-H1 Hydrometric Monitoring Station, 2012

Figure A5-9

Rescan™ Engineers & Scientists

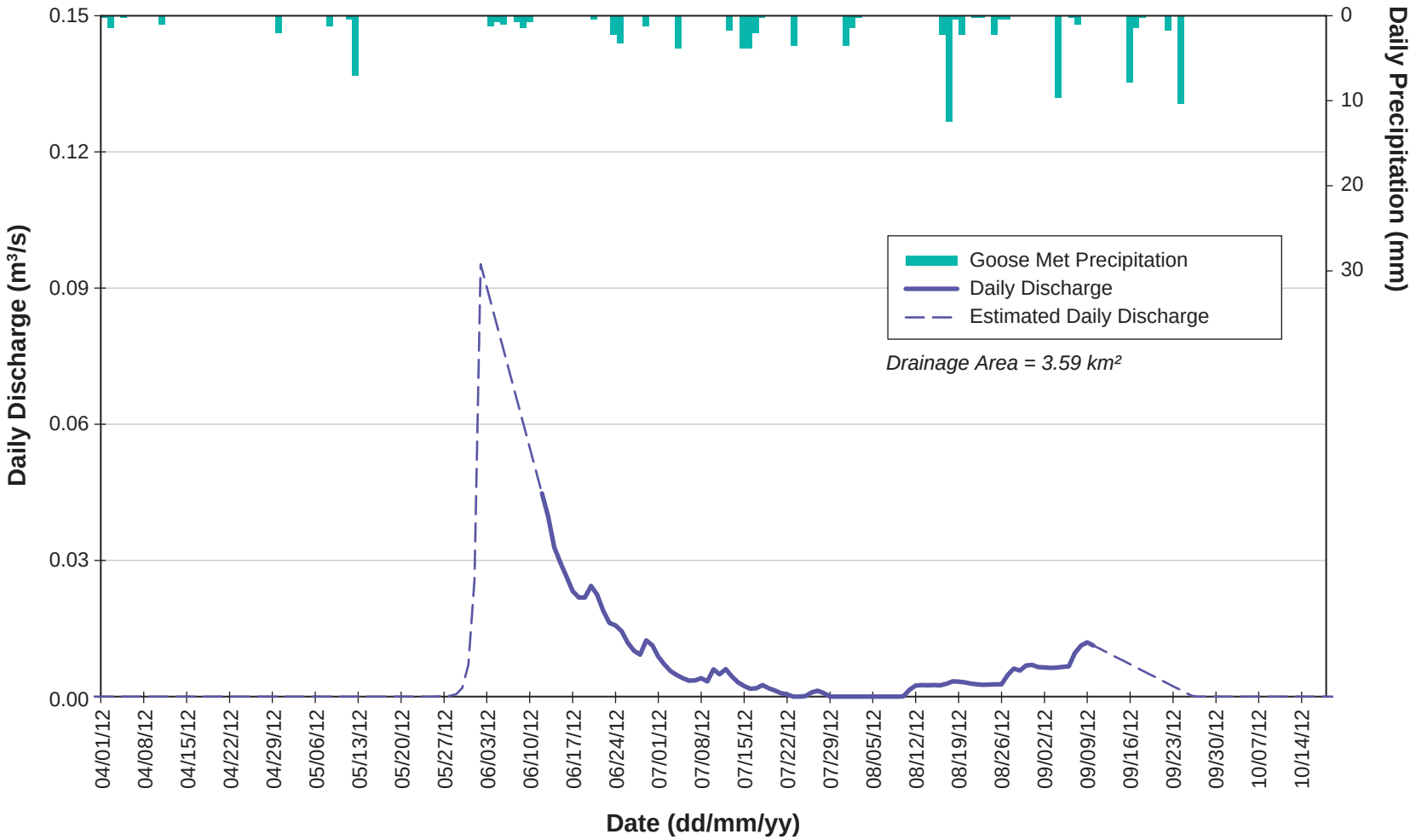


Figure A5-10

Sabina GOLD & SILVER CORP.

Annual Hydrograph at BL-H1
Hydrometric Monitoring Station, 2012

Figure A5-10

Rescan™ Engineers & Scientists

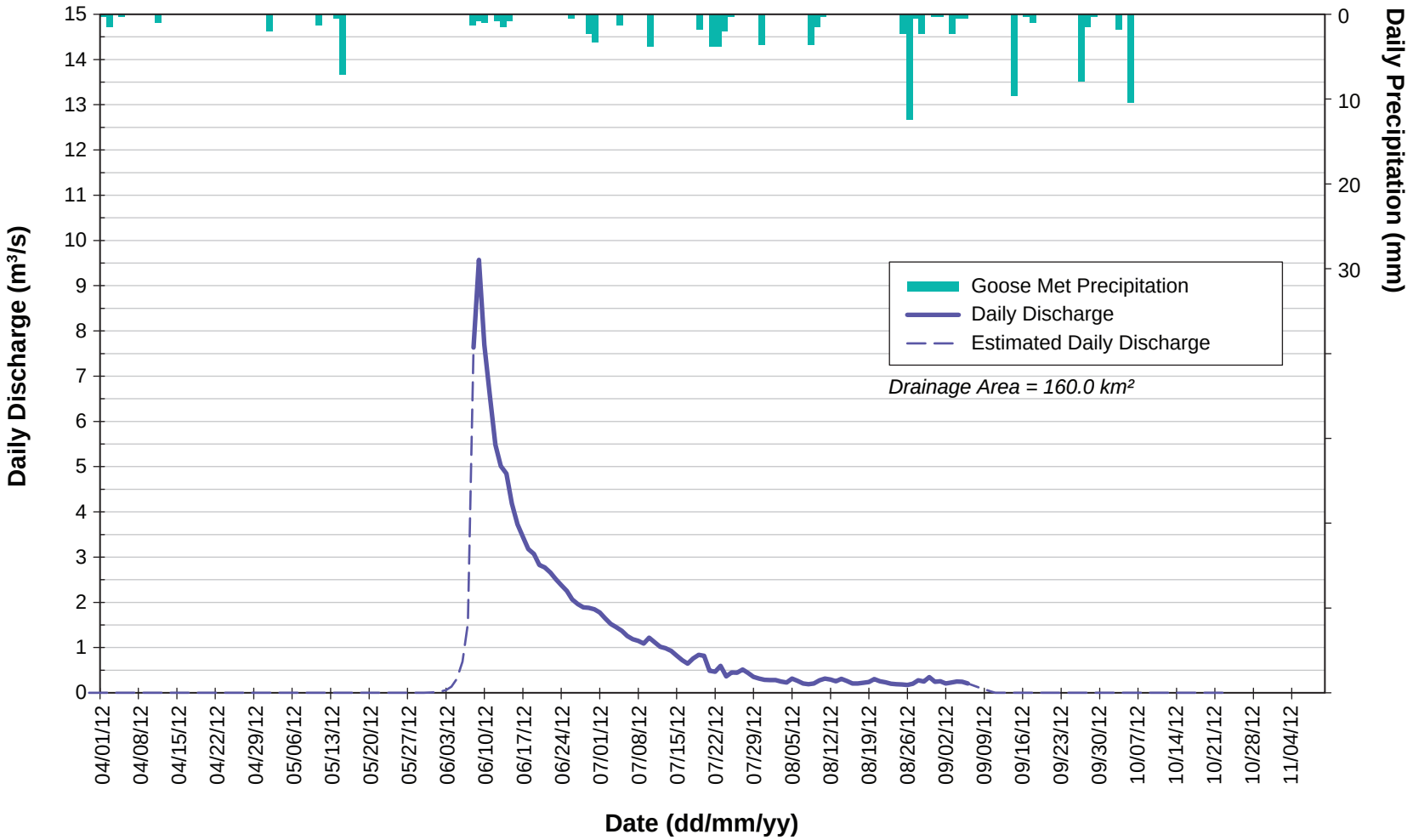


Figure A5-11

Sabina GOLD & SILVER CORP.

Annual Hydrograph at BL-H2
Hydrometric Monitoring Station, 2012

Figure A5-11

Rescan™ Engineers & Scientists

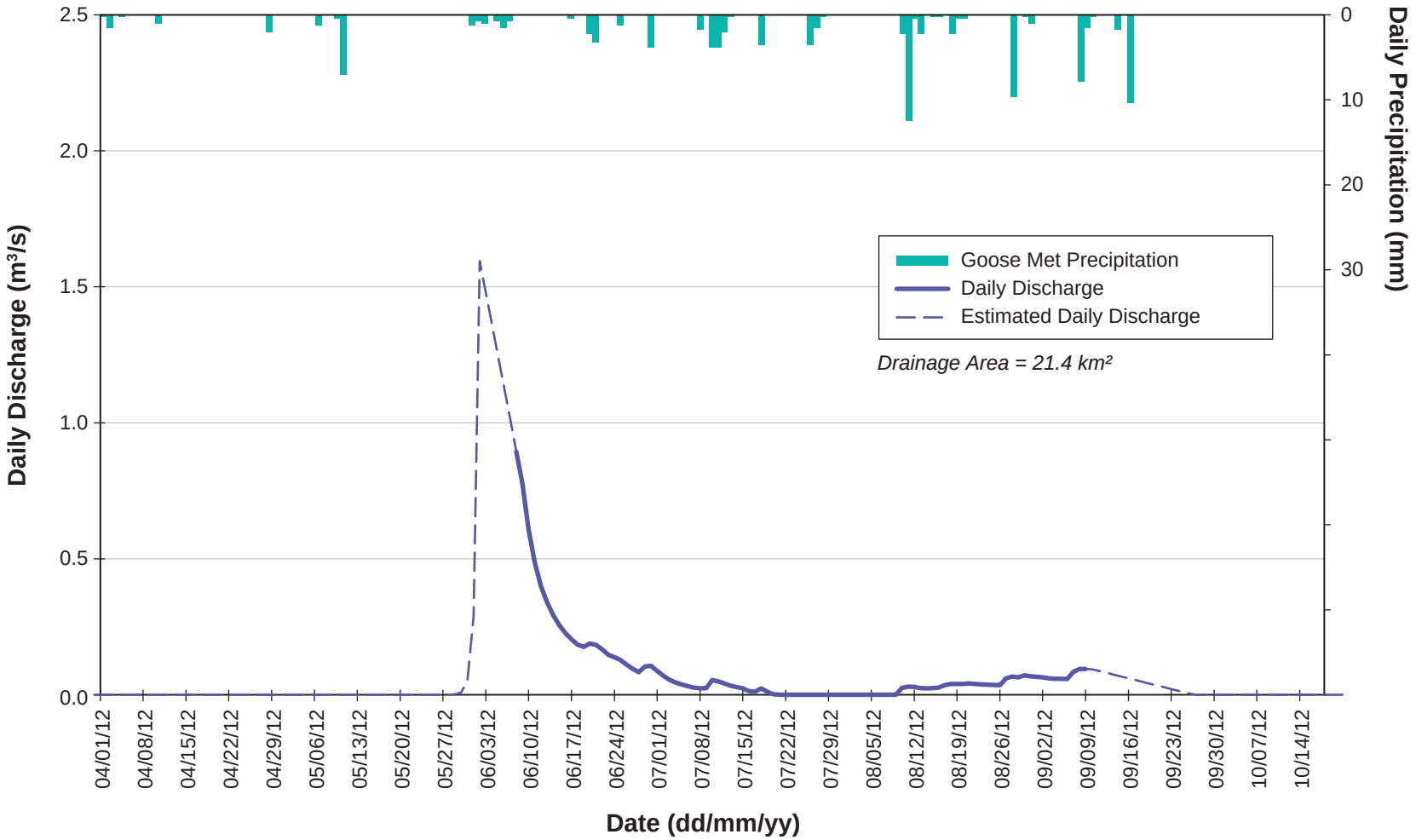


Figure A5-12

Sabina GOLD & SILVER CORP.

Annual Hydrograph at BL-H3
Hydrometric Monitoring Station, 2012

Figure A5-12

Rescan™ Engineers & Scientists

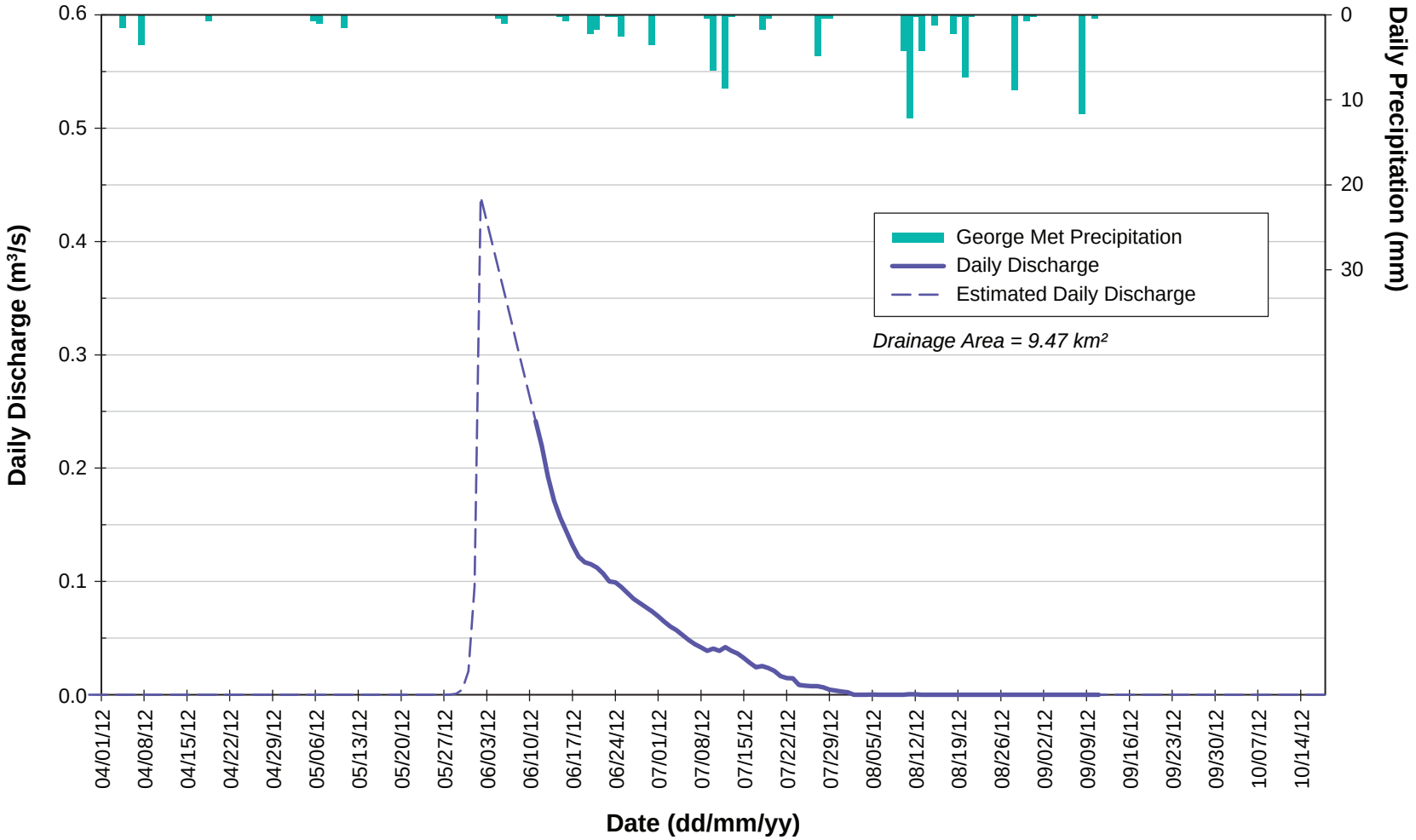


Figure A5-13

Sabina GOLD & SILVER CORP.

Annual Hydrograph at REFC-H1 Hydrometric Monitoring Station, 2012

Figure A5-13

Rescan™ Engineers & Scientists

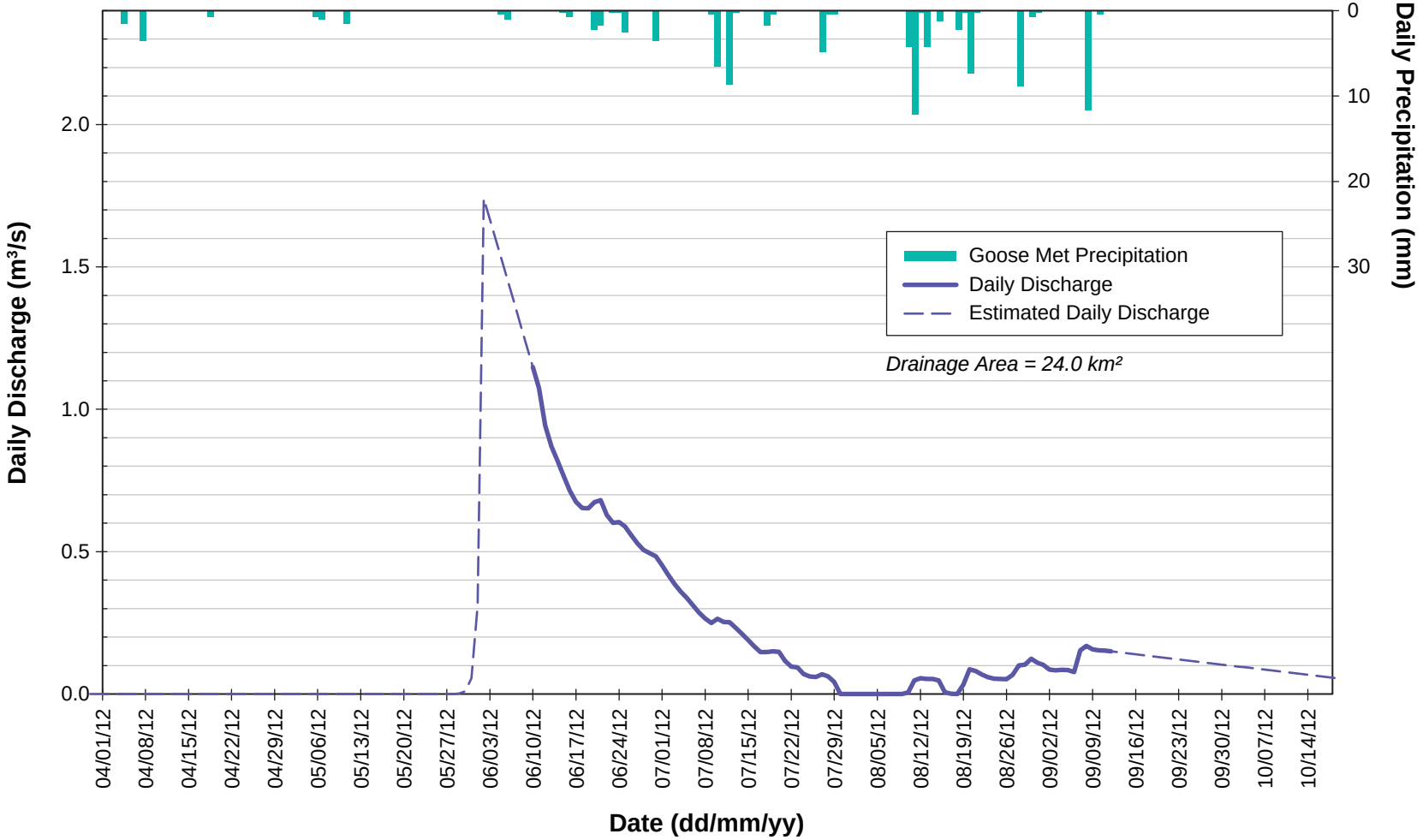


Figure A5-14

Sabina GOLD & SILVER CORP.

Annual Hydrograph at KL-H1 Hydrometric Monitoring Station, 2012

Figure A5-14

Rescan™ Engineers & Scientists

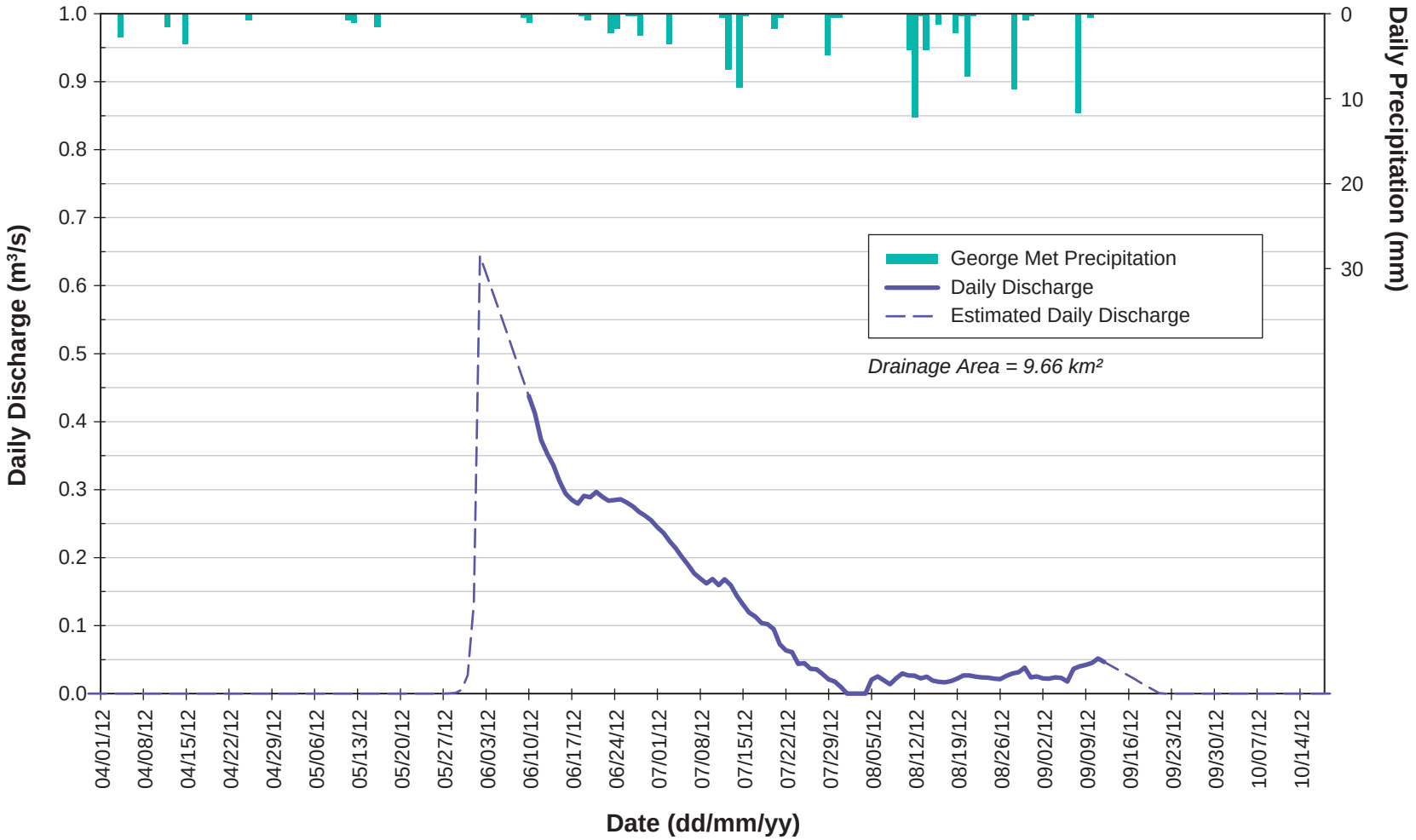


Figure A5-15

Sabina GOLD & SILVER CORP.

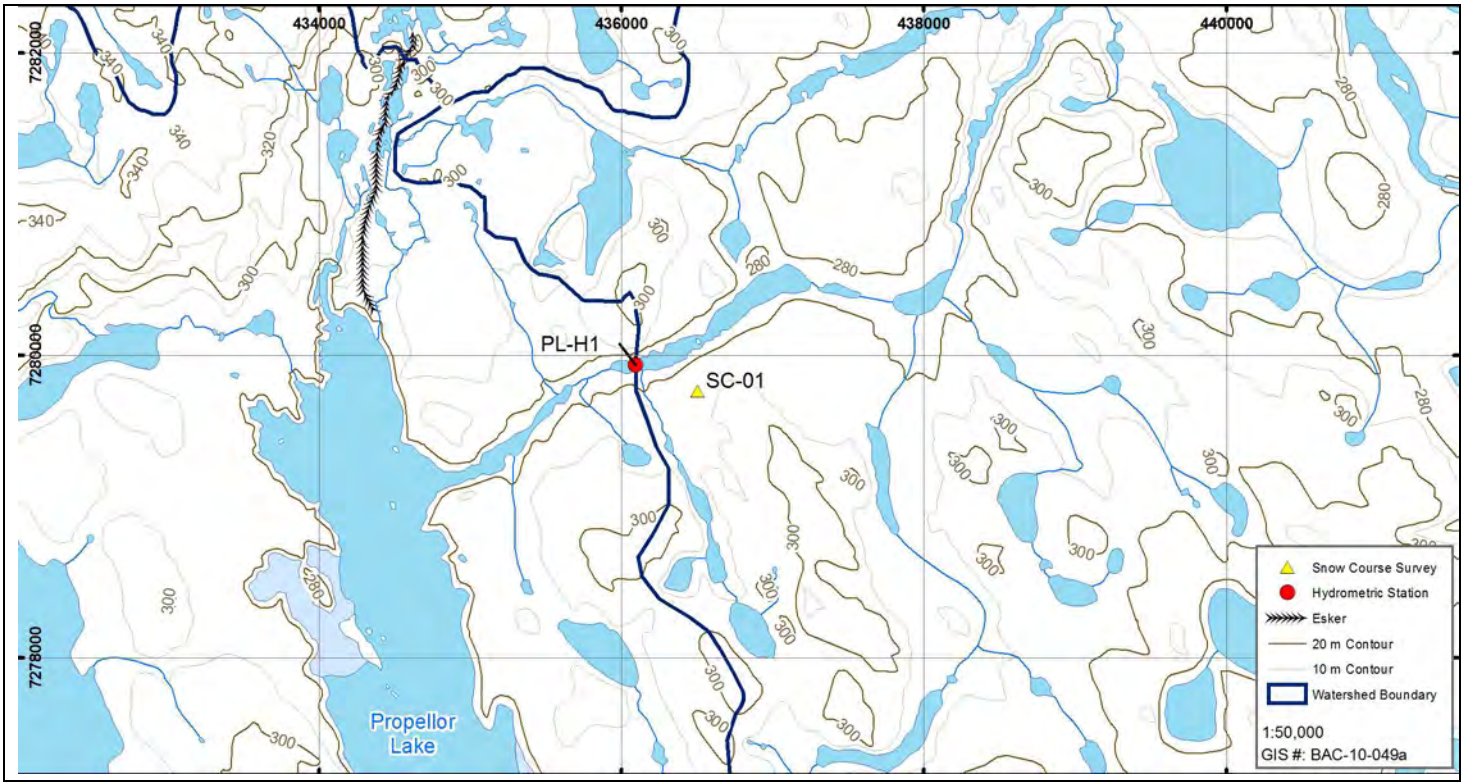
Annual Hydrograph at KL-H2 Hydrometric Monitoring Station, 2012

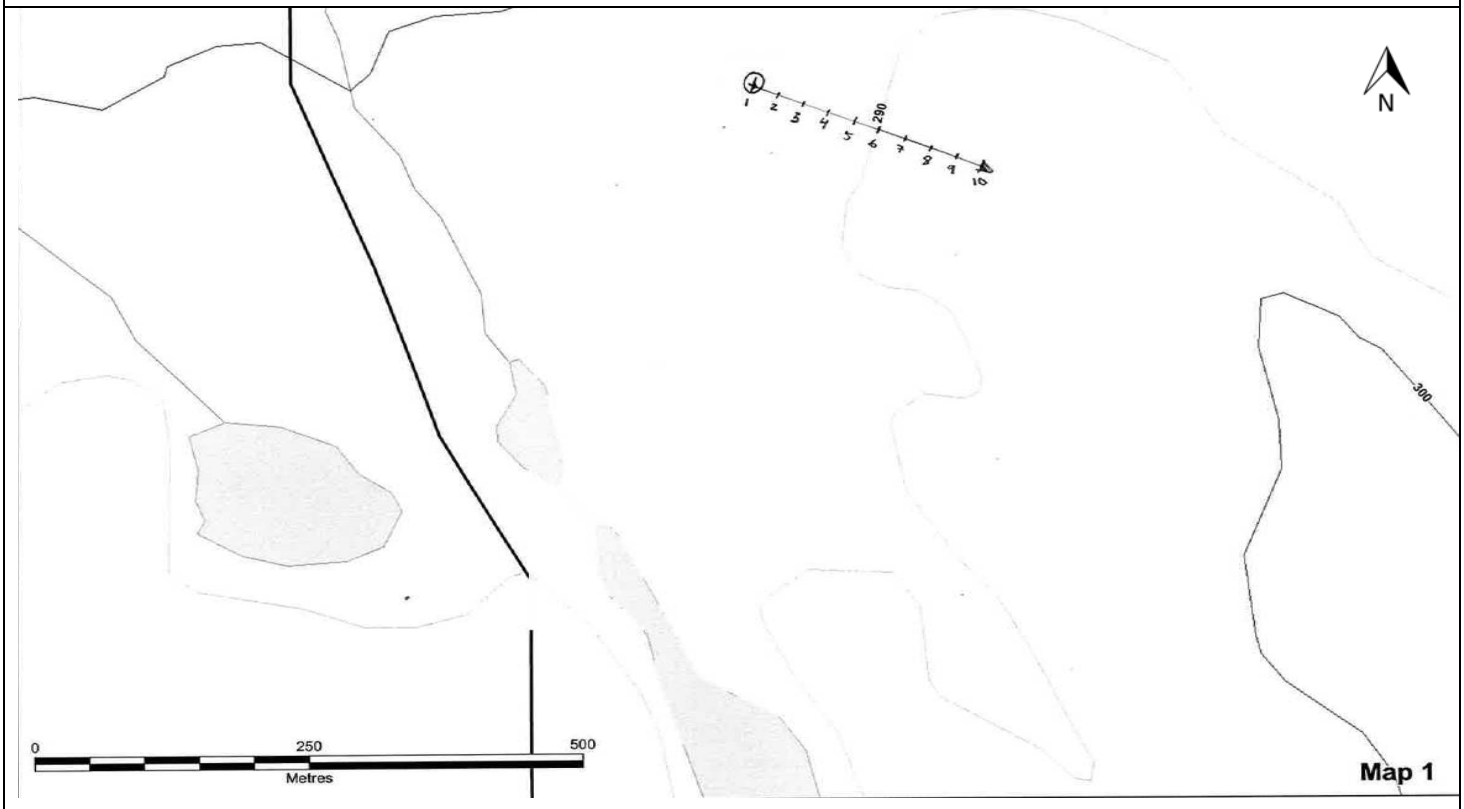
Figure A5-15

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Appendix 6
Snow Course Survey

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Engineers and Scientists





BEARING	110	ASPECT.	WNW
MAP No.	1	DATE SURVEYED	April 25 2012
DATE ESTD.	April 25 2012		
DRAINAGE	Propellor	UTM Zone 13	436502E 7279764N
REMARKS			

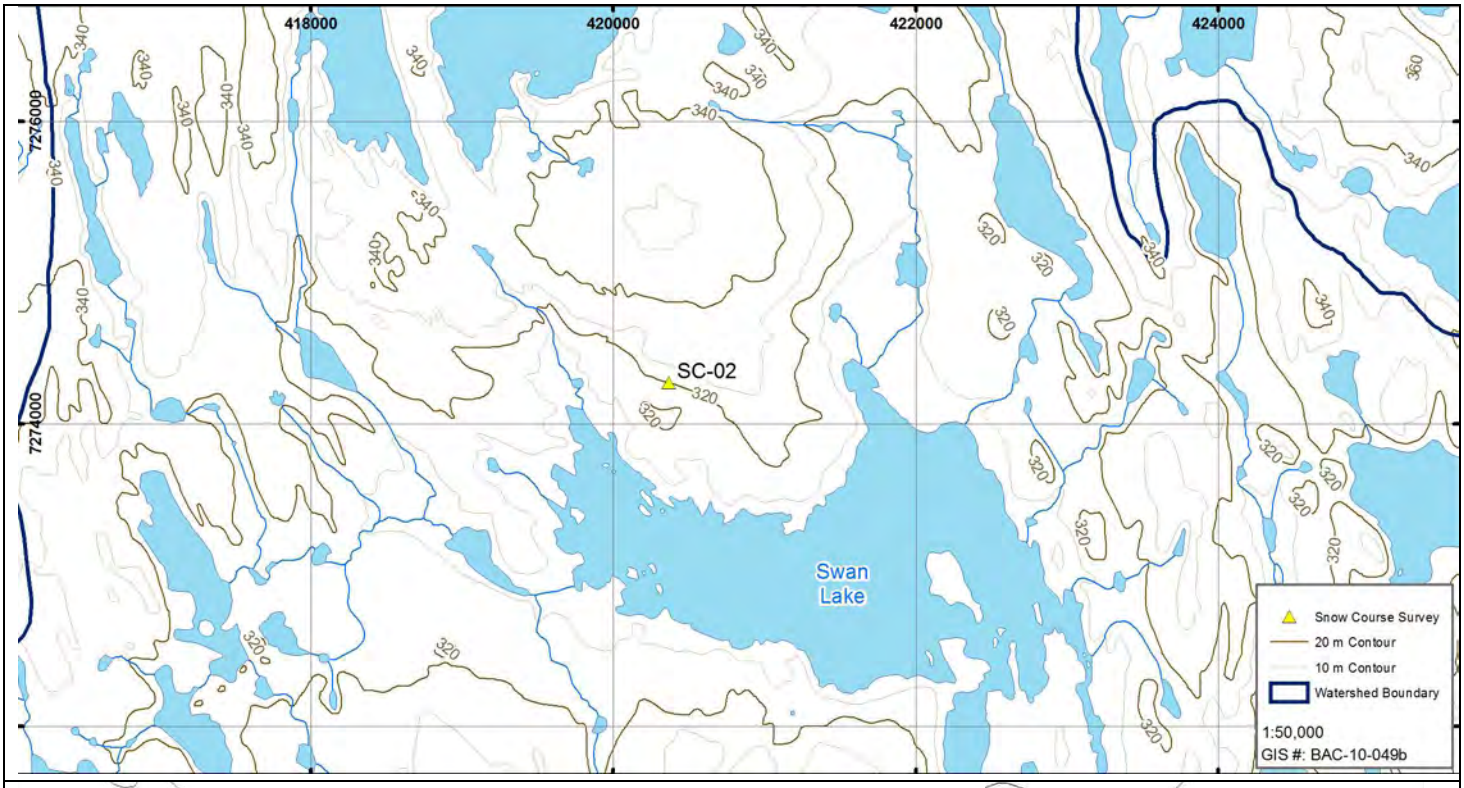
Rescan™

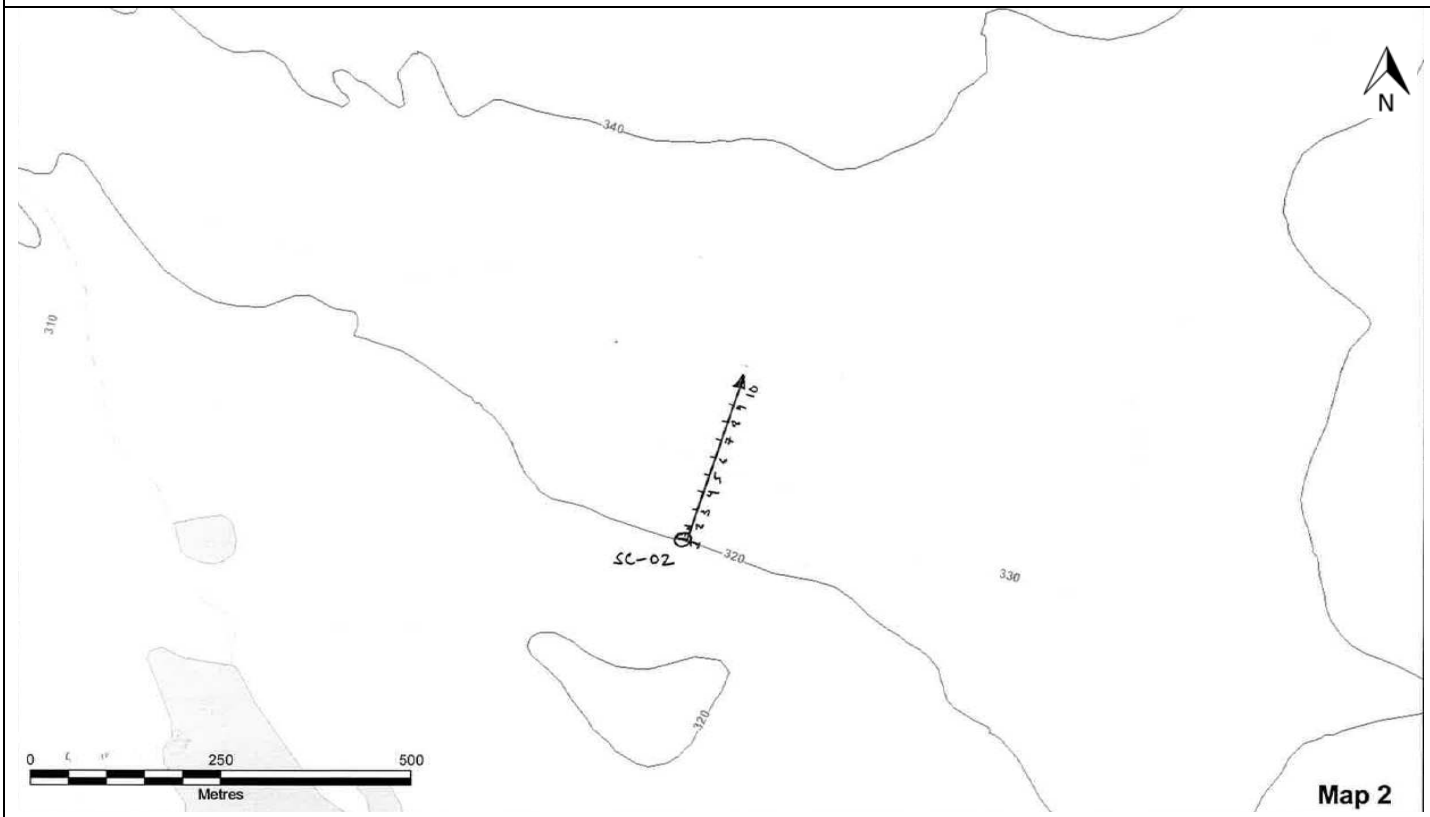
Sabina GOLD & SILVER CORP.

Snow Course: SC-01 Goose Property

Back River

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BEARING	18	ASPECT.	SSW
MAP No.	2	DATE SURVEYED	April 21 2012
DATE ESTD.	April 21 2012		
DRAINAGE	Swan Lake	UTM Zone 13	420367E 7274271N
REMARKS			

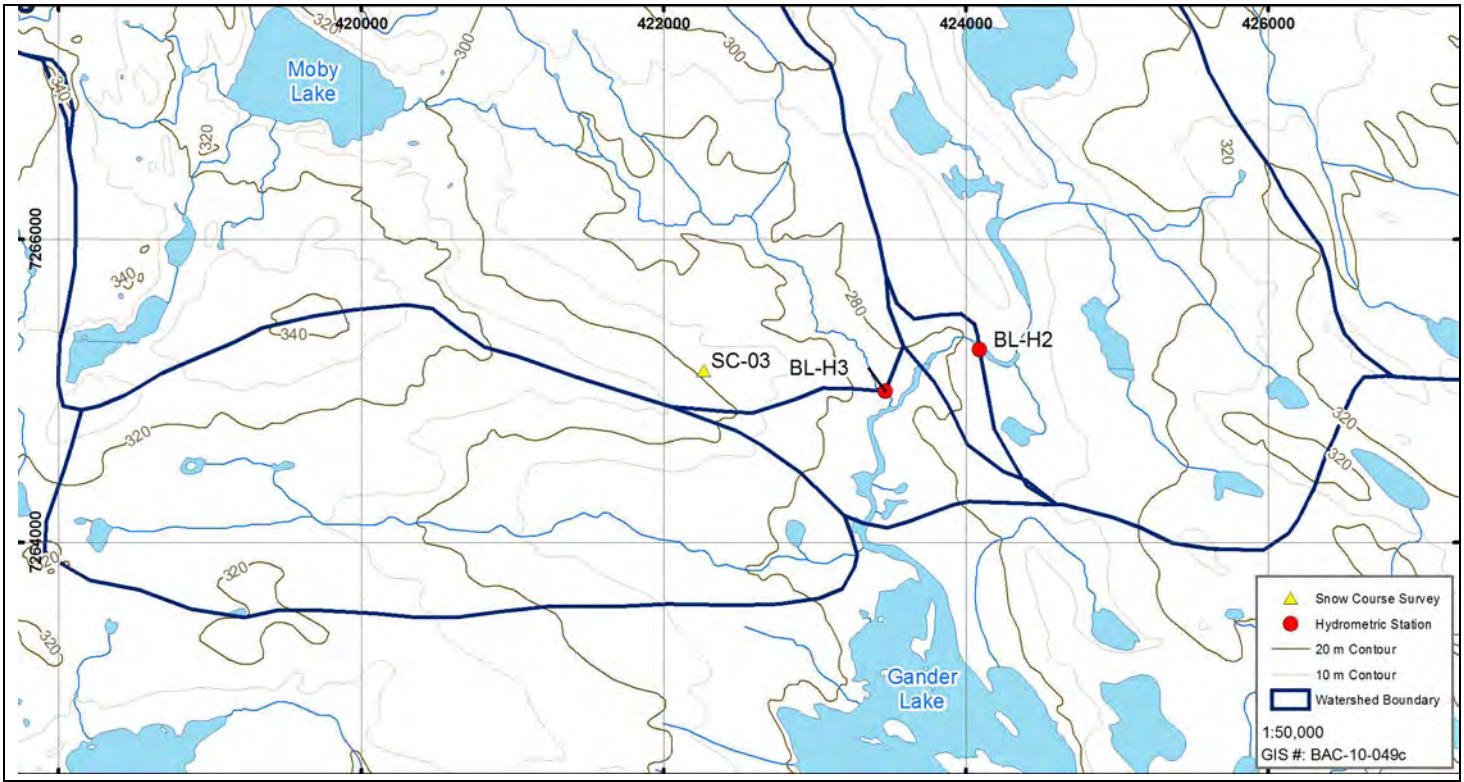
Rescan™

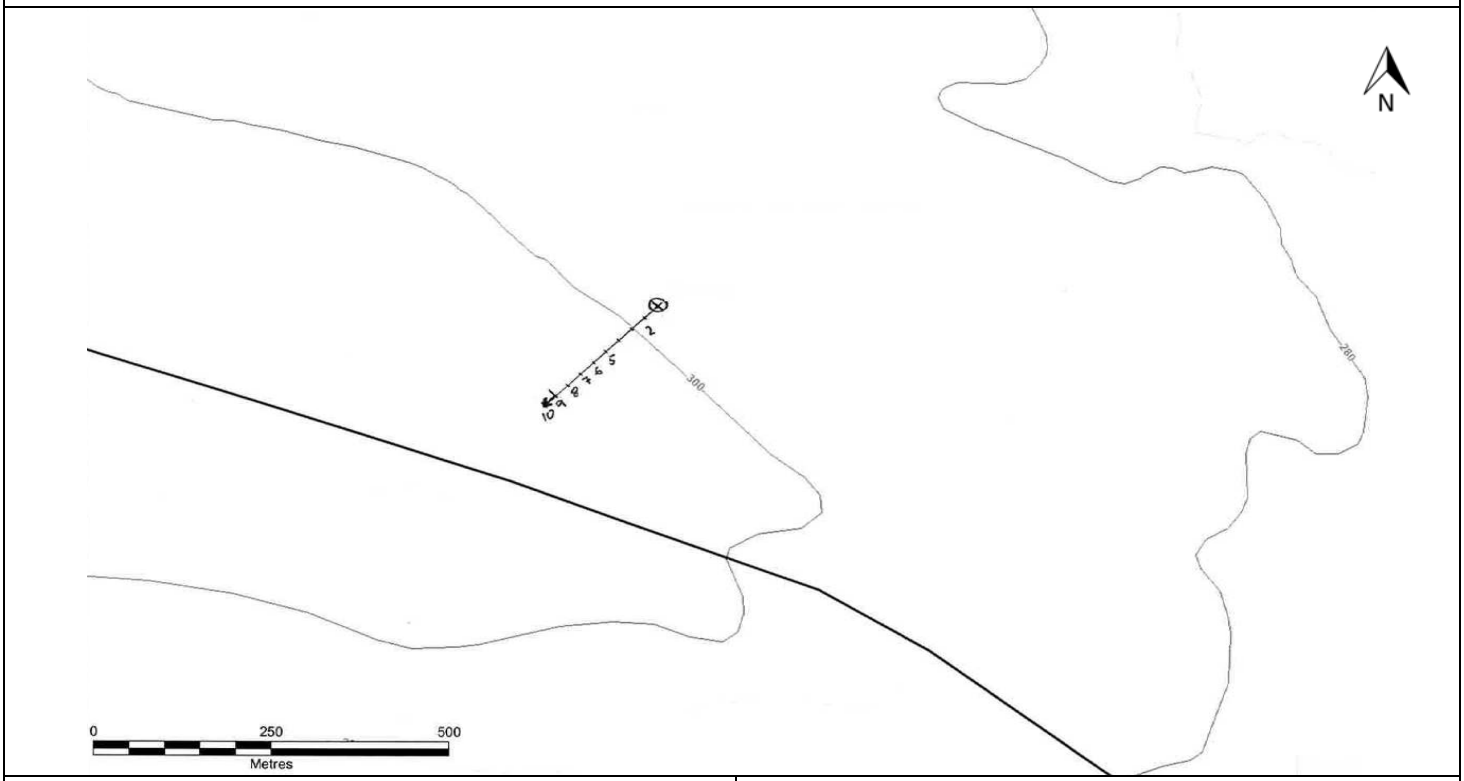
Sabina GOLD & SILVER CORP.

Snow Course: SC-02 Goose Property

Back River

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BEARING	229	ASPECT.	NE
MAP No.	3	DATE SURVEYED	April 24 2012
DATE ESTD.	April 24 2012		
DRAINAGE	Moby Lake	UTM Zone 13	422265E 7265136N
REMARKS			

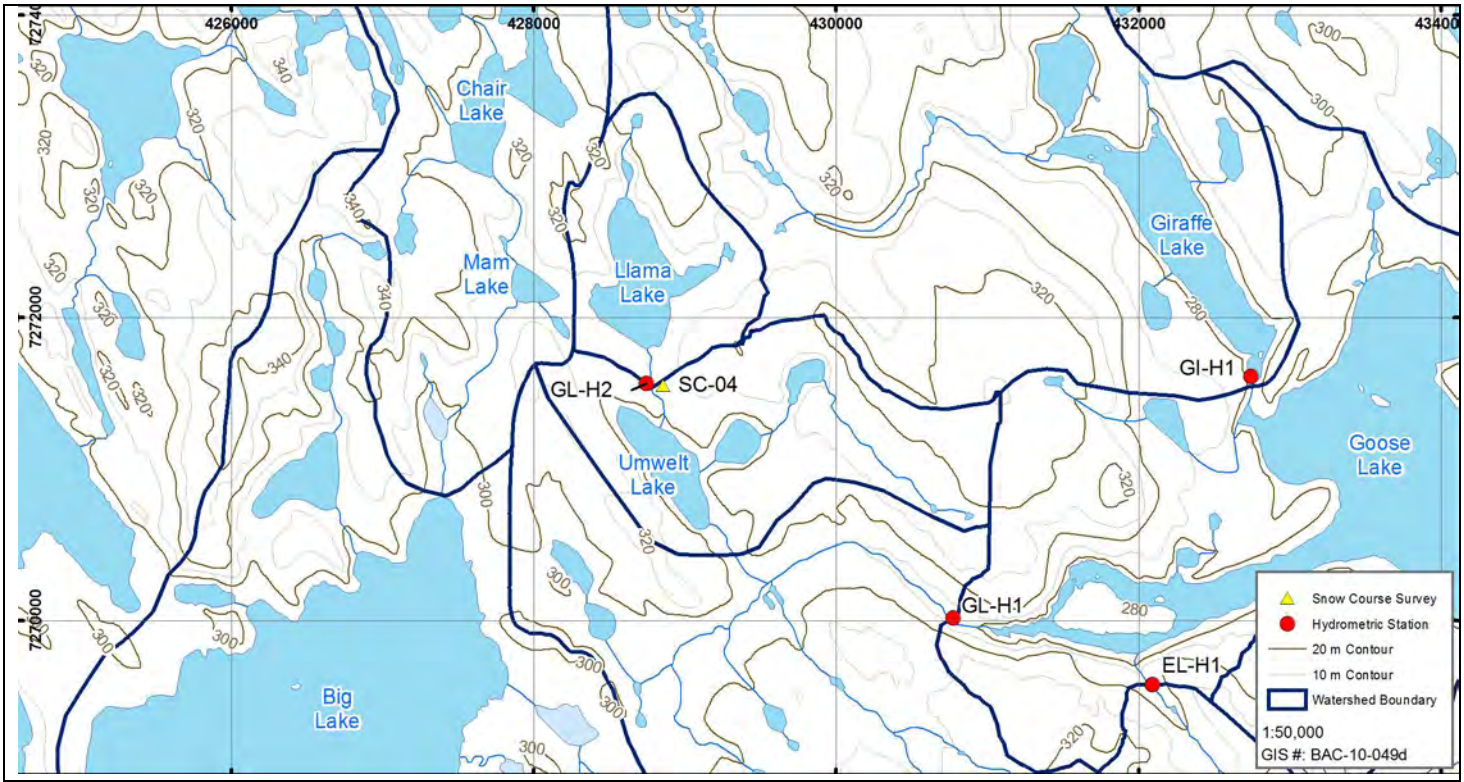
Rescan™

Sabina GOLD & SILVER CORP.

Snow Course: SC-03 Goose Property

Back River

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Map 4

BEARING	90	ASPECT.	Flat
MAP No.	4	DATE SURVEYED	April 24 2012
DATE ESTD.	April 24 2012		
DRAINAGE	Llama Lake	UTM Zone 13	428855E 7271553N
REMARKS	Flat		

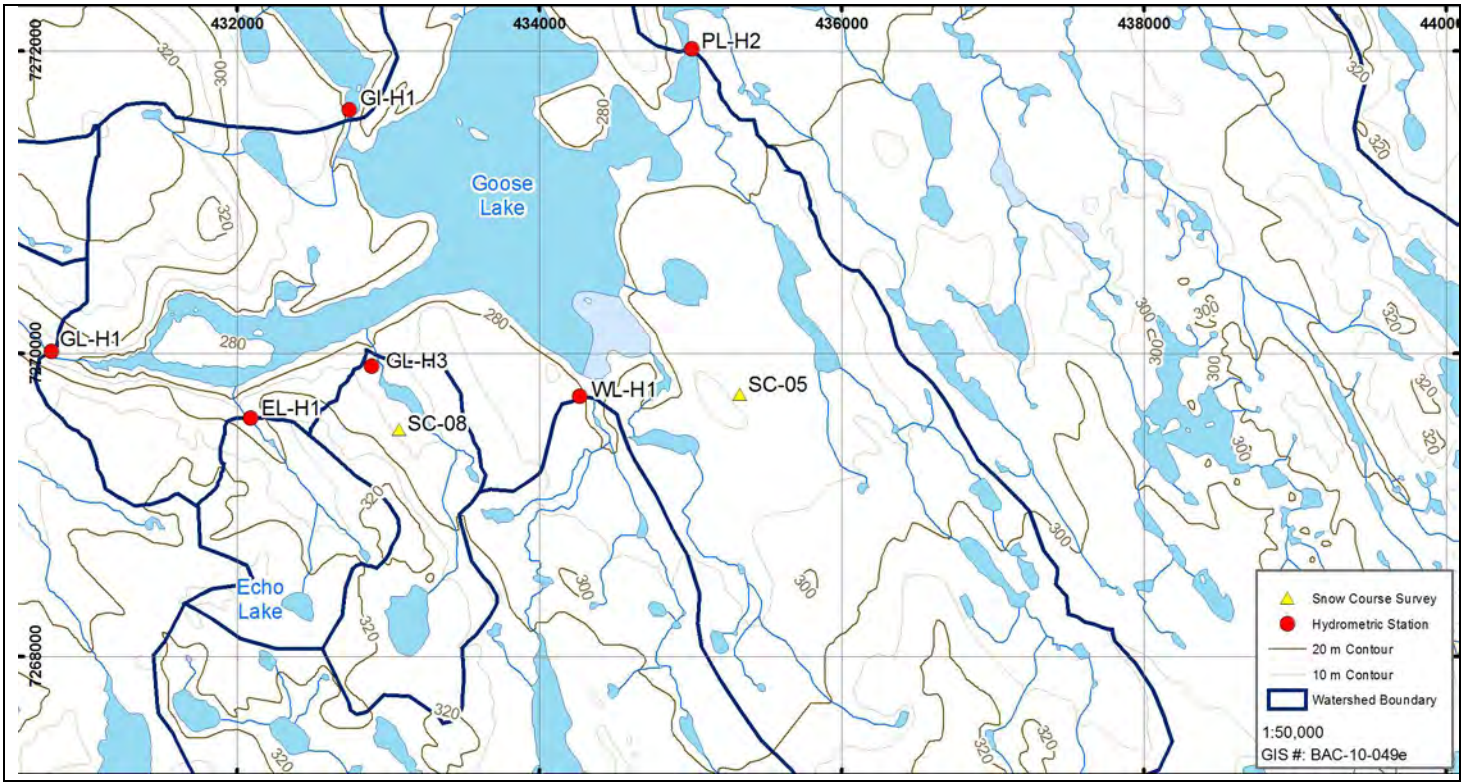
Rescan™

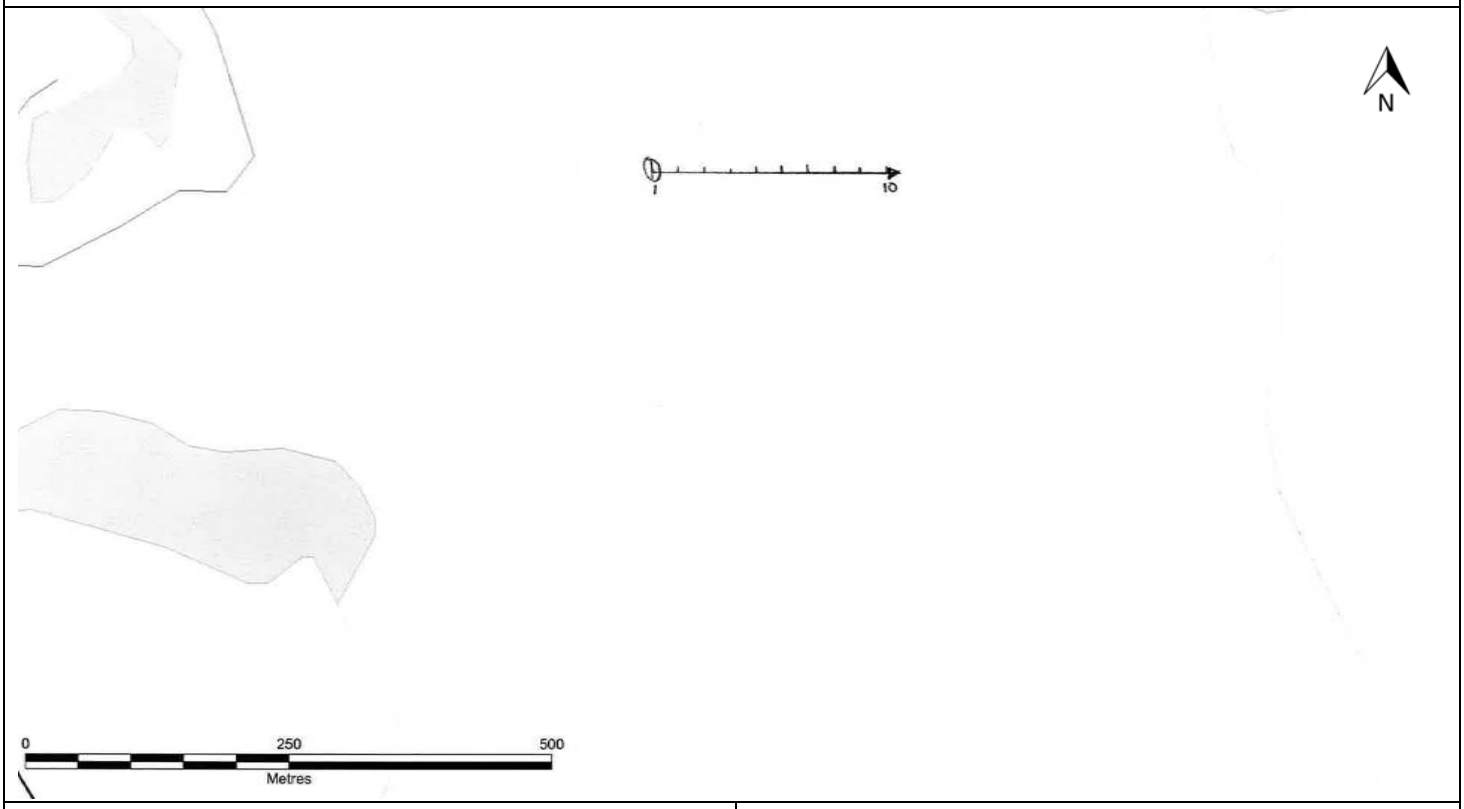
Sabina GOLD & SILVER CORP.

Snow Course: SC-04 Goose Property

Back River

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BEARING	90	ASPECT.	Flat
MAP No.	5	DATE SURVEYED	April 24 2012
DATE ESTD.	April 24 2012		
DRAINAGE	Goose Lake	UTM Zone 13	435325E 7269732N
REMARKS	Flat		

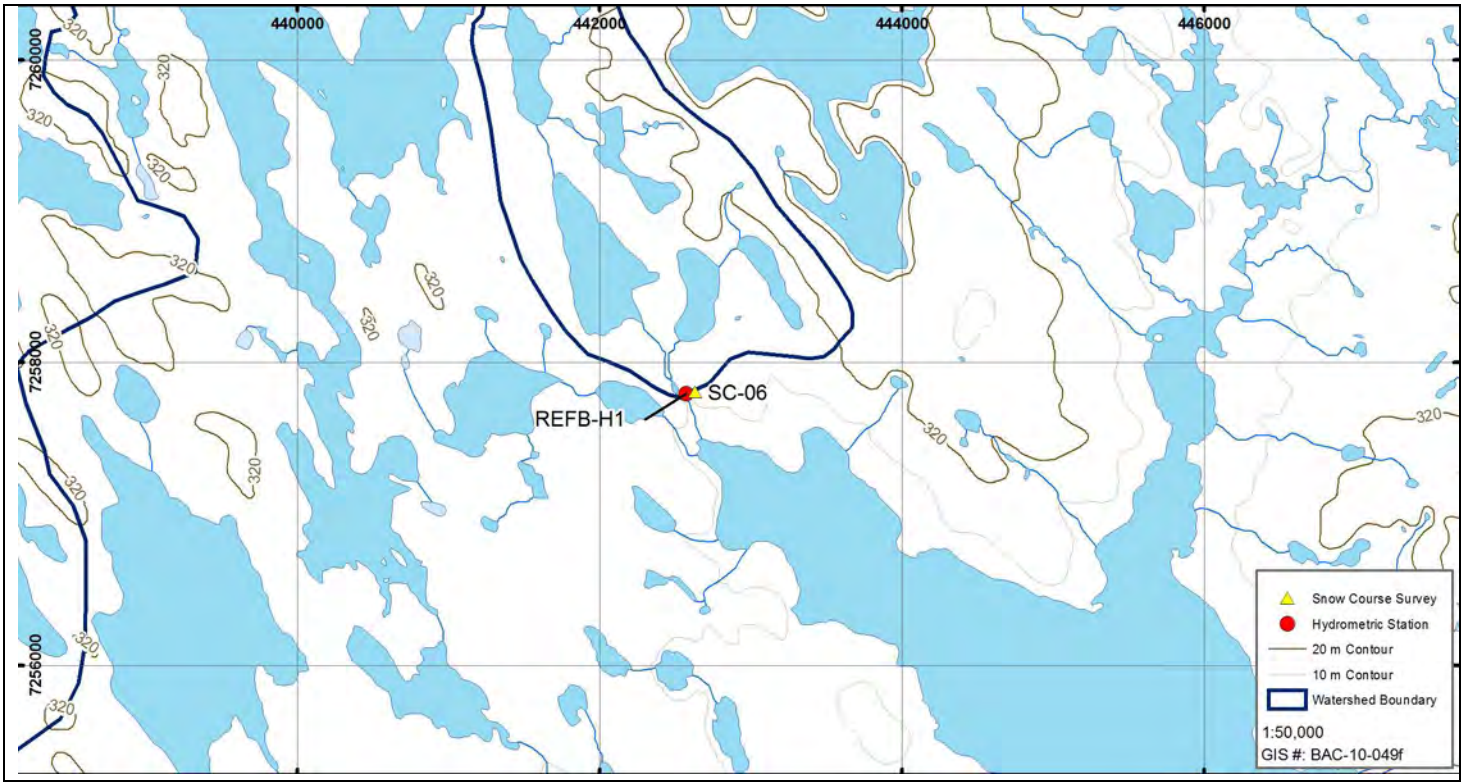
Rescan™

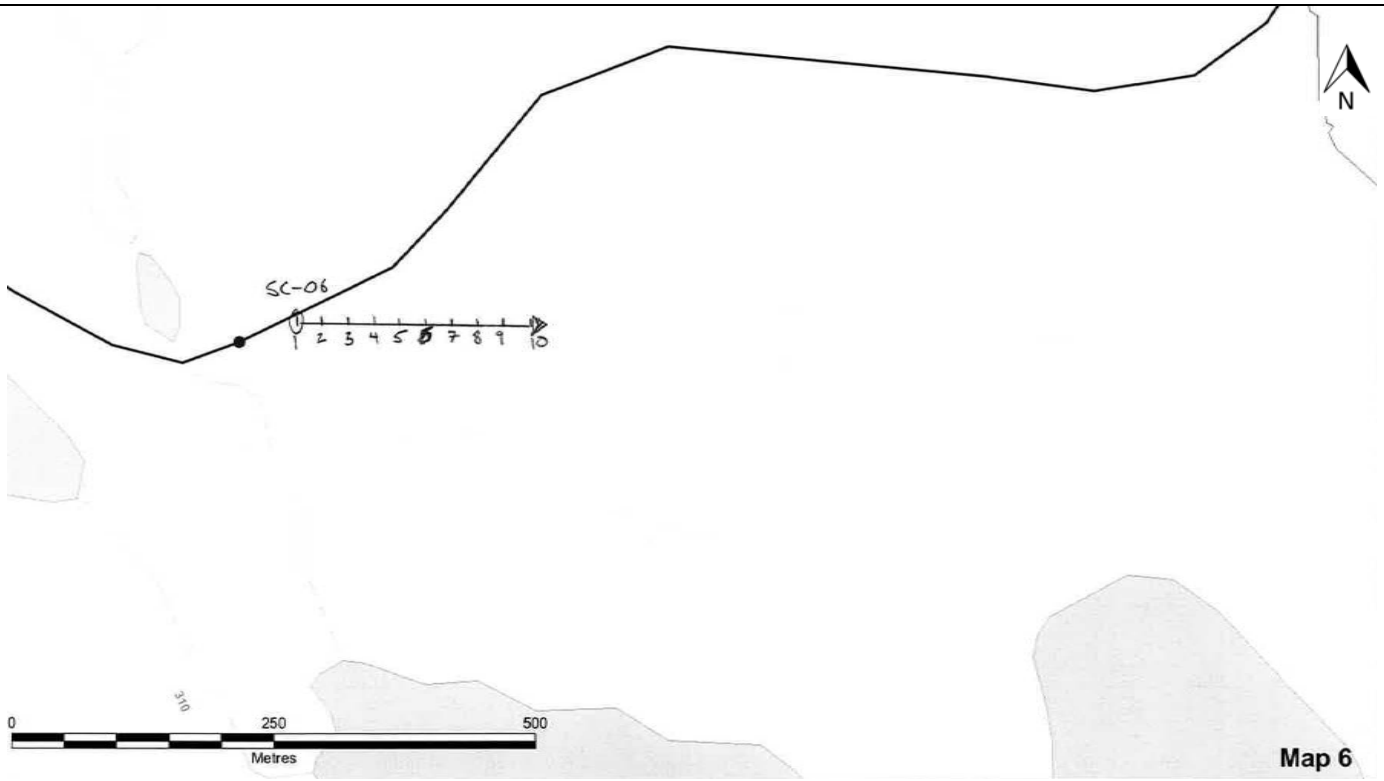
Sabina GOLD & SILVER CORP.

Snow Course: SC-05 Goose Property

Back River

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BEARING	90	ASPECT.	Flat
MAP No.	6	DATE SURVEYED	April 24 2012
DATE ESTD.	April 24 2012		
DRAINAGE	Reference Lake B	UTM Zone 13	442629E 7257810N
REMARKS	Flat		

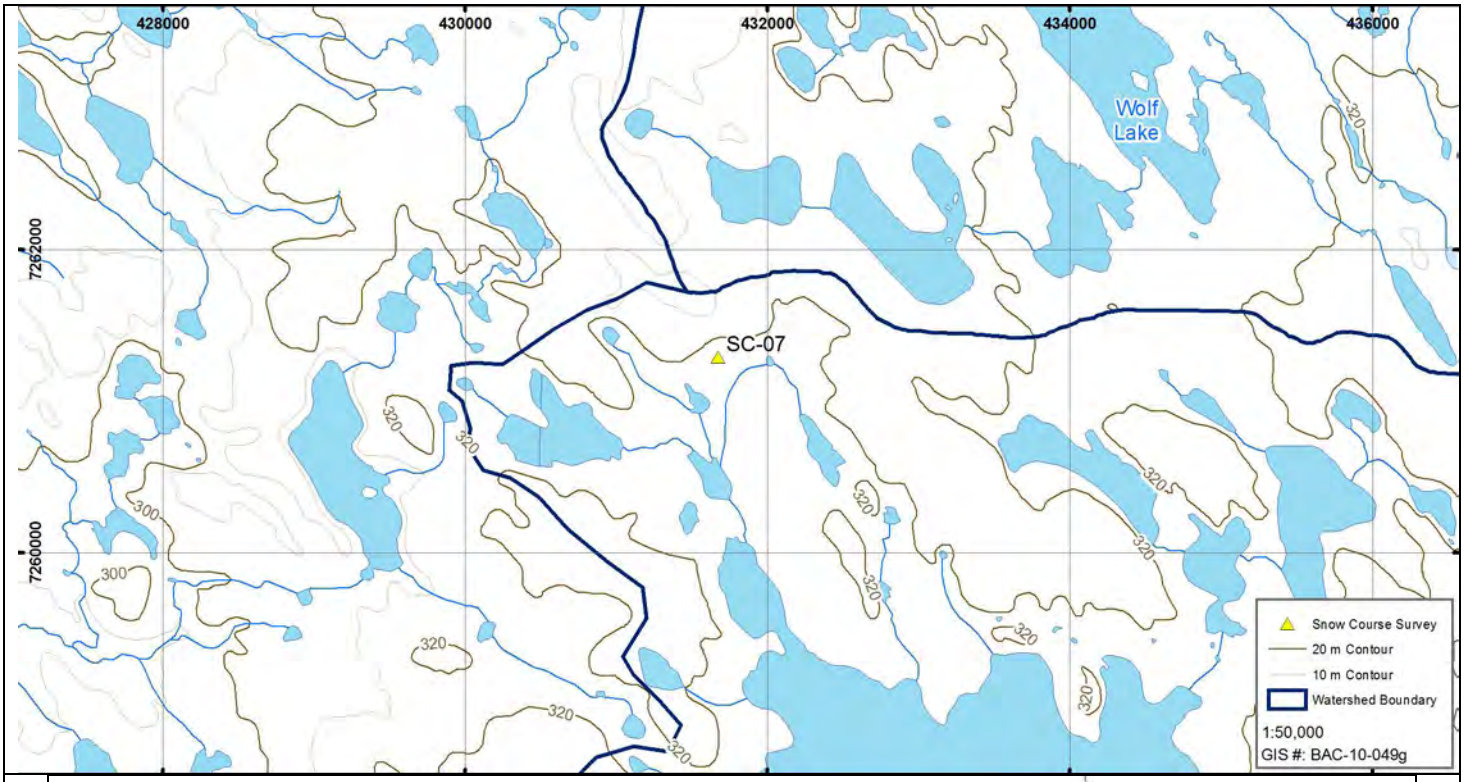
Rescan™

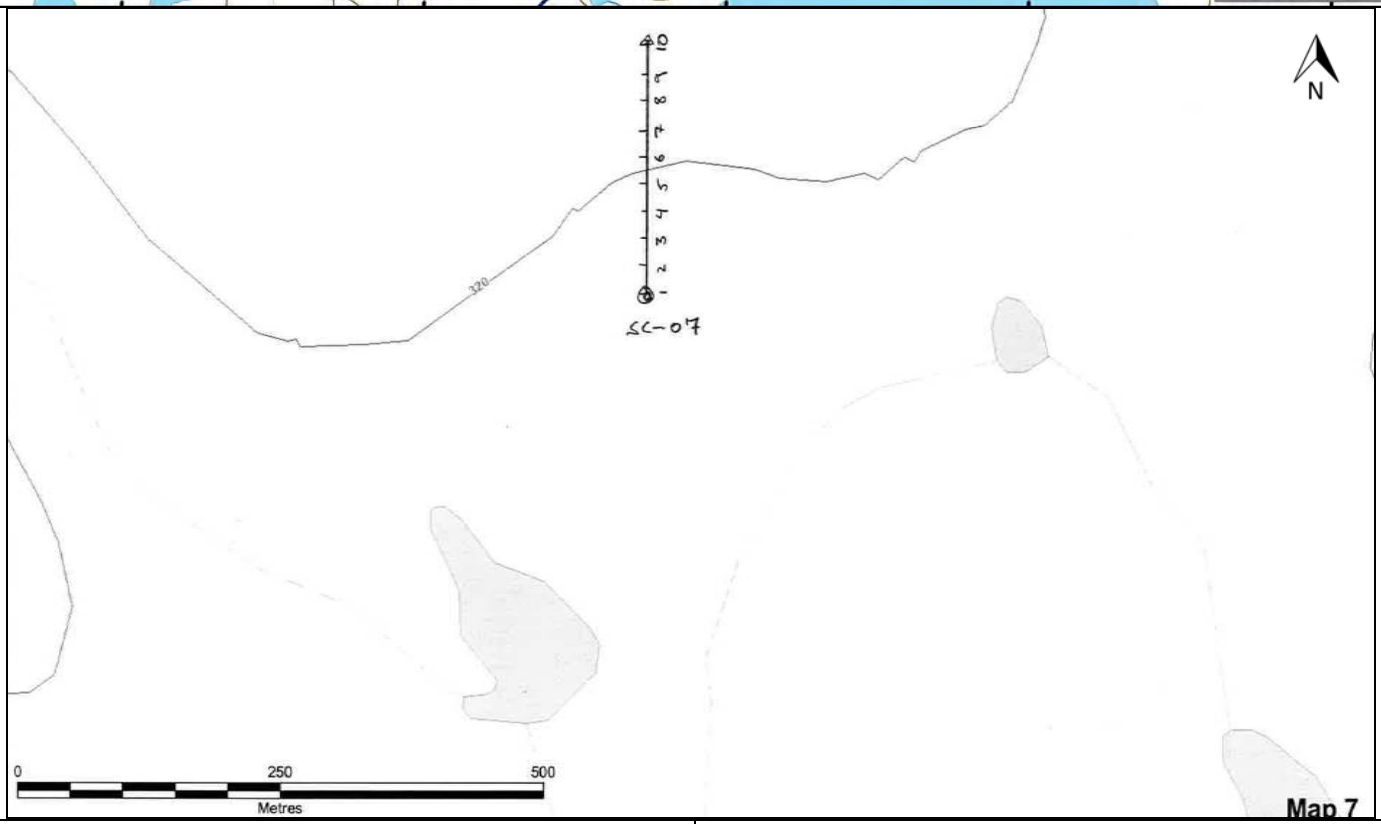
Sabina GOLD & SILVER CORP.

Snow Course: SC-06 Goose Property

Back River

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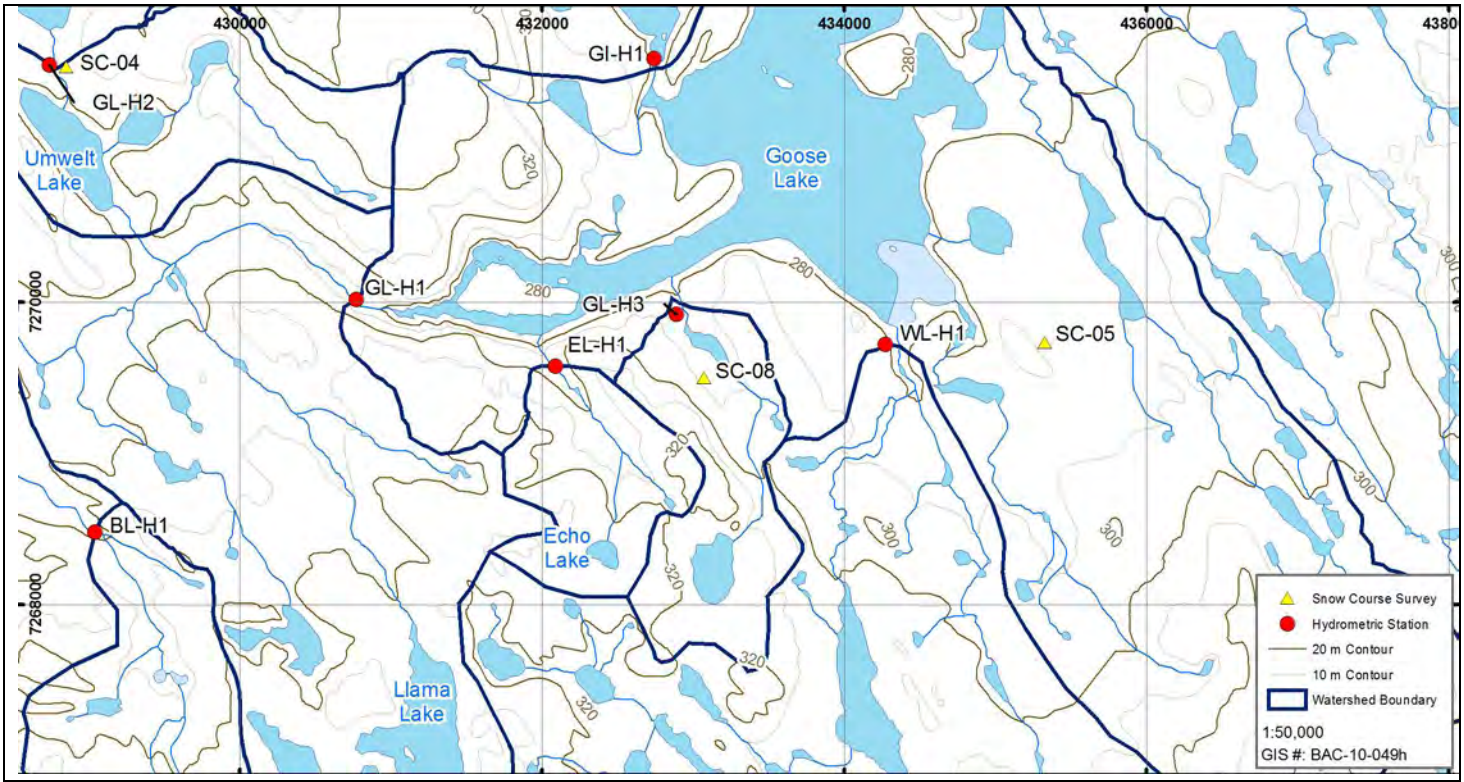


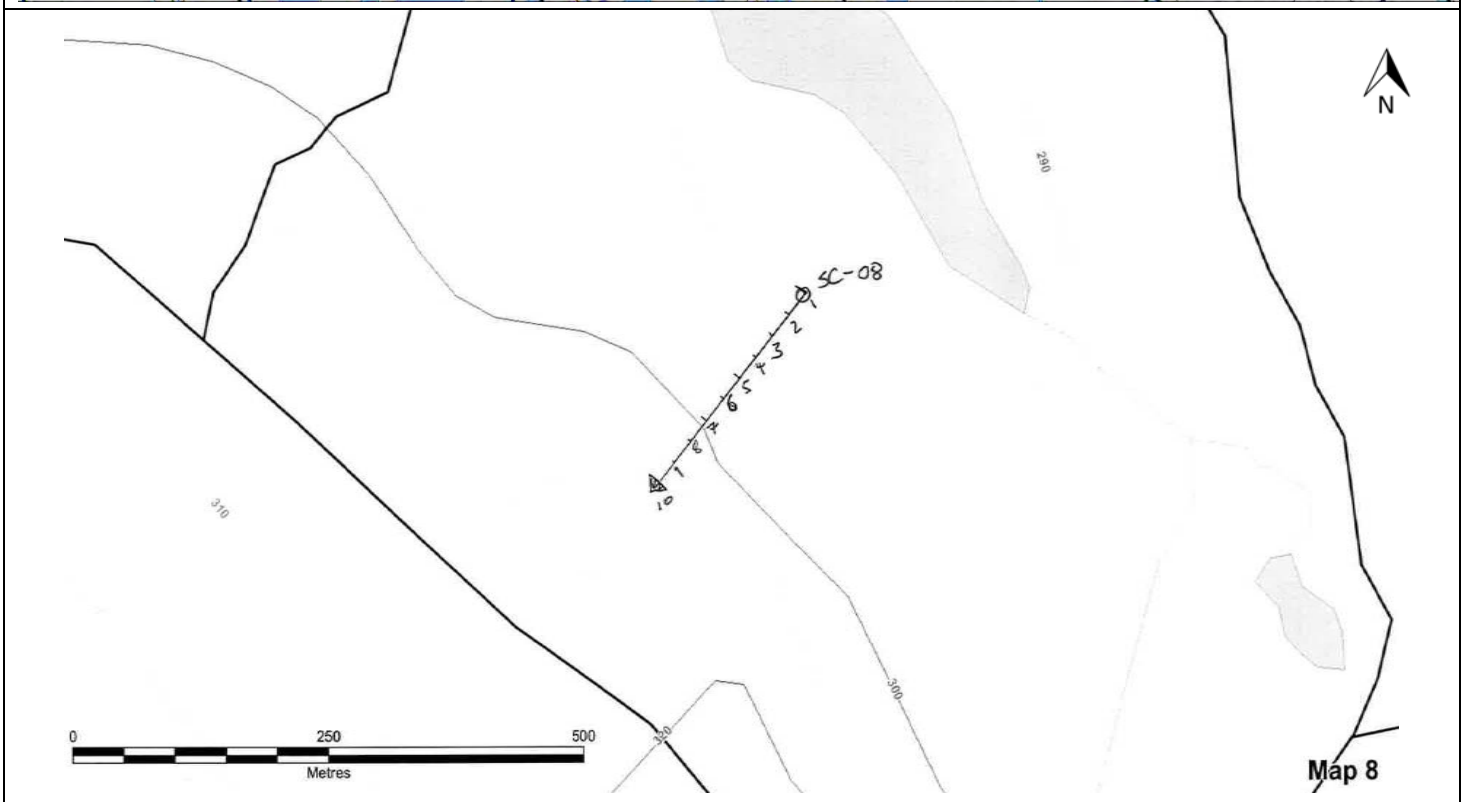
BEARING	0	ASPECT.	SE
MAP No.	7	DATE SURVEYED	April 23 2012
DATE ESTD.	April 23 2012		
DRAINAGE	South of Wolf	UTM Zone 13	431670E 7261290N
REMARKS			

Snow Course: SC-07 Goose Property

Back River

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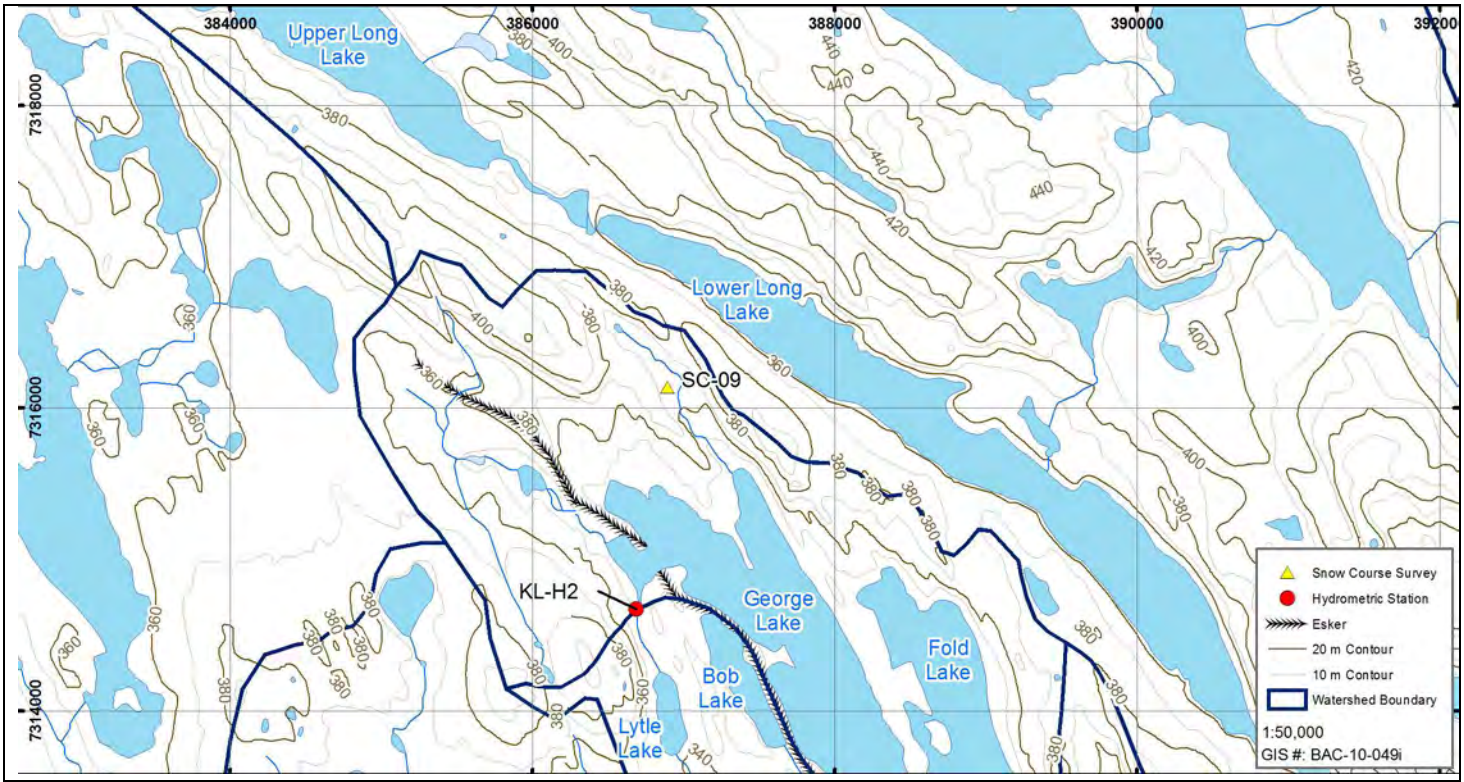


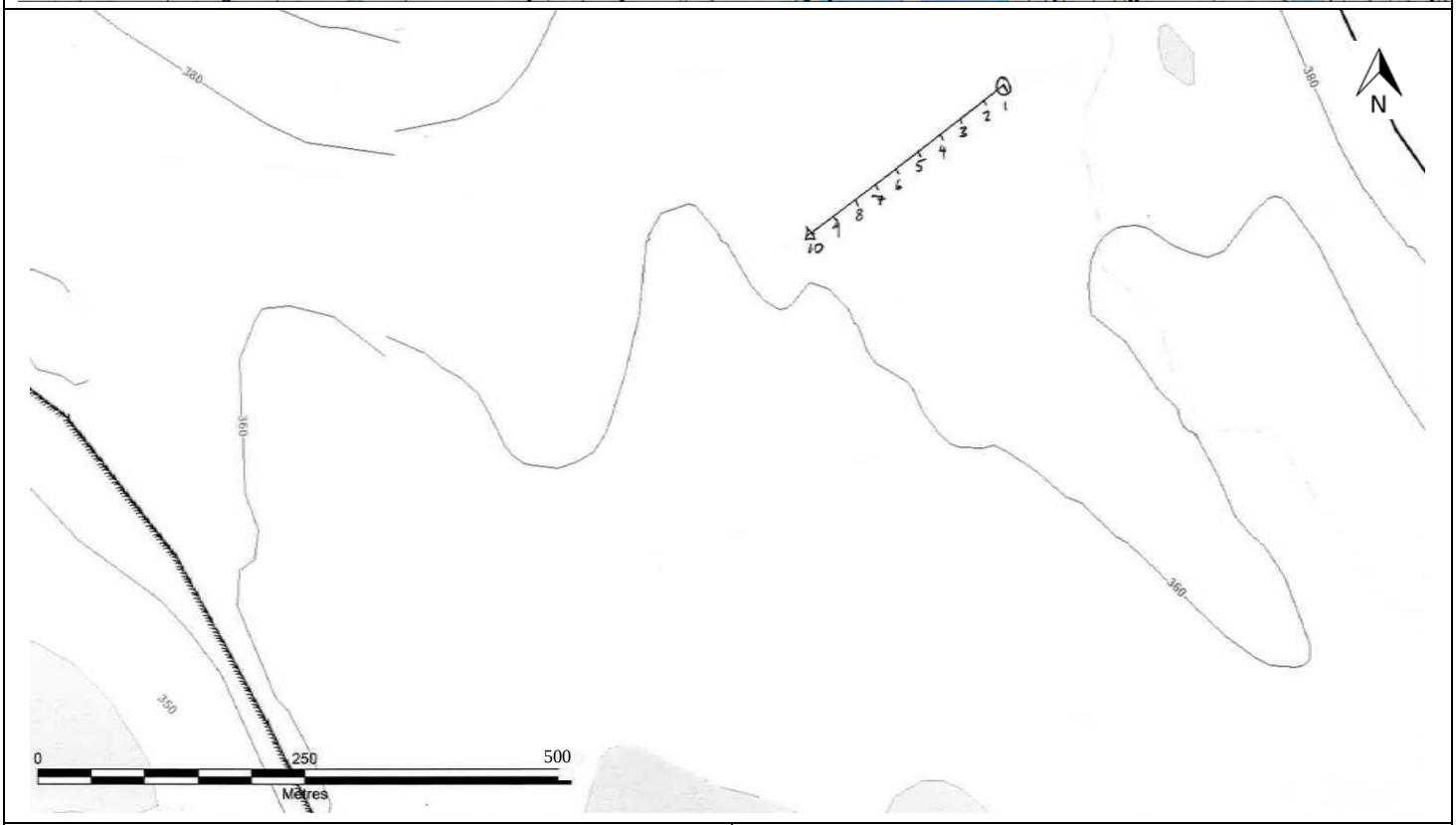
BEARING	220	ASPECT.	NE
MAP No.	8	DATE SURVEYED	April 25 2012
DATE ESTD.	April 25 2012		
DRAINAGE	Llama Lake	UTM Zone 13	433071E 7269498N
REMARKS	Steep		

Snow Course: SC-08 Goose Property

Back River

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BEARING	220	ASPECT.	NE
MAP No.	8	DATE SURVEYED	April 20 2012
DATE ESTD.	April 20 2012		
DRAINAGE	George Lake	UTM Zone 13	386892E 7316137N
REMARKS	Steep		

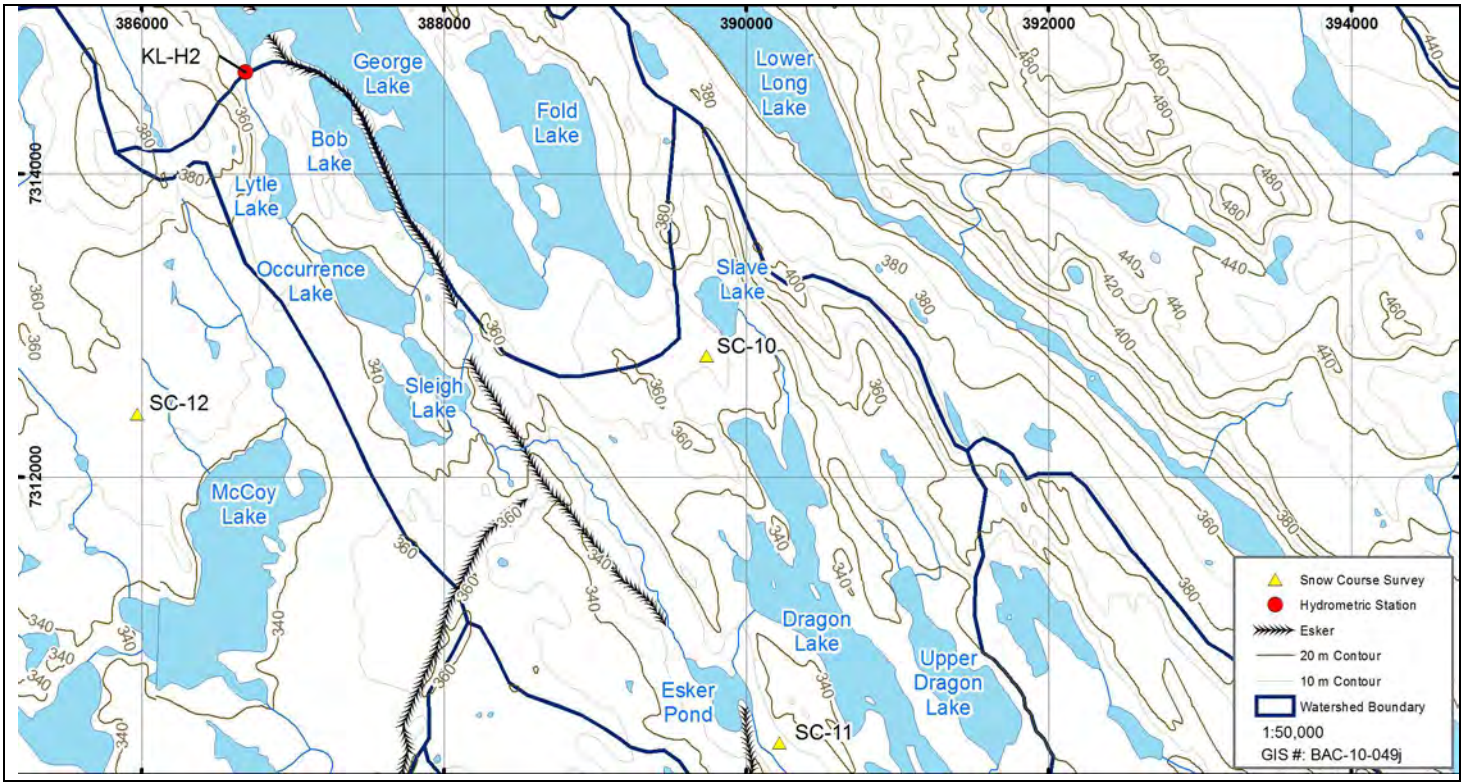
Rescan™

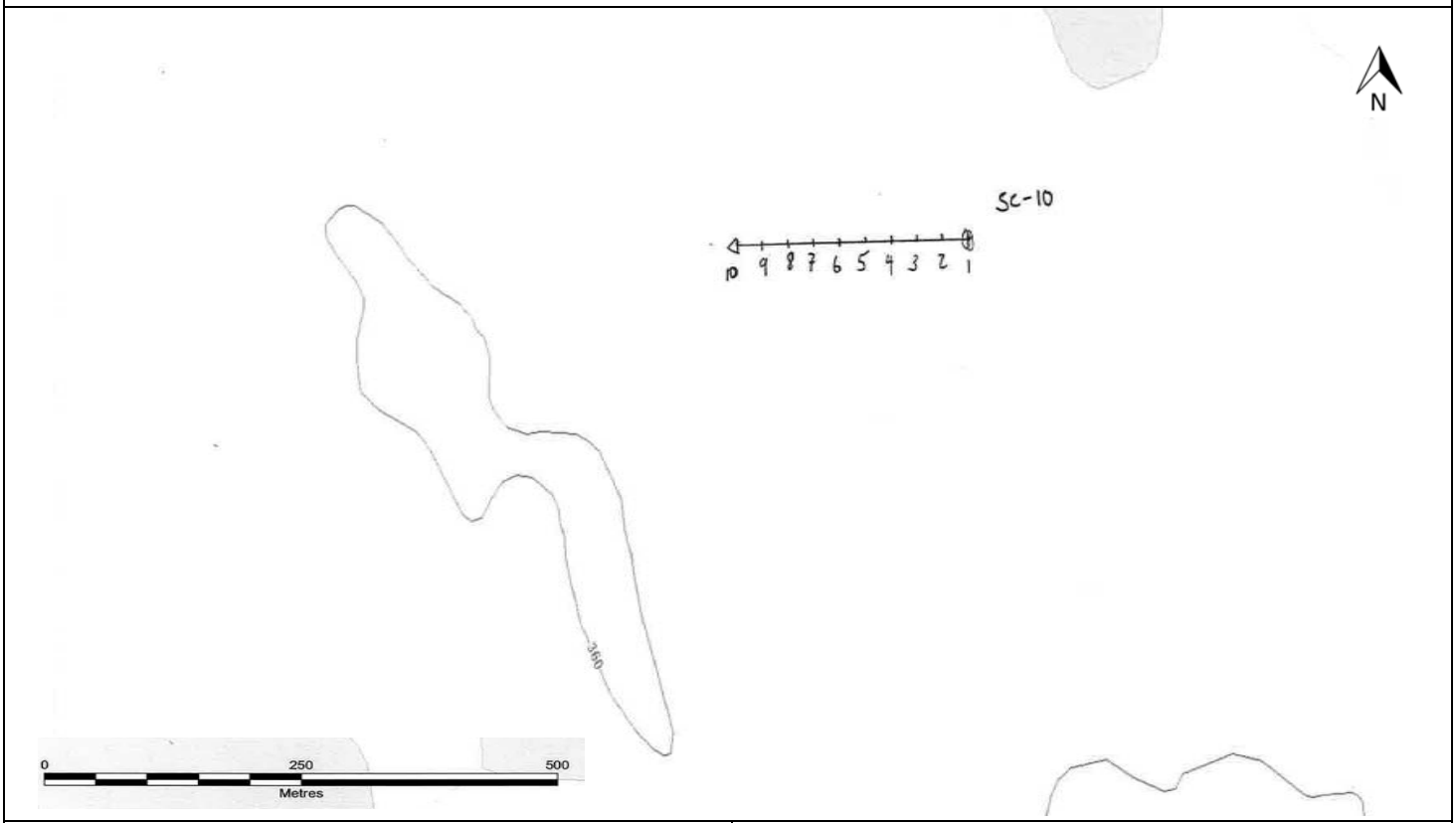
Sabina GOLD & SILVER CORP.

Snow Course: SC-09 George Property

Back River

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BEARING	270	ASPECT.	Flat
MAP No.	10	DATE SURVEYED	April 20 2012
DATE ESTD.	April 20 2012		
DRAINAGE	George Lake	UTM Zone 13	389735E 7312798N
REMARKS	Flat		

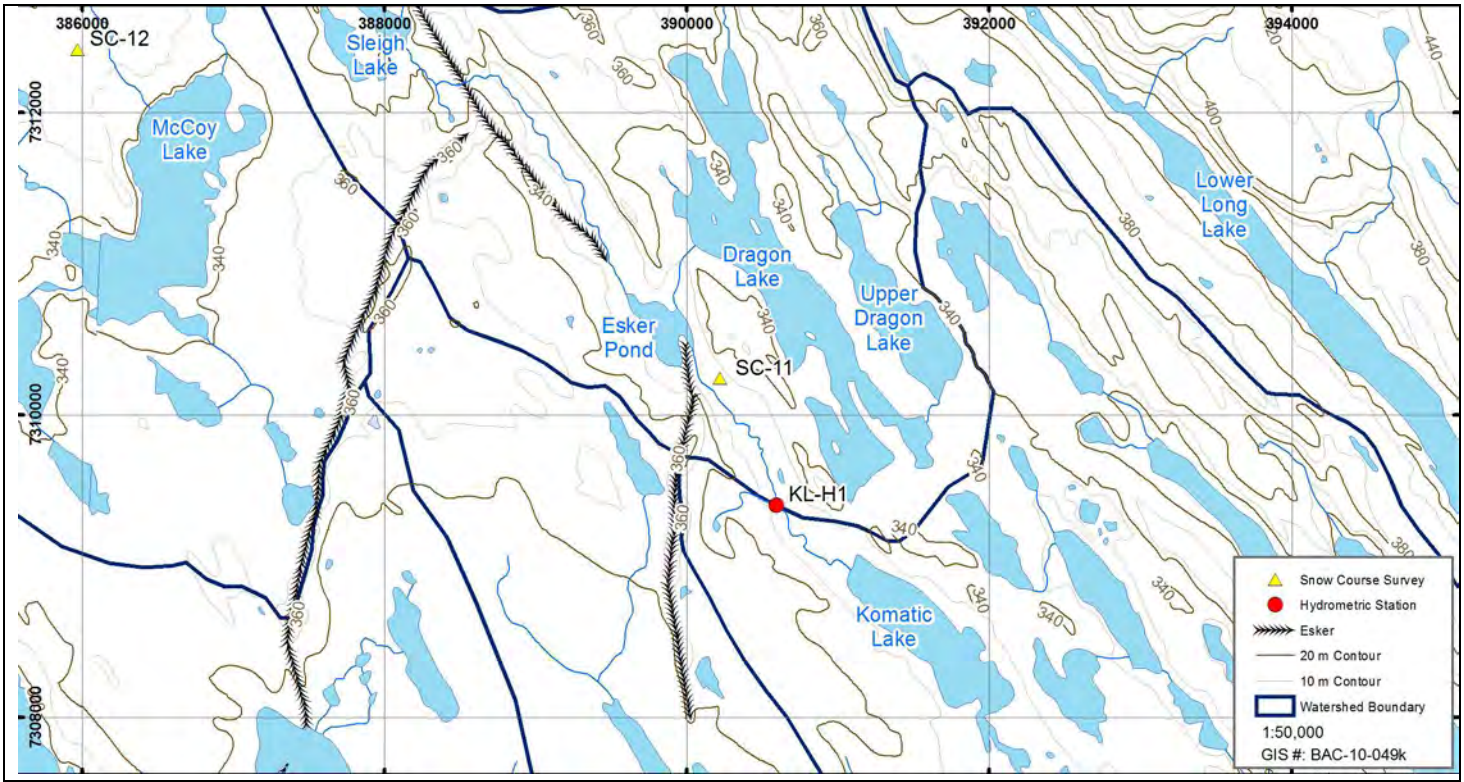
Rescan™

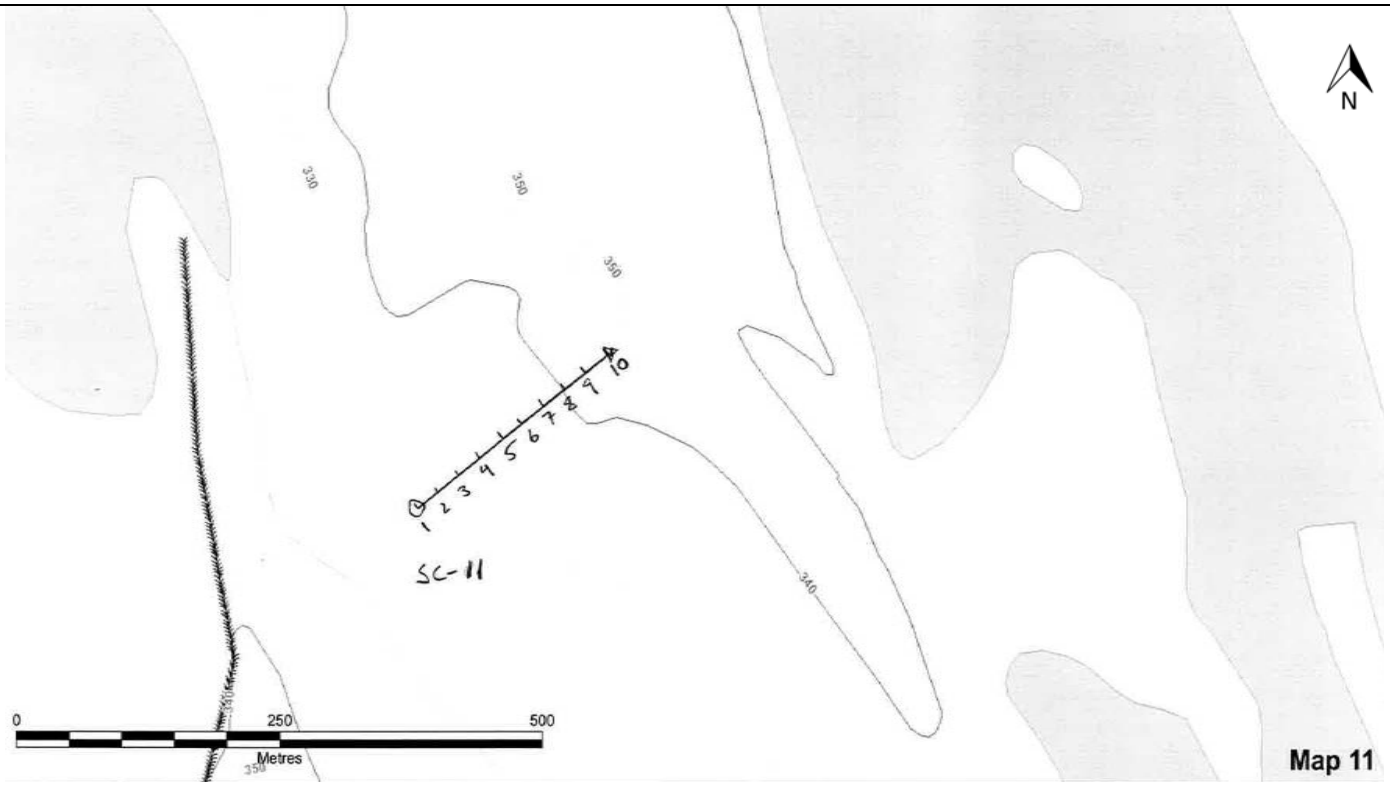
Sabina GOLD & SILVER CORP.

Snow Course: SC-10 George Property

Back River

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BEARING	56	ASPECT.	SW
MAP No.	11	DATE SURVEYED	April 22 2012
DATE ESTD.	April 22 2012		
DRAINAGE	Komatic Lake	UTM Zone 13	390220E 7310240N
REMARKS			

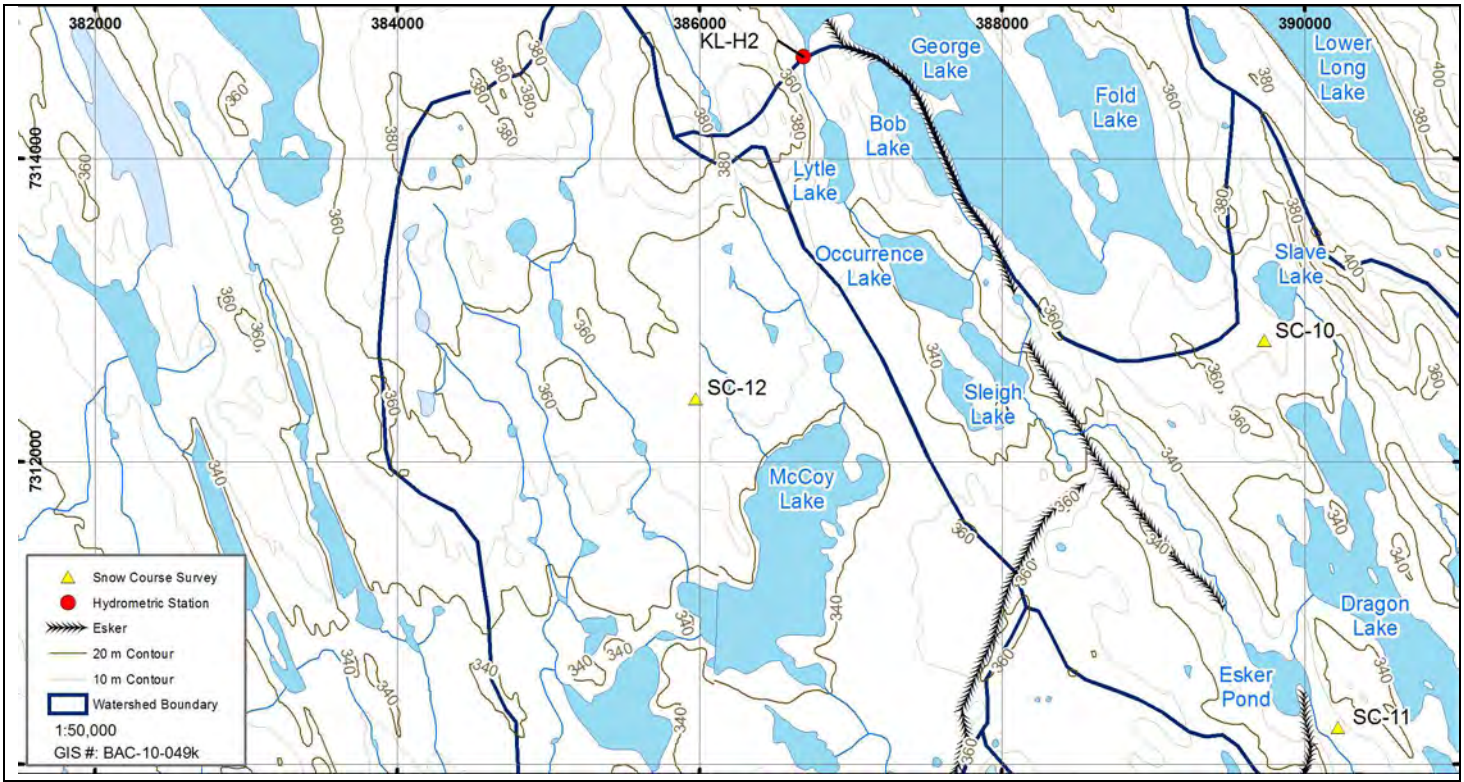
Rescan™

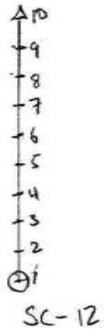
Sabina GOLD & SILVER CORP.

Snow Course: SC-11 George Property

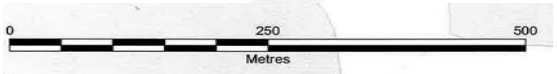
Back River

G:\mtaylor\public\Snow Course Templates\









BEARING	0	ASPECT.	Flat
MAP No.	12	DATE SURVEYED	April 22 2012
DATE ESTD.	April 22 2012		
DRAINAGE	Dragon Lake	UTM Zone 13	385971E 7312414N
REMARKS	Flat		

Rescan™

Sabina GOLD & SILVER CORP.

Snow Course: SC-12 George Property

Back River

G:\mtaylor\public\Snow Course Templates\

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-01		2012	4	25
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property				
Observer's Name:	C.Hall				
Number of		**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
Tubes Used:	2	**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	31	27	31	79	70	9	33
2	48	46	43	86	70	16	35
3	30	29	27	79	70	9	31
4	51	51	50	88	70	18	35
5	46	42	39	83	70	13	31
6	53	50	52	88	70	18	36
7	34	34	33	82	70	12	35
8	24	19	22	76	70	6	32
9	25	22	25	77	70	7	32
10	37	37	37	83	70	13	35
Total		357				121	
Average		**36**				**12.1**	**34**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:10 a.m. p.m. ended 10:05 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-14.4	˚C
	Blowing		Calm	X			
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground	X			
Ground under snow:	Dry	X	Damp		Wet		Frozen X

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-02		2012	4	21
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property				
Observer's Name:	C.Hall				
Number of Tubes Used:	3	**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
		No:			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	104	101	97	108	71	37	37
2	195	192	190	192	113	79	41
3	30	26	29	81	71	10	38
4	63	60	50	90	71	19	32
5	52	51	50	91	71	20	39
6	46	42	45	88	71	17	40
7	21	19	19	78	71	7	37
8	16	15	14	76	71	5	33
9	10	8	10	74	71	3	38
10	21	16	20	76	71	5	31
Total		530				202	
Average		**53**				**20.2**	**37**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 1:45 a.m. p.m. ended 3:20 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-14	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry	X	Damp		Wet		Frozen

D. General Condition en Route

Snow line elevatio 0 metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-03		2012	4	24
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property				
Observer's Name:	C.Hall				
Number of		**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
Tubes Used:	2	**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	60	57	59	90	71	19	33
2	84	80	80	96	71	25	31
3	47	44	47	88	71	17	39
4	47	44	42	84	71	13	30
5	47	42	44	86	71	15	36
6	8	3	8	72	71	1	33
7	43	43	37	85	71	14	33
8	18	15	18	76	71	5	33
9	60	60	55	92	71	21	35
10	78	73	73	96	71	25	34
Total		461				155	
Average		**46**				**15.5**	**34**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:20 a.m. ended 10:05 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-14.1	˚C
	Blowing		Calm	X			
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry		Damp		Wet		Frozen	X

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-04		2012	4	21
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property				
Observer's Name:	C.Hall				
Number of		**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
Tubes Used:	2	**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	51	48	49	87	71	16	33
2	80	80	79	100	72	28	35
3	42	41	42	83	71	12	29
4	69	69	65	94	71	23	33
5	111	107	111	112	71	41	38
6	67	67	65	94	71	23	34
7	12	10	12	74	71	3	30
8	39	35	36	81	71	10	29
9	31	27	28	79	71	8	30
10	30	26	28	81	71	10	38
Total		510				174	
Average		**51**				**17.4**	**33**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:45 a.m. p.m. ended 11:07 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-14.6	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult			
Ground Reached on all Samples:	Yes	X	No*					
Ice Layers:	In snowpack	X	On ground					
Ground under snow:	Dry	X	Damp		Wet		Frozen	

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General			
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-05			2012	4	24
				Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property					
Observer's Name:	C.Hall					
Number of		**Driving Wrench Used:**	**Yes:**	X	**Scale No.:**	4S141
Tubes Used:	2		**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	43	42	43	84	70	14	33
2	68	67	68	92	70	22	33
3	69	66	63	92	70	22	33
4	74	70	73	93	70	23	33
5	54	50	49	84	70	14	28
6	16	13	14	74	70	4	31
7	40	38	40	83	70	13	34
8	56	51	53	89	70	19	37
9	33	30	32	80	70	10	33
10	50	50	43	86	70	16	32
Total		477				157	
Average		**48**				**15.7**	**33**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 1:25 a.m. ended 2:30 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-11.7	˚C
	Blowing		Calm	X			
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy	X	Moderately Difficult		Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry		Damp		Wet		Frozen	X

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-06		2012	4	23
Snow Course Name:	Back River Project - Goose Property		**Year**	**Month**	**Day**
Observer's Name:	C.Hall				
Number of Tubes Used:	2	**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
		No:			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	53	48	47	86	71	15	31
2	71	69	65	94	71	23	33
3	50	50	48	88	71	17	34
4	43	39	42	84	71	13	33
5	39	37	39	83	71	12	32
6	38	34	38	82	71	11	32
7	66	66	64	96	71	25	38
8	75	72	69	95	71	24	33
9	77	77	75	99	71	28	36
10	72	69	70	95	71	24	35
Total		561				192	
Average		**56**				**19.2**	**34**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:45 a.m. p.m. ended 11:07 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-14.6	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult			
Ground Reached on all Samples:	Yes	X	No*					
Ice Layers:	In snowpack	X	On ground					
Ground under snow:	Dry	X	Damp		Wet		Frozen	

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General			
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-07		2012	4	23
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - Goose Property				
Observer's Name:	C.Hall				
Number of		**Driving Wrench Used:** **Yes:**	X	**Scale No.:**	4S141
Tubes Used:	3	**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	143	140	142	169	113	56	40
2	49	46	48	132	113	19	41
3	57	54	54	134	113	21	39
4	50	47	50	130	113	17	36
5	63	61	63	135	113	22	36
6	96	96	94	151	113	38	40
7	128	126	117	162	113	49	39
8	98	98	98	152	113	39	40
9	71	71	68	139	113	26	37
10	52	50	51	134	113	21	42
Total		789				308	
Average		**79**				**30.8**	**39**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 12:23 a.m. ended 1:30 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-10.5	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry	X	Damp		Wet		Frozen	

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-08		2012	4	25
Snow Course Nam	Back River Project - Goose Property		**Year**	**Month**	**Day**
Observer's Name:	C.Hall				
Number of Tubes Used:	4	**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
		No:			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	88	81	75	185	154	31	38
2	51	58	51	175	154	21	36
3	44	40	38	168	154	14	35
4	37	32	32	166	154	12	38
5	63	60	61	175	154	21	35
6	135	135	125	204	154	50	37
7	293	292	283	280	154	126	43
8	163	160	155	216	154	62	39
9	17	17	17	161	154	7	41
10	28	25	28	163	154	9	36
Total		900				353	
Average		**90**				**35.3**	**38**

Please complete in field or as soon after snow sampling as possible.

Time sampling began 1:45 a.m. ended 3:00 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-10.3	˚C
	Blowing		Calm	X			
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground	X			
Ground under snow:	Dry	X	Damp		Wet		Frozen	X

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-09		2012	4	20
Snow Course Name:	Back River Project - George Property		**Year**	**Month**	**Day**
Observer's Name:	C.Hall				
Number of Tubes Used:	3	**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
		No:			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	8	6	8	Container & Core*	Container**	Core***	n/a
2	37	37	37	Container & Core*	Container*	Core***	n/a
3	12	10	12	Container & Core*	Container*	Core***	n/a
4	66	63	60	Container & Core*	Container*	Core***	n/a
5	23	23	23	Container & Core*	Container*	Core***	n/a
6	13	11	13	Container & Core*	Container*	Core***	n/a
7	8	8	8	Container & Core*	Container*	Core***	n/a
8	18	17	18	Container & Core*	Container*	Core***	n/a
9	3	3	3	Container & Core*	Container*	Core***	n/a
10	158	156	157	191	56	135	n/a
Total		334				135	
Average		**33**				**13.5**	**40.4**

**Weight of bulk sampling container and total snow cores sampled*

***Weight of bulk sampling container*

****Weight of total snow cores sampled*

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:25 a.m. p.m. ended 10:30 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-6.5	˚C
	Blowing		Calm	X			
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No		Yes*	X	Which Stations	10	
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult			
Ground Reached on all Samples:	Yes	X	No*					
Ice Layers:	In snowpack		On ground					
Ground under snow:	Dry	X	Damp		Wet		Frozen	

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General			
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

Scouring on ridges and drifting in the low areas.

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-10		2012	4	20
			Year	**Month**	**Day**
Snow Course Name:	Back River Project - George Property				
Observer's Name:	C.Hall				
Number of		**Driving Wrench Used: Yes:**	X	**Scale No.:**	4S141
Tubes Used:	4	**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	18	17	17	Container & Core*	Container**	Core***	n/a
2	178	178	178	Container & Core*	Container*	Core***	n/a
3	0	0	0	Container & Core*	Container*	Core***	n/a
4	410	410	410	Container & Core*	Container*	Core***	n/a
5	147	145	145	Container & Core*	Container*	Core***	n/a
6	5	5	5	Container & Core*	Container*	Core***	n/a
7	5	3	5	Container & Core*	Container*	Core***	n/a
8	8	6	8	Container & Core*	Container*	Core***	n/a
9	57	54	53	Container & Core*	Container*	Core***	n/a
10	33	27	32	296	56	240	n/a
Total		845				240	
Average		85				24	28.4

**Weight of bulk sampling container and total snow cores sampled*

***Weight of bulk sampling container*

****Weight of total snow cores sampled*

Please complete in field or as soon after snow sampling as possible.

Time sampling began 12:50 a.m. ended 2:20 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-1.1	˚C
	Blowing		Calm	X			
Skies:	Clear		Partly Cloudy	X	Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No		Yes*	X	Which Stations	2, 4 and 5	
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult		Very Difficult	X		
Ground Reached on all Samples:	Yes		No*	X				
Ice Layers:	In snowpack	X	On ground					
Ground under snow:	Dry	X	Damp		Wet		Frozen	

D. General Condition en Route

Snow line elevation n/a metres

Thaw:	None	X	Sunny slopes		General			
Small streams:	Bridged with snow	X	Open		Clear		Muddy	

*Describe fully under remarks

E. Remarks:

Scouring on ridges and drifting in the low areas.

Ground not reached at station 4 but sample was included in the bulk sample (probing adjacent to the sample indicated the ground was almost reached but ice layers prevented digging in any further).

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-11			2012	4	22
Snow Course Name:	Back River Project - George Property			**Year**	**Month**	**Day**
Observer's Name:	C.Hall					
Number of		**Driving Wrench Used:**	**Yes:**	X	**Scale No.:**	4S141
Tubes Used:	4		**No:**			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	28	23	26	161	154	7	30
2	81	81	79	185	154	31	38
3	58	58	57	177	154	23	40
4	25	24	23	162	154	8	33
5	27	20	25	160	154	6	30
6	5	5	5	156	154	2	40
7	12	8	11	157	154	3	38
8	9	6	7	156	154	2	33
9	62	60	62	178	154	24	40
10	46	43	45	170	154	16	37
Total		328				122	
Average		33				12.2	36

Please complete in field or as soon after snow sampling as possible.

Time sampling began 9:20 a.m. p.m. ended 10:40 a.m. p.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-16	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry	X	Damp		Wet		Frozen

D. General Condition en Route

Snow line elevatio 0 metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy

*Describe fully under remarks

E. Remarks:

British Columbia Ministry of Water, Land and Air Protection- Environmental Protection Division- Flood Hazard/River Forecast Centre

Back River Project Environmental Baseline Study (Project no. 833-002-02)

SNOW SURVEY FIELD DATA SHEET

Snow Course No.	SC-12			2012	4	22
				Year	**Month**	**Day**
Snow Course Name:	Back River Project - George Property					
Observer's Name:	C.Hall					
Number of Tubes Used:	2	**Driving Wrench Used:**	**Yes:** X	**Scale No.:**	4S141	
			No:			

Station Number	Snow Depth (cm)		Core Length (cm)	Weight of Tube and Core (cm)	Weight Tube Only Before Sampling (cm)	Snow-Water Equivalent (cm)	Density (%)
	With Dirt Plug	Without Dirt Plug					
1	16	14	15	66	61	5	36
2	59	59	53	83	61	22	37
3	103	103	101	105	61	44	43
4	60	56	55	80	61	19	34
5	75	72	74	90	61	29	40
6	56	53	55	83	61	22	42
7	76	76	75	93	61	32	42
8	13	9	13	64	61	3	33
9	17	12	17	66	61	5	42
10	48	45	43	79	61	18	40
Total		499				199	
Average		50				19.9	39

Please complete in field or as soon after snow sampling as possible.

Time sampling began 12:28 a.m. ended 1:36 a.m.

A. Weather Conditions at Snow Course

	Freezing	X	Thawing		Temp	-10	˚C
	Blowing	X	Calm				
Skies:	Clear	X	Partly Cloudy		Overcast		
Precipitation:	None	X	Raining		Snowing		

B. Surface Snow Conditions at Snow Course

Fresh fallen snow depth 0 cm

	Wet		Dry	X			
	Soft		Crusted	X			
Support:	None		Person on skies/snowshoes		Person on foot	X	
Serious Drifting:	No	X	Yes*		Which Stations		
Evidence of oversnow traffic:	Yes*		No	X			

C. Sampling Conditions

	Easy		Moderately Difficult	X	Very Difficult		
Ground Reached on all Samples:	Yes	X	No*				
Ice Layers:	In snowpack	X	On ground				
Ground under snow:	Dry	X	Damp		Wet		Frozen

D. General Condition en Route

Snow line elevatio 0 metres

Thaw:	None	X	Sunny slopes		General		
Small streams:	Bridged with snow	X	Open		Clear		Muddy

*Describe fully under remarks

E. Remarks:

Appendix V6-1C

Investigating Impacts of the Proposed Development and Withdrawal at the Goose Property on Umwelt Lake Volume and Outflows

Rescan™
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Memorandum

DATE:	September 20, 2013
TO:	Deborah Muggli, Ph.D., M.Sc., RP Bio.
FROM:	Ali Naghibi, Ph.D., P.Eng. and David Luzi, M.Sc.
SUBJECT:	Investigating Impacts of the Proposed Development and Withdrawal at the Goose Property on Umwelt Lake Volume and Outflows

1. Introduction

This memo examines the impacts of the proposed development at the Goose Property on Umwelt Lake volume and outflows during the Operations phase of the Project. All Project components were assumed to be left in a physically and environmentally stable condition at Closure. Therefore, no effects analysis was performed for Reclamation/Closure and Post-closure phases of the Project.

2. Summary

The proposed Goose Property development (i.e., diversion of water from Llama Pit and Umwelt Pit catchment to the TIA) is expected to reduce Umwelt Lake outflows by 49%.

The impact on the lake volume during the summer months is expected to be significant; however, such an effect cannot be quantified without further information including the lake invert elevation and the lake volume-outflow relation.

No water withdrawal from Umwelt Lake is proposed, and therefore the lake volume during the winter will not be affected by the Project.

3. Data Source and Assumptions

The final water management plan for the Goose Property is not available; however, a list of the Project components and catchments upstream of Umwelt Lake, the natural runoff of which may be diverted to and stored in the TIA, is summarized in Table 1.

Table 1. List of Potential Water Diversion from Components and Catchments to the TIA

Component/Catchment	Area* (km^2)
Llama Pit	1.7
Umwelt Pit	0.3
Total	2.0

*: *Include both disturbed and undisturbed areas that report to the TIA.*

Contact water from disturbed areas (Llama Pit and Umwelt Pit), was assumed to be diverted to the TIA. In addition, runoff from the undisturbed catchments that drain into these disturbed areas was

considered to be diverted to the TIA. These diversion areas sum up to 49% of Umwelt Lake Watershed (Station UM-H1; drainage area 4.1 km^2).

Flow data at Umwelt Lake outlet (Station UM-H1) was not collected before 2013. That is, full-year flow data is not available at this location. In the absence of such data, it was assumed that the flow volumes were proportional to the catchment area. That is, 49% of the natural runoff into Umwelt Lake will be reduced due to the diversion into the TIA. Once the complete 2013 flow data are available, this assumption may be adjusted. It was conservatively assumed that a *Q* m^3/day upstream runoff reduction and lake water withdrawal would result in *Q* m^3/day reduction from the lake outflow, as well as *Q* m^3/day reduction from the lake volume.

At the baseline conditions, there is no streamflow during the winter, nor is any winter water withdrawal from Umwelt Lake planned. Therefore, no assessment was performed for streamflows during the winter.

The aforementioned data and assumptions may be improved when additional data (e.g., 2013 streamflow data, lake elevation-outflow relationship, and natural lake level variations) are available.

4. Analysis and Results

As previously mentioned, water from 49% of the catchment areas that would naturally drain into Umwelt Lake will be reduced by diversion into the TIA. Therefore, the lake outflow is expected to be reduced by 49%.

As previously mentioned, full-year flow data is not available at UM-H1. Based on catchment area proportions, the average Umwelt Lake outflows during 2011 and 2012 was estimated to be 0.6 million m^3/year (Table 2). A 49% reduction in lake outflows would be equivalent of 0.3 million m^3/year which is greater than the lake volume, 0.24 million m^3, (Rescan 2012). Although these values show that the effects on lake volume will be significant, such an effect cannot be quantified without further information including the invert elevation of the lake, and the lake volume-outflow relation.

Table 2. Average of 2011 and 2012 Volumetric Water Yield (million m^3) for Hydrometric Stations in the Goose Property Area

Hydrometric Station	Area (km^2)	Annual Flow Volume (Mm^3)	Annual Runoff (mm)
GL-H1	18	*1.58*	87.8
GL-H2	1.7	*0.36*	216.6
UM-H1	4.1	*0.61*[*]	150[*]

[*]: *not measured - estimated based on catchment area proportional to GL-H1 and GL-H2*

We trust that this analysis provides the information required with the available data. Please do not hesitate to contact us if you have any questions or concerns or require any additional analysis.

Prepared By:



Ali Naghibi, Ph.D., P. Eng.
Water Resources Engineer

Reviewed By:



David Luzi, M.Sc.
Hydrology Discipline Lead

References

DFO. 2010. *DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut, Fisheries and Oceans Canada, 21 June 2010.* http://mvlwb.ca/Boards/WLWB/Registry/2010/W2010C0005/W2010C0005%20-%20Land%20Use%20Permit%20Application%20-%20DFO%20Water%20Withdrawal%20Protocol%20-%20Aug%2025_10.pdf.

Rescan. 2012. *Back River Project 2011 Freshwater Baseline Report*. Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd.: Vancouver, BC.

Appendix V6-1D

Investigating Impacts of the Proposed Development and Withdrawal at the Goose Property on Goose Lake Volume and Outflows

Rescan™
an ERM company

Memorandum

DATE:	September 10, 2013
TO:	Deborah Muggli, Ph.D., M.Sc., RP Bio.
FROM:	Ali Naghibi, Ph.D., P.Eng. and David Luzi, M.Sc.
SUBJECT:	Investigating Impacts of the Proposed Development and Withdrawal at the Goose Property on Goose Lake Volume and Outflows

1. Introduction

This memo examines the impacts of the proposed water diversion and water withdrawal scenarios at the Goose Property on Goose Lake volume and outflows during the Site Preparation/Construction and Operations phases of the Project. All Project components were assumed to be left in a physically and environmentally stable condition at Closure. Therefore, no effects analysis was performed for Reclamation/Closure and Post-closure phases of the Project.

2. Summary

The water diversion and lake water withdrawal scenarios considered in this study include:

- **Water Diversion:** Contact water from disturbed areas (WRSA-A, WRSA-B, TIA, TIA berms, Landfill, Llama Pit, Umwelt Pit, Main Pit) will be diverted to the TIA. In addition, runoff from the undisturbed catchments that report to these disturbed areas will be diverted to the TIA. These diversion areas sum up to 11% of Goose Lake Watershed (Station PL-H2), and account for 17% of total runoff in this watershed. These diversions were assumed to be in place during Site Preparation/Construction and Operations phases of the Project.
- **Water Withdrawal**: Up to 280 m^3/day of year-round withdrawal (102,200 m^3/year) from Goose Lake was considered for domestic and miscellaneous industrial uses. In addition 720 m^3/day of year-round withdrawal (262,800 m^3/year) was proposed for mill operation uses. During the freshet, in June, an additional 1000 m^3/day (30,000 m^3/year) was assumed to be withdrawn for mill operation uses.

Impacts of the proposed diversion and withdrawal scenarios on Goose Lake outflows and water surface elevations are summarized in Table 1. The average lake outflow reduction was estimated to be 21% for normal years.

Winter withdrawal rates (1000 m^3/day) were less than the maximum allowable withdrawal based on the DFO (2010) protocol for over-wintering habitat (2208 m^3/day). Maximum water level drawdown during the winter, compared to the baseline condition, was 10 cm. During the summer, maximum water level drawdown, compared to the baseline condition, was 6 cm (Table 1).

Table 1. Effects of Proposed Water Diversion and Withdrawal on Goose Lake Outflows and Water Surface Elevation during the Open Water Season (June to September)

						Jun-Sep	
		June	July	August	September	Average	Max Daily
Lake Outflow Reduction	(million m^3)	0.51	0.05	0.02	0.02		
	(% of Baseline Flows)	21.3%	15.6%	22.7%	17.7%	21.2%	27.1%
Lake Volume Reduction	(million m^3)	0.07	0.02	0.02	0.01		
	(% of Baseline Volume)	0.7%	0.2%	0.2%	0.1%	0.4%	1.3%
Lake Elevation Reduction	(*m* drawdown from Baseline)	0.031	0.008	0.007	0.006	0.018	0.061

3. Data Sources and Assumptions

The final water management plan for the Goose Property is not available; however, a list of the Project components and catchments, the natural runoff of which may be diverted to and stored in the TIA, is summarized in Table 2.

Table 2. List of Potential Water Diversion from Components and Catchments to the TIA

Component/Catchment	Area[a] (km^2)	Reference Watershed[b]	Reference Watershed Area (km^2)
WRSA-A[c]	3.35	GI-H1	27.4
WRSA-A[d]	0.25	GL-H2	1.7
WRSA-B	3.19	PL-H2	101.5
Quarry	n/a	GL-H3	1.8
TIA	1.36	GI-H1	27.4
TIA berms	0.35	GI-H1	27.4
Landfill	0.33	GI-H1	27.4
Stockpile	n/a	GI-H1	27.4
Llama Pit	1.7	GL-H2	1.7
Umwelt Pit	0.33	GL-H1	18
Main Pit	0.49	WL-H1	32.7
Plant	0.23	GI-H1	27.4
Total	**11.6**		

[a]: *Include both disturbed and undisturbed areas that report to the TIA.*
[b]: *The watershed within which the component is located.*
[c]: *Part of the WRSA-A that is located within the GI-H1 watershed.*
[d]: *Part of the WRSA-A that is located within the GL-H2 watershed.*

Contact water from disturbed areas (WRSA-A, WRSA-B, TIA, TIA berms, Landfill, Llama Pit, Umwelt Pit, Main Pit), was assumed to be diverted to the TIA. In addition, runoff from the undisturbed catchments that drain into these disturbed areas was considered to be diverted to the TIA. These diversion areas sum up to 11% of Goose Lake Watershed (Station PL-H2), and account for 17% of total runoff in this watershed.

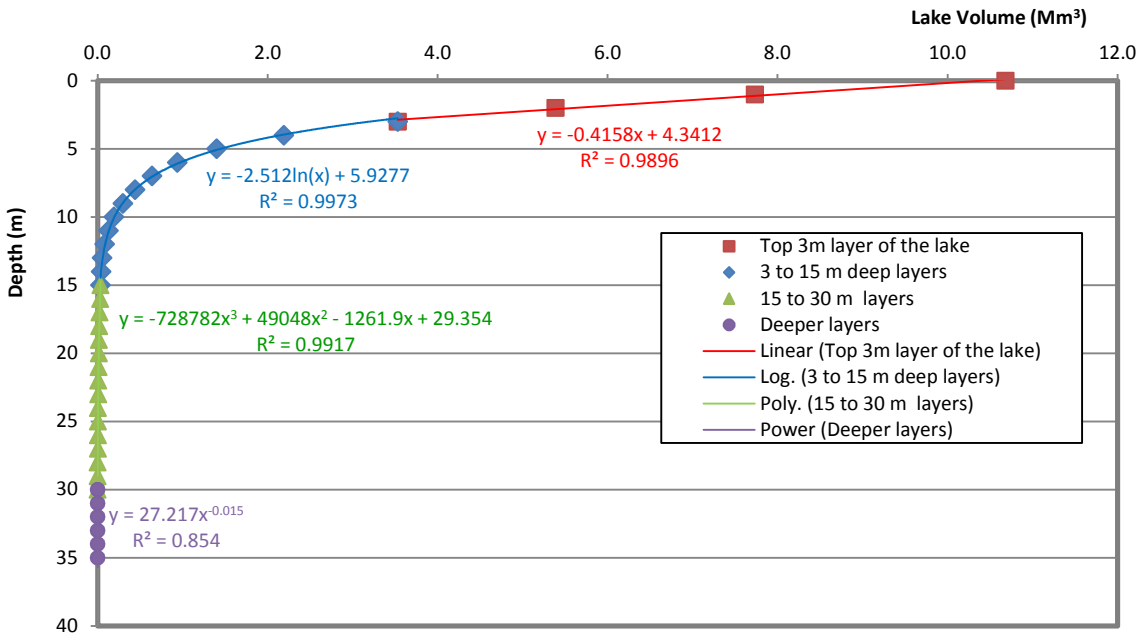
The proposed water withdrawal from Goose Lake for domestic and industrial uses is 2000 m^3/day during the freshet (i.e., in June) and 1000 m^3/day during the rest of the year. This includes 210 m^3/day for domestic use, 720 m^3/day for mill operations, and 70 m^3/day for miscellaneous industrial uses. In this study, no other potential withdrawal from Goose Lake was considered (e.g., Goose-George winter road).

The following assessments were performed for the aforementioned diversion and withdrawal scenarios. For the purpose of this study, the winter season was assumed to be October through May during which there would be no inflow to the lake (Rescan 2012b).

- **Impacts during the winter:** To assess the effects on lake volume, the compliance of lake water withdrawal in accordance with DFO (2010 was assessed to determine whether the withdrawal rate does not adversely affect the lake during the winter when there is no inflow to the lake. At the baseline conditions, there is no streamflow at the Goose Lake outlet channel during the winter. Therefore, no assessment was performed for streamflows during the winter.
- **Impacts during the summer:** A reservoir routing simulation was performed to estimate the potential effects of the diversion and withdrawal on Goose Lake volume and outflow.

Goose Lake volume data were based on the 2011 bathymetry survey (Rescan 2012a). The depth-volume relationship based on the 2011 bathymetry survey is shown in Figure 1. The full lake volume during the bathymetry survey (August 2011) was 10.67 million m^3; the volume of the lake under 2 m ice cover would be approximately 5.39 million m^3. It is seen that the depth-volume relationship in the top 3m layer of the lake can sufficiently be represented by a linear equation (Figure 1). That is, 1.0 Mm^3 change in the lake volume will result in a 42 cm change in the water elevation.

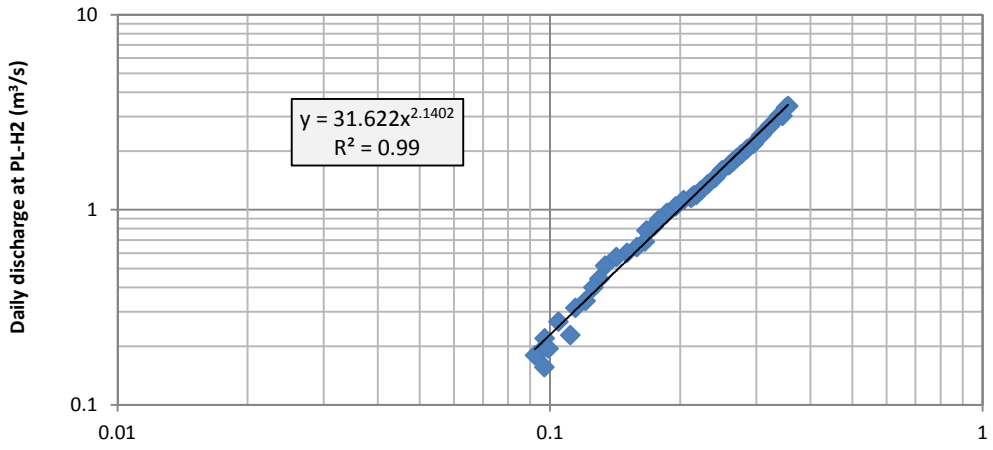
Figure 1. Depth-Volume Relation for Goose Lake



Daily timeseries of water level at Goose Lake (Station GC-L1) and streamflow at Station PL-H2 during June 7 to July 20, 2013, were used to develop a relationship between the lake water level and outflow.

A survey was conducted on June 16, 2013, and the lake outlet invert elevation was estimated to be 0.270 m below the lake water level. The pressure transducer at GC-L1 recorded a water surface elevation of 98.21 m on that day. That is, the lake outlet invert elevation is 97.94 (m) based on the local datum at Station GC-L1. The relationship between the daily water head above the invert elevation and daily flow discharge at Station PL-H2 is shown in Figure 2. The head-discharge relationship on the log-log graph is linear with a strong correlation (R^2 = 0.99). That is, the observed water elevation and outflow data, as well as the presumed invert elevation, could reliably be used in the reservoir routing analysis.

Figure 2. Daily Head-Discharge Curve



Major assumptions in this study include:

- Monthly flows during 2011 and 2012 (Rescan 2012b) were used to estimate the baseline conditions at the Goose Property (Table 3). Station PL-H2 was assumed to represent lake outflows.
- Based on assessment of regional hydrometric stations, i.e., active WSC stations and neighbouring projects stations, it was assumed that the 2012 flows were representative of long-term average flows.
- It was assumed that the linear relationship between Goose Lake volume and elevation (Figure 1) could be extrapolated for elevations higher than those of the 2011 bathymetry.
- During the winter (October to May) the lake does not have any live storage; that is, winter withdrawal will be taken from the dead storage. Therefore, a portion of June inflows to the lake will be used to compensate the volume of water that was withdrawn during October to May.

These assumptions may be improved when additional data (e.g., natural lake level variations and long-term record of streamflows) are available.

Table 3. Average of 2011 and 2012 Volumetric Water Yield (million m^3) for Hydrometric Stations in the Goose Property Area

Hydrometric Station	Area (km^2)	January-May	June	July	August	September	October-December	Total Annual (Mm^3)	Annual Runoff (mm)
GL-H1	18	*0.003*	*1.06*	0.27	0.023	*0.22*	*0*	*1.58*	87.8
GL-H2	1.7	*0.001*	*0.26*	0.059	0.005	*0.034*	*0*	*0.36*	216.6
GL-H3	1.8	*0.001*	*0.49*	0.13	0	*0.10*	*0*	*0.71*	389.9
PL-H1	204.4	*0.016*	*17.12*	6.04	0.57	*2.48*	*0.048*	*26.28*	128.5
PL-H2	101.5	*0.005*	*5.24*	1.70	0.46	*1.75*	*0.008*	*9.16*	90.3
GI-H1	27.4	*0.004*	*2.09*	0.81	0.25	*0.71*	*0.026*	*3.88*	141.7
EL-H1	1.4	*0*	*0.06*	0.009	0.001	*0.020*	*0*	*0.09*	66.3
WL-H1	32.7	*0.003*	*2.09*	0.52	0.068	*0.36*	*0*	*3.04*	93.1
REFB-H1	5.3	*0.001*	*0.19*	0.041	0.000	*0.019*	*0*	*0.25*	47.9
BL-H1	3.6	*0.001*	*0.10*	0.007	0.006	*0.015*	*0*	*0.13*	35.9
BL-H2	160	*0.001*	*7.96*	2.34	0.66	*0.15*	*0*	*11.12*	69.5
BL-H3	21.4	*0.005*	*1.24*	0.060	0.078	*0.13*	*0*	*1.52*	70.8

4. Analysis and Results

4.1 Impacts during the Winter

Fisheries and Oceans Canada (DFO) in the Northwest Territories and Nunavut have provided guidance for winter water withdrawal limits to mitigate impact on fish through oxygen depletion, loss of over-wintering habitat and/or reductions in littoral habitat (DFO 2010). In one winter season, total water withdrawal from a single waterbody is not to exceed 10% of the available water volume calculated using the appropriate maximum expected ice thickness. For the purpose of this study, the winter season was assumed to be October through May during which there is no inflow to the lake (Rescan 2012b). The maximum ice thickness in the project area, which is above the tree line, was estimated to be 2 m (DFO 2010).

The volume of water in Goose Lake under 2 m ice cover is 5.39 million m^3. Therefore, the maximum allowable withdrawal during the winter season without violating the DFO (2010) protocol can be calculated as follows:

Maximum allowable winter withdrawal = $\frac{10\%(5.39\times10^6 m^3)}{243(days)} = 2208\ m^3/day$

The maximum allowable winter withdrawal available is 2208 m^3/day, which is greater than the proposed winter withdrawal of 1000 m^3/day (which would result in an under-ice volume reduction of 5%). Therefore, the proposed withdrawal will not violate requirements of DFO (2010) protocol for winter water withdrawal.

The proposed maximum 1000 m^3/day water withdrawal would result in 0.24 million m^3 volume reduction during the winter. The maximum water withdrawal associated with this volume reduction is 10 cm.

4.2 Impacts during Open Water Season

Impacts of water withdrawal on lake outflows during the open water season (June to September) were estimated with a reservoir routing scheme:

$$V_{i+1=}V_i + I_i - O_i \qquad \text{Equation (1)}$$

Where

i : daily timesteps (day)
V_i : volume of the lake at the beginning of timestep *i* (mcm)
I_i : lake inflow during timestep *i* (mcm). This is the net inflow. That is, the losses (e.g., evaporation) are already deducted.
O_i : lake outflow during timestep *i* (mcm)

The relationship between daily lake outflows and water level (Figure 2) was used in the form of:

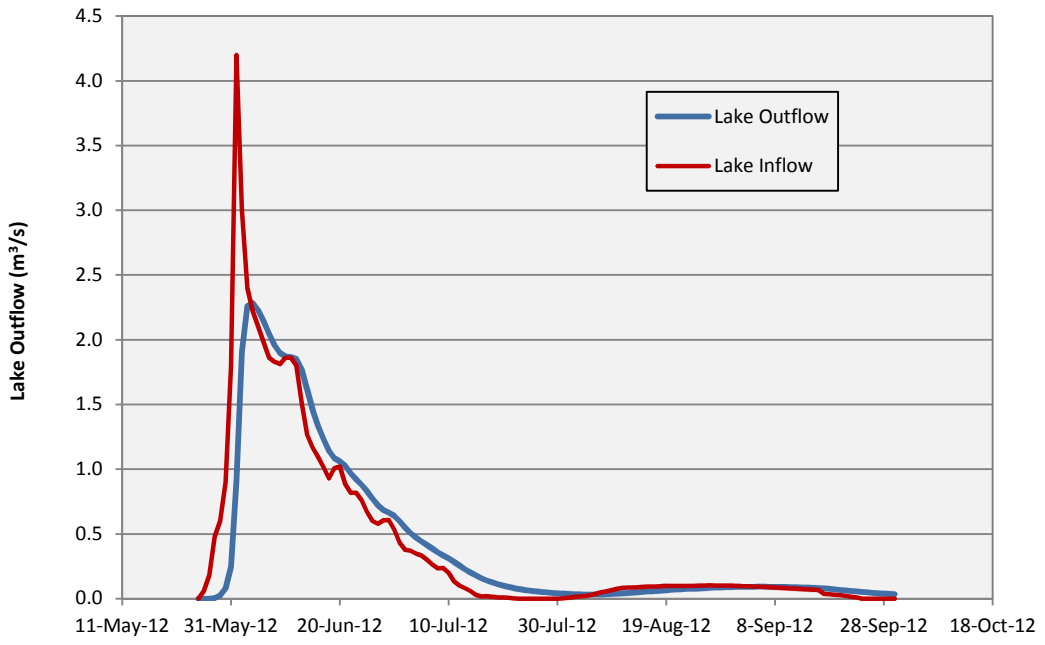
$$O_i = 31.622 \times \left(\frac{E_i + E_{i+1}}{2} - 97.94\right)^{2.14} \times 0.0864 \qquad \text{Equation (2)}$$

Where

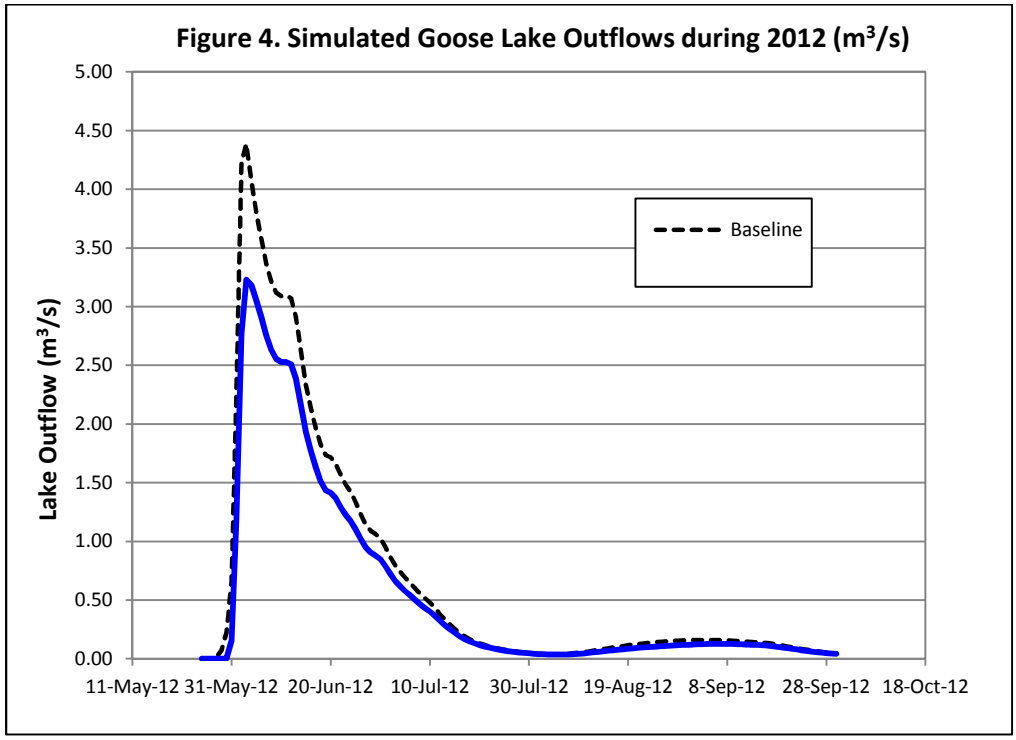
E_i : lake water level at the beginning of timesteps (m)
0.0864 : m^3/s to mcm convertor

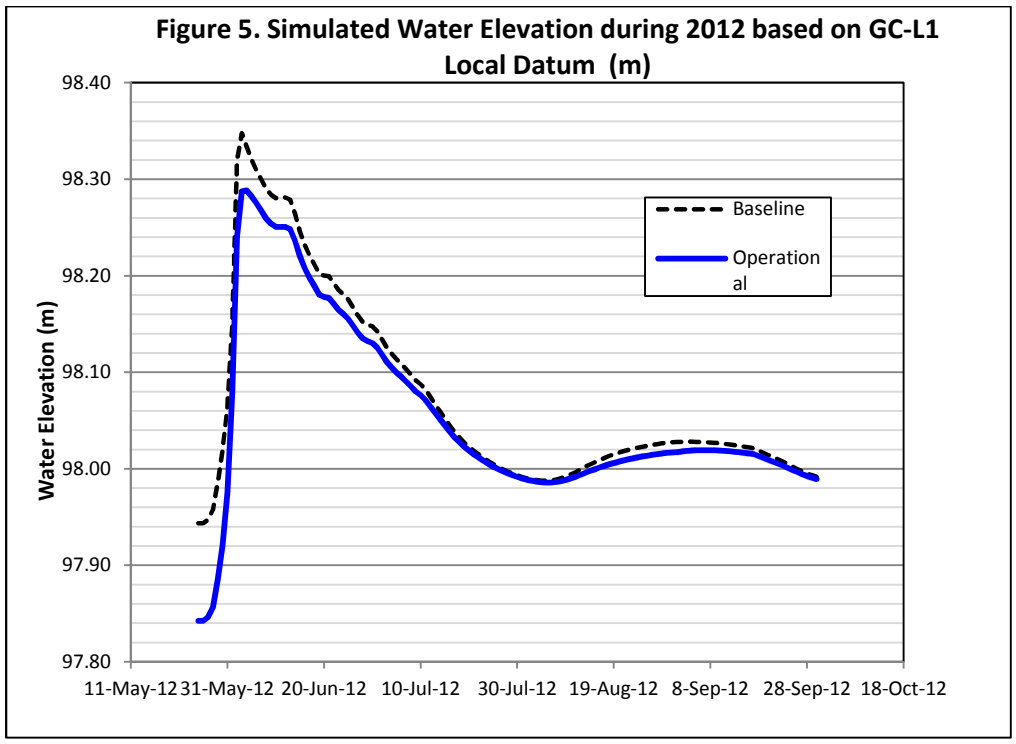
Observed daily flows at PL-H2 during 2012 was used as the lake outflow timeseries (O_i) in Equations 1 and 2; and the corresponding lake inflow hydrograph was estimated. The inflow hydrograph represents the net inflows from which the losses (e.g., evaporation) are already deducted (Figure 3).

Figure 3. Simulated Goose Lake Baseline Inflow and Outflow during 2012



The simulated baseline inflow hydrograph was then used in Equations 1 and 2 to estimate the lake elevation and outflows for all water diversion and withdrawal scenarios. The results are summarized in Figures 4 and 5, and Table 1. The average and maximum lake outflow reductions, compared to the baseline condition, were 21% and 27%, respectively. Maximum water elevation drawdown compared to the baseline conditions was 6 cm in the summer, and 10 cm in the winter.





We trust that this analysis provides the information required with the available data. Please do not hesitate to contact us if you have any questions or concerns or require any additional analysis.

Prepared By:



Ali Naghibi, Ph.D., P. Eng.
Water Resources Engineer

Reviewed By:



David Luzi, M.Sc.
Hydrology Discipline Lead

References

DFO 2010. *DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut, Fisheries and Oceans Canada, 21 June 2010.* http://mvlwb.ca/Boards/WLWB/Registry/2010/W2010C0005/W2010C0005%20-%20Land%20Use%20Permit%20Application%20-%20DFO%20Water%20Withdrawal%20Protocol%20-%20Aug%2025_10.pdf.

Rescan 2012a. *Back River Project 2012 Freshwater Baseline Report*. Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd.: Vancouver, BC.

Rescan. 2012b. *Back River Project 2012 Hydrology Baseline Report*. Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd.: Vancouver, BC.

Appendix V6-1E

Investigating Impacts of the Proposed Development and Withdrawal at the Goose Property on Propeller Lake Volume and Outflows

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Memorandum

DATE: September 6, 2013

TO: Deborah Muggli, Ph.D., M.Sc., RP Bio.

FROM: Ali Naghibi, Ph.D., P.Eng. and David Luzi, M.Sc.

SUBJECT: Investigating Impacts of the Proposed Development and Withdrawal at the Goose Property on Propeller Lake Volume and Outflows

1. Introduction

This memo examines the impacts of the proposed development and water withdrawal on Propeller Lake volume and outflows during the Operations phase of the Project. All Project components were assumed to be left in a physically and environmentally stable condition at Closure. Therefore, no effects analysis was performed for Reclamation/Closure and Post-closure phases of the Project.

2. Summary

Impacts of the proposed Goose Property development and withdrawal on Propeller Lake outflows are summarized in Table 1. The average lake outflow reduction during June to September was estimated to be 9.7%.

Table 1. Propeller Lake Outflow and Volume Reduction due to all Diversions at Goose Property and Water Withdrawals from Goose Lake and Propeller Lake

						Jun-Sep	
		June	July	August	September	Average	Max Monthly
Lake Outflow Reduction	(million m^3)	1.69	0.37	0.15	0.33		
	(% of Baseline Flows)	9.9%	6.2%	26.7%	13.1%	9.7%	26.7%
Lake Volume Reduction	(million m^3)	1.69	0.37	0.15	0.33		
	(% of Baseline Volume)	6.4%	1.4%	0.6%	1.2%	2.3%	6.2%

Winter withdrawal rates (1,510 m^3/day) were less than the maximum allowable withdrawal based on the DFO (2010) protocol for over-wintering habitat (10,930 m^3/day).

3. Data Sources and Assumptions

Average flows during 2011 and 2012 (Table 2) were used to estimate the baseline conditions at the Propeller Lake outflow and at upstream catchments (Rescan 2012). Station PL-H1 was assumed to represent lake outflows.

Table 2. Average Volumetric Water Yield (million m^3) for Hydrometric Station PL-H1 in 2011 and 2012

Hydrometric Station	Area (km^2)	January-May	June	July	August	September	October-December	Total Annual (Mm^3)	Annual Runoff (mm)
GL-H1	18	*0.003*	*1.06*	0.27	0.023	*0.22*	*0*	*1.58*	87.8
GL-H2	1.7	*0.001*	*0.26*	0.059	0.005	*0.034*	*0*	*0.36*	216.6
GL-H3	1.8	*0.001*	*0.49*	0.13	0	*0.10*	*0*	*0.71*	389.9
PL-H1	204.4	*0.016*	*17.12*	6.04	0.57	*2.48*	*0.048*	*26.28*	128.5
PL-H2	101.5	*0.005*	*5.24*	1.70	0.46	*1.75*	*0.008*	*9.16*	90.3
GI-H1	27.4	*0.004*	*2.09*	0.81	0.25	*0.71*	*0.026*	*3.88*	141.7
EL-H1	1.4	*0*	*0.06*	0.009	0.001	*0.020*	*0*	*0.09*	66.3
WL-H1	32.7	*0.003*	*2.09*	0.52	0.068	*0.36*	*0*	*3.04*	93.1
REFB-H1	5.3	*0.001*	*0.19*	0.041	0.000	*0.019*	*0*	*0.25*	47.9
BL-H1	3.6	*0.001*	*0.10*	0.007	0.006	*0.015*	*0*	*0.13*	35.9
BL-H2	160	*0.001*	*7.96*	2.34	0.66	*0.15*	*0*	*11.12*	69.5
BL-H3	21.4	*0.005*	*1.24*	0.060	0.078	*0.13*	*0*	*1.52*	70.8

The final water management plan for the Goose Property is not available; however, a list of the Project components and catchments, the natural runoff of which may be diverted to and stored in the TIA, is summarized in Table 3.

Table 3. List of Potential Water Diversion from Components and Catchments to the TIA

Component/Catchment	Area[a] (km^2)	Reference Watershed[b]	Reference Watershed Area (km^2)
WRSA-A[c]	3.35	GI-H1	27.4
WRSA-A[d]	0.25	GL-H2	1.7
WRSA-B	3.19	PL-H2	101.5
Quarry	n/a	GL-H3	1.8
TIA	1.36	GI-H1	27.4
TIA berms	0.35	GI-H1	27.4
Landfill	0.33	GI-H1	27.4
Stockpile	n/a	GI-H1	27.4
Llama Pit	1.70	GL-H2	1.7
Umwelt Pit	0.33	GL-H1	18
Main Pit	0.49	WL-H1	32.7
Plant	0.23	GI-H1	27.4
Total	**11.6**		

[a]: *Include both disturbed and undisturbed areas that report to the TIA.*
[b]: *The watershed within which the component is located.*
[c]: *Part of the WRSA-A that is located within the GI-H1 watershed.*
[d]: *Part of the WRSA-A that is located within the GL-H2 watershed.*

Contact water from disturbed areas (WRSA-A, WRSA-B, TIA, TIA berms, Landfill, Llama Pit, Umwelt Pit, Main Pit), was assumed to be diverted to the TIA. In addition, runoff from the undisturbed catchments that drain into these disturbed areas was considered to be diverted to the TIA. These diversion areas sum up to 11% of Goose Lake Watershed (Station PL-H2), and account for 17% of total runoff in this watershed.

The proposed water withdrawal from Goose Lake and Propeller Lake is:

- Goose Lake: 2,000 m^3/day during the freshet, i.e., in June, and 1,000 m^3/day during the rest of the year (total of 0.40 million m^3/year).
- Propeller Lake: 2,510 m^3/day during the freshet, i.e., in June, and 1,510 m^3/day during the rest of the year (total of 0.58 million m^3/year).

The following assessments were performed for the aforementioned development and withdrawal scenarios. For the purpose of this study, the winter season was assumed to be October through May during which there is no inflow to the lake (Rescan 2012).

- **Impacts during the winter:** To estimate the effects on lake volume, the compliance of lake water withdrawal in accordance with DFO (2010) was assessed to determine whether the withdrawal rate does not adversely affect the lake during the winter when there is no inflow to the lake. At the baseline conditions, there is no streamflow at the Propeller Lake outlet channel during the winter. Therefore, no assessment was performed for streamflows during the winter.
- **Impacts during the summer:** During the winter the lake does not have any live storage; that is, winter withdrawal will be taken from the dead storage. Therefore, a portion of June inflows to the lake is used to compensate the volume of water that was withdrawn during the winter. Taking this compensation into account it was conservatively assumed that a Q m^3/day upstream runoff reduction and lake water withdrawal would result in Q m^3/day reduction from the lake outflow, as well as Q m^3/day reduction from the lake volume.

Propeller Lake volume (52.25 million m^3) and the volume of lake under 2m ice (26.56 million m^3) were taken from Tetra Tech bathymetry (Tetra Tech 2013).

The aforementioned data and assumptions may be improved when additional data (e.g., lake elevation-outflow relationship, natural lake level variations, and long-term record of streamflows) are available.

4. Analysis and Results

4.1 Impacts during the Winter

Fisheries and Oceans Canada (DFO) in the Northwest Territories and Nunavut have provided guidance for winter water withdrawal limits to mitigate impact on fish through oxygen depletion, loss of over-wintering habitat and/or reductions in littoral habitat (DFO 2010). In one winter season, total water withdrawal from a single waterbody is not to exceed 10% of the available water volume calculated using the appropriate maximum expected ice thickness. For the purpose of this study, the winter season was assumed to be October through May during which there is no inflow to the lake (Rescan 2012b). The maximum ice thickness in the project area, which is above the tree line, was estimated to be 2 m (DFO 2010).

The volume of water in Propeller Lake under 2 m ice cover is 26.56 million m^3(Tetra Terch, 2013). Therefore, the maximum allowable withdrawal during the winter season without violating the DFO (2010) protocol can be calculated as follows:

Maximum allowable winter withdrawal = $\frac{10\%(26.56\times10^6 m^3)}{243(days)} = 10{,}930\ m^3/day$

The maximum allowable winter withdrawal available is 10,930 m^3/day, which is greater than the proposed winter withdrawal of 1,510 m^3/day (which would result in an under-ice volume reduction of 1%) during the operations phase. Therefore, the proposed withdrawal will not violate requirements of DFO (2010) protocol for winter water withdrawal.

4.2 Impacts during the Open Water Season

During the winter the lake does not have any live storage; that is, the 1,510 m^3/day winter withdrawal will be taken from the dead storage. Therefore, a portion of June inflows to the lake is used to compensate the volume of water that was withdrawn during the winter. Taking this compensation into account, and using the conservative approach as described in Section 3, lake outflow and lake volume reductions were summarized in Table 1. Average Lake outflow reduction during the summer was estimated to be 9.7%.

We trust that this analysis provides the information required with the available data. Please do not hesitate to contact us if you have any questions or concerns or require any additional analysis.

Prepared By:



Ali Naghibi, Ph.D., P. Eng.
Water Resources Engineer

Reviewed By:



David Luzi, M.Sc.
Hydrology Discipline Lead

References

DFO 2010. *DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut, Fisheries and Oceans Canada, 21 June 2010.* http://mvlwb.ca/Boards/WLWB/Registry/2010/W2010C0005/W2010C0005%20-%20Land%20Use%20Permit%20Application%20-%20DFO%20Water%20Withdrawal%20Protocol%20-%20Aug%2025_10.pdf.

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Appendix V6-1F

Investigating Impacts of the Proposed Development and Withdrawal at the George Property on George Lake Volume and Outflows

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Memorandum

DATE:	September 10, 2013
TO:	Deborah Muggli, Ph.D., M.Sc., RP Bio.
FROM:	Ali Naghibi, Ph.D., P.Eng. and David Luzi, M.Sc.
SUBJECT:	Investigating Impacts of the Proposed Development and Withdrawal at the George Property on George Lake Volume and Outflows

1. Introduction

This memo examines the impacts of the proposed development and water withdrawal at the George Property on George Lake volume and outflows during the Site Preparation/Construction and Operations phases of the Project. All Project components were assumed to be left in a physically and environmentally stable condition at Closure. Therefore, no effects analysis was performed for Reclamation/Closure and Post-closure phases of the Project.

2. Summary

The development and lake water withdrawal scenarios considered in this study include:

- **Development:** Disturbed areas (WRSA-C, WRSA-D, WRSA-E, LCP North Pit, and Landfill) reduce the natural runoff into George Lake through increased losses (i.e., decreased runoff coefficient). The natural runoff coefficient (47%) was assumed to be decreased to 30% in these areas during Site Preparation/Construction and Operations. , and Reclamation and closure phases of the Project.
- **Water Withdrawal**: Up to 115 m^3/day of year-round water withdrawal (42,000 m^3/year) from George Lake was considered for domestic and dust suppression uses.

Impacts of the proposed development and withdrawal on George Lake outflows and water surface elevations are summarized in Table 1. The average lake outflow reduction was estimated to be 9.7% for normal years.

Winter withdrawal rates (115 m^3/day) were less than the maximum allowable withdrawal based on the DFO (2010) protocol for over-wintering habitat (950 m^3/day). Maximum water level drawdown, compared to the baseline condition, was 8 cm (Table 1).

3. Data Sources and Assumptions

The final water management plan for the George Property is not available; however, a list of the Project components and catchments, the natural runoff of which would drain into George Lake, is summarized in Table 2. In this analysis it was assumed that the development is complete at the end of Site Preparation and Construction phase. It is seen that 18.5% (i.e., 1.79 / 9.70) of the lake watershed is impacted by Project components.

Table 1. Effects of Proposed Water Diversion and Withdrawal on George Lake Outflow and Water Surface Elevation during the Open Water Season (June to September)

						Jun-Sep	
		June	July	August	September	Average	Max Monthly
Lake Outflow Reduction	(million m^3)	0.10	0.03	0.01	0.01		
	(% of Baseline Flows)	10.0%	7.8%	13.1%	13.5%	9.7%	13.5%
Lake Volume Reduction	(million m^3)	010	0.03	0.01	0.01		
	(% of Baseline Volume)	1.9%	0.5%	0.1%	0.1%	0.7%	1.9%
Lake Elevation Reduction	(*m* drawdown from Baseline)	0.08	0.02	0.01	0.01	0.03	0.08

Table 2. List of Potential Development Areas at George Property

Component/Catchment	Area[a] (km^2)	Reference Watershed[b]	Reference Watershed Area (km^2)
WRSA-E	0.51	KL-H2	9.7
WRSA-D	0.42	KL-H2	9.7
WRSA-C	0.67	KL-H2	9.7
LCP North	0.06	KL-H2	9.7
Landfill	0.13	KL-H2	9.7
Total	**1.79**		

[a]*: Includes both disturbed and undisturbed areas that report to George Lake.*
[b]*: It is conservatively assumed that LCP north and WRSA-E are completely located within the KL-H2 watershed.*

In the water balance model developed by Knight Piesold, the natural runoff coefficient was assumed to be 0.47. For waste rock storage areas, the runoff coefficient was reduced to 0.30 (i.e., 36% reduction from the natural runoff coefficient). In this analysis, the runoff coefficients of LCP North and Landfill were conservatively assumed to be similar to those of waste rock storage areas. These reduced runoff coefficient values were assumed to be in place throughout the Site Preparation/Construction and Operations. The Reclamation and Closure plan of the Project is expected to leave all Project components in a physically and environmentally stable condition without significant effects on the environment. Therefore, no effects analysis was performed for Reclamation/Closure and Post-closure phases of the Project.

The proposed water withdrawal from George Lake includes up to 45 m^3/day of year-round withdrawal (16,400 m^3/year) for domestic use and 70 m^3/day of year-round withdrawal (25,550 m^3/year) for dust suppression.

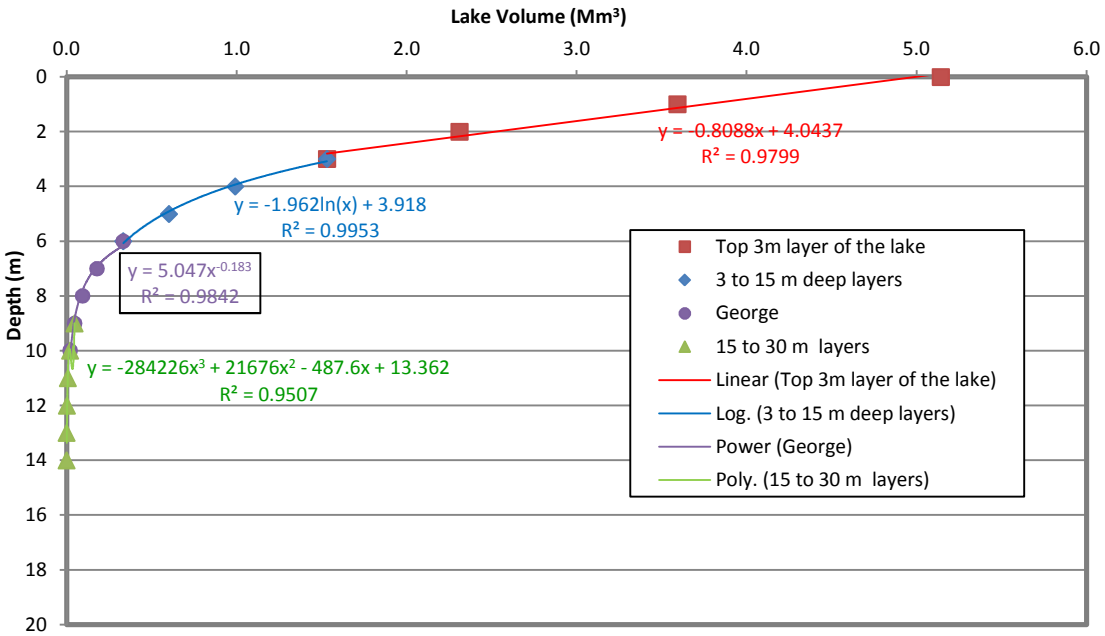
The following assessments were performed for the aforementioned development and withdrawal scenarios. For the purpose of this study, the winter season was assumed to be October through May during which there would be no inflow to the lake (Rescan 2012b).

- **Impacts during the winter:** To estimate the effects on lake volume, the compliance of lake water withdrawal in accordance with DFO (2010) was assessed to determine whether the withdrawal rate does not adversely affect the lake during the winter when there is no inflow to the lake. At the baseline conditions, there is no streamflow at the George Lake outlet channel during the winter. Therefore, no assessment was performed for streamflows during the winter.

- **Impacts during the summer:** During the winter the lake does not have any live storage; that is, winter withdrawal will be taken from the dead storage. Therefore, a portion of June inflows to the lake is used to compensate the volume of water that was withdrawn during the winter. Taking this compensation into account, it was conservatively assumed that a *Q* m^3/day upstream runoff reduction and lake water withdrawal would result in *Q* m^3/day reduction from the lake outflow, as well as *Q* m^3/day reduction from the lake volume.

George Lake volume data were based on the 2012 bathymetry survey (Rescan 2012a). The depth-volume relationship based on the 2012 bathymetry survey is shown in Figure 1. The full lake volume during the bathymetry survey was 5.14 million m^3; the volume of the lake under 2 m ice cover would be approximately 2.31 million m^3. It is seen that the depth-volume relationship in the top 3m layer of the lake can sufficiently be represented by a linear equation (Figure 1). That is, 1.0 million m^3 change in the lake volume will result in a 81 cm change in the water elevation.

Figure 1. Depth-Volume Relation for George Lake



Major assumptions in this study include:

- Monthly flows during 2012 (Rescan 2012b) were used to estimate the baseline conditions at the George Property (Table 3). Station KL-H2 was assumed to represent lake outflows.
- Based on assessment of regional hydrometric stations, i.e., active WSC stations and neighbouring projects stations, it was assumed that the 2012 flows were representative of long-term average flows.
- It was assumed that the linear relationship between George Lake volume and elevation (Figure 1) could be extrapolated for elevations higher than those of the bathymetry.
- During the winter (October to May) the lake does not have any live storage; that is, winter withdrawal will be taken from the dead storage. Therefore, a portion of June inflows to the lake will be used to compensate the volume of water that was withdrawn during October to May.

Table 3. Volumetric Water Yield (million m3) for Hydrometric Station KL-H2 in 2012

Hydrometric Station	Area (km^2)	January-May	June	July	August	September	October-December	Total Annual (Mm^3)	Annual Runoff (mm)
KL-H1	9.7	0	0.95	0.32	0.06	0.05	0	*1.38*	143

These assumptions may be improved when additional data (e.g., lake elevation-outflow relationship, natural lake level variations, and long-term record of streamflows) are available.

4. Analysis and Results

4.1 Impacts during the Winter

Fisheries and Oceans Canada (DFO) in the Northwest Territories and Nunavut have provided guidance for winter water withdrawal limits to mitigate impact on fish through oxygen depletion, loss of over-wintering habitat and/or reductions in littoral habitat (DFO 2010). In one winter season, total water withdrawal from a single waterbody is not to exceed 10% of the available water volume calculated using the appropriate maximum expected ice thickness. For the purpose of this study, the winter season was assumed to be October through May during which there is no inflow to the lake (Rescan 2012b). The maximum ice thickness in the project area, which is above the tree line, was estimated to be 2 m (DFO 2010).

The volume of water in George Lake under 2 m ice cover is 2.31 million m^3. Therefore, the maximum allowable withdrawal during the winter season without violating the DFO (2010) protocol can be calculated as follows:

$$\textit{Maximum allowable winter withdrawal} = \frac{10\%\left(2.31\times10^{6}m^{3}\right)}{243(days)} = 950\ m^{3}/day$$

The maximum allowable winter withdrawal available is 950 m^3/day, which is greater than the proposed water withdrawal of 115 m^3/day (which would result in an under-ice volume reduction of 1%). Therefore, the proposed withdrawal will not violate requirements of DFO (2010) protocol for winter water withdrawal.

The proposed maximum 115 m^3/day water withdrawal would result in 0.03 million m^3 volume reduction during the winter. The maximum water withdrawal associated with this volume reduction is 2 cm.

4.2 Impacts during the Open Water Season

As previously mentioned, 18.5% of the lake watershed will be developed by Project components, and the runoff coefficient of developed areas will be reduced by 36% compared to the baseline conditions. Therefore, it is expected that the George Lake inflows be reduced by 6.7% (18.5% * 36%) due to upstream development.

During the winter the lake does not have any live storage; that is, the 115 m^3/day winter withdrawal will be taken from the dead storage. Therefore, a portion of June inflows to the lake would be used to compensate the volume of water that was withdrawn during the winter. Taking this compensation into account, and using the conservative approach as described in Section 3, lake volume and outflow reductions were estimated and summarized in Table 1. Average Lake outflow reduction during the summer was estimated to be 9.7%, and the lake elevation was estimated to be drawn down by up to 8 cm.

We trust that this analysis provides the information required with the available data. Please do not hesitate to contact us if you have any questions or concerns or require any additional analysis.

Prepared By:



Ali Naghibi, Ph.D., P. Eng.
Water Resources Engineer

Reviewed By:



David Luzi, M.Sc.
Hydrology Discipline Lead

References

DFO 2010. *DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut, Fisheries and Oceans Canada, 21 June 2010.* http://mvlwb.ca/Boards/WLWB/Registry/2010/W2010C0005/W2010C0005%20-%20Land%20Use%20Permit%20Application%20-%20DFO%20Water%20Withdrawal%20Protocol%20-%20Aug%2025_10.pdf.

Rescan 2012a. *Back River Project 2012 Freshwater Baseline Report*. Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd.: Vancouver, BC.

Rescan. 2012b. *Back River Project 2012 Hydrology Baseline Report*. Prepared for Sabina Gold & Silver Corp. by Rescan Environmental Services Ltd.: Vancouver, BC.

Appendix V6-2A

Analytical Results of the Umwelt Westbay Groundwater Sampling Program

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RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
Sixth Floor
1111 West Hastings Street
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Date Received: 03-JUN-13
Report Date: 20-JUN-13 16:51 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1310386

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-295953
Legal Site Desc:



Amber Springer
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1310386-1 Water 01-JUN-13 10:00 IWB-1-2013	L1310386-2 Water 01-JUN-13 10:00 ZONE1-1-2013	L1310386-3 Water 01-JUN-13 10:00 ZONE5-1-2013	L1310386-4 Water 02-JUN-13 10:00 ZONE4-1-2013	L1310386-5 Water ALS TRAVEL BLANK
WATER						
Physical Tests	Conductivity (uS/cm)	22300	173000	180000	154000	2.2
	Hardness (as CaCO3) (mg/L)	25400	142000	150000	146000	
	pH (pH)	6.98	7.71	7.88	7.67	7.31
	Total Suspended Solids (mg/L)	490	245	253	572	<3.0
	Total Dissolved Solids (mg/L)	57500	187000	201000	188000	<10
	Turbidity (NTU)	118	138	10.6	396	<0.10
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	20.3	36.0	43.0	31.1	<2.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	20.3	36.0	43.0	31.1	<2.0
	Ammonia, Total (as N) (mg/L)	0.851	3.84	4.43	3.77	0.0081 RRV
	Bromide (Br) (mg/L)	315	1580	1660	1500	<0.050
	Chloride (Cl) (mg/L)	23800	114000	120000	109000	<0.50
	Fluoride (F) (mg/L)	0.067	0.43	0.46	0.41	<0.020
	Nitrate (as N) (mg/L)	<0.50 DLM	<0.50 DLM	<0.50 DLM	<0.50 DLM	<0.0050
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.10 DLM	<0.10 DLM	<0.10 DLM	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	<25 DLM	<25 DLM	<25 DLM	<25 DLM	0.138 RRV
	Orthophosphate-Dissolved (as P) (mg/L)	0.877	0.045	0.047	0.057	<0.0010
	Phosphorus (P)-Total (mg/L)	68.7	1.40	0.416	2.32	<0.0020
	Sulfate (SO4) (mg/L)	<50 DLM	<50 DLM	<50 DLM	<50 DLM	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	1.41	4.13	<1.5 DLA	<0.60 DLA	<0.0030
	Antimony (Sb)-Total (mg/L)	<0.010 DLA	0.016	<0.025 DLA	<0.010 DLA	<0.000050
	Arsenic (As)-Total (mg/L)	<0.0060 DLA	0.0209	<0.015 DLA	<0.0060 DLA	<0.000030
	Barium (Ba)-Total (mg/L)	0.442	2.91	2.80	2.76	<0.000050
	Beryllium (Be)-Total (mg/L)	<0.040 DLA	<0.040 DLA	<0.10 DLA	<0.040 DLA	<0.00020
	Bismuth (Bi)-Total (mg/L)	<0.10 DLA	<0.10 DLA	<0.25 DLA	<0.10 DLA	<0.00050
	Boron (B)-Total (mg/L)	3.0	15.0	13.2	11.6	<0.0050
	Cadmium (Cd)-Total (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0050 DLA	<0.0020 DLA	<0.000010
	Calcium (Ca)-Total (mg/L)	8770	59000	55500	51100	<0.020
	Chromium (Cr)-Total (mg/L)	0.070	0.062	<0.050 DLA	<0.020 DLA	<0.00010
	Cobalt (Co)-Total (mg/L)	<0.020 DLA	<0.020 DLA	<0.050 DLA	<0.020 DLA	<0.00010
	Copper (Cu)-Total (mg/L)	<0.10 DLA	<0.10 DLA	<0.25 DLA	<0.10 DLA	<0.00050
	Iron (Fe)-Total (mg/L)	5.00	15.8	2.7	<1.0 DLA	<0.010
	Lead (Pb)-Total (mg/L)	0.017	0.019	<0.025 DLA	<0.010 DLA	<0.000050
	Lithium (Li)-Total (mg/L)	8.28	46.7	45.3	38.7	<0.0050
	Magnesium (Mg)-Total (mg/L)	29.5	48.3	70.0	70.0	<0.0050
	Manganese (Mn)-Total (mg/L)	0.093	0.395	0.475	0.346	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310386-6				
	Description	Water				
	Sampled Date					
	Sampled Time					
	Client ID	ALS FIELD BLANK				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	<2.0				
	Hardness (as CaCO3) (mg/L)					
	pH (pH)	6.86				
	Total Suspended Solids (mg/L)	<3.0				
	Total Dissolved Solids (mg/L)	<10				
	Turbidity (NTU)	<0.10				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	<2.0				
	Ammonia, Total (as N) (mg/L)	<0.0050				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	<0.020				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	<0.050				
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010				
	Phosphorus (P)-Total (mg/L)	<0.0020				
	Sulfate (SO4) (mg/L)	<0.50				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030				
	Antimony (Sb)-Total (mg/L)	<0.000050				
	Arsenic (As)-Total (mg/L)	<0.000030				
	Barium (Ba)-Total (mg/L)	<0.000050				
	Beryllium (Be)-Total (mg/L)	<0.00020				
	Bismuth (Bi)-Total (mg/L)	<0.00050				
	Boron (B)-Total (mg/L)	<0.0050				
	Cadmium (Cd)-Total (mg/L)	<0.000010				
	Calcium (Ca)-Total (mg/L)	<0.020				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	<0.010				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.0050				
	Magnesium (Mg)-Total (mg/L)	<0.0050				
	Manganese (Mn)-Total (mg/L)	<0.000050				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1310386-1 Water 01-JUN-13 10:00 IWB-1-2013	L1310386-2 Water 01-JUN-13 10:00 ZONE1-1-2013	L1310386-3 Water 01-JUN-13 10:00 ZONE5-1-2013	L1310386-4 Water 02-JUN-13 10:00 ZONE4-1-2013	L1310386-5 Water ALS TRAVEL BLANK
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.076	0.351	0.365	0.323	<0.000050
	Nickel (Ni)-Total (mg/L)	0.069	0.068	DLA <0.050	DLA <0.020	<0.00010
	Phosphorus (P)-Total (mg/L)	50.7	DLA <30	DLA <30	DLA <30	<0.30
	Potassium (K)-Total (mg/L)	2890	2540	2260	2240	<0.050
	Selenium (Se)-Total (mg/L)	DLA <0.020	0.047	DLA <0.050	DLA <0.020	<0.00010
	Silicon (Si)-Total (mg/L)	2.1	DLA <5.0	DLA <5.0	DLA <5.0	<0.050
	Silver (Ag)-Total (mg/L)	DLA <0.0020	0.0027	DLA <0.0050	DLA <0.0020	<0.000010
	Sodium (Na)-Total (mg/L)	267	1070	1210	1160	<0.010
	Strontium (Sr)-Total (mg/L)	166	896	899	823	<0.00020
	Thallium (Tl)-Total (mg/L)	DLA <0.010	DLA <0.010	DLA <0.025	DLA <0.010	<0.000050
	Tin (Sn)-Total (mg/L)	DLA <0.020	DLA <0.020	DLA <0.050	DLA <0.020	<0.00010
	Titanium (Ti)-Total (mg/L)	DLA <0.20	DLA <1.0	DLA <1.0	DLA <1.0	<0.010
	Uranium (U)-Total (mg/L)	DLA <0.0020	DLA <0.0020	DLA <0.0050	DLA <0.0020	<0.000010
	Vanadium (V)-Total (mg/L)	<0.20	DLA <0.20	DLA <0.50	DLA <0.20	<0.0010
	Zinc (Zn)-Total (mg/L)	2.61	DLA <0.60	DLA <1.5	DLA <0.60	<0.0030
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	DLA <0.20	DLA <0.20	DLA <0.50	5.28	
	Antimony (Sb)-Dissolved (mg/L)	DLA <0.010	DLA <0.010	DLA <0.025	DLA <0.010	
	Arsenic (As)-Dissolved (mg/L)	DLA <0.0060	0.0102	DLA <0.015	DLA <0.0060	
	Barium (Ba)-Dissolved (mg/L)	0.445	2.93	3.02	3.12	
	Beryllium (Be)-Dissolved (mg/L)	DLA <0.040	DLA <0.040	DLA <0.10	DLA <0.040	
	Bismuth (Bi)-Dissolved (mg/L)	DLA <0.10	DLA <0.10	DLA <0.25	DLA <0.10	
	Boron (B)-Dissolved (mg/L)	3.0	14.9	13.9	13.2	
	Cadmium (Cd)-Dissolved (mg/L)	DLA <0.0020	DLA <0.0020	DLA <0.0050	DLA <0.0020	
	Calcium (Ca)-Dissolved (mg/L)	10100	56900	59900	58200	
	Chromium (Cr)-Dissolved (mg/L)	DLA <0.020	DLA <0.020	DLA <0.050	0.053	
	Cobalt (Co)-Dissolved (mg/L)	DLA <0.020	DLA <0.020	DLA <0.050	DLA <0.020	
	Copper (Cu)-Dissolved (mg/L)	0.058	0.056	DLA <0.10	0.070	
	Iron (Fe)-Dissolved (mg/L)	DLA <0.20	DLA <1.0	DLA <1.0	28.8	
	Lead (Pb)-Dissolved (mg/L)	DLA <0.010	DLA <0.010	DLA <0.025	0.029	
	Lithium (Li)-Dissolved (mg/L)	8.62	48.0	46.4	44.2	
	Magnesium (Mg)-Dissolved (mg/L)	29.4	45.1	73.8	78.9	
	Manganese (Mn)-Dissolved (mg/L)	0.378	0.287	0.448	0.563	
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0669	0.338	0.392	0.387	
	Nickel (Ni)-Dissolved (mg/L)	0.026	0.055	DLA <0.050	0.032	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310386-6				
	Description	Water				
	Sampled Date					
	Sampled Time					
	Client ID	ALS FIELD BLANK				
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00010				
	Phosphorus (P)-Total (mg/L)	<0.30				
	Potassium (K)-Total (mg/L)	<0.050				
	Selenium (Se)-Total (mg/L)	<0.00010				
	Silicon (Si)-Total (mg/L)	<0.050				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	<0.010				
	Strontium (Sr)-Total (mg/L)	<0.00020				
	Thallium (Tl)-Total (mg/L)	<0.000050				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.010				
	Uranium (U)-Total (mg/L)	<0.000010				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	<0.0030				
Dissolved Metals	Dissolved Metals Filtration Location					
	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Bismuth (Bi)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310386-1	L1310386-2	L1310386-3	L1310386-4	L1310386-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	01-JUN-13	01-JUN-13	01-JUN-13	02-JUN-13	
	Sampled Time	10:00	10:00	10:00	10:00	
	Client ID	IWB-1-2013	ZONE1-1-2013	ZONE5-1-2013	ZONE4-1-2013	ALS TRAVEL BLANK
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<6.0 DLA	<30 DLA	<30 DLA	<30 DLA	
	Potassium (K)-Dissolved (mg/L)	3110	2420	2500	2510	
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA	0.031	<0.050 DLA	<0.020 DLA	
	Silicon (Si)-Dissolved (mg/L)	<1.0 DLA	<5.0 DLA	<5.0 DLA	<5.0 DLA	
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0050 DLA	0.0042	
	Sodium (Na)-Dissolved (mg/L)	279	1050	1270	1250	
	Strontium (Sr)-Dissolved (mg/L)	171	891	954	938	
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.025 DLA	<0.010 DLA	
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.050 DLA	<0.020 DLA	
	Titanium (Ti)-Dissolved (mg/L)	<0.20 DLA	<1.0 DLA	<1.0 DLA	<1.0 DLA	
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0050 DLA	<0.0020 DLA	
	Vanadium (V)-Dissolved (mg/L)	<0.20 DLA	<0.20 DLA	<0.50 DLA	<0.20 DLA	
	Zinc (Zn)-Dissolved (mg/L)	1.23	<0.20 DLA	<0.50 DLA	0.56	
Glycols	Diethylene Glycol (mg/L)	<50000 DLA	<500 DLA	<500 DLA	<1000 DLA	
	Ethylene Glycol (mg/L)	<50000 DLA	<500 DLA	<500 DLA	<1000 DLA	
	1,2-Propylene Glycol (mg/L)	632000	3840	2810	37700	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310386-6				
	Description	Water				
	Sampled Date					
	Sampled Time					
	Client ID	ALS FIELD BLANK				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silicon (Si)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Strontium (Sr)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					
Glycols	Diethylene Glycol (mg/L)					
	Ethylene Glycol (mg/L)					
	1,2-Propylene Glycol (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Iron (Fe)-Dissolved	DLA	L1310386-1, -2, -3, -4
Duplicate	Phosphorus (P)-Dissolved	DLA	L1310386-1, -2, -3, -4
Duplicate	Silicon (Si)-Dissolved	DLA	L1310386-1, -2, -3, -4
Duplicate	Titanium (Ti)-Dissolved	DLA	L1310386-1, -2, -3, -4
Duplicate	Sulfate (SO4)	DLM	L1310386-1, -2, -3, -4, -5, -6
Duplicate	Bromide (Br)	DLM	L1310386-1, -5, -6
Duplicate	Chloride (Cl)	DLM	L1310386-1, -5, -6
Duplicate	Bromide (Br)	DLM	L1310386-1, -2, -3, -4, -5, -6
Duplicate	Chloride (Cl)	DLM	L1310386-1, -2, -3, -4, -5, -6
Duplicate	Nitrite (as N)	DLM	L1310386-1, -2, -3, -4, -5, -6
Duplicate	Bromide (Br)	DLM	L1310386-2, -3, -4
Duplicate	Total Kjeldahl Nitrogen	DLM	L1310386-1, -2, -3, -4, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Phosphorus (P)-Total	MS-B	L1310386-2, -3, -4, -5, -6
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Cobalt (Co)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1310386-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1310386-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

Reference Information

ANIONS-NO3-IC-VA Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA Water Fluoride by SIE APHA 4500-F "Fluoride"

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA Water Fluoride by SIE APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA Water Dissolved Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

FE-TOT-LOW-ICP-VA Water Total Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

GLY-WAT-FID-VA Water Glycols in Water by GCFID SW-846, METHOD 8015B, EPA

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 8015B, published by the United States Environmental Protection Agency (EPA). The procedure involves treatment of the sample with a strong base (NaOH) and benzoyl chloride to form the corresponding benzoate esters. The benzoate esters are then extracted with iso-octane and the extract is analyzed by capillary column gas chromatography with flame ionization detection (FID).

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Reference Information

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-295953

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

10- 295953

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan / ERM Canada	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2: Rusto.Martinka@erm.com Cody.Cameron@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: 604-689-9460 Fax:		
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194096-0012	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only) L1310386	**ALS Contact:** Amber Springer	**Sampler:** Tyler Gale

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chemistry	Nutrients	Total Metals	Dissolved Metals	Glycols	Number of Containers
IWB-1-2013		01-Jun-13		Water	X	X	X	X	X	5
Zone 1-1-2013		01-Jun-13		"	X	X	X	X	X	5
Zone5-1-2013		01-Jun-13		"	X	X	X	X	X	5
Zone4-1-2013		02-Jun-13	10:00	"	X	X	X	X	X	5
ALS Travel Blank				"	X	X	X	X	X	3
ALS Field Blank				"	X	X	X	X	X	3

L1310386-COFC

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Most samples very high TDS, Calcium and Chloride (possibly hundreds of g/L).

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature: Cooler 1 May 3.4 Avg 2.0 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
				June 3/13	12:30					

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

Cooler 1 May 3.4 Avg 2.0

WHITE PAPER CO. 604 951-3900

GENERAL TERMS AND CONDITIONS:

These terms and conditions are incorporated in and form part of the Agreement between ALS Laboratory Group – Environmental Division ("ALS") and the party named in the Offer (the "Client").

1. Definitions. Capitalized Terms not defined in these Terms and Conditions have the definitions set out in the other Agreement documents.
2. The Services. ALS will provide the Services to the Client as described in the Offer and in any change of custody form provided with any sample.
3. Prices. ALS may review and change all prices, fees, surcharges or other charges set out in the Agreement if there are changes to ALS's cost beyond ALS's control, including changes in legislative requirements, Client variations of sample numbers and Client requests for changes to standard reporting requirements. Notwithstanding Condition 3, all quotations are reviewed and updated on a yearly basis.
4. Payment Terms. The Client shall pay ALS within 30 days of the invoice date OAC. ALS may, for reasonable business reasons, require the Client to arrange for payment in advance.
5. Quotation Numbers. The Client shall provide the quotation number to ALS (where applicable) to ensure correct pricing.
6. Taxes. Applicable taxes are not included in prices, surcharges and additional fees and will be added at the time of invoicing.
7. Quality Control. ALS has an extensive QA/QC program and all analytical data reported is analyzed using approved, referenced procedures followed by checks and reviews of senior managers and quality assurance personnel.
8. No Guarantee of Results. Results are obtained from chemical measurements. The Client is responsible for informing itself on the limitation of the results and acknowledges that the results are not guaranteed.
9. Standard of Care. ALS will use reasonable care and diligence as required by the laws of the province or territory where the sample is tested.
10. Storage. Where possible, ALS will store samples for 30 days from the date a final report is issued to the Client, after which ALS may discard the sample.
11. Holds. If the Client requests a sample be placed on hold, ALS will store the sample for 60 days for the quoted price, after which ALS will invoice the Client and discard the sample.
12. Archives. If the Client requests a sample be archived, ALS will store the sample for 6 months for the quoted price, after which ALS will invoice the Client and discard the sample.
13. Handling Protocol. Legal sample handling protocol must be arranged before samples are collected. ALS may charge a 20% surcharge on the list price plus the hourly technologist or chemist rates for legal sample protocol. Samples processed under legal protocol are stored indefinitely (storage charges may apply).
14. Samples. The quality, condition, content and source of samples stored and tested are not known to ALS except as declared and described on the chain of custody form completed and submitted by the Client and accompanying the sample.
15. Risk of Loss. ALS will use reasonable care to protect samples during storage, however all samples are stored at the Client's risk and the Client is responsible for obtaining appropriate insurance, if desired. The Client acknowledges that during the performance of the Services samples may be altered, lost, damaged or destroyed and the Client releases ALS from any claim the Client may have for any loss or damage to the sample.
16. Environmental. The Client must comply with all applicable environment legislation, including labeling all hazardous samples to comply with WHMIS and TDG regulations, and must provide appropriate material safety data sheets that include the nature of the hazard and a contact name and phone number to call for information. The Client will indemnify ALS for all loss or damages, including any fine or cost of complying with an order of any government authority, resulting from the Client's breach of this paragraph.
17. Hazardous Materials Disposal. ALS may return, at the Client's cost, hazardous material to the Client for disposal.
18. Hazardous Materials Surcharge. ALS may apply an additional surcharge for handling of hazardous samples or samples with Naturally Occuring Radioactive Materials (NORM), H2S, CN, etc.
19. Sample Containers. ALS may ship sample containers to the Client's location by the most cost effective means using ALS preferred courier suppliers, within the specified project timeline.
20. Additional Charges. ALS may charge the Client (a) its cost for emergency bottle shipments and shipments to and from a remote site, and (b) where pick up and delivery services are provided, subject in each instance to a minimum charge of $25.00.
21. Large Bottle Orders. The Client shall provide ALS with 24 hours notice for large bottle orders.
22. Re-Tests. ALS reserves the right to re-test any samples that remains in its possession. Re-tests requested by the Client may be charged.
23. Waiver. The Client is responsible for making any assessment regarding the suitability of the Services and the intended results for the Client's purposes and waives any claims against ALS it may have as a result of the interpretation of the results. The Client shall indemnify ALS for all claims made by any third party against ALS in respect of all losses however arising from the performance of the Services or the use of any report provided in the performance of the Services.
24. Limitation of Liability. In no event shall ALS be liable for any consequential, indirect, incidental, special, exemplary or punitive damages, whether foreseeable of unforeseeable, (including claims for loss of profits or revenue or losses caused by stoppage of other work or impairment of other assets) incurred by the Client arising out of breach or failure of express of implied warranty, breach of contract, breach of warranty, misrepresentation, negligence, strict liability in tort or otherwise. In any event, the liability of ALS to the Client shall be limited to the cost of testing the sample as requested in the chain of custody form under which the sample was originally deposited. For the purposes of this paragraph and paragraphs 8, 15, 16, 23 and 25, as the applicable, "ALS" includes without limitations its directors, officers, employees and affiliates and the "Client" includes without limitation any third party that may have a claim against ALS through the Client.
25. Notice of Liability. Notwithstanding paragraph 24, ALS shall not be liable to the Client unless the Client provides notice in writing to ALS of such loss or damage, together with full particulars thereof, within 30 days of the Client's receipt of the report of the analysis of the sample giving rise to such liability. The provisions of this paragraph allocate the risk under the Agreement between the Client and ALS, and the fees to be paid by the Client to ALS reflect this allocation of risks and the limitations of liability in this Agreement.
26. Entire Agreement. The Agreement is the entire agreement between the parties and supercedes and takes precedence over any terms and conditions contained in any documentation provided by the Client. ALS's execution of any subsequent documentation from the Client only acknowledges receipt and not acceptance of any terms or conditions therein. If there is a conflict between these terms and conditions and any other Agreement document, these terms and conditions prevail.

GENF 19.00 Terms

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 03-JUN-13
Report Date: 27-JUN-13 11:46 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1310404

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-295955
Legal Site Desc:



Amber Springer
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310404-1	L1310404-2	L1310404-3		
	Description	Water	Water	Water		
	Sampled Date	02-JUN-13	19-MAY-13	27-MAY-13		
	Sampled Time	13:00	10:00	14:00		
	Client ID	ZONE3-1-2013	WB-13-551M	DF02		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	180000	145000	150000		
	Hardness (as CaCO3) (mg/L)	142000	115000	120000		
	pH (pH)	7.64	7.71	8.20		
	Total Suspended Solids (mg/L)	142	2670	503		
	Total Dissolved Solids (mg/L)	208000	135000	144000		
	Turbidity (NTU)	31.0	255	134		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	42.1	4.4	25.4		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Total (as CaCO3) (mg/L)	42.1	4.4	25.4		
	Ammonia, Total (as N) (mg/L)	4.31	3.85	3.22		
	Bromide (Br) (mg/L)	1550	1100	1170		
	Chloride (Cl) (mg/L)	112000	84700	85400 DLM		
	Fluoride (F) (mg/L)	0.46	0.49	<2.0 DLM		
	Nitrate (as N) (mg/L)	<0.50 DLM	<0.50 DLM	<0.50 DLM		
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.10 DLM	<0.10 DLM		
	Total Kjeldahl Nitrogen (mg/L)	<25 DLM	<25 DLM	<25 DLM		
	Orthophosphate-Dissolved (as P) (mg/L)	0.069	0.0233	0.0423		
	Phosphorus (P)-Total (mg/L)	2.70	0.097	0.057		
	Sulfate (SO4) (mg/L)	<50 DLM	<50 DLM	<50 DLM		
Total Metals	Aluminum (Al)-Total (mg/L)	1.14	11.0	4.81		
	Antimony (Sb)-Total (mg/L)	<0.010 DLA	<0.010 DLA	<0.010 DLA		
	Arsenic (As)-Total (mg/L)	0.0101	0.0160	0.0098		
	Barium (Ba)-Total (mg/L)	2.91	2.59	1.86		
	Beryllium (Be)-Total (mg/L)	<0.040 DLA	<0.040 DLA	<0.040 DLA		
	Bismuth (Bi)-Total (mg/L)	<0.10 DLA	<0.10 DLA	<0.10 DLA		
	Boron (B)-Total (mg/L)	14.5	9.8	10.3		
	Cadmium (Cd)-Total (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0020 DLA		
	Calcium (Ca)-Total (mg/L)	57000	42400	41100		
	Chromium (Cr)-Total (mg/L)	0.055	0.197	0.047		
	Cobalt (Co)-Total (mg/L)	<0.020 DLA	<0.020 DLA	<0.020 DLA		
	Copper (Cu)-Total (mg/L)	<0.10 DLA	0.29	<0.10 DLA		
	Iron (Fe)-Total (mg/L)	5.0	79.3	18.6		
	Lead (Pb)-Total (mg/L)	<0.010 DLA	0.104	0.024		
	Lithium (Li)-Total (mg/L)	41.6	31.4	31.2		
	Magnesium (Mg)-Total (mg/L)	51.1	47.1	35.1		
	Manganese (Mn)-Total (mg/L)	0.165	0.943	0.468		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310404-1	L1310404-2	L1310404-3		
	Description	Water	Water	Water		
	Sampled Date	02-JUN-13	19-MAY-13	27-MAY-13		
	Sampled Time	13:00	10:00	14:00		
	Client ID	ZONE3-1-2013	WB-13-551M	DF02		
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Total (mg/L)	0.413	0.373	0.240		
	Nickel (Ni)-Total (mg/L)	0.068	0.199	0.095		
	Phosphorus (P)-Total (mg/L)	DLA <30	DLA <30	DLA <30		
	Potassium (K)-Total (mg/L)	2310	1690	1570		
	Selenium (Se)-Total (mg/L)	DLA <0.020	DLA <0.020	DLA <0.020		
	Silicon (Si)-Total (mg/L)	DLA <5.0	27.9	7.7		
	Silver (Ag)-Total (mg/L)	DLA <0.0020	0.0095	0.0032		
	Sodium (Na)-Total (mg/L)	1150	924	820		
	Strontium (Sr)-Total (mg/L)	976	657	652		
	Thallium (Tl)-Total (mg/L)	DLA <0.010	DLA <0.010	DLA <0.010		
	Tin (Sn)-Total (mg/L)	DLA <0.020	DLA <0.020	DLA <0.020		
	Titanium (Ti)-Total (mg/L)	DLA <1.0	DLA <1.0	DLA <1.0		
	Uranium (U)-Total (mg/L)	DLA <0.0020	DLA <0.0020	DLA <0.0020		
	Vanadium (V)-Total (mg/L)	DLA <0.20	DLA <0.20	DLA <0.20		
	Zinc (Zn)-Total (mg/L)	DLA <0.60	DLA <0.60	DLA <0.60		
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.22	0.30	0.23		
	Antimony (Sb)-Dissolved (mg/L)	DLA <0.010	DLA <0.010	DLA <0.010		
	Arsenic (As)-Dissolved (mg/L)	0.0064	0.0129	0.0138		
	Barium (Ba)-Dissolved (mg/L)	2.95	2.81	2.14		
	Beryllium (Be)-Dissolved (mg/L)	DLA <0.040	DLA <0.040	DLA <0.040		
	Bismuth (Bi)-Dissolved (mg/L)	DLA <0.10	DLA <0.10	DLA <0.10		
	Boron (B)-Dissolved (mg/L)	14.6	10.7	12.2		
	Cadmium (Cd)-Dissolved (mg/L)	DLA <0.0020	DLA <0.0020	DLA <0.0020		
	Calcium (Ca)-Dissolved (mg/L)	56800	46000	48000		
	Chromium (Cr)-Dissolved (mg/L)	DLA <0.020	0.069	DLA <0.020		
	Cobalt (Co)-Dissolved (mg/L)	DLA <0.020	DLA <0.020	DLA <0.020		
	Copper (Cu)-Dissolved (mg/L)	DLA <0.040	0.214	0.040		
	Iron (Fe)-Dissolved (mg/L)	DLA <1.0	DLA <1.0	DLA <1.0		
	Lead (Pb)-Dissolved (mg/L)	DLA <0.010	DLA <0.010	DLA <0.010		
	Lithium (Li)-Dissolved (mg/L)	42.9	35.8	36.1		
	Magnesium (Mg)-Dissolved (mg/L)	52.1	44.0	37.8		
	Manganese (Mn)-Dissolved (mg/L)	0.128	0.737	0.378		
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Dissolved (mg/L)	0.382	0.388	0.284		
	Nickel (Ni)-Dissolved (mg/L)	0.051	0.174	0.079		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1310404-1	L1310404-2	L1310404-3		
	Description	Water	Water	Water		
	Sampled Date	02-JUN-13	19-MAY-13	27-MAY-13		
	Sampled Time	13:00	10:00	14:00		
	Client ID	ZONE3-1-2013	WB-13-551M	DF02		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<30 DLA	<30 DLA	<30 DLA		
	Potassium (K)-Dissolved (mg/L)	2380	1950	1810		
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.020 DLA		
	Silicon (Si)-Dissolved (mg/L)	<5.0 DLA	<5.0 DLA	<5.0 DLA		
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0020 DLA		
	Sodium (Na)-Dissolved (mg/L)	1170	1010	932		
	Strontium (Sr)-Dissolved (mg/L)	974	735	772		
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.010 DLA		
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.020 DLA		
	Titanium (Ti)-Dissolved (mg/L)	<1.0 DLA	<1.0 DLA	<1.0 DLA		
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0020 DLA		
	Vanadium (V)-Dissolved (mg/L)	<0.20 DLA	<0.20 DLA	<0.20 DLA		
	Zinc (Zn)-Dissolved (mg/L)	<0.20 DLA	<0.20 DLA	0.23		
Glycols	Diethylene Glycol (mg/L)	<250 DLA				
	Ethylene Glycol (mg/L)	<250 DLA				
	1,2-Propylene Glycol (mg/L)	1690				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Sulfate (SO4)	DLM	L1310404-1, -2, -3
Duplicate	Chloride (Cl)	DLM	L1310404-2, -3
Duplicate	Chloride (Cl)	DLM	L1310404-1, -2, -3
Duplicate	Nitrite (as N)	DLM	L1310404-1, -2, -3
Duplicate	Bromide (Br)	DLM	L1310404-1, -2, -3
Duplicate	Total Kjeldahl Nitrogen	DLM	L1310404-1, -2, -3
Matrix Spike	Phosphorus (P)-Total	MS-B	L1310404-1, -2, -3
Matrix Spike	Cadmium (Cd)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Zinc (Zn)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1310404-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1310404-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA Water Fluoride by SIE APHA 4500-F "Fluoride"

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA Water Fluoride by SIE APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA Water Dissolved Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

FE-TOT-LOW-ICP-VA Water Total Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

GLY-WAT-FID-VA Water Glycols in Water by GCFID SW-846, METHOD 8015B, EPA

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 8015B, published by the United States Environmental Protection Agency (EPA). The procedure involves treatment of the sample with a strong base (NaOH) and benzoyl chloride to form the corresponding benzoate esters. The benzoate esters are then extracted with iso-octane and the extract is analyzed by capillary column gas chromatography with flame ionization detection (FID).

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United

Reference Information

States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-295955

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

10- 295955

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To		Report Format / Distribution		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)	
Company:	Rescan | ERM	Standard:	X Other (specify):	X	Regular (Standard Turnaround Times - Business Days)
Contact:	Tyler Gale	Select: PDF	X Excel X Digital Fax		Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	1111 W. Hastings St.	Email 1:	Tyler.Gale@~~ERM~~rescan.com		Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Vancouver BC	Email 2:	Cody.Cameron@erm.com		Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	604-689-9460 Fax:		Rusto.Martinka@erm.com		

Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	1094090-0012
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	

Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem.	Nutrients (P)	Total Metals (P)	Dissolved Metals (F)	Glycols (P)	Number of Containers
Zone3-1-2013		2-Jun-13	13:00	Water	—	—	—	—	—	5
WB-13-55|m		19-May-13	10:00	"	—	—	—	—		4
DF02		27-May-13	14:00	"	—	—	—	—		4

L1310404-COFC

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Expect very high TDS, Calcium, Chloride (tens to hundreds of g/L). Empty sample bottles and preservative capsules have been used (dirty).

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
				June 3/13	12:30	Mar 3.9 Arr 2.4 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

WHITE PAPER CO. 604 951-3900

GENERAL TERMS AND CONDITIONS:

These terms and conditions are incorporated in and form part of the Agreement between ALS Laboratory Group – Environmental Division ("ALS") and the party named in the Offer (the "Client").

1. Definitions. Capitalized Terms not defined in these Terms and Conditions have the definitions set out in the other Agreement documents.
2. The Services. ALS will provide the Services to the Client as described in the Offer and in any change of custody form provided with any sample.
3. Prices. ALS may review and change all prices, fees, surcharges or other charges set out in the Agreement if there are changes to ALS's cost beyond ALS's control, including changes in legislative requirements, Client variations of sample numbers and Client requests for changes to standard reporting requirements. Notwithstanding Condition 3, all quotations are reviewed and updated on a yearly basis.
4. Payment Terms. The Client shall pay ALS within 30 days of the invoice date OAC. ALS may, for reasonable business reasons, require the Client to arrange for payment in advance.
5. Quotation Numbers. The Client shall provide the quotation number to ALS (where applicable) to ensure correct pricing.
6. Taxes. Applicable taxes are not included in prices, surcharges and additional fees and will be added at the time of invoicing.
7. Quality Control. ALS has an extensive QA/QC program and all analytical data reported is analyzed using approved, referenced procedures followed by checks and reviews of senior managers and quality assurance personnel.
8. No Guarantee of Results. Results are obtained from chemical measurements. The Client is responsible for informing itself on the limitation of the results and acknowledges that the results are not guaranteed.
9. Standard of Care. ALS will use reasonable care and diligence as required by the laws of the province or territory where the sample is tested.
10. Storage. Where possible, ALS will store samples for 30 days from the date a final report is issued to the Client, after which ALS may discard the sample.
11. Holds. If the Client requests a sample be placed on hold, ALS will store the sample for 60 days for the quoted price, after which ALS will invoice the Client and discard the sample.
12. Archives. If the Client requests a sample be archived, ALS will store the sample for 6 months for the quoted price, after which ALS will invoice the Client and discard the sample.
13. Handling Protocol. Legal sample handling protocol must be arranged before samples are collected. ALS may charge a 20% surcharge on the list price plus the hourly technologist or chemist rates for legal sample protocol. Samples processed under legal protocol are stored indefinitely (storage charges may apply).
14. Samples. The quality, condition, content and source of samples stored and tested are not known to ALS except as declared and described on the chain of custody form completed and submitted by the Client and accompanying the sample.
15. Risk of Loss. ALS will use reasonable care to protect samples during storage, however all samples are stored at the Client's risk and the Client is responsible for obtaining appropriate insurance, if desired. The Client acknowledges that during the performance of the Services samples may be altered, lost, damaged or destroyed and the Client releases ALS from any claim the Client may have for any loss or damage to the sample.
16. Environmental. The Client must comply with all applicable environment legislation, including labeling all hazardous samples to comply with WHMIS and TDG regulations, and must provide appropriate material safety data sheets that include the nature of the hazard and a contact name and phone number to call for information. The Client will indemnify ALS for all loss or damages, including any fine or cost of complying with an order of any government authority, resulting from the Client's breach of this paragraph.
17. Hazardous Materials Disposal. ALS may return, at the Client's cost, hazardous material to the Client for disposal.
18. Hazardous Materials Surcharge. ALS may apply an additional surcharge for handling of hazardous samples or samples with Naturally Occuring Radioactive Materials (NORM), H2S, CN, etc.
19. Sample Containers. ALS may ship sample containers to the Client's location by the most cost effective means using ALS preferred courier suppliers, within the specified project timeline.
20. Additional Charges. ALS may charge the Client (a) its cost for emergency bottle shipments and shipments to and from a remote site, and (b) where pick up and delivery services are provided, subject in each instance to a minimum charge of $25.00.
21. Large Bottle Orders. The Client shall provide ALS with 24 hours notice for large bottle orders.
22. Re-Tests. ALS reserves the right to re-test any samples that remains in its possession. Re-tests requested by the Client may be charged.
23. Waiver. The Client is responsible for making any assessment regarding the suitability of the Services and the intended results for the Client's purposes and waives any claims against ALS it may have as a result of the interpretation of the results. The Client shall indemnify ALS for all claims made by any third party against ALS in respect of all losses however arising from the performance of the Services or the use of any report provided in the performance of the Services.
24. Limitation of Liability. In no event shall ALS be liable for any consequential, indirect, incidental, special, exemplary or punitive damages, whether foreseeable of unforeseeable, (including claims for loss of profits or revenue or losses caused by stoppage of other work or impairment of other assets) incurred by the Client arising out of breach or failure of express of implied warranty, breach of contract, breach of warranty, misrepresentation, negligence, strict liability in tort or otherwise. In any event, the liability of ALS to the Client shall be limited to the cost of testing the sample as requested in the chain of custody form under which the sample was originally deposited. For the purposes of this paragraph and paragraphs 8, 15, 16, 23 and 25, as the applicable, "ALS" includes without limitations its directors, officers, employees and affiliates and the "Client" includes without limitation any third party that may have a claim against ALS through the Client.
25. Notice of Liability. Notwithstanding paragraph 24, ALS shall not be liable to the Client unless the Client provides notice in writing to ALS of such loss or damage, together with full particulars thereof, within 30 days of the Client's receipt of the report of the analysis of the sample giving rise to such liability. The provisions of this paragraph allocate the risk under the Agreement between the Client and ALS, and the fees to be paid by the Client to ALS reflect this allocation of risks and the limitations of liability in this Agreement.
26. Entire Agreement. The Agreement is the entire agreement between the parties and supercedes and takes precedence over any terms and conditions contained in any documentation provided by the Client. ALS's execution of any subsequent documentation from the Client only acknowledges receipt and not acceptance of any terms or conditions therein. If there is a conflict between these terms and conditions and any other Agreement document, these terms and conditions prevail.

GENF 19.00 Terms

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 27-JUN-13
Report Date: 15-JUL-13 17:25 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1323663

Project P.O. #:	NOT SUBMITTED
Job Reference:	0194096-0012
C of C Numbers:	10-186497
Legal Site Desc:	

Comments: Both glycols vials were received broken - analysis was not possible.

Amber Springer
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1323663-1				
	Description	Water				
	Sampled Date	26-JUN-13				
	Sampled Time	13:00				
	Client ID	ZONE3-2-2013				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	155000				
	Hardness (as CaCO3) (mg/L)	111000				
	pH (pH)	7.50				
	Total Suspended Solids (mg/L)	371				
	Total Dissolved Solids (mg/L)	159000 AI				
	Turbidity (NTU)	17.1				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	22.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	22.0				
	Ammonia, Total (as N) (mg/L)	3.05				
	Bromide (Br) (mg/L)	1140				
	Chloride (Cl) (mg/L)	90200				
	Fluoride (F) (mg/L)	<2.0 DLM				
	Nitrate (as N) (mg/L)	2.30				
	Nitrite (as N) (mg/L)	<0.10 DLM				
	Total Kjeldahl Nitrogen (mg/L)	<50 DLM				
	Orthophosphate-Dissolved (as P) (mg/L)	0.0695				
	Phosphorus (P)-Total (mg/L)	0.147				
	Sulfate (SO4) (mg/L)	<50 DLM				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.60 DLA				
	Antimony (Sb)-Total (mg/L)	<0.010 DLA				
	Arsenic (As)-Total (mg/L)	<0.0060 DLA				
	Barium (Ba)-Total (mg/L)	5.83				
	Beryllium (Be)-Total (mg/L)	<0.040 DLA				
	Bismuth (Bi)-Total (mg/L)	<0.10 DLA				
	Boron (B)-Total (mg/L)	11.3				
	Cadmium (Cd)-Total (mg/L)	<0.0020 DLA				
	Calcium (Ca)-Total (mg/L)	46100				
	Chromium (Cr)-Total (mg/L)	<0.020 DLA				
	Cobalt (Co)-Total (mg/L)	<0.020 DLA				
	Copper (Cu)-Total (mg/L)	<0.10 DLA				
	Iron (Fe)-Total (mg/L)	1.00				
	Lead (Pb)-Total (mg/L)	<0.010 DLA				
	Lithium (Li)-Total (mg/L)	33.3				
	Magnesium (Mg)-Total (mg/L)	471				
	Manganese (Mn)-Total (mg/L)	1.45				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1323663-1				
	Description	Water				
	Sampled Date	26-JUN-13				
	Sampled Time	13:00				
	Client ID	ZONE3-2-2013				
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010				
	Molybdenum (Mo)-Total (mg/L)	0.271				
	Nickel (Ni)-Total (mg/L)	0.040				
	Phosphorus (P)-Total (mg/L)	<15				
	Potassium (K)-Total (mg/L)	1800				
	Selenium (Se)-Total (mg/L)	<0.020 DLA				
	Silicon (Si)-Total (mg/L)	<2.5				
	Silver (Ag)-Total (mg/L)	<0.0020 DLA				
	Sodium (Na)-Total (mg/L)	3910				
	Strontium (Sr)-Total (mg/L)	821				
	Thallium (Tl)-Total (mg/L)	<0.010 DLA				
	Tin (Sn)-Total (mg/L)	<0.020 DLA				
	Titanium (Ti)-Total (mg/L)	<0.50				
	Uranium (U)-Total (mg/L)	<0.0020 DLA				
	Vanadium (V)-Total (mg/L)	<0.20 DLA				
	Zinc (Zn)-Total (mg/L)	<0.60 DLA				
Dissolved Metals	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	<0.20 DLA				
	Antimony (Sb)-Dissolved (mg/L)	<0.010 DLA				
	Arsenic (As)-Dissolved (mg/L)	<0.0060 DLA				
	Barium (Ba)-Dissolved (mg/L)	5.64				
	Beryllium (Be)-Dissolved (mg/L)	<0.040 DLA				
	Bismuth (Bi)-Dissolved (mg/L)	<0.10 DLA				
	Boron (B)-Dissolved (mg/L)	10.8				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0020 DLA				
	Calcium (Ca)-Dissolved (mg/L)	43800				
	Chromium (Cr)-Dissolved (mg/L)	<0.020 DLA				
	Cobalt (Co)-Dissolved (mg/L)	<0.020 DLA				
	Copper (Cu)-Dissolved (mg/L)	<0.040 DLA				
	Iron (Fe)-Dissolved (mg/L)	<0.50				
	Lead (Pb)-Dissolved (mg/L)	<0.010 DLA				
	Lithium (Li)-Dissolved (mg/L)	32.9				
	Magnesium (Mg)-Dissolved (mg/L)	437				
	Manganese (Mn)-Dissolved (mg/L)	1.34				
	Mercury (Hg)-Dissolved (mg/L)	<0.000010				
	Molybdenum (Mo)-Dissolved (mg/L)	0.251				
	Nickel (Ni)-Dissolved (mg/L)	0.020				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1323663-1				
	Description	Water				
	Sampled Date	26-JUN-13				
	Sampled Time	13:00				
	Client ID	ZONE3-2-2013				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<15				
	Potassium (K)-Dissolved (mg/L)	1600				
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA				
	Silicon (Si)-Dissolved (mg/L)	<2.5				
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA				
	Sodium (Na)-Dissolved (mg/L)	3590				
	Strontium (Sr)-Dissolved (mg/L)	760				
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA				
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA				
	Titanium (Ti)-Dissolved (mg/L)	<0.50				
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA				
	Vanadium (V)-Dissolved (mg/L)	<0.20 DLA				
	Zinc (Zn)-Dissolved (mg/L)	<0.20 DLA				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Aluminum (Al)-Dissolved	DLA	L1323663-1
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1323663-1
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1323663-1
Duplicate	Copper (Cu)-Dissolved	DLA	L1323663-1
Duplicate	Lead (Pb)-Dissolved	DLA	L1323663-1
Duplicate	Silver (Ag)-Dissolved	DLA	L1323663-1
Duplicate	Tin (Sn)-Dissolved	DLA	L1323663-1
Duplicate	Zinc (Zn)-Dissolved	DLA	L1323663-1
Duplicate	Fluoride (F)	DLM	L1323663-1
Duplicate	Nitrite (as N)	DLM	L1323663-1
Duplicate	Bromide (Br)	DLM	L1323663-1
Duplicate	Bromide (Br)	DLM	L1323663-1
Method Blank	Boron (B)-Total	MB-LOR	L1323663-1
Matrix Spike	Phosphorus (P)-Total	MS-B	L1323663-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1323663-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1323663-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1323663-1
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1323663-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1323663-1
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1323663-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1323663-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1323663-1
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1323663-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1323663-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1323663-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1323663-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1323663-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1323663-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1323663-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1323663-1
Matrix Spike	Total Kjeldahl Nitrogen	MSTN	L1323663-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
AI	Analytical interferences may be present. Result may be biased high.
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
MSTN	TKN Matrix Spike recovery was low due to interference from high nitrate, which causes negative bias on TKN.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA Water Fluoride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA Water Nitrite in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

FE-DIS-LOW-ICP-VA Water Dissolved Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

FE-TOT-LOW-ICP-VA Water Total Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Reference Information

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-ULTRA-MS-VA	Water	Total Metals in Water by ICPMS (Ultra)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Reference Information

Chain of Custody Numbers:

10-186497

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

10-186497

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan - ERM	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2: Rusto.Martinka@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: 604-689-9460 Fax:	Email 3: Daniel.Helm@erm.com	
Invoice To Same as Report ? (circle) (Yes) or No (if No, provide details)	**Client / Project Information**	
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194096-0012	
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only) L1323663	**ALS Contact:** Amber Springer **Sampler:** Tyler Gale	

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem	Nutrients (P)	Total Metals (P)	Dissolved Metals (F/P)	Glycols (P)							Number of Containers
Zone3-2-2013		26-Jun-13	13:00	Water	X	X	X	X	X							5

L1323663-COFC

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Expect very high TDS (100s of g/L), Chloride and Calcium (10s of g/L). Glycols up to 1000s of mg/L.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
				Jun. 27/13	11:30	8.3 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

WHITE PAPER CO. 604 951-3900

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 08-JUL-13
Report Date: 23-JUL-13 16:06 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1328754

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-186496
Legal Site Desc:



Amber Springer
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1328754-1	L1328754-2			
	Description	WATER	WATER			
	Sampled Date	03-JUL-13	03-JUL-13			
	Sampled Time	20:00	16:30			
	Client ID	ZONE3-3-2013	BLANK			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	140000	3.7			
	Hardness (as CaCO3) (mg/L)	93100	4.07			
	pH (pH)	7.37	5.82			
	Total Suspended Solids (mg/L)	134	<3.0			
	Total Dissolved Solids (mg/L)	143000 AI	<10			
	Turbidity (NTU)	8.30	<0.10			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	16.8	<2.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	16.8	<2.0			
	Ammonia, Total (as N) (mg/L)	1.93	<0.0050			
	Bromide (Br) (mg/L)	660	<0.050			
	Chloride (Cl) (mg/L)	77600	0.87			
	Fluoride (F) (mg/L)	0.94	<0.030			
	Nitrate (as N) (mg/L)	<0.50 DLM	0.0085			
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)	2.57	<0.050			
	Orthophosphate-Dissolved (as P) (mg/L)	0.0311	0.0060			
	Phosphorus (P)-Total (mg/L)	0.183	0.0074			
	Sulfate (SO4) (mg/L)	<50 DLM	<0.50			
Total Metals	Aluminum (Al)-Total (mg/L)	<0.60 DLA	<0.0030			
	Antimony (Sb)-Total (mg/L)	<0.010 DLA	<0.000050			
	Arsenic (As)-Total (mg/L)	<0.0060 DLA	<0.000030			
	Barium (Ba)-Total (mg/L)	6.49	0.000118 RRV			
	Beryllium (Be)-Total (mg/L)	<0.040 DLA	<0.00020			
	Bismuth (Bi)-Total (mg/L)	<0.10 DLA	<0.00050			
	Boron (B)-Total (mg/L)	7.9	<0.0050			
	Cadmium (Cd)-Total (mg/L)	<0.0020 DLA	<0.000010			
	Calcium (Ca)-Total (mg/L)	36100	0.388 RRV			
	Chromium (Cr)-Total (mg/L)	<0.020 DLA	0.00016 RRV			
	Cobalt (Co)-Total (mg/L)	<0.020 DLA	<0.00010			
	Copper (Cu)-Total (mg/L)	<0.10 DLA	<0.00050			
	Iron (Fe)-Total (mg/L)	2.95	<0.010			
	Lead (Pb)-Total (mg/L)	<0.010 DLA	0.000123 RRV			
	Lithium (Li)-Total (mg/L)	22.4	<0.0050			
	Magnesium (Mg)-Total (mg/L)	650	0.0054 RRV			
	Manganese (Mn)-Total (mg/L)	1.87	0.000188 RRV			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1328754-1	L1328754-2			
	Description	WATER	WATER			
	Sampled Date	03-JUL-13	03-JUL-13			
	Sampled Time	20:00	16:30			
	Client ID	ZONE3-3-2013	BLANK			
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Total (mg/L)	0.184	0.000182 RRV			
	Nickel (Ni)-Total (mg/L)	0.023	0.00050 RRV			
	Phosphorus (P)-Total (mg/L)	<15 DLA	<0.30			
	Potassium (K)-Total (mg/L)	1170	<0.050			
	Selenium (Se)-Total (mg/L)	<0.020 DLA	<0.00010			
	Silicon (Si)-Total (mg/L)	<2.5 DLA	<0.050			
	Silver (Ag)-Total (mg/L)	<0.0020 DLA	<0.000010			
	Sodium (Na)-Total (mg/L)	5080	0.103			
	Strontium (Sr)-Total (mg/L)	640	0.00701 RRV			
	Thallium (Tl)-Total (mg/L)	<0.010 DLA	<0.000050			
	Tin (Sn)-Total (mg/L)	<0.020 DLA	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.67	<0.010			
	Uranium (U)-Total (mg/L)	<0.0020 DLA	<0.000010			
	Vanadium (V)-Total (mg/L)	<0.20 DLA	<0.0010			
	Zinc (Zn)-Total (mg/L)	<0.60 DLA	<0.0030			
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	<0.20 DLA	<0.0030			
	Antimony (Sb)-Dissolved (mg/L)	<0.010 DLA	<0.000050			
	Arsenic (As)-Dissolved (mg/L)	<0.0060 DLA	<0.000030			
	Barium (Ba)-Dissolved (mg/L)	6.46	0.000494 DTC			
	Beryllium (Be)-Dissolved (mg/L)	<0.040 DLA	<0.00020			
	Bismuth (Bi)-Dissolved (mg/L)	<0.10 DLA	<0.00050			
	Boron (B)-Dissolved (mg/L)	8.2	<0.0050			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0020 DLA	<0.000010			
	Calcium (Ca)-Dissolved (mg/L)	36200	1.59 DTC			
	Chromium (Cr)-Dissolved (mg/L)	<0.020 DLA	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	<0.020 DLA	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	<0.040 DLA	<0.00050			
	Iron (Fe)-Dissolved (mg/L)	<0.50 DLA	<0.010			
	Lead (Pb)-Dissolved (mg/L)	<0.010 DLA	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	23.2	<0.0050			
	Magnesium (Mg)-Dissolved (mg/L)	658	0.0231 DTC			
	Manganese (Mn)-Dissolved (mg/L)	1.86	0.000690 DTC			
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)	0.185	0.000133 RRV			
	Nickel (Ni)-Dissolved (mg/L)	<0.020 DLA	0.00051 RRV			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1328754-1	L1328754-2			
	Description	WATER	WATER			
	Sampled Date	03-JUL-13	03-JUL-13			
	Sampled Time	20:00	16:30			
	Client ID	ZONE3-3-2013	BLANK			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<15 DLA	<0.30			
	Potassium (K)-Dissolved (mg/L)	1170	0.059 RRV			
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA	<0.00010			
	Silicon (Si)-Dissolved (mg/L)	<2.5 DLA	<0.050			
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	5070	0.245 DTC			
	Strontium (Sr)-Dissolved (mg/L)	653	0.0267 DTC			
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA	<0.000050			
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	0.66	<0.010			
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA	<0.000010			
	Vanadium (V)-Dissolved (mg/L)	<0.20 DLA	<0.0010			
	Zinc (Zn)-Dissolved (mg/L)	<0.20 DLA	0.0061 RRV			
Glycols	Diethylene Glycol (mg/L)	<5.0	<5.0			
	Ethylene Glycol (mg/L)	<5.0	<5.0			
	1,2-Propylene Glycol (mg/L)	228	<5.0			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1328754-1, -2
Duplicate	Lithium (Li)-Dissolved	DLA	L1328754-1, -2
Duplicate	Molybdenum (Mo)-Dissolved	DLA	L1328754-1, -2
Duplicate	Potassium (K)-Dissolved	DLA	L1328754-1, -2
Duplicate	Tin (Sn)-Dissolved	DLA	L1328754-1, -2
Duplicate	Bromide (Br)	DLM	L1328754-2
Matrix Spike	Phosphorus (P)-Total	MS-B	L1328754-1, -2
Matrix Spike	Barium (Ba)-Total	MS-B	L1328754-1
Matrix Spike	Calcium (Ca)-Total	MS-B	L1328754-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1328754-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L1328754-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1328754-1, -2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1328754-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1328754-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
AI	Analytical interferences may be present. Result may be biased high.
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F "Fluoride"

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA Water Fluoride by SIE APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA Water Dissolved Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

FE-TOT-LOW-ICP-VA Water Total Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

GLY-WAT-FID-VA Water Glycols in Water by GCFID SW-846, METHOD 8015B, EPA

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 8015B, published by the United States Environmental Protection Agency (EPA). The procedure involves treatment of the sample with a strong base (NaOH) and benzoyl chloride to form the corresponding benzoate esters. The benzoate esters are then extracted with iso-octane and the extract is analyzed by capillary column gas chromatography with flame ionization detection (FID).

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PH-MAN-VA Water pH by Manual Meter APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-MAN-VA Water pH by Manual Meter APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Location

Reference Information

Laboratory Definition Code	
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-186496

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

10-186496

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To Rescan - ERM	**Report Format / Distribution**	**Service Request:** (Rush subject to availability - Contact ALS to confirm TAT)
Company:	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone: 604 689 9460 Fax:	Email 2: Rusto.Martinka@erm.com Daniel.Helm@gmail.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Invoice To Same as Report ? (circle) Yes or No (If No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: ~~0190~~ 0194096-0012	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only) L1328754	ALS Contact: Amber Springer	Sampler: Daniel Helm

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem	Nutrients	Total Metals	Dissolved Metals	Glycols	Number of Containers
					F/P	F/P	F/P	F/P	F/P	
Zone3-3-2013		03-Jul-13	20:00	Water	X	X	X	X	X	5
Blank		03-Jul-13	16:30	Water	X	X	X	X	X	5

Short Holding Time

Rush Processing

L1328754-COFC

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Daniel Helm	4 Jul 2013	9:00	Brittany	July 8	13:00	8.5 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 11-JUL-13
Report Date: 25-JUL-13 15:26 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1331208

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-186495
Legal Site Desc:



Amber Springer
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1331208-1				
	Description	water				
	Sampled Date	07-JUL-13				
	Sampled Time	16:00				
	Client ID	ZONE-4-2-2013				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	138000				
	Hardness (as CaCO3) (mg/L)	94200				
	pH (pH)	7.43				
	Total Suspended Solids (mg/L)	516				
	Total Dissolved Solids (mg/L)	127000				
	Turbidity (NTU)	11.6				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	18.4				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	18.4				
	Ammonia, Total (as N) (mg/L)	2.07				
	Bromide (Br) (mg/L)	696				
	Chloride (Cl) (mg/L)	62800				
	Fluoride (F) (mg/L)	<2.0 DLM				
	Nitrate (as N) (mg/L)	<0.50 DLM				
	Nitrite (as N) (mg/L)	<0.10 DLM				
	Total Kjeldahl Nitrogen (mg/L)	18.4				
	Orthophosphate-Dissolved (as P) (mg/L)	0.169				
	Phosphorus (P)-Total (mg/L)	0.425				
	Sulfate (SO4) (mg/L)	<50 DLM				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.60 DLA				
	Antimony (Sb)-Total (mg/L)	<0.010 DLA				
	Arsenic (As)-Total (mg/L)	<0.0060 DLA				
	Barium (Ba)-Total (mg/L)	5.45				
	Beryllium (Be)-Total (mg/L)	<0.010 DLA				
	Bismuth (Bi)-Total (mg/L)	<0.10 DLA				
	Boron (B)-Total (mg/L)	8.3				
	Cadmium (Cd)-Total (mg/L)	<0.0020 DLA				
	Calcium (Ca)-Total (mg/L)	34100				
	Chromium (Cr)-Total (mg/L)	<0.020 DLA				
	Cobalt (Co)-Total (mg/L)	<0.020 DLA				
	Copper (Cu)-Total (mg/L)	<0.10 DLA				
	Iron (Fe)-Total (mg/L)	1.66				
	Lead (Pb)-Total (mg/L)	<0.010 DLA				
	Lithium (Li)-Total (mg/L)	24.3				
	Magnesium (Mg)-Total (mg/L)	531				
	Manganese (Mn)-Total (mg/L)	1.91				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1331208-1				
	Description	water				
	Sampled Date	07-JUL-13				
	Sampled Time	16:00				
	Client ID	ZONE-4-2-2013				
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010				
	Molybdenum (Mo)-Total (mg/L)	0.192				
	Nickel (Ni)-Total (mg/L)	<0.020 DLA				
	Phosphorus (P)-Total (mg/L)	<15 DLA				
	Potassium (K)-Total (mg/L)	1250				
	Selenium (Se)-Total (mg/L)	<0.020 DLA				
	Silicon (Si)-Total (mg/L)	<2.5 DLA				
	Silver (Ag)-Total (mg/L)	<0.0020 DLA				
	Sodium (Na)-Total (mg/L)	3970				
	Strontium (Sr)-Total (mg/L)	607				
	Thallium (Tl)-Total (mg/L)	<0.010 DLA				
	Tin (Sn)-Total (mg/L)	<0.020 DLA				
	Titanium (Ti)-Total (mg/L)	0.56				
	Uranium (U)-Total (mg/L)	<0.0020 DLA				
	Vanadium (V)-Total (mg/L)	<0.10 DLA				
	Zinc (Zn)-Total (mg/L)	<0.60 DLA				
Dissolved Metals	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	<0.20 DLA				
	Antimony (Sb)-Dissolved (mg/L)	<0.010 DLA				
	Arsenic (As)-Dissolved (mg/L)	<0.0060 DLA				
	Barium (Ba)-Dissolved (mg/L)	5.61				
	Beryllium (Be)-Dissolved (mg/L)	<0.010 DLA				
	Bismuth (Bi)-Dissolved (mg/L)	<0.10 DLA				
	Boron (B)-Dissolved (mg/L)	8.9				
	Cadmium (Cd)-Dissolved (mg/L)	<0.0020 DLA				
	Calcium (Ca)-Dissolved (mg/L)	36800				
	Chromium (Cr)-Dissolved (mg/L)	<0.020 DLA				
	Cobalt (Co)-Dissolved (mg/L)	<0.020 DLA				
	Copper (Cu)-Dissolved (mg/L)	<0.040 DLA				
	Iron (Fe)-Dissolved (mg/L)	<0.50 DLA				
	Lead (Pb)-Dissolved (mg/L)	<0.010 DLA				
	Lithium (Li)-Dissolved (mg/L)	25.5				
	Magnesium (Mg)-Dissolved (mg/L)	553				
	Manganese (Mn)-Dissolved (mg/L)	1.93				
	Mercury (Hg)-Dissolved (mg/L)	<0.000010				
	Molybdenum (Mo)-Dissolved (mg/L)	0.201				
	Nickel (Ni)-Dissolved (mg/L)	0.021				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1331208-1				
	Description	water				
	Sampled Date	07-JUL-13				
	Sampled Time	16:00				
	Client ID	ZONE-4-2-2013				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<15 DLA				
	Potassium (K)-Dissolved (mg/L)	1270				
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA				
	Silicon (Si)-Dissolved (mg/L)	<2.5 DLA				
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA				
	Sodium (Na)-Dissolved (mg/L)	4080				
	Strontium (Sr)-Dissolved (mg/L)	651				
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA				
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA				
	Titanium (Ti)-Dissolved (mg/L)	0.54				
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA				
	Vanadium (V)-Dissolved (mg/L)	<0.10 DLA				
	Zinc (Zn)-Dissolved (mg/L)	0.24				
Glycols	Diethylene Glycol (mg/L)	<100 DLA				
	Ethylene Glycol (mg/L)	<100 DLA				
	1,2-Propylene Glycol (mg/L)	2260				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Nitrite (as N)	DLM	L1331208-1
Duplicate	Nitrate (as N)	DLM	L1331208-1
Method Blank	Strontium (Sr)-Total	MB-LOR	L1331208-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1331208-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1331208-1
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1331208-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1331208-1
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1331208-1
Matrix Spike	Barium (Ba)-Total	MS-B	L1331208-1
Matrix Spike	Calcium (Ca)-Total	MS-B	L1331208-1
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1331208-1
Matrix Spike	Manganese (Mn)-Total	MS-B	L1331208-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L1331208-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1331208-1
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L1331208-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1331208-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1331208-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

		Dissolved Fe in Water by ICPOES	EPA SW-846 3005A/6010B

Reference Information

FE-DIS-LOW-ICP-VA Water

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

FE-TOT-LOW-ICP-VA Water Total Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

GLY-WAT-FID-VA Water Glycols in Water by GCFID SW-846, METHOD 8015B, EPA

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 8015B, published by the United States Environmental Protection Agency (EPA). The procedure involves treatment of the sample with a strong base (NaOH) and benzoyl chloride to form the corresponding benzoate esters. The benzoate esters are then extracted with iso-octane and the extract is analyzed by capillary column gas chromatography with flame ionization detection (FID).

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the

Reference Information

American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-186495

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

10-186495

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan - ERM	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone: 604 689 9460 Fax:	Email 2: Rusto.Martinka@erm.com Daniel.Helm@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194096-0012	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone:	Quote #:	
Lab Work Order # (lab) L1331208-COFC	ALS Contact: Amber Springer	Sampler: Daniel Helm

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem	Nutrients	Total Metals	Dissolved Metals	Glycols	Number of Containers
					F	P	P	F	P	
	Zone-4-2-2013	07-Jul-13	16:00	Water	X	X	X	X	X	5

Short Holding Time

Rush Processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
			TN	3July13	13:00	18 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 19-JUL-13
Report Date: 01-AUG-13 11:17 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1335008

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-295673
Legal Site Desc:

Amber Springer
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1335008-1	L1335008-2	L1335008-3	L1335008-4	
	Description	Water	Water	Water	Water	
	Sampled Date	15-JUL-13	15-JUL-13	16-JUL-13	15-JUL-13	
	Sampled Time	13:00	18:00	13:30	15:00	
	Client ID	ZONE3-4-2013	ZONE6-1-2013	ZONE4-3-2013	ZONE3-4A-2013	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	120000	120000	137000		
	Hardness (as CaCO3) (mg/L)	70600	72200	87200		
	pH (pH)	7.10	7.23	7.82		
	Total Suspended Solids (mg/L)	165	178	231		
	Total Dissolved Solids (mg/L)	111000 AI	118000 AI	150000 AI		
	Turbidity (NTU)	48.1	41.7	7.42		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	7.8	8.5	20.9		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0		
	Alkalinity, Total (as CaCO3) (mg/L)	7.8	8.5	20.9		
	Ammonia, Total (as N) (mg/L)	1.00	1.01	2.09		
	Bromide (Br) (mg/L)	503	524	724		
	Chloride (Cl) (mg/L)	58300	61200	73100		
	Fluoride (F) (mg/L)	0.93	0.92	0.50		
	Nitrate (as N) (mg/L)	<0.50 DLM	<0.50 DLM	<0.50 DLM		
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.10 DLM	<0.10 DLM		
	Total Kjeldahl Nitrogen (mg/L)	2.49	1.80	3.09		
	Orthophosphate-Dissolved (as P) (mg/L)	0.0208	0.0320	0.173		
	Phosphorus (P)-Total (mg/L)	0.212	0.299	0.535		
	Sulfate (SO4) (mg/L)	<50 DLM	<50 DLM	<50 DLM		
Total Metals	Aluminum (Al)-Total (mg/L)	<0.30 DLA	<0.30 DLA	<0.60 DLA		
	Antimony (Sb)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Arsenic (As)-Total (mg/L)	<0.0030 DLA	<0.0030 DLA	<0.0060 DLA		
	Barium (Ba)-Total (mg/L)	7.36	7.70	5.78		
	Beryllium (Be)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Bismuth (Bi)-Total (mg/L)	<0.050 DLA	<0.050 DLA	<0.10 DLA		
	Boron (B)-Total (mg/L)	5.46	5.72	8.4		
	Cadmium (Cd)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Calcium (Ca)-Total (mg/L)	25200	27000	33500		
	Chromium (Cr)-Total (mg/L)	0.016	0.015	<0.020 DLA		
	Cobalt (Co)-Total (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Copper (Cu)-Total (mg/L)	<0.050 DLA	<0.050 DLA	<0.10 DLA		
	Iron (Fe)-Total (mg/L)	4.59	4.73	1.54		
	Lead (Pb)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Lithium (Li)-Total (mg/L)	14.4	14.7	23.3		
	Magnesium (Mg)-Total (mg/L)	789	850	540		
	Manganese (Mn)-Total (mg/L)	2.38	2.59	1.98		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1335008-1	L1335008-2	L1335008-3	L1335008-4	
	Description	Water	Water	Water	Water	
	Sampled Date	15-JUL-13	15-JUL-13	16-JUL-13	15-JUL-13	
	Sampled Time	13:00	18:00	13:30	15:00	
	Client ID	ZONE3-4-2013	ZONE6-1-2013	ZONE4-3-2013	ZONE3-4A-2013	
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Total (mg/L)	0.113	0.119	0.182		
	Nickel (Ni)-Total (mg/L)	0.014	0.016	<0.020 DLA		
	Phosphorus (P)-Total (mg/L)	<15 DLA	<15 DLA	<15 DLA		
	Potassium (K)-Total (mg/L)	630	686	1190		
	Selenium (Se)-Total (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Silicon (Si)-Total (mg/L)	<2.5 DLA	<2.5 DLA	<2.5 DLA		
	Silver (Ag)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Sodium (Na)-Total (mg/L)	5760	5930	4210		
	Strontium (Sr)-Total (mg/L)	502	518	598		
	Thallium (Tl)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Tin (Sn)-Total (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Titanium (Ti)-Total (mg/L)	0.68	0.68	0.63		
	Uranium (U)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Vanadium (V)-Total (mg/L)	<0.050 DLA	<0.050 DLA	<0.10 DLA		
	Zinc (Zn)-Total (mg/L)	<0.30 DLA	<0.30 DLA	<0.60 DLA		
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA	<0.20 DLA		
	Antimony (Sb)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Arsenic (As)-Dissolved (mg/L)	<0.0030	<0.0030 DLA	<0.0060 DLA		
	Barium (Ba)-Dissolved (mg/L)	7.46	7.36	5.64		
	Beryllium (Be)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Bismuth (Bi)-Dissolved (mg/L)	<0.050 DLA	<0.050 DLA	<0.10 DLA		
	Boron (B)-Dissolved (mg/L)	5.76	5.91	8.6		
	Cadmium (Cd)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Calcium (Ca)-Dissolved (mg/L)	27000	27600	34100		
	Chromium (Cr)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Cobalt (Co)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Copper (Cu)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.040 DLA		
	Iron (Fe)-Dissolved (mg/L)	3.37	3.10	<0.50 DLA		
	Lead (Pb)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Lithium (Li)-Dissolved (mg/L)	14.9	15.3	22.9		
	Magnesium (Mg)-Dissolved (mg/L)	789	804	518		
	Manganese (Mn)-Dissolved (mg/L)	2.51	2.51	1.89		
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Dissolved (mg/L)	0.117	0.121	0.180		
	Nickel (Ni)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1335008-1	L1335008-2	L1335008-3	L1335008-4	
	Description	Water	Water	Water	Water	
	Sampled Date	15-JUL-13	15-JUL-13	16-JUL-13	15-JUL-13	
	Sampled Time	13:00	18:00	13:30	15:00	
	Client ID	ZONE3-4-2013	ZONE6-1-2013	ZONE4-3-2013	ZONE3-4A-2013	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Phosphorus (P)-Dissolved (mg/L)	<15 DLA	<15 DLA	<15 DLA		
	Potassium (K)-Dissolved (mg/L)	651	671	1120		
	Selenium (Se)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Silicon (Si)-Dissolved (mg/L)	<2.5 DLA	<2.5 DLA	<2.5 DLA		
	Silver (Ag)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Sodium (Na)-Dissolved (mg/L)	5790	5700	4010		
	Strontium (Sr)-Dissolved (mg/L)	532	541	596		
	Thallium (Tl)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA	<0.010 DLA		
	Tin (Sn)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.020 DLA		
	Titanium (Ti)-Dissolved (mg/L)	0.66	0.68	0.61		
	Uranium (U)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.0020 DLA		
	Vanadium (V)-Dissolved (mg/L)	<0.050 DLA	<0.050 DLA	<0.10 DLA		
	Zinc (Zn)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA	<0.20 DLA		
Glycols	Diethylene Glycol (mg/L)	<50 DLA	<50 DLA	<250 DLA	<50 DLA	
	Ethylene Glycol (mg/L)	<50 DLA	<50 DLA	<250 DLA	<50 DLA	
	1,2-Propylene Glycol (mg/L)	673	663	2530	697	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Method Blank	Calcium (Ca)-Total	MB-LOR	L1335008-1, -2, -3
Method Blank	Strontium (Sr)-Total	MB-LOR	L1335008-1, -2, -3
Method Blank	Zinc (Zn)-Total	MB-LOR	L1335008-1, -2, -3
Method Blank	Sodium (Na)-Total	MB-LOR	L1335008-1, -2, -3
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1335008-1, -2, -3
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L1335008-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1335008-1, -2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1335008-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
AI	Analytical interferences may be present. Result may be biased high.
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F "Fluoride"

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA	Water	Dissolved Fe in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Reference Information

FE-TOT-LOW-ICP-VA Water Total Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

GLY-WAT-FID-VA Water Glycols in Water by GCFID SW-846, METHOD 8015B, EPA

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 8015B, published by the United States Environmental Protection Agency (EPA). The procedure involves treatment of the sample with a strong base (NaOH) and benzoyl chloride to form the corresponding benzoate esters. The benzoate esters are then extracted with iso-octane and the extract is analyzed by capillary column gas chromatography with flame ionization detection (FID).

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society

Reference Information

of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-295673

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

10- 295673

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan - ERM	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone: 604 689 9460 Fax:	Email 2: Yaming.Chen@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Invoice To Same as Report ? (circle) Yes or No (If No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194096-0012	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only)	**ALS Contact:** / **Sampler:**	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem	Nutrients	Total Metals	Dissolved Metals	Glycols	Number of Containers
Zone3-4-2013		15-Jul-13	13:00	Water						5
Zone6-1-2013		15-Jul-13	18:00	"						5
Zone4-3-2013		16-Jul-13	13:30	"						5
Zone3-4A-2013		15-Jul-13	15:00	"					X	1

Short Holding Time

Rush Processing

L1335008-COFC

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natu

pect very high TDS (~100 g/L), Calcium, chloride and Sodium (10s of g/L) in all samples. Please minimize impact of dilution detection limits as much as possible

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
ale	16-Jul-13	Morning		16/7/13	10:30	max 7.2 avg 6.7 °C				

Y.C July 19/13 19:20 9.7°C.

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
1111 West Hastings Street
6/Floor
Vancouver BC V6E 2J3

Date Received: 05-SEP-13
Report Date: 11-SEP-13 17:14 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1358466

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-295672
Legal Site Desc:

Amber Springer
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1358466-1	L1358466-2	L1358466-3	L1358466-4	
	Description	Water	Water	Water	Water	
	Sampled Date	02-SEP-13	03-SEP-13	04-SEP-13	04-SEP-13	
	Sampled Time	12:00	12:00	12:00	16:00	
	Client ID	ZONE4-4-2013	ZONE5-2-2013	ZONE3-5-2013	ZONE6-2-2013	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	136000	145000	106000	106000	
	Hardness (as CaCO3) (mg/L)	87000	105000	59000	57300	
	pH (pH)	7.70	7.95	6.99	6.80	
	Total Suspended Solids (mg/L)	93.1	147	102	122	
	Total Dissolved Solids (mg/L)	125000	135000	88500	91400	
	Turbidity (NTU)	9.15	4.60	56.5	61.1	
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	19.1	19.4	10.3	9.5	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Alkalinity, Total (as CaCO3) (mg/L)	19.1	19.4	10.3	9.5	
	Ammonia, Total (as N) (mg/L)	2.06	2.43	0.631	0.633	
	Bromide (Br) (mg/L)	902	1030	553	553	
	Chloride (Cl) (mg/L)	71500	79600	51800	51800	
	Fluoride (F) (mg/L)	0.62	0.67	0.72	0.71	
	Nitrate (as N) (mg/L)	<0.50 DLM	<0.50 DLM	<0.50 DLM	<0.50 DLM	
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.10 DLM	<0.10 DLM	<0.10 DLM	
	Total Kjeldahl Nitrogen (mg/L)	19.8	16.6	14.7	19.0	
	Orthophosphate-Dissolved (as P) (mg/L)	0.132	0.146	0.0141	0.0049	
	Phosphorus (P)-Total (mg/L)	0.400	0.313	0.276	0.314	
	Sulfate (SO4) (mg/L)	<50 DLM	<50 DLM	<50 DLM	<50 DLM	
Total Metals	Aluminum (Al)-Total (mg/L)		<0.60 DLA	<0.30 DLA	<0.30 DLA	
	Antimony (Sb)-Total (mg/L)		<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Arsenic (As)-Total (mg/L)		<0.0060 DLA	<0.0030 DLA	<0.0030 DLA	
	Barium (Ba)-Total (mg/L)		3.17	8.31	8.44	
	Beryllium (Be)-Total (mg/L)		<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Bismuth (Bi)-Total (mg/L)		<0.10 DLA	<0.050 DLA	<0.050 DLA	
	Boron (B)-Total (mg/L)		10.1	4.67	4.83	
	Cadmium (Cd)-Total (mg/L)		<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Calcium (Ca)-Total (mg/L)		42700	21800	21900	
	Chromium (Cr)-Total (mg/L)		<0.020 DLA	0.014 DLA	0.013 DLA	
	Cobalt (Co)-Total (mg/L)		<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Copper (Cu)-Total (mg/L)		<0.10 DLA	<0.050 DLA	<0.050 DLA	
	Iron (Fe)-Total (mg/L)		<1.0 DLA	6.88 DLA	6.71 DLA	
	Lead (Pb)-Total (mg/L)		<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Lithium (Li)-Total (mg/L)		30.1	9.90	10.2	
	Magnesium (Mg)-Total (mg/L)		446	959	974	
	Manganese (Mn)-Total (mg/L)		1.15	3.10	3.15	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1358466-1	L1358466-2	L1358466-3	L1358466-4	
	Description	Water	Water	Water	Water	
	Sampled Date	02-SEP-13	03-SEP-13	04-SEP-13	04-SEP-13	
	Sampled Time	12:00	12:00	12:00	16:00	
	Client ID	ZONE4-4-2013	ZONE5-2-2013	ZONE3-5-2013	ZONE6-2-2013	
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)		<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Total (mg/L)		0.256	0.0687	0.0697	
	Nickel (Ni)-Total (mg/L)		0.035	0.021	0.018	
	Phosphorus (P)-Total (mg/L)		<30 DLA	<15 DLA	<15 DLA	
	Potassium (K)-Total (mg/L)		1420	428	436	
	Selenium (Se)-Total (mg/L)		<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Silicon (Si)-Total (mg/L)		<5.0 DLA	<2.5 DLA	<2.5 DLA	
	Silver (Ag)-Total (mg/L)		<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Sodium (Na)-Total (mg/L)		3220	6940	7020	
	Strontium (Sr)-Total (mg/L)		674	414	416	
	Thallium (Tl)-Total (mg/L)		<0.010	<0.0050 DLA	<0.0050 DLA	
	Tin (Sn)-Total (mg/L)		<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Titanium (Ti)-Total (mg/L)		<1.1 DLA	<0.60 DLA	<0.60 DLA	
	Uranium (U)-Total (mg/L)		<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Vanadium (V)-Total (mg/L)		<0.10 DLA	<0.050 DLA	<0.050 DLA	
	Zinc (Zn)-Total (mg/L)		<0.60 DLA	0.43	0.38	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	<0.20 DLA	<0.20 DLA	0.11	<0.10 DLA	
	Antimony (Sb)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Arsenic (As)-Dissolved (mg/L)	<0.0060 DLA	<0.0060 DLA	<0.0030 DLA	<0.0030 DLA	
	Barium (Ba)-Dissolved (mg/L)	5.71	2.91	8.41	7.97	
	Beryllium (Be)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Bismuth (Bi)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA	<0.050 DLA	<0.050 DLA	
	Boron (B)-Dissolved (mg/L)	7.9	9.9	4.77	4.69	
	Cadmium (Cd)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Calcium (Ca)-Dissolved (mg/L)	33900	41200	22000	21400	
	Chromium (Cr)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Cobalt (Co)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Copper (Cu)-Dissolved (mg/L)	0.053	<0.040 DLA	<0.020 DLA	<0.020 DLA	
	Iron (Fe)-Dissolved (mg/L)	<1.0 DLA	<1.0 DLA	6.16	6.22	
	Lead (Pb)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Lithium (Li)-Dissolved (mg/L)	22.0	29.3	10.1	9.93	
	Magnesium (Mg)-Dissolved (mg/L)	565	421	980	929	
	Manganese (Mn)-Dissolved (mg/L)	2.05	1.10	3.20	2.95	
	Mercury (Hg)-Dissolved (mg/L)	0.000179	<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Dissolved (mg/L)	0.183	0.239	0.0701	0.0645	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1358466-1	L1358466-2	L1358466-3	L1358466-4	
	Description	Water	Water	Water	Water	
	Sampled Date	02-SEP-13	03-SEP-13	04-SEP-13	04-SEP-13	
	Sampled Time	12:00	12:00	12:00	16:00	
	Client ID	ZONE4-4-2013	ZONE5-2-2013	ZONE3-5-2013	ZONE6-2-2013	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	0.012	<0.010 DLA	
	Phosphorus (P)-Dissolved (mg/L)	<30 DLA	<30 DLA	<15 DLA	<15 DLA	
	Potassium (K)-Dissolved (mg/L)	1140	1360	440	415	
	Selenium (Se)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Silicon (Si)-Dissolved (mg/L)	<5.0 DLA	<5.0 DLA	<2.5 DLA	<2.5 DLA	
	Silver (Ag)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Sodium (Na)-Dissolved (mg/L)	4290	3070	7170	6710	
	Strontium (Sr)-Dissolved (mg/L)	591	660	416	396	
	Thallium (Tl)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA	<0.0050 DLA	<0.0050 DLA	
	Tin (Sn)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA	<0.010 DLA	<0.010 DLA	
	Titanium (Ti)-Dissolved (mg/L)	<1.1 DLA	<1.1 DLA	<0.60 DLA	<0.60 DLA	
	Uranium (U)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0010 DLA	<0.0010 DLA	
	Vanadium (V)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA	<0.050 DLA	<0.050 DLA	
	Zinc (Zn)-Dissolved (mg/L)	0.34	<0.20 DLA	0.18	0.17	
Glycols	Diethylene Glycol (mg/L)	<100 DLA	<100 DLA	<100 DLA	<100 DLA	
	Ethylene Glycol (mg/L)	<100 DLA	<100 DLA	<100 DLA	<100 DLA	
	1,2-Propylene Glycol (mg/L)	1290	1050	500	500	

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Bromide (Br)	DLM	L1358466-1, -2, -3, -4
Duplicate	Chloride (Cl)	DLM	L1358466-1, -2, -3, -4
Duplicate	Bromide (Br)	DLM	L1358466-1, -2, -3, -4
Duplicate	Nitrite (as N)	DLM	L1358466-1, -2, -3, -4
Duplicate	Bromide (Br)	DLM	L1358466-1, -2, -3, -4
Duplicate	Nitrite (as N)	DLM	L1358466-1, -2, -3, -4
Duplicate	Nitrate (as N)	DLM	L1358466-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F "Fluoride"

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA	Water	Dissolved Fe in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

FE-TOT-LOW-ICP-VA	Water	Total Fe in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method

Reference Information

6010B).

GLY-WAT-FID-VA Water Glycols in Water by GCFID SW-846, METHOD 8015B, EPA

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 8015B, published by the United States Environmental Protection Agency (EPA). The procedure involves treatment of the sample with a strong base (NaOH) and benzoyl chloride to form the corresponding benzoate esters. The benzoate esters are then extracted with iso-octane and the extract is analyzed by capillary column gas chromatography with flame ionization detection (FID).

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-295672

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

10- 295672

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan - ERM	Standard: X Other (specify):	Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	X Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver B.C.	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2: Rusto.Martinka@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: Fax:		

Invoice To	Client / Project Information
Same as Report ? (circle) (Yes) or No (if No, provide details)	
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194096-0012
Company:	PO / AFE:
Contact:	LSD:
Address:	
Phone: Fax:	Quote #:
Lab Work Order # (lab use only) L1358466	**ALS Contact:** Amber Springer **Sampler:** Tyler Gale

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem (P)	Nutrients (P)	Total Metals (P)	Dissolved Metals (F/P)	Glycols (P)	Number of Containers
	Zone 4-4-2013	Sept. 02/13	12:00	Water	X	X		X	X	4
	Zone 5-2-2013	03-Sep-13	12:00	Water	X	X	X	X	X	5
	Zone 3-5-2013	04-Sep-13	12:00	Water	X	X	X	X	X	5
	Zone 6-2-2013	04-Sep-13	16:00	Water	X	X	X	X	X	5



Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR- ...s

Please minimize dilution to minize effect on detection limits. Expect TDS of 10s to 100s of g/L, Calcium, Chloride, Sodium 10s of g/L in all samples.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Tyler Gale	Sept. 5/13	Morning		Sept. 5/13	2:05	max 3.3 avg 2.4 °C				

RESCAN ENVIRONMENTAL SERVICES
ATTN: Tyler Gale
1111 West Hastings Street
6/Floor
Vancouver BC V6E 2J3

Date Received: 23-SEP-13
Report Date: 25-SEP-13 16:15 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1366894

Project P.O. #: NOT SUBMITTED
Job Reference: 0194096-0012
C of C Numbers: 10-251297
Legal Site Desc:

Amber Springer
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1366894-1	L1366894-2			
	Description	Water	Water			
	Sampled Date	16-SEP-13	17-SEP-13			
	Sampled Time					
	Client ID	ZONE5-3-2013	ZONE3-6-2013			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	91700	102000			
	Hardness (as CaCO3) (mg/L)	51900	52400			
	pH (pH)	8.01	6.92			
	Total Suspended Solids (mg/L)	28.9	53.4			
	Total Dissolved Solids (mg/L)	73400	82900			
	Turbidity (NTU)	9.76	58.7			
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	16.2	10.7			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	16.2	10.7			
	Ammonia, Total (as N) (mg/L)	0.591	0.477			
	Bromide (Br) (mg/L)	618	584			
	Chloride (Cl) (mg/L)	45400	50300			
	Fluoride (F) (mg/L)	0.57	0.70			
	Nitrate (as N) (mg/L)	<0.50 DLM	<0.50 DLM			
	Nitrite (as N) (mg/L)	<0.10 DLM	<0.10 DLM			
	Total Kjeldahl Nitrogen (mg/L)	0.913	0.722			
	Orthophosphate-Dissolved (as P) (mg/L)	0.0768	0.0409			
	Phosphorus (P)-Total (mg/L)	0.237	0.176			
	Sulfate (SO4) (mg/L)	<50 DLM	<50 DLM			
Total Metals	Aluminum (Al)-Total (mg/L)	<0.30 DLA	<0.30 DLA			
	Antimony (Sb)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Arsenic (As)-Total (mg/L)	0.0079	0.0068			
	Barium (Ba)-Total (mg/L)	2.74	8.37			
	Beryllium (Be)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Bismuth (Bi)-Total (mg/L)	<0.050 DLA	<0.050 DLA			
	Boron (B)-Total (mg/L)	5.21	4.08			
	Cadmium (Cd)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA			
	Calcium (Ca)-Total (mg/L)	19400	19400			
	Chromium (Cr)-Total (mg/L)	0.010	<0.010 DLA			
	Cobalt (Co)-Total (mg/L)	<0.010 DLA	<0.010 DLA			
	Copper (Cu)-Total (mg/L)	<0.050 DLA	<0.050 DLA			
	Iron (Fe)-Total (mg/L)	1.15	6.85			
	Lead (Pb)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Lithium (Li)-Total (mg/L)	11.6	7.89			
	Magnesium (Mg)-Total (mg/L)	786	1010			
	Manganese (Mn)-Total (mg/L)	2.01	3.17			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1366894-1	L1366894-2			
	Description	Water	Water			
	Sampled Date	16-SEP-13	17-SEP-13			
	Sampled Time					
	Client ID	ZONE5-3-2013	ZONE3-6-2013			
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Total (mg/L)	0.0885	0.0590			
	Nickel (Ni)-Total (mg/L)	0.017	0.019			
	Phosphorus (P)-Total (mg/L)	<6.0 DLA	<6.0 DLA			
	Potassium (K)-Total (mg/L)	435	361			
	Selenium (Se)-Total (mg/L)	<0.010 DLA	<0.010 DLA			
	Silicon (Si)-Total (mg/L)	<1.0 DLA	1.0			
	Silver (Ag)-Total (mg/L)	<0.0010 DLA	0.0070			
	Sodium (Na)-Total (mg/L)	5090	7140			
	Strontium (Sr)-Total (mg/L)	342	398			
	Thallium (Tl)-Total (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Tin (Sn)-Total (mg/L)	<0.010 DLA	<0.010 DLA			
	Titanium (Ti)-Total (mg/L)	<0.20 DLA	<0.20 DLA			
	Uranium (U)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA			
	Vanadium (V)-Total (mg/L)	<0.050 DLA	<0.050 DLA			
	Zinc (Zn)-Total (mg/L)	0.38	0.50			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD			
	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	<0.10 DLA	<0.10 DLA			
	Antimony (Sb)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Arsenic (As)-Dissolved (mg/L)	0.0080	0.0075			
	Barium (Ba)-Dissolved (mg/L)	2.82	8.68			
	Beryllium (Be)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Bismuth (Bi)-Dissolved (mg/L)	<0.050 DLA	<0.050 DLA			
	Boron (B)-Dissolved (mg/L)	5.30	4.08			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA			
	Calcium (Ca)-Dissolved (mg/L)	19500	19300			
	Chromium (Cr)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA			
	Cobalt (Co)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA			
	Copper (Cu)-Dissolved (mg/L)	<0.020 DLA	<0.020 DLA			
	Iron (Fe)-Dissolved (mg/L)	0.89	6.16			
	Lead (Pb)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Lithium (Li)-Dissolved (mg/L)	11.8	8.09			
	Magnesium (Mg)-Dissolved (mg/L)	801	1040			
	Manganese (Mn)-Dissolved (mg/L)	2.03	3.24			
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)	0.0873	0.0563			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1366894-1	L1366894-2			
	Description	Water	Water			
	Sampled Date	16-SEP-13	17-SEP-13			
	Sampled Time					
	Client ID	ZONE5-3-2013	ZONE3-6-2013			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	0.011	0.011			
	Phosphorus (P)-Dissolved (mg/L)	<6.0 DLA	<6.0 DLA			
	Potassium (K)-Dissolved (mg/L)	446	370			
	Selenium (Se)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA			
	Silicon (Si)-Dissolved (mg/L)	<1.0 DLA	<1.0 DLA			
	Silver (Ag)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA			
	Sodium (Na)-Dissolved (mg/L)	5200	7180			
	Strontium (Sr)-Dissolved (mg/L)	338	399			
	Thallium (Tl)-Dissolved (mg/L)	<0.0050 DLA	<0.0050 DLA			
	Tin (Sn)-Dissolved (mg/L)	<0.010 DLA	<0.010 DLA			
	Titanium (Ti)-Dissolved (mg/L)	<0.20 DLA	<0.20 DLA			
	Uranium (U)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA			
	Vanadium (V)-Dissolved (mg/L)	<0.050 DLA	<0.050 DLA			
	Zinc (Zn)-Dissolved (mg/L)	0.24	0.35			
Glycols	Diethylene Glycol (mg/L)	<100 DLA	<100 DLA			
	Ethylene Glycol (mg/L)	<100 DLA	<100 DLA			
	1,2-Propylene Glycol (mg/L)	1800	760			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Aluminum (Al)-Dissolved	DLA	L1366894-1, -2
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1366894-1, -2
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1366894-1, -2
Duplicate	Cobalt (Co)-Dissolved	DLA	L1366894-1, -2
Duplicate	Copper (Cu)-Dissolved	DLA	L1366894-1, -2
Duplicate	Lead (Pb)-Dissolved	DLA	L1366894-1, -2
Duplicate	Silver (Ag)-Dissolved	DLA	L1366894-1, -2
Duplicate	Tin (Sn)-Dissolved	DLA	L1366894-1, -2
Duplicate	Uranium (U)-Dissolved	DLA	L1366894-1, -2
Duplicate	Antimony (Sb)-Dissolved	DLA	L1366894-1, -2
Duplicate	Beryllium (Be)-Dissolved	DLA	L1366894-1, -2
Duplicate	Chromium (Cr)-Dissolved	DLA	L1366894-1, -2
Duplicate	Selenium (Se)-Dissolved	DLA	L1366894-1, -2
Duplicate	Thallium (Tl)-Dissolved	DLA	L1366894-1, -2
Duplicate	Vanadium (V)-Dissolved	DLA	L1366894-1, -2
Duplicate	Phosphorus (P)-Dissolved	DLA	L1366894-1, -2
Duplicate	Silicon (Si)-Dissolved	DLA	L1366894-1, -2
Duplicate	Titanium (Ti)-Dissolved	DLA	L1366894-1, -2
Duplicate	Chloride (Cl)	DLM	L1366894-1, -2
Duplicate	Nitrite (as N)	DLM	L1366894-1, -2
Duplicate	Nitrate (as N)	DLM	L1366894-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

F-SIE-VA	Water	Fluoride by SIE	APHA 4500-F "Fluoride"

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

F-SIE-VA Water Fluoride by SIE APHA 4500-F Fluoride

This analysis is carried out using procedures adapted from APHA Method 4500-F "Fluoride". Fluoride is determined using a selective ion electrode. This method has a significant negative interference (i.e. results could be biased low) when Al3+ is present in the sample at a concentration greater than 2.5 mg/L.

FE-DIS-LOW-ICP-VA Water Dissolved Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

FE-TOT-LOW-ICP-VA Water Total Fe in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

GLY-WAT-FID-VA Water Glycols in Water by GCFID SW-846, METHOD 8015B, EPA

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 8015B, published by the United States Environmental Protection Agency (EPA). The procedure involves treatment of the sample with a strong base (NaOH) and benzoyl chloride to form the corresponding benzoate esters. The benzoate esters are then extracted with iso-octane and the extract is analyzed by capillary column gas chromatography with flame ionization detection (FID).

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-ULTRA-MS-VA Water Diss. Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-ULTRA-MS-VA Water Total Metals in Water by ICPMS (Ultra) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-251297

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

L1366894-COFC

10-251297

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Report To		Report Format / Distribution		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)	
Company:	Roscan	Standard:	Other (specify):		Regular (Standard Turnaround Times - Business Days)
Contact:	Tyler Gale	Select: PDF	Excel Digital Fax	X	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	Vancouver, BC	Email 1:	Tyler.Gale@roscan.com		Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
		Email 2:			Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	Fax:				

Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	0194096-0012
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	

Lab Work Order # (lab use only)	L1366894	ALS Contact:	Amber	Sampler:	Rusto

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General	Nutrients	Total Metals	Diss. Metals	Glycols	Number of Containers
	Zone 5-3-2013	16-09-13		Water	X	X	X	X	X	5
	Zone 3-6-2013	17-09-13		Water	X	X	X	X	X	5

RUSH

Priority processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Expect high TDS (10-100 g/L) as well as Ca, Cl, Na.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Rusto	Date: 18-09-13	Time: 12:00	Received by: Paige	Date: Sept. 23	Time: 12:00	Temperature: 7 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

L1366894-COFC

10-251297

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Roscan	Standard: Other (specify):	Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF Excel Digital Fax	X Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: Vancouver, BC	Email 1: Tyler.Gale@roscan.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2:	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: Fax:		

Invoice To	Client / Project Information
Same as Report ? (circle) Yes or No (if No, provide details)	Job #: 0194096-0012
Copy of Invoice with Report? (circle) Yes or No	PO / AFE:
Company:	LSD:
Contact:	
Address:	Quote #:
Phone: Fax:	

Lab Work Order # (lab use only): L1366894 | **ALS Contact:** Amber | **Sampler:** Rusto

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	F/P General	F/P Nutrients	F/P Total Metals	F/P Diss. Metals	F/P Glycols	Number of Containers
	Zone 5-3-2013	16-09-13		Water	X	X	X	X	X	5
	Zone 3-6-2013	17-09-13		Water	X	X	X	X	X	5

RUSH

Priority processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Expect high TDS (to ~100 g/L) as well as Ca, Cl, Na.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Rusto	Date: 18-09-13	Time: 12:00	Received by: Paige	Date: Sept. 23	Time: 12:00	Temperature: 7 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

Appendix V6-2B

Completion Report, Westbay System Monitoring Well: 13-GSE-319

Rescan™
an ERM company

Schlumberger Water Services

Schlumberger Canada Limited
3480 Gilmore Way, Suite 110
Burnaby, BC V5G 4Y1
Canada
Tel. +1.604.430.4272
Fax. +1.604.430.3538

COMPLETION REPORT

Westbay System Monitoring Well:

13-GSE-319

Back River, NU

Prepared for:

Rescan Environmental Services Ltd.
Sixth Floor, 1111 W. Hastings St.
Vancouver, BC
V6E 2J3
Canada

Prepared by:

Schlumberger Water Services
WB927
June 27, 2013

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APPENDIX

Monitoring Well: 13-GSE-319

1. Introduction

This report and the attached appendix documents the technical services carried out by Schlumberger Water Services (SWS) under Rescan Environmental Services Ltd. (Rescan) P.O. No. 0194096-0012 dated May 1, 2013. A Westbay System completion was installed in borehole 13-GSE-319 at the Sabina Gold & Silver Corp., Back River Development, Nunavut.

Westbay technical services representatives Mr. Mark Lessard and Mr. Dennis Oertel were on site for the installation of the Westbay System well from May 20 to June 2, 2013. All field work was supervised on site by Rescan representatives Mr. Tyler Gale, Mr. Cody Cameron and Mr. Rusto Martinka.

This report documents the installation tasks and related QA checks.

2. Previous Activities

The borehole was drilled by Major Drilling Group International Inc. using a diamond core rotary method at a nominal 96-mm diameter (HQ-size). The borehole angle was set to a nominal plunge angle of 78 degrees below horizontal. A brine mixture with added polymers was used as a drilling fluid and to keep the borehole from freezing. A nominal 4-inch permanent surface casing was installed in the borehole to a depth of about 9 meters (30-ft). A gyroscopic directional survey was performed in the borehole prior to the installation of the Westbay casing. Core logging was used to determine the positioning of the sampling zones. The borehole was flushed with brine immediately prior to lowering of the Westbay casing.

(Note: depth for the borehole is with respect to top of surface casing. There is no correction for borehole angle from vertical. Monitoring well reference elevation was not available at the time of writing).

Table 1, Summary of Westbay System Well Installation

Monitoring Well No.	Installation Date	Borehole Depth (m)	MP38 Casing Length (m)	No. Monitoring Zones
13-GSE-319	May 27 – 31	782.6	782.4	5

3. Installation

The Westbay completion in borehole 13-GSE-319 was installed according to the procedure described below.

3.1 Preparation of Monitoring Well Design

Monitoring zone locations for the borehole was provided to Schlumberger Water Services by Mr. Tyler Gale of Rescan. The well design was created based on the requested monitoring zone locations. The well design was used to prepare a Casing Installation Log, which specifies the location of components in the well. This log was reviewed by Mr. Gale prior to installation of the well. The Casing Installation Log as approved was used as an installation guide in the field. A field copy of the log is in the appendix.

A measurement port coupling was included in each monitoring zone to provide the capability to measure fluid pressures and collect fluid samples. Measurement port couplings were also included in QA zones to provide QA testing capabilities and to permit operation of the squeeze relief venting capabilities of the Model 6055 packer inflation tool. A pumping port coupling was included in each monitoring zone to provide purging and hydraulic conductivity testing capabilities. A pumping port was also placed above the two packers located directly above the expected base of permafrost. This pumping port was placed as part of a procedure to introduce a glycol/water mixture into the annulus in the permafrost zone. The well design included a long tailpipe below the bottom packer. This tailpipe was used to rest the Westbay casing string on the borehole bottom during retrieval of the temporary guide tube. Mr. Gale requested that optional synthetic (PET) filters were not to be installed over the measurement port couplings in the monitoring zones.

3.2 Layout of Westbay Casing Components

Prior to installation, the Westbay System casing components were set out on racks at the borehole, according to the sequence indicated on the Casing Installation Log. Each casing length was numbered beginning with the lowermost as an aid to confirming the proper sequence of components. The appropriate Westbay System couplings were attached to the casing sections. Magnetic location collars were attached 0.6-m below the top of the measurement port in each sampling zone and one at 10-m below ground surface. Each casing component was visually inspected. Serial numbers for each packer, pumping port and measurement port coupling were recorded on the Casing Installation Log. The well component layout was confirmed with the log before the components were lowered into the borehole.

3.3 Lowering of Westbay Components

The Westbay casing components were lowered into the borehole by hand through HQ drill rods (nominal 76-mm ID) used as a temporary guide tube. Each Westbay casing, packer and coupling was confirmed to be in the correct sequence during lowering. A record of placement of each casing component and coupling are noted on the Casing Installation Log by check marks. The joints in the monitoring zones were tested with a minimum internal hydraulic pressure of 150 psi for one minute to confirm hydraulic seals. At the request of Rescan, no testing of other Westbay casing joints were done, as part of a plan to minimize installation time.

A 2:1 water/propylene glycol mixture supplied by Rescan was added to the Westbay casing when necessary to counter buoyancy effects while components were lowered into the borehole and for testing of joint seals.

3.4 Positioning of Westbay Components

After the components were lowered into the well and the guide tube was removed, the Westbay casing string was positioned as illustrated on the Casing Installation Log. The Westbay casing string was supported in this position while packer inflation was carried out. The positioning of the Westbay casing components is based on the "nominal" lengths of Westbay casing components. The positioning calculations do not include allowances for borehole temperature or deviation effects.

The attached figure titled “MOSDAX Transducer Position” provides information to correlate the position of MOSDAX Transducer sensors to the reference position at the top of the Measurement Port. The attached figure titled “Dimensions of Packer Seals and Monitoring Zones” outlines the calculations used to determine the packer depths and zone length.

The Summary Casing Log, which shows the final "as-built" locations of the components in the well, is included in the appendix. The depths of key items in the well are shown on Table 2 in the appendix.

3.5 Inflation of Westbay System Packers and Placement of Antifreeze Solution

The Westbay packers were inflated using a 2:1 proplyene glycol/water mixture provided by Rescan. The Westbay Model No. 6055 vented inflation tool was used for packer inflation. All of the packers appear to have inflated normally. The data for inflation of each packer are provided on the Westbay Packer Inflation Records included in the appendix.

The packers were inflated in a specific sequence as part of a procedure to introduce and control an antifreeze solution in the well annulus through the permafrost zone:

- Two packers positioned immediately above the expected base of permafrost were inflated.
- The pumping port above the upper inflated packer was opened.
- A 2:1 mixture of water and propylene glycol supplied by Rescan was pumped inside the Westbay casing, out the pumping port and into the well annulus. Pumping continued until a return flow of the mixture was observed from the well annulus at ground level, indicating that the well annulus was full of the antifreeze mixture.
- The Westbay packers in the permafrost were inflated, confining the antifreeze mixture.
- The pumping port port was closed.
- The remaining Westbay packers in the well were inflated.

4. Fluid Pressure Measurements

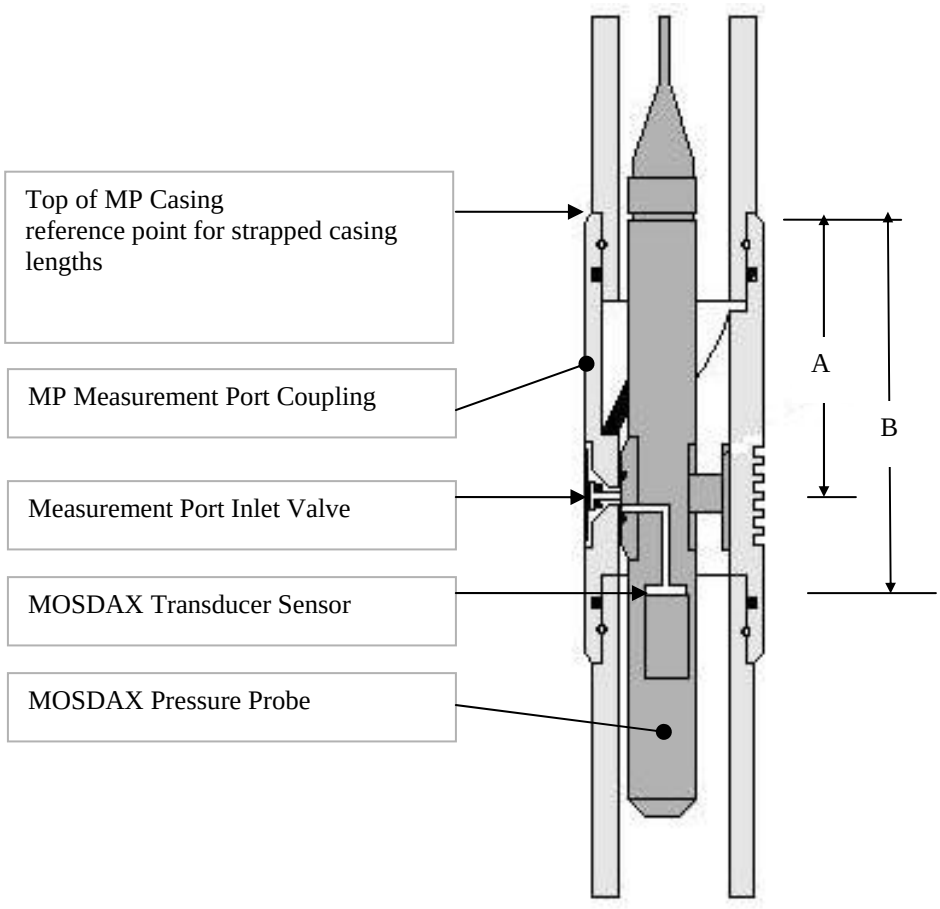
In order to minimize the time required to lower the Westbay casing and complete the tasks for placement of antifreeze in the borehole annulus, the standard SWS procedure to measure a profile of pressure measurements before packer inflation was not done.

After packer inflation was completed, fluid pressures were measured at each measurement port. At that time, the in-situ formation pressures may not have recovered from the pre-installation activities. Longer term monitoring may be required to establish representative fluid pressures.

A plot of the Post-Inflation Piezometric levels is shown on Figure 1 in the Appendix. The calculations were not corrected for borehole deviation or fluid density. The calculated results are reported as equivalent fresh water levels. The data were examined to confirm proper operation of the measurement ports and as a check on the presence of annulus seals between monitoring zones. The calculation sheet for the pressure profile is enclosed in the appendix.

MOSDAX Transducer Position

In an MP System Measurement Port Coupling



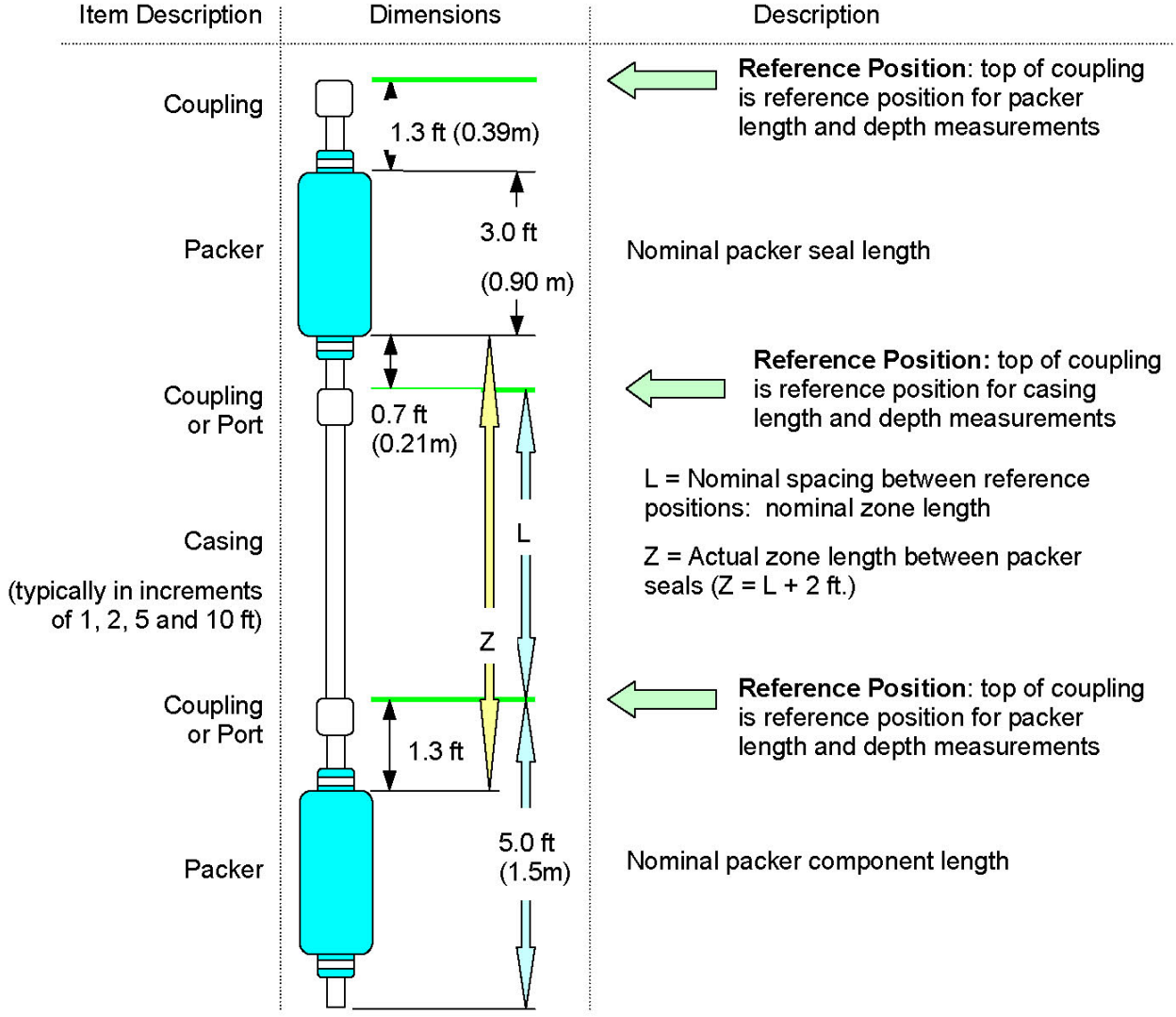
System	Measurement Port Type	A	B
Plastic MP38	0222, 0205	4.5" (114.3 mm)	6.5" (165.1 mm)

Technical Note

Schlumberger WATER SERVICES

Dimensions of Packer Seals and Monitoring Zones

Westbay System – Plastic MP38



Discussion Points:

- The top of a coupling (Regular Coupling, Measurement Port or Pumping Port) is the reference point for describing nominal depths and nominal lengths. Actual positions of packer seals and zone lengths are determined with respect to the appropriate reference positions.
- Packer Position Example: A packer with a nominal depth of 50 ft (15.2m), will have a nominal packer seal position of 51.3 to 54.3 ft. (15.59 to 16.49m)
- Zone Length Example: A zone whose upper packer is at 50 ft (15.2m) and bottom packer is at 70 ft (21.3m) will have a nominal zone length of 15 ft (4.6m) and an actual zone length (between packer seals) of 15.0+1.3+0.7 = 17.0ft. (4.6 + 0.39 + 0.2 = 5.19m)
- Information on the position of Measurement Port Valve and MOSDAX Transducer sensor, used for detailed calculation of piezometric level measurements, are described separately.

Schlumberger Private

APPENDIX

Monitoring Well 13-GSE-319

As-Built Casing Summary	-6 pages
Summary Casing Log	-6 pages
Post- Inflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (May 31, 2013)	-1 page
Figure 1, Post-Inflation Profile	-1 page
Casing Installation Log (field copy)	-18 pages
Westbay Packer Inflation Records	-17 pages

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
280	0203							-3.0
279	20101		0202					-2.9
278	20102		0202					-2.6
277	20102		0202					-2.0
276	20102		0202					-1.4
275	20102		0202					-0.8
274	20105		0202					-0.2
273	20105		0202					1.3
272	20110		0202					2.9
271	20110		0202			0216	0.6	5.9
270	20110		0202					8.9
269	20110		0202					12.0
268	20110		0202					15.0
267	20110		0202					18.1
266	20110		0202					21.1
265	20110		0202					24.2
264	20110		0202					27.2
263	20110		0202					30.3
262	20110		0202					33.3
261	20110		0202					36.4
260	20110		0202					39.4
259	20110		0202					42.5
258	20110		0202					45.5
257	20110		0202					48.6
256	20110		0202					51.6
255	20110		0202					54.7
254	20110		0202					57.7
253	20110		0202					60.8
252	20110		0202					63.8
251	20110		0202					66.9
250	20110		0202					69.9
249	20110		0202					73.0
248	20110		0202					76.0
247	20110		0202					79.0
246	0238	18314	0202					82.1
245	20110		0205	Measurement Port	7655	0216	0.6	**83.6**
244	20105		0202					86.7
243	20110		0202			`		88.2
242	20110		0202					91.2
241	20110		0202					94.3
240	20110		0202					97.3
239	20110		0202					100.4
238	20110		0202					103.4
237	20110		0202					106.5
236	20110		0202					109.5
235	20110		0202					112.6
234	20110		0202					115.6
233	20110		0202					118.7
232	20110		0202					121.7
231	20110		0202					124.8

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
230	20110		0202					127.8
229	20110		0202					130.9
228	20110		0202					133.9
227	20110		0202					137.0
226	20110		0202					140.0
225	20110		0202					143.1
224	20110		0202					146.1
223	20110		0202					149.2
222	20110		0202					152.2
221	20110		0202					155.2
220	20110		0202					158.3
219	20110		0202					161.3
218	20110		0202					164.4
217	20110		0202					167.4
216	20110		0202					170.5
215	20110		0202					173.5
214	20110		0202					176.6
213	0238	18313	0202					179.6
212	20110		0205	Measurement Port	7649	0216	0.6	**181.2**
211	20105		0202					184.2
210	20110		0202					185.7
209	20110		0202					188.8
208	20110		0202					191.8
207	20110		0202					194.9
206	20110		0202					197.9
205	20110		0202					201.0
204	20110		0202					204.0
203	20110		0202					207.1
202	20110		0202					210.1
201	20110		0202					213.2
200	20110		0202					216.2
199	20110		0202					219.3
198	20110		0202					222.3
197	20110		0202					225.3
196	20110		0202					228.4
195	20110		0202					231.4
194	20110		0202					234.5
193	20110		0202					237.5
192	20110		0202					240.6
191	20110		0202					243.6
190	20110		0202					246.7
189	20110		0202					249.7
188	20110		0202					252.8
187	20110		0202					255.8
186	20110		0202					258.9
185	20110		0202					261.9
184	20110		0202					265.0
183	20110		0202					268.0
182	20110		0202					271.1
181	20110		0202					274.1

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
180	20110		0202					277.2
179	0238	18312	0202					280.2
178	20110		0205	Measurement Port	7630	0216	0.6	**281.7**
177	20105		0202					284.8
176	20110		0202					286.3
175	20110		0202					289.4
174	20110		0202					292.4
173	20110		0202					295.4
172	20110		0202					298.5
171	20110		0202					301.5
170	20110		0202					304.6
169	20110		0202					307.6
168	20110		0202					310.7
167	20110		0202					313.7
166	20110		0202					316.8
165	20110		0202					319.8
164	20110		0202					322.9
163	20110		0202					325.9
162	20110		0202					329.0
161	20110		0202					332.0
160	20110		0202					335.1
159	20110		0202					338.1
158	20110		0202					341.2
157	20110		0202					344.2
156	20110		0202					347.3
155	20110		0202					350.3
154	20110		0202					353.4
153	20110		0202					356.4
152	20110		0202					359.5
151	20110		0202					362.5
150	20110		0202					365.6
149	20110		0202					368.6
148	20110		0202					371.6
147	20110		0202					374.7
146	20110		0202					377.7
145	0238	18311	0202					380.8
144	20110		0205	Measurement Port	7653	0216	0.6	**382.3**
143	20105		0202					385.4
142	20110		0202					386.9
141	20110		0202					389.9
140	20110		0202					393.0
139	20110		0202					396.0
138	20110		0202					399.1
137	20110		0202					402.1
136	20110		0202					405.2
135	20110		0202					408.2
134	20110		0202					411.3
133	20110		0202					414.3
132	20110		0202					417.4
131	20110		0202					420.4

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
130	20110		0202					423.5
129	20110		0202					426.5
128	20110		0202					429.6
127	20110		0202					432.6
126	20110		0202					435.7
125	20110		0202					438.7
124	20110		0202					441.7
123	20110		0202					444.8
122	20110		0206	Pumping Port	306	0216	0.6	**447.8**
121	0238	18290	0202					451.0
120	20110		0205	Measurement Port	7648			**452.5**
119	0238	18289	0202					455.5
118	20110		0205	Measurement Port	7631			**457.1**
117	20110		0202					460.1
116	20110		0202					463.2
115	20110		0202					466.2
114	20110		0202					469.3
113	20110		0202					472.3
112	20110		0202					475.3
111	20110		0202					478.4
110	20110		0202					481.4
109	20110		0202					484.5
108	20110		0202					487.5
107	20110		0202					490.6
106	20110		0202					493.6
105	20110		0202					496.7
104	20110		0202					499.7
103	20110		0202					502.8
102	20110		0202					505.8
101	20110		0202					508.9
100	20110		0202					511.9
99	20110		0202					515.0
98	20110		0202					518.0
97	20110		0202					521.1
96	20110		0202					524.1
95	20110		0202					527.2
94	20110		0202					530.2
93	0238	18287	0202					533.3
92	20105		0205	Measurement Port	7657	0216	0.6	**534.8**
91	20105		0206	Pumping Port	301			**536.3**
90	0238	18288	0202					537.9
89	20110		0205	Measurement Port	7654			**539.4**
88	20110		0202					542.5
87	20110		0202					545.5
86	20110		0202					548.6
85	20110		0202					551.6
84	20110		0202					554.7
83	20110		0202					557.7
82	20110		0202					560.8
81	20110		0202					563.8

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
80	20110		0202					566.9
79	20110		0202					569.9
78	20110		0202					573.0
77	20110		0202					576.0
76	20110		0202					579.1
75	20110		0202					582.1
74	20110		0202					585.1
73	20110		0202					588.2
72	20110		0202					591.2
71	20110		0202					594.3
70	20110		0202					597.3
69	20110		0202					600.4
68	20110		0202					603.4
67	20110		0202					606.5
66	20110		0202					609.5
65	20110		0202					612.6
64	20110		0202					615.6
63	20110		0202					618.7
62	20110		0202					621.7
61	0238	18285	0202					624.8
60	20105		0205	Measurement Port	7659	0216	0.6	**626.3**
59	20105		0206	Pumping Port	302			**627.8**
58	0238	18286	0202					629.4
57	20110		0205	Measurement Port	7651			**630.9**
56	20110		0202					634.0
55	20110		0202					637.0
54	20110		0202					640.1
53	20110		0202					643.1
52	0238	18295	0202					646.2
51	20105		0205	Measurement Port	7660	0216	0.6	**647.7**
50	20105		0206	Pumping Port	303			**649.2**
49	0238	18294	0202					650.8
48	20110		0205	Measurement Port	7652			**652.4**
47	20105		0202					655.4
46	20110		0202					656.9
45	20110		0202					660.0
44	20110		0202					663.0
43	20110		0202					666.1
42	0238	18292	0202					669.1
41	20105		0205	Measurement Port	7656	0216	0.6	**670.6**
40	20110		0206	Pumping Port	305			**672.2**
39	20101		0202					675.3
38	0238	18293	0202					675.6
37	20110		0205	Measurement Port	7650			**677.1**
36	20110		0202					680.2
35	20110		0202					683.2
34	20110		0202					686.3
33	20110		0202					689.3
32	20110		0202					692.4
31	0238	18291	0202					695.4

Item No.	Component Part Number	Component S/N	Coupling P/N	Component Discription	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
30	20105		0205	Measurement Port	7658	0216	0.6	**696.9**
29	20105		0206	Pumping Port	304			**698.5**
28	0238	18300	0202					700.1
27	20110		0205	Measurement Port	7629			**701.6**
26	20110		0202					704.6
25	20110		0202					707.7
24	20110		0202					710.7
23	20110		0202					713.8
22	20110		0202					716.8
21	20110		0202					719.9
20	20110		0202					722.9
19	20110		0202					726.0
18	20110		0202					729.0
17	20110		0202					732.1
16	20110		0202					735.1
15	20110		0202					738.1
14	20110		0202					741.2
13	20110		0202					744.2
12	20110		0202					747.3
11	20110		0202					750.3
10	20110		0202					753.4
9	20110		0202					756.4
8	20110		0202					759.5
7	20110		0202					762.5
6	20110		0202					765.6
5	20110		0202					768.6
4	20110		0202					771.7
3	20110		0202					774.7
2	20110		0202					777.8
1	20105		0202					780.8
0	0203							782.3

Depths are with respect to top of the 4-inch steel surface casing.

* Component positions are referenced to the top of the subject Westbay System coupling.

* Packer positions are referenced to the top Westbay System coupling on the packer.

Monitoring zone dimensions are determined as described on the attached “Dimensions of Packer Seals and Monitoring Zones”.

The position of a MOSDAX Transducer in a Measurement Port is illustrated in the attached “MOSDAX Transducer Position”.

This information may be used in calculating piezometric levels.

Summary Casing Log

Company: Rescan
Well: 13-GSE-319
Site: Sabina
Project: Back River Project

Job No: WB927
Author: ML

Well Information

Reference Datum: Top of 4-in SC.
Elevation of Datum: 0.00 m.
MP Casing Top: 0.00 m.
MP Casing Length: 782.39 m.

Borehole Depth: 782.60 m.
Borehole Inclination: 77 Degrees
Borehole Diameter: 96.00 mm

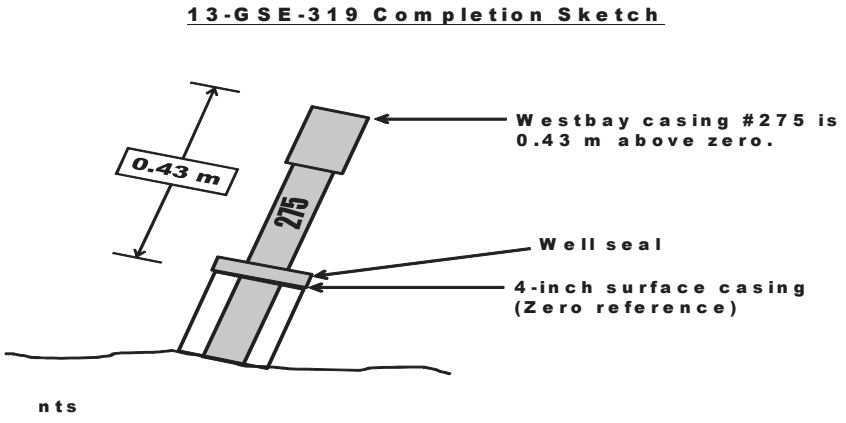
Well Description:
MP38
Other References:

File Information

File Name: WB-13.WWD
Report Date: Thu Jun 06 13:21:23 2013

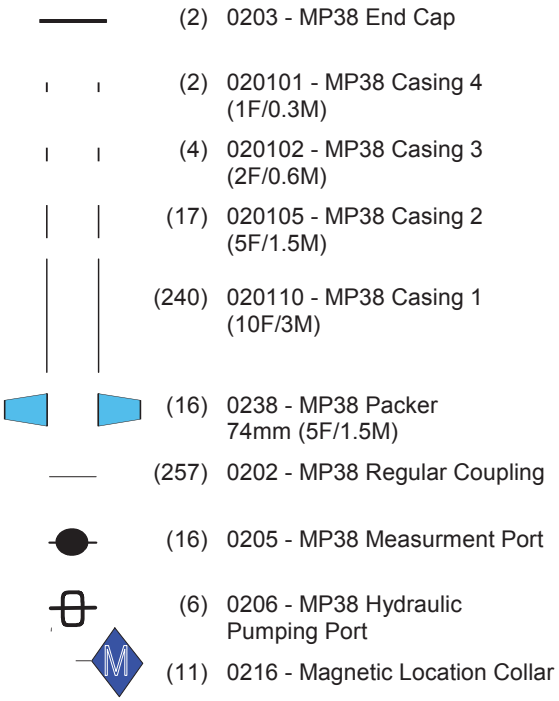
File Date: Jun 06 13:19:40 2013

Sketch of Wellhead Completion



Legend

(Qty) MP Components (Library - WD Library 7/27/00)	Geology	Backfill/Casing



(2) 0203 - MP38 End Cap

(2) 020101 - MP38 Casing 4 (1F/0.3M)

(4) 020102 - MP38 Casing 3 (2F/0.6M)

(17) 020105 - MP38 Casing 2 (5F/1.5M)

(240) 020110 - MP38 Casing 1 (10F/3M)

(16) 0238 - MP38 Packer 74mm (5F/1.5M)

(257) 0202 - MP38 Regular Coupling

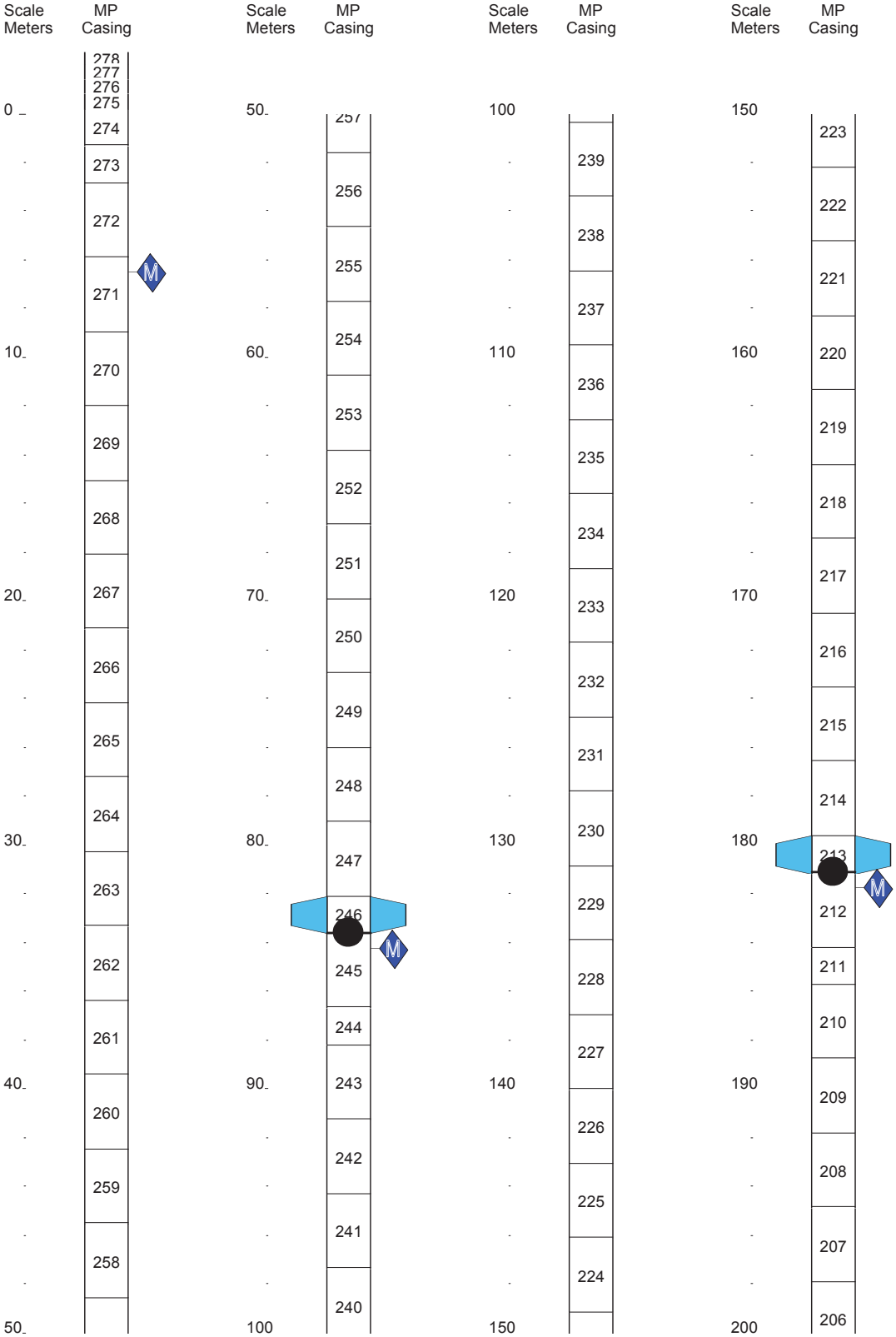
(16) 0205 - MP38 Measurment Port

(6) 0206 - MP38 Hydraulic Pumping Port

(11) 0216 - Magnetic Location Collar

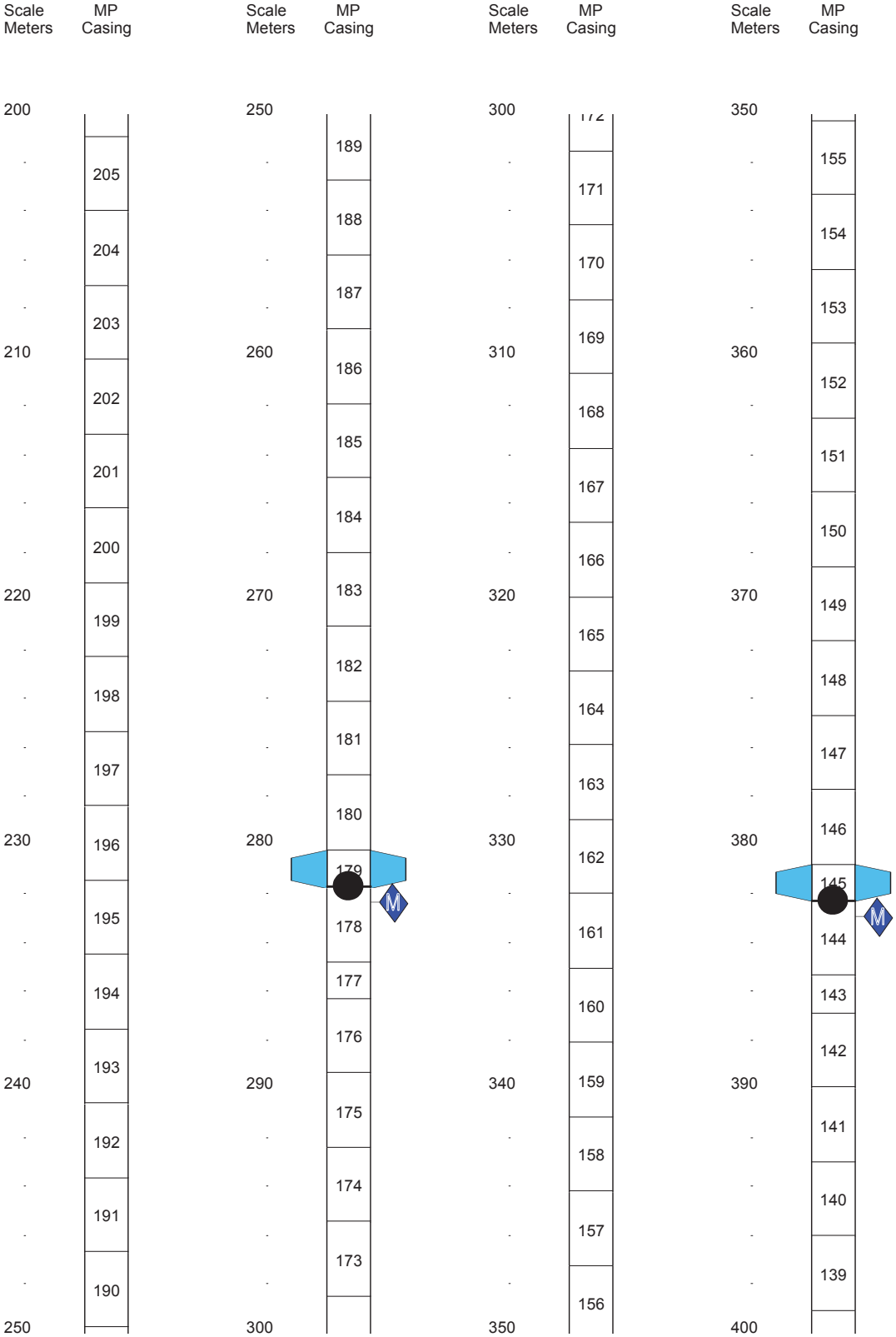
Summary Casing Log
Rescan

Job No: WB927
Well: 13-GSE-319



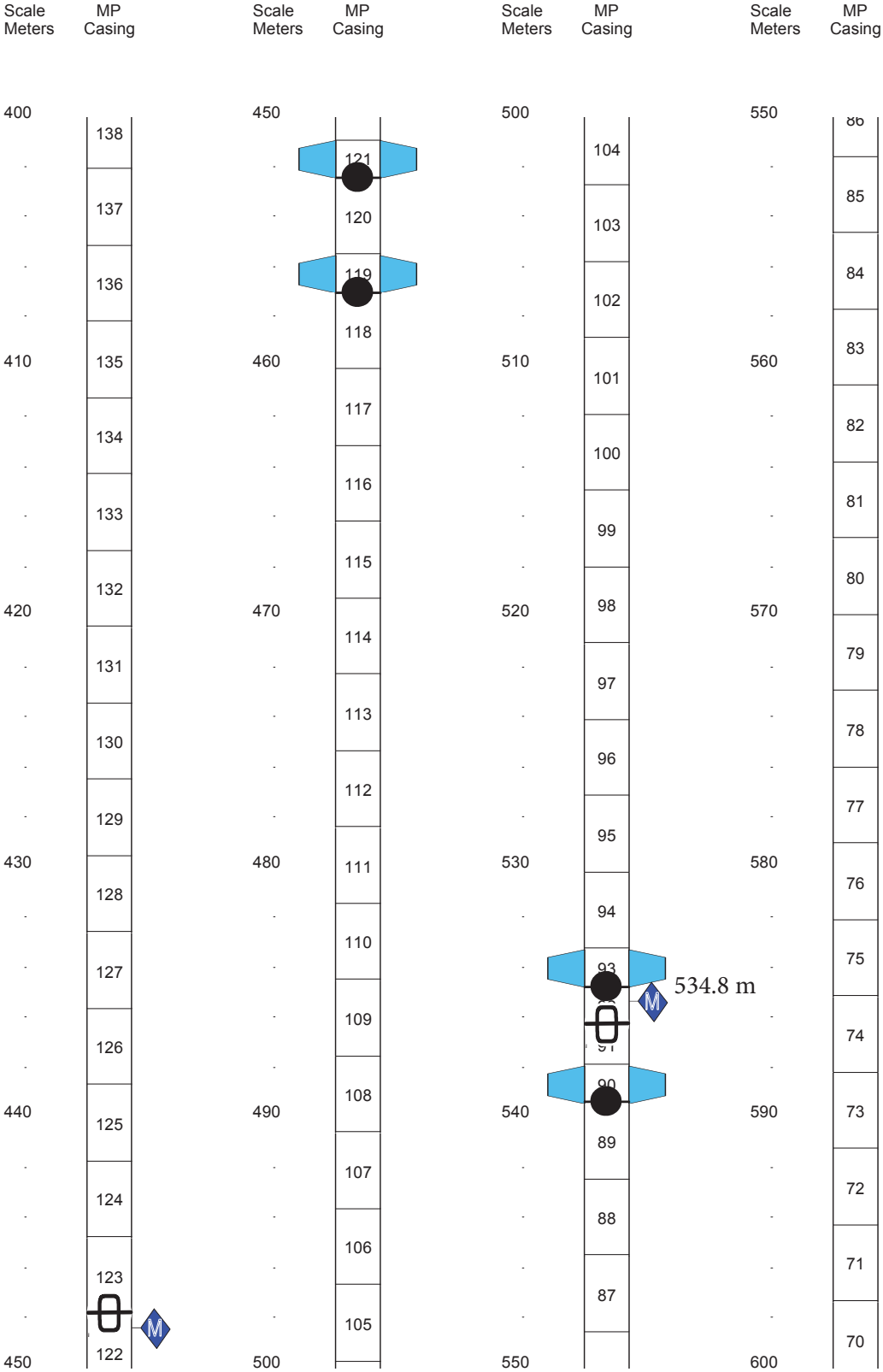
Summary Casing Log
Rescan

Job No: WB927
Well: 13-GSE-319



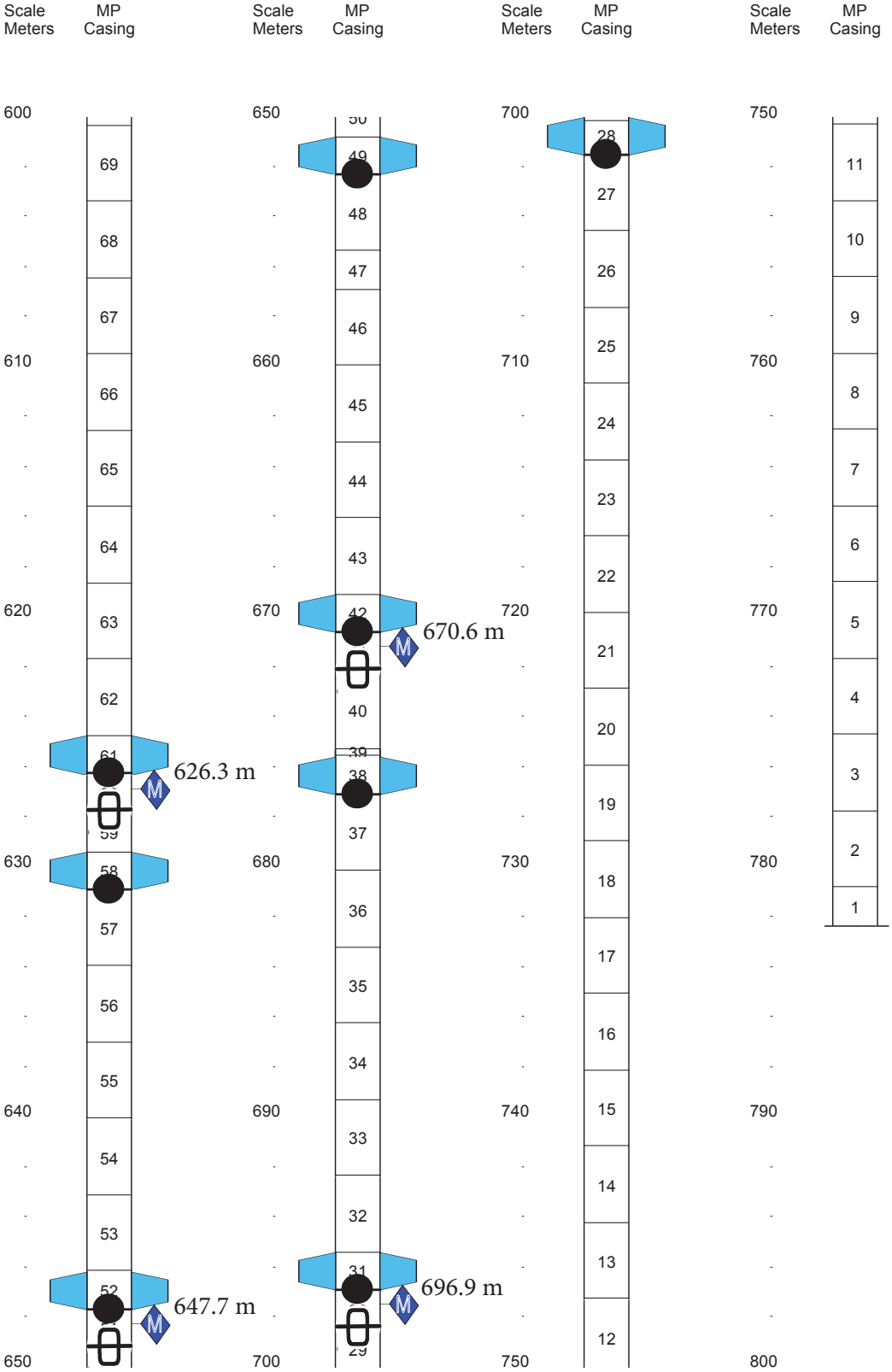
Summary Casing Log
Rescan

Job No: WB927
Well: 13-GSE-319



Summary Casing Log
Rescan

Job No: WB927
Well: 13-GSE-319



Post Inflation Profile

Schlumberger Water Services

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Well No.: 13-GSE-319
Datum: Top of 4-in casing
Elev. G.S.: Ø
Height of Westbay above ~~G.S.~~ Zero: ≈ 41 in
Elev. top of Westbay Casing: Ø
Reference Elevation: Ø
Borehole angle: ≈ 77 Deg

Probe Type: Sampler o/c
Serial No.: EMS 4629
Probe Range: 2000 psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Not adjust For borehole deviation.

Date: May 31/13
Client: RESCAN
Job No.: WB927
Location: Goose Lake
Weather: Warm - Clear
Operator: TG/RM/ML/DO

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 14.20 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)

	Start	Finish
Pressure	14.20	14.28
Temp	20.74°C	~1.40°C
Time	16:51	18:43

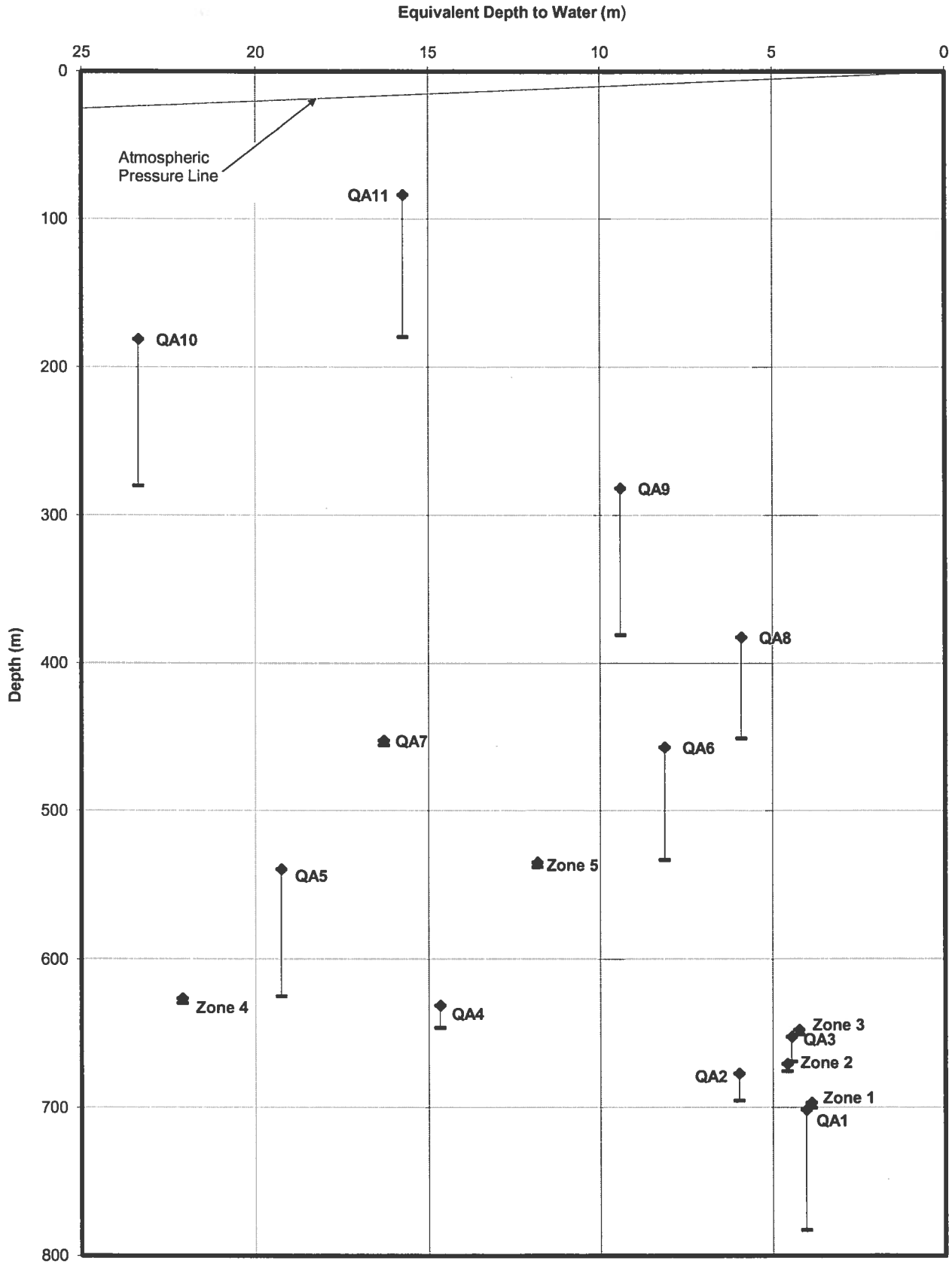
Port No.	Port Position From Log (ft/m)	Port Position From Cable (ft/m)	True Port Depth "Dp" (ft/m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (ft/m) H = (P2-Patm)/w	Piez. Level Outside Port (ft/m) Dz = Dp - H	ZONE	Comments: counter offset	Comments: collar
1	701.57	696.7	-	981.70	1006.10	17:26	2.37	981.70	697.54	+4.03	QA1	4.87	692.5-m loop
2	696.92	692.4	-	974.80	999.70	17:31	2.70	974.84	693.0	3.9	Zone1		
3	677.11	672.4	-	946.05	968.55	17:35	2.68	946.04	671.1	6.0	QA2		
4	670.64	666.1	-	936.72	961.33	17:39	2.60	936.71	666.1	4.6	Zone2	4.54	
5	652.35	647.9	-	910.27	935.50	17:43	2.46	910.20	647.9	4.5	QA3		
6	647.70	643.3	-	903.61	929.20	17:48	2.36	903.59	643.5	4.2	Zone3	9.40	
7	630.94	626.6	-	879.27	890.53	17:51	2.25	879.31	616.3	14.7	QA4		
8	626.29	621.9	-	872.66	873.34	17:55	2.12	872.61	604.2	22.1	Zone4		
9	539.43	535.2	-	748.09	753.86	18:03	1.25	748.08	520.2	19.3	QA5		
10	534.78	530.7	-	741.49	757.83	18:06	1.09	741.47	522.9	11.8	Zone5		
11	457.06	453.2	-	630.24	652.57	18:15	0.15	630.22	448.9	8.1	QA6		
12	452.49	448.7	-	623.70	634.46	18:19	0.01	623.73	436.2	16.3	QA7		
13	382.31	378.8	-	523.32	549.45	18:22	-0.44	523.32	376.4	5.9	QA8		
14	281.73	278.9	-	379.10	401.44	18:29	-1.34	379.17	272.3	9.4	QA9		
15	181.15	178.8	-	233.94	238.57	18:34	-2.18	233.92	157.8	23.4	QA10		
	(P1)	(P2)		Time	Temp	(P1)							
16	83.62	81.9	-	92.82	110.73	18:38	-2.38	92.82	67.9	15.7	QA11		

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: 13-GSE-319

Not adjusted for borehole deviation.
Not adjusted for borehole water salinity.

Profile Date: May 31, 2013
Comments: Post-Inflation Profile



Client: Rescan
Site: Back River
Datum: 4-in surface casing

Figure 1

Plot By: ML Date: 6/6/13
Checked By: DL Date: Jun 7/2013
Westbay Project: WB927

Casing Installation Log

Company: Rescan
Well: 13-GSE-319
Site: Sabina
Project: Back River Project

Job No: WB927
Author: ML

Well Information

Reference Datum: Top of surface casing
Elevation of Datum: 0.00 m.
MP Casing Top: 0.00 m.
MP Casing Length: ~~777.82~~ 782.4 m, ML

Borehole Depth: 778.00 m. 782.6 m. ML
Borehole Inclination: 77 Degrees
Borehole Diameter: 96.00 mm

Well Description:
MP38
Other References:

File Information

File Name: WB-13D2.WWD
Report Date: Sat May 25 18:37:39 2013

File Date: May 25 18:36:05 2013

Comments

Zero reference is top of surface casing - ZS
Filter socks not to be used - ZS

Log Information

Borehole condition confirmed.	(method)_____	Date: _____
MP well design & preparation.	By: ML	Date: May 25/13
MP well design checked.	By: ML ZS	Date: May 27/13
MP well and borehole approved to install.	By: [signature]	Date: May 27/13

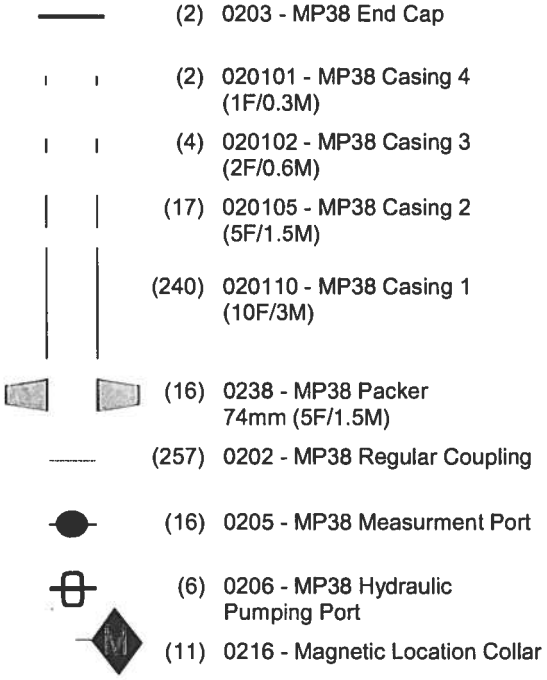
Zones lowered 0.6 m from original to offset core barrel.
ZS May 27/13

Legend

(Qty) MP Components (Library - WD Library 7/27/00)

Geology

Backfill/Casing



(2) 0203 - MP38 End Cap

(2) 020101 - MP38 Casing 4 (1F/0.3M)

(4) 020102 - MP38 Casing 3 (2F/0.6M)

(17) 020105 - MP38 Casing 2 (5F/1.5M)

(240) 020110 - MP38 Casing 1 (10F/3M)

(16) 0238 - MP38 Packer 74mm (5F/1.5M)

(257) 0202 - MP38 Regular Coupling

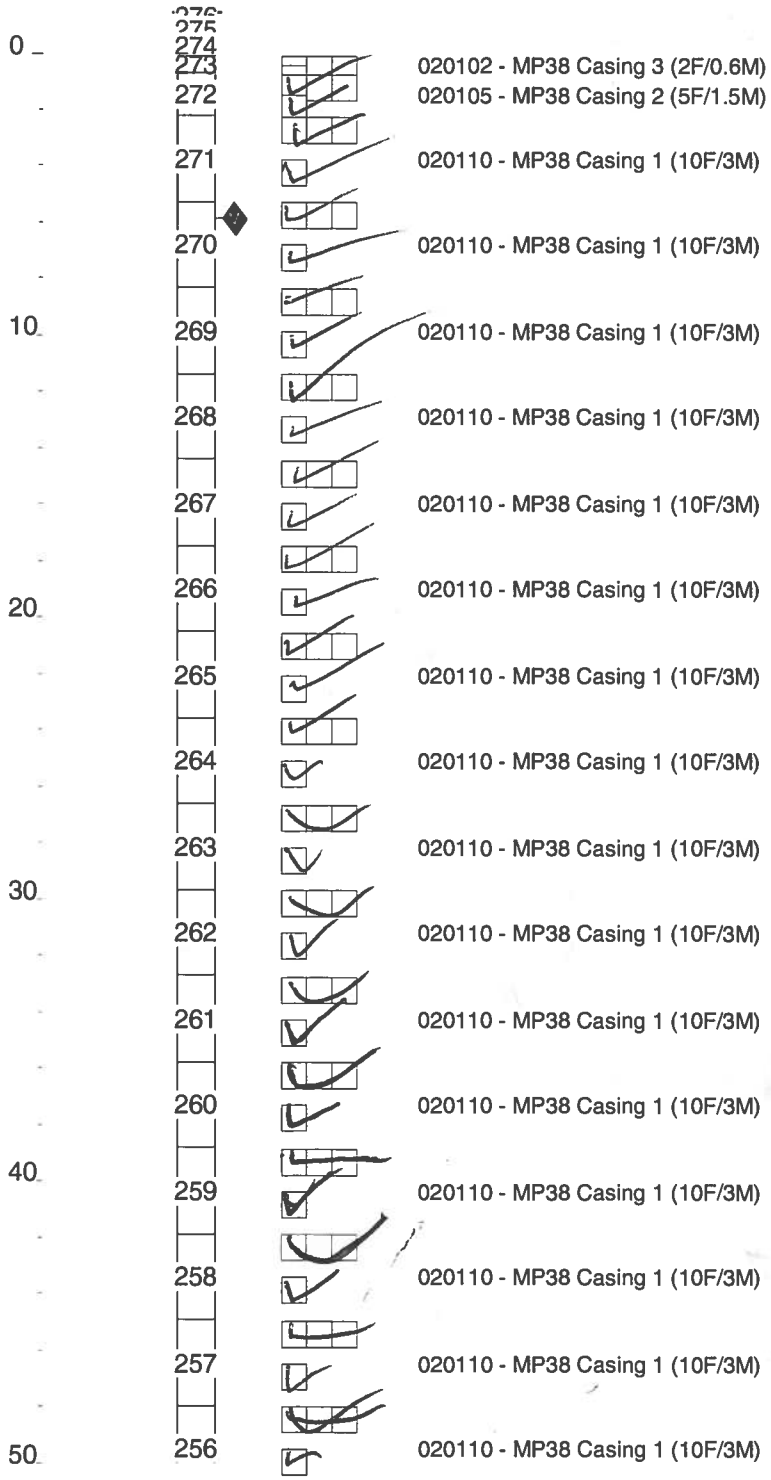
(16) 0205 - MP38 Measurment Port

(6) 0206 - MP38 Hydraulic Pumping Port

(11) 0216 - Magnetic Location Collar

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



Finish lowering Westbay Casing at 5:10 pm on May 28, 2013.

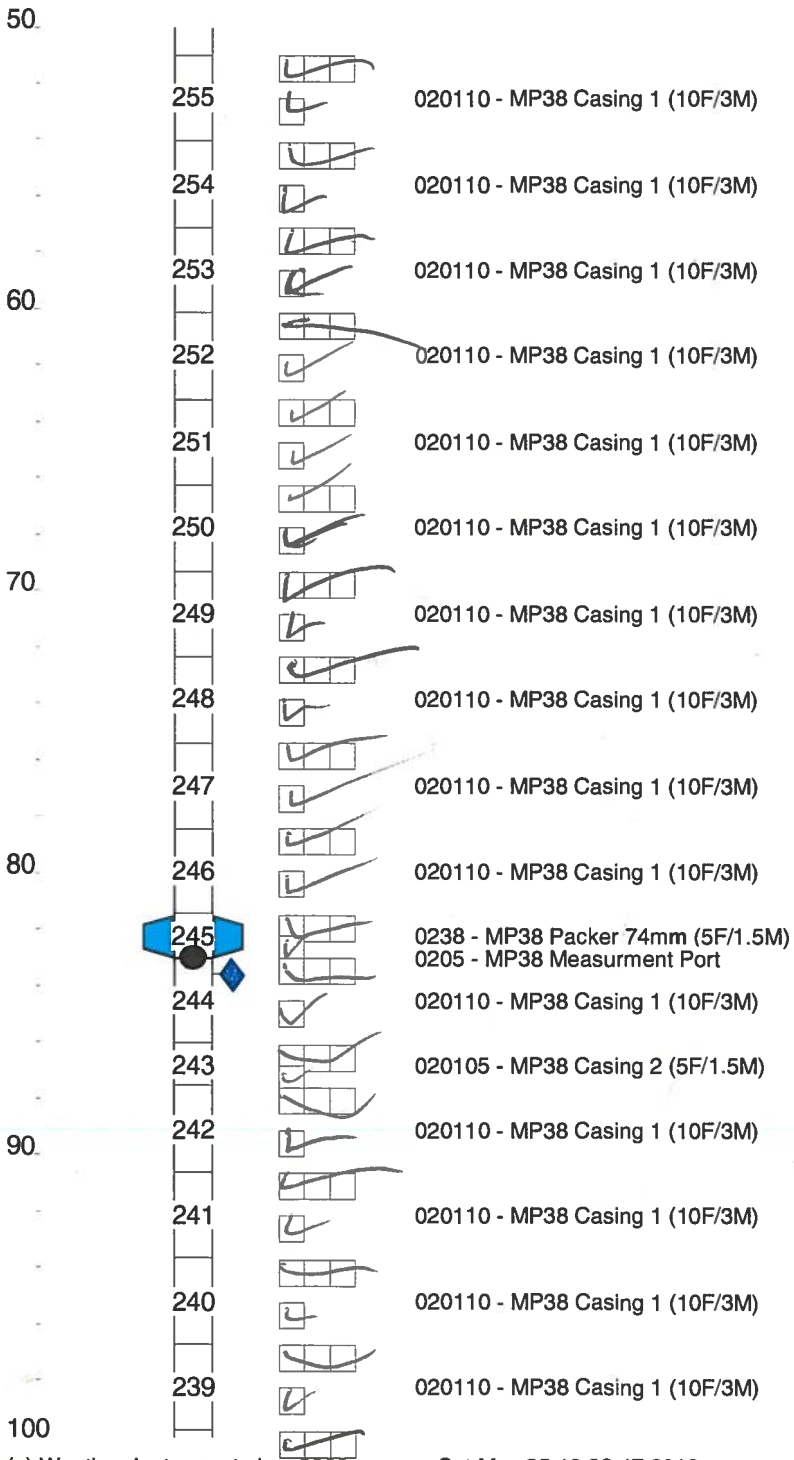
Westbay Casing about 200. lbs. + 20. L glycol/water mixture added to Westbay Casing before inflating packers.

(c) Westbay Instruments Inc. 2000

Sat May 25 18:38:47 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



18314/145 ps:
7655

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Sat May 25 18:38:47 2013

Casing Installation Log
Rescan

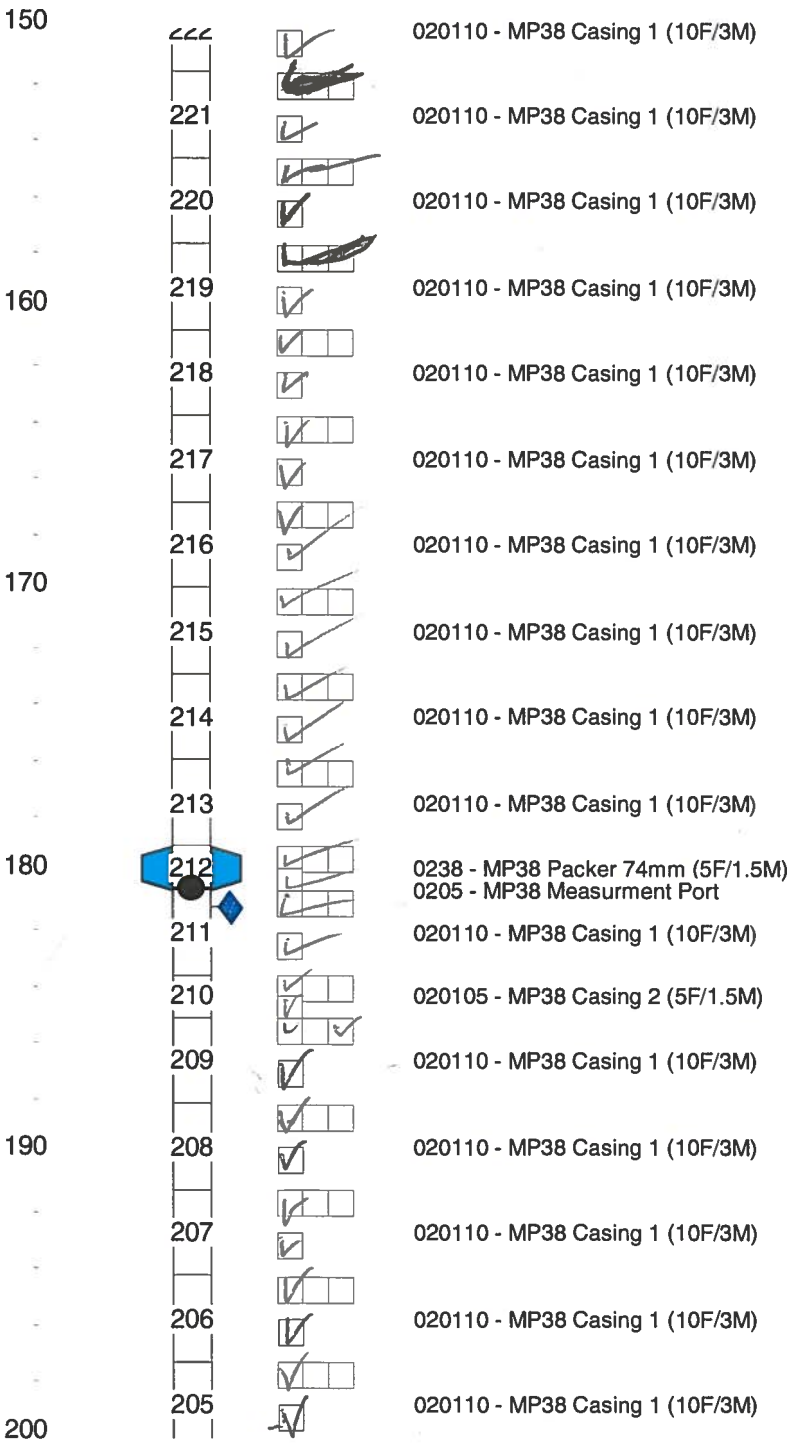
Job No: WB927
Well: 13-GSE-319

Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
100				
	238	☑	020110 - MP38 Casing 1 (10F/3M)	
	237	☑	020110 - MP38 Casing 1 (10F/3M)	
	236	☑	020110 - MP38 Casing 1 (10F/3M)	
110	235	☑	020110 - MP38 Casing 1 (10F/3M)	
	234	☑	020110 - MP38 Casing 1 (10F/3M)	
	233	☑	020110 - MP38 Casing 1 (10F/3M)	
120	232	☑	020110 - MP38 Casing 1 (10F/3M)	
	231	☑	020110 - MP38 Casing 1 (10F/3M)	
	230	☑	020110 - MP38 Casing 1 (10F/3M)	
130	229	☑	020110 - MP38 Casing 1 (10F/3M)	
	228	☑	020110 - MP38 Casing 1 (10F/3M)	
	227	☑	020110 - MP38 Casing 1 (10F/3M)	
	226	☑	020110 - MP38 Casing 1 (10F/3M)	
140	225	☑	020110 - MP38 Casing 1 (10F/3M)	
	224	☑	020110 - MP38 Casing 1 (10F/3M)	
	223	☑	020110 - MP38 Casing 1 (10F/3M)	
150				

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Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



18313/140 ps:
7649

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Sat May 25 18:38:47 2013

Casing Installation Log
Rescan

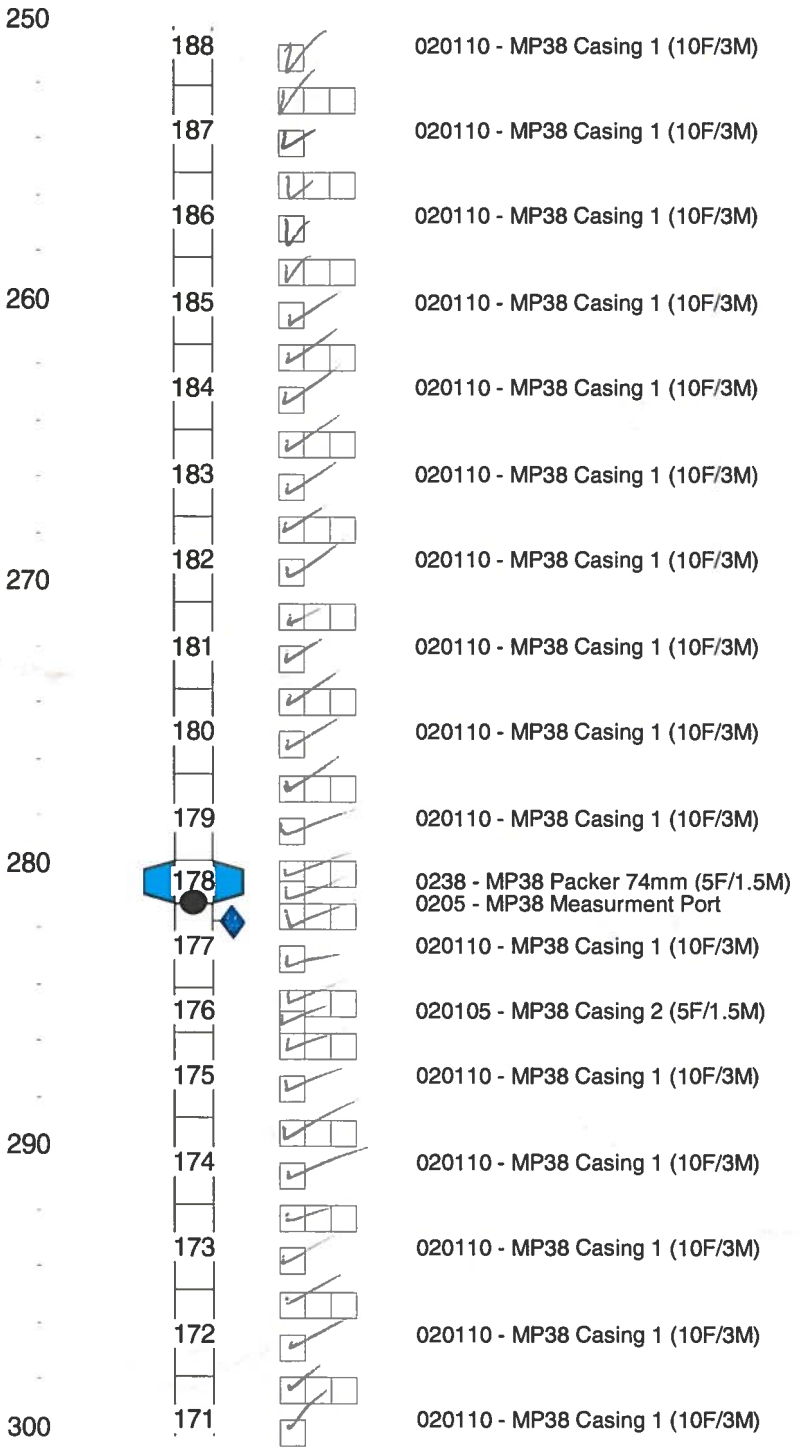
Job No: WB927
Well: 13-GSE-319

Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
200				
	204		020110 - MP38 Casing 1 (10F/3M)	
	203		020110 - MP38 Casing 1 (10F/3M)	
	202		020110 - MP38 Casing 1 (10F/3M)	
210	201		020110 - MP38 Casing 1 (10F/3M)	
	200		020110 - MP38 Casing 1 (10F/3M)	
	199		020110 - MP38 Casing 1 (10F/3M)	
220	198		020110 - MP38 Casing 1 (10F/3M)	
	197		020110 - MP38 Casing 1 (10F/3M)	WBWL 40m
	196		020110 - MP38 Casing 1 (10F/3M)	
230	195		020110 - MP38 Casing 1 (10F/3M)	
	194		020110 - MP38 Casing 1 (10F/3M)	
	193		020110 - MP38 Casing 1 (10F/3M)	
	192		020110 - MP38 Casing 1 (10F/3M)	
240	191		020110 - MP38 Casing 1 (10F/3M)	
	190		020110 - MP38 Casing 1 (10F/3M)	
	189		020110 - MP38 Casing 1 (10F/3M)	
250				

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Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



18312/140 ps:
7630

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Sat May 25 18:39:02 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

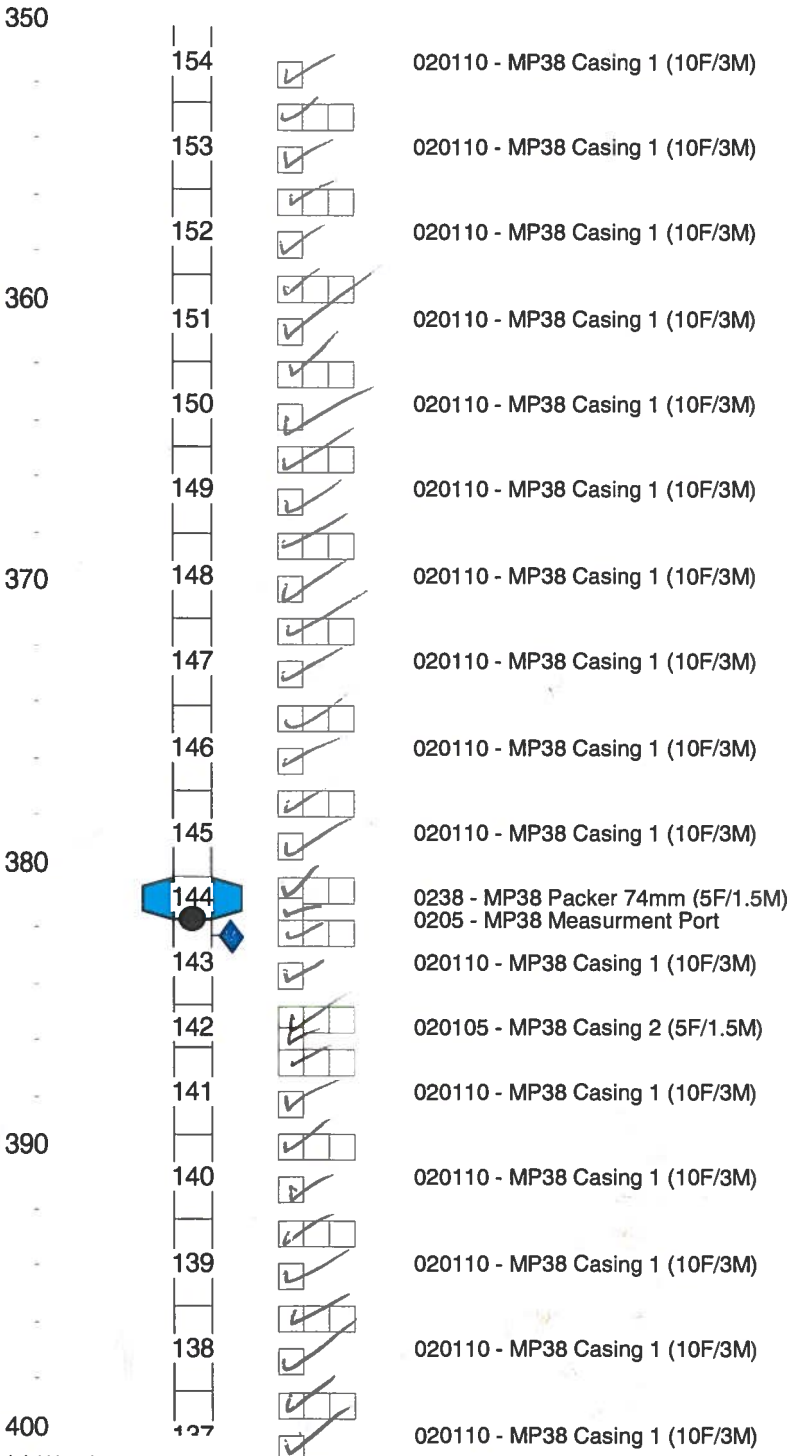
Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
300				
	170		020110 - MP38 Casing 1 (10F/3M)	
	169		020110 - MP38 Casing 1 (10F/3M)	
	168		020110 - MP38 Casing 1 (10F/3M)	
310	167		020110 - MP38 Casing 1 (10F/3M)	
	166		020110 - MP38 Casing 1 (10F/3M)	
	165		020110 - MP38 Casing 1 (10F/3M)	
320	164		020110 - MP38 Casing 1 (10F/3M)	
	163		020110 - MP38 Casing 1 (10F/3M)	
	162		020110 - MP38 Casing 1 (10F/3M)	
330	161		020110 - MP38 Casing 1 (10F/3M)	
	160		020110 - MP38 Casing 1 (10F/3M)	
	159		020110 - MP38 Casing 1 (10F/3M)	
340	158		020110 - MP38 Casing 1 (10F/3M)	
	157		020110 - MP38 Casing 1 (10F/3M)	
	156		020110 - MP38 Casing 1 (10F/3M)	
	155		020110 - MP38 Casing 1 (10F/3M)	
350				

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Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

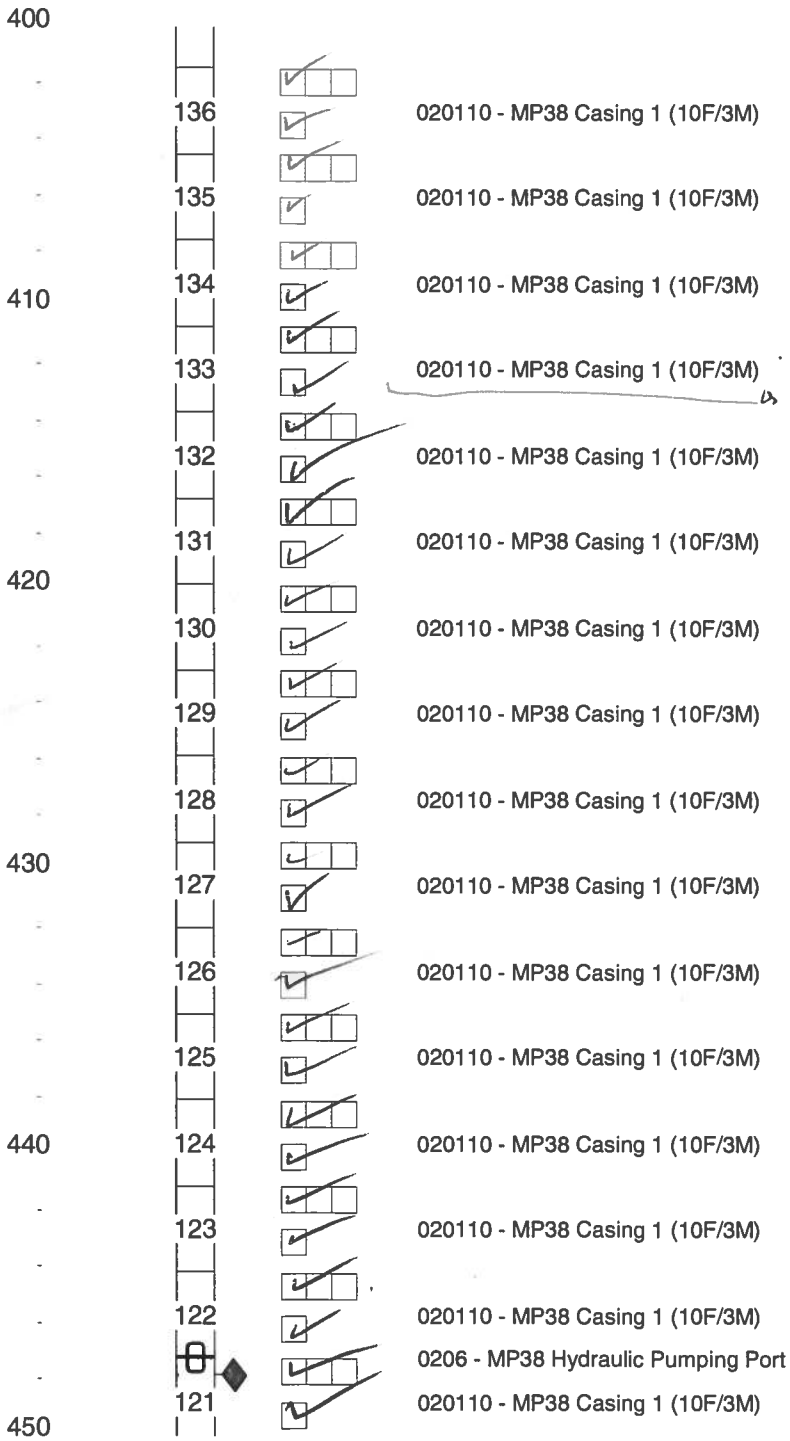


1831 | 145 psi
7653

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Sat May 25 18:39:02 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



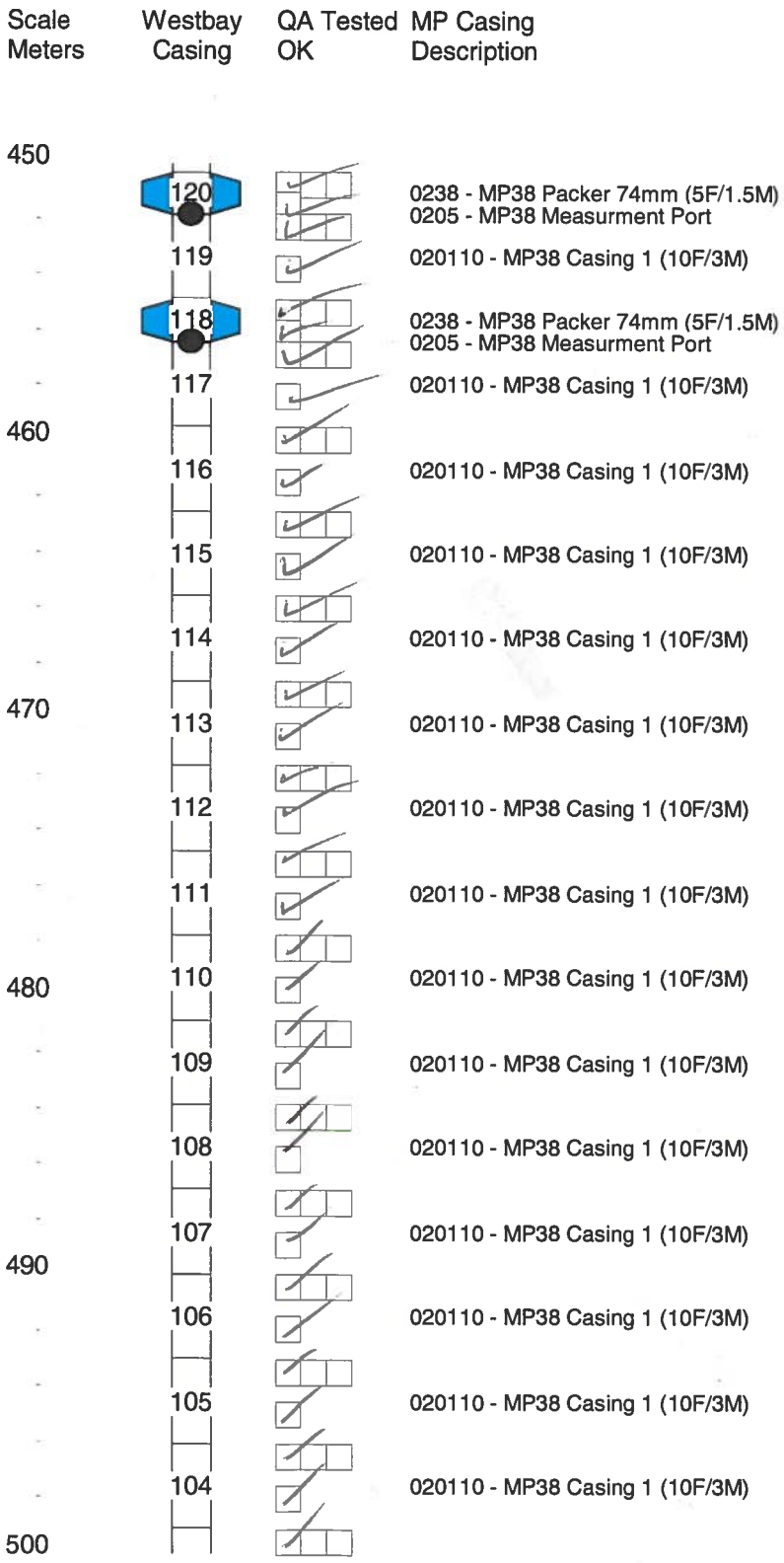
changed

10-ft casing exchanged due to deep scratches on face surface.

306

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

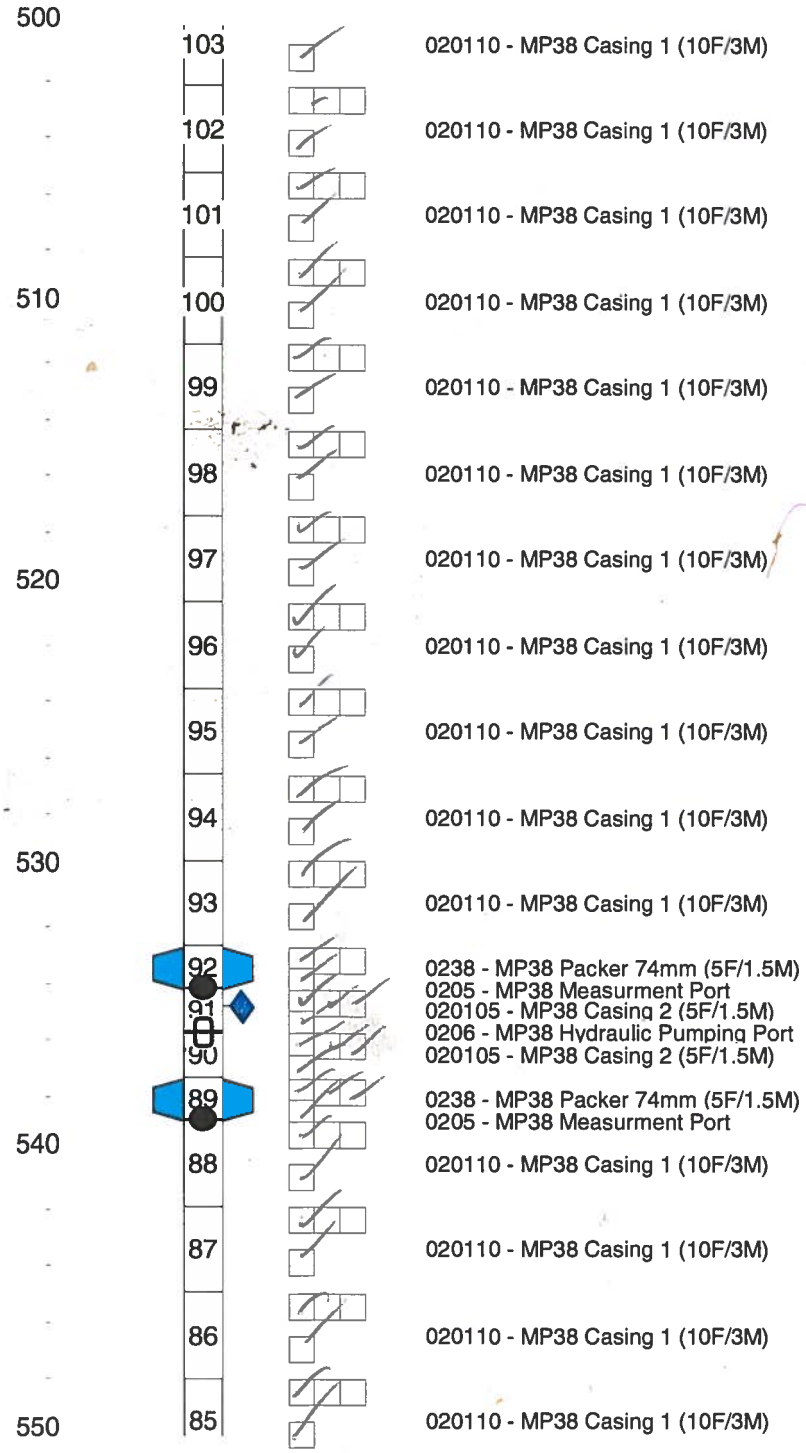


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Sat May 25 18:39:19 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



18287/145 ps: 7657 301

18288/145 ps: 7654

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Sat May 25 18:39:19 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

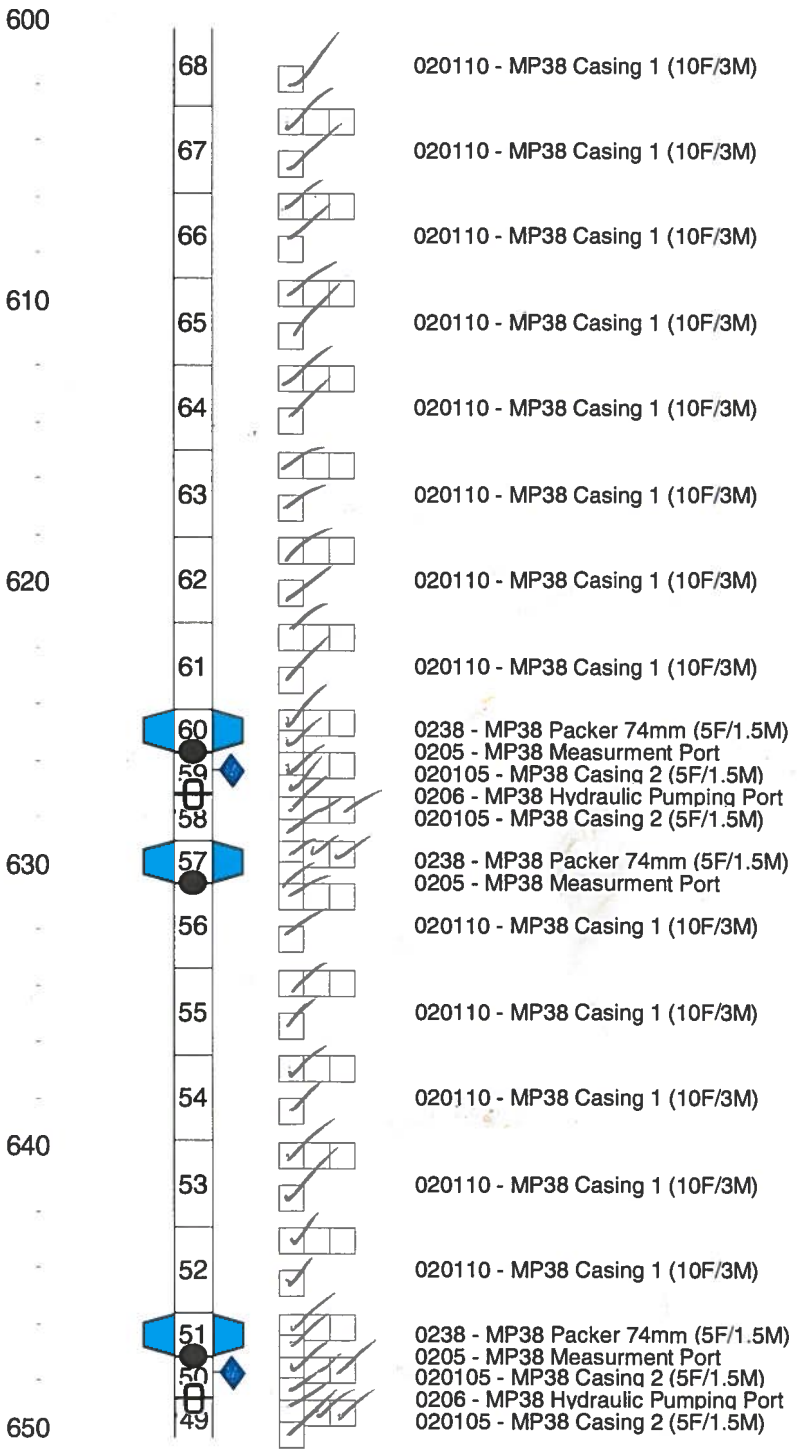
Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
550				
	84		020110 - MP38 Casing 1 (10F/3M)	
	83		020110 - MP38 Casing 1 (10F/3M)	
	82		020110 - MP38 Casing 1 (10F/3M)	
560	81		020110 - MP38 Casing 1 (10F/3M)	
	80		020110 - MP38 Casing 1 (10F/3M)	
	79		020110 - MP38 Casing 1 (10F/3M)	
570	78		020110 - MP38 Casing 1 (10F/3M)	
	77		020110 - MP38 Casing 1 (10F/3M)	
	76		020110 - MP38 Casing 1 (10F/3M)	
580	75		020110 - MP38 Casing 1 (10F/3M)	
	74		020110 - MP38 Casing 1 (10F/3M)	
	73		020110 - MP38 Casing 1 (10F/3M)	
590	72		020110 - MP38 Casing 1 (10F/3M)	
	71		020110 - MP38 Casing 1 (10F/3M)	
	70		020110 - MP38 Casing 1 (10F/3M)	12/12
	69		020110 - MP38 Casing 1 (10F/3M)	
600				

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Sat May 25 18:39:19 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



Serial Numbers

11.57

18285/145 ps:
7659
302

18286/145 ps:
7651

Add

10.43

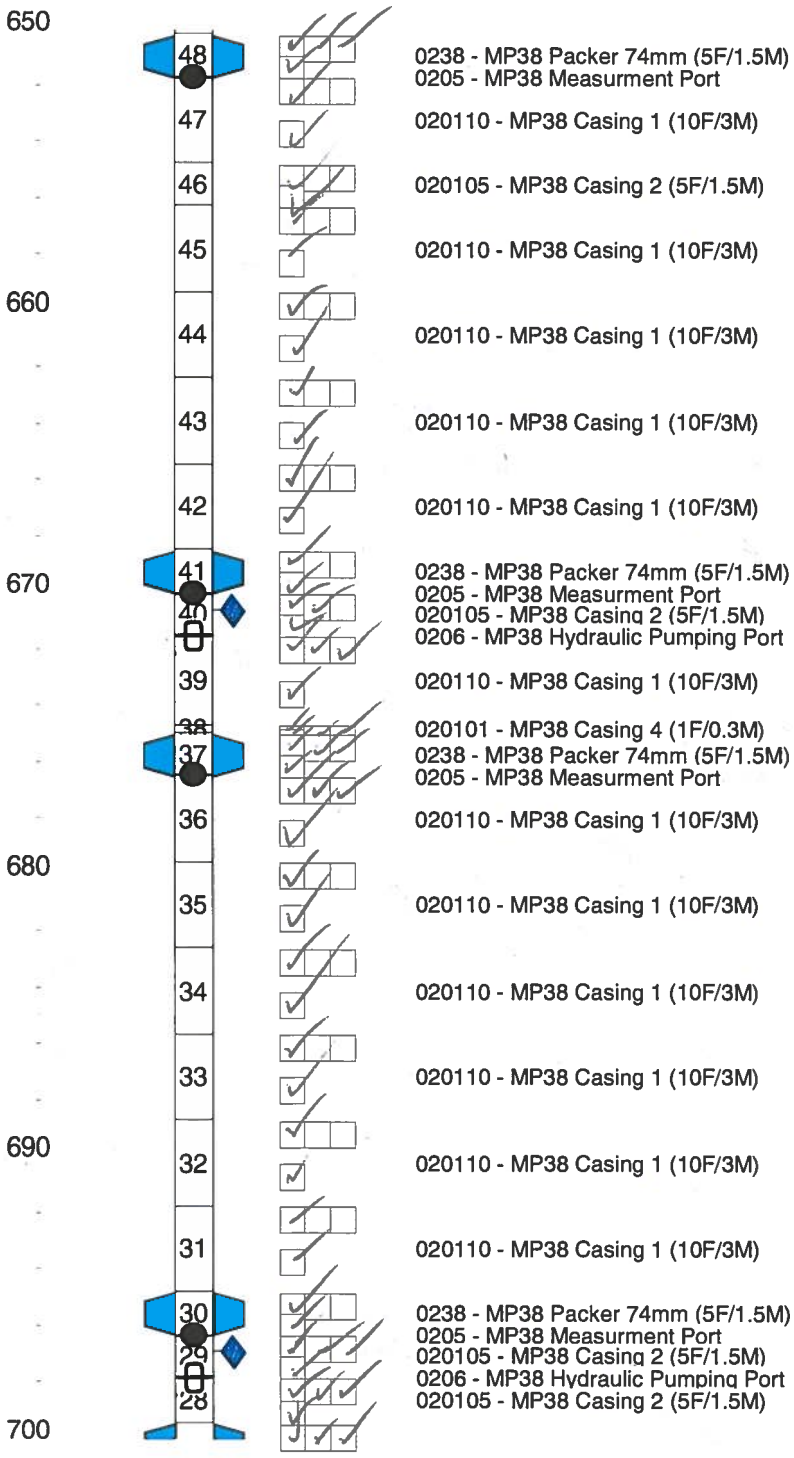
18295/145 ps:
7660
~~7642~~
303

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Sat May 25 18:39:33 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319



Serial Numbers

18294/145 psi
7652
Add

18292/150 psi
7656
Add 305

18293/145 psi
7650

Add

9:55 18291/145 psi
7658
Add
304

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Sat May 25 18:39:33 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
700		✓	0238 - MP38 Packer 74mm (5F/1.5M) 0205 - MP38 Measurment Port	18300/150 psi 7629
	26	✓	020110 - MP38 Casing 1 (10F/3M)	
	25	✓	020110 - MP38 Casing 1 (10F/3M)	
	24	✓	020110 - MP38 Casing 1 (10F/3M)	
710	23	✓	020110 - MP38 Casing 1 (10F/3M)	Add glycol/water
	22	✓	020110 - MP38 Casing 1 (10F/3M)	
	21	✓	020110 - MP38 Casing 1 (10F/3M)	
720	20	✓	020110 - MP38 Casing 1 (10F/3M)	Add glycol/water
	19	✓	020110 - MP38 Casing 1 (10F/3M)	
	18	✓	020110 - MP38 Casing 1 (10F/3M)	
730	17	✓	020110 - MP38 Casing 1 (10F/3M)	
	16	✓	020110 - MP38 Casing 1 (10F/3M)	
	15	✓	020110 - MP38 Casing 1 (10F/3M)	
740	14	✓	020110 - MP38 Casing 1 (10F/3M)	Add glycol/water
	13	✓	020110 - MP38 Casing 1 (10F/3M)	
	12	✓	020110 - MP38 Casing 1 (10F/3M)	
	11	✓	020110 - MP38 Casing 1 (10F/3M)	Add glycol/water to Westbay casing
750				

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Sat May 25 18:39:33 2013

Casing Installation Log
Rescan

Job No: WB927
Well: 13-GSE-319

Scale Meters	Westbay Casing	QA Tested OK	MP Casing Description	Serial Numbers
750				
	12	✓	020110 - MP38 Casing 1 (10F/3M)	9.00 am
	11	✓	020110 - MP38 Casing 1 (10F/3M)	
	10	✓	020110 - MP38 Casing 1 (10F/3M)	
760	9	✓	020110 - MP38 Casing 1 (10F/3M)	
	8	✓	020110 - MP38 Casing 1 (10F/3M)	
	7	✓	020110 - MP38 Casing 1 (10F/3M)	
	6	✓	020110 - MP38 Casing 1 (10F/3M)	
770	5	✓	020110 - MP38 Casing 1 (10F/3M)	
	4	✓	020110 - MP38 Casing 1 (10F/3M)	
	3	✓	020110 - MP38 Casing 1 (10F/3M)	
	2	✓	020110 - MP38 Casing 1 (10F/3M)	
	1	✓	020110 - MP38 Casing 1 (10F/3M)	
780	19 removed	✓	020105 - MP38 Casing 2 (5F/1.5M)	Bottom 1-ft casing removed from string.
		✓	0203 - MP38 End Cap 4 (1F/0.3M)	

8:30 - start lowering casing, May 28, 2013.
Joint test tool: 230 psi.

790 Bore hole water level ≈5 m below zero before lowering Westbay casing. Guide tube in well.

800 Add: added glycol/water mixture to Westbay Casing.

Schlumberger
Water Services

Sheet 1 of 17

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML / DO | Date Inflated: May 27/13

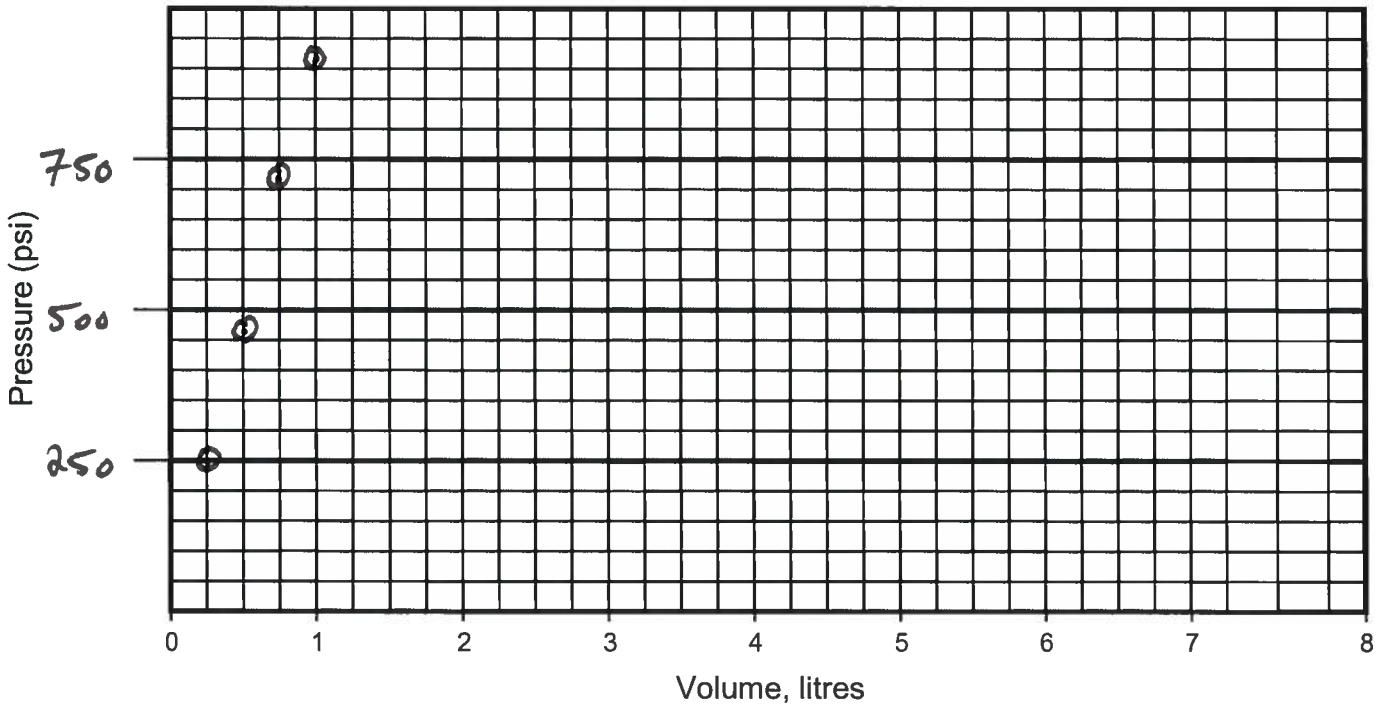
Packer No. BWT | Depth (ft / m): ~ 465 | Inflation Tool No.: TFW852

Packer Valve Pressure, P_V: n/a psi | Final Line Pressure, P_L: 910 psi | Tool Pressure, P_T: 450 psi

Borehole Water Level: 3 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = n/a psi

Volume, litres	0.25	0.5	0.75	1.0						
Pressure, psi	250	470	720	910						
Volume, litres										
Pressure, psi										



Comments: Blank wall test | Time - 10:31 am

Schlumberger
Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 30/13

Packer No. 1, comp. #27 | Depth (~~ft~~/ m): 700.0 | Inflation Tool No.: TIW 852

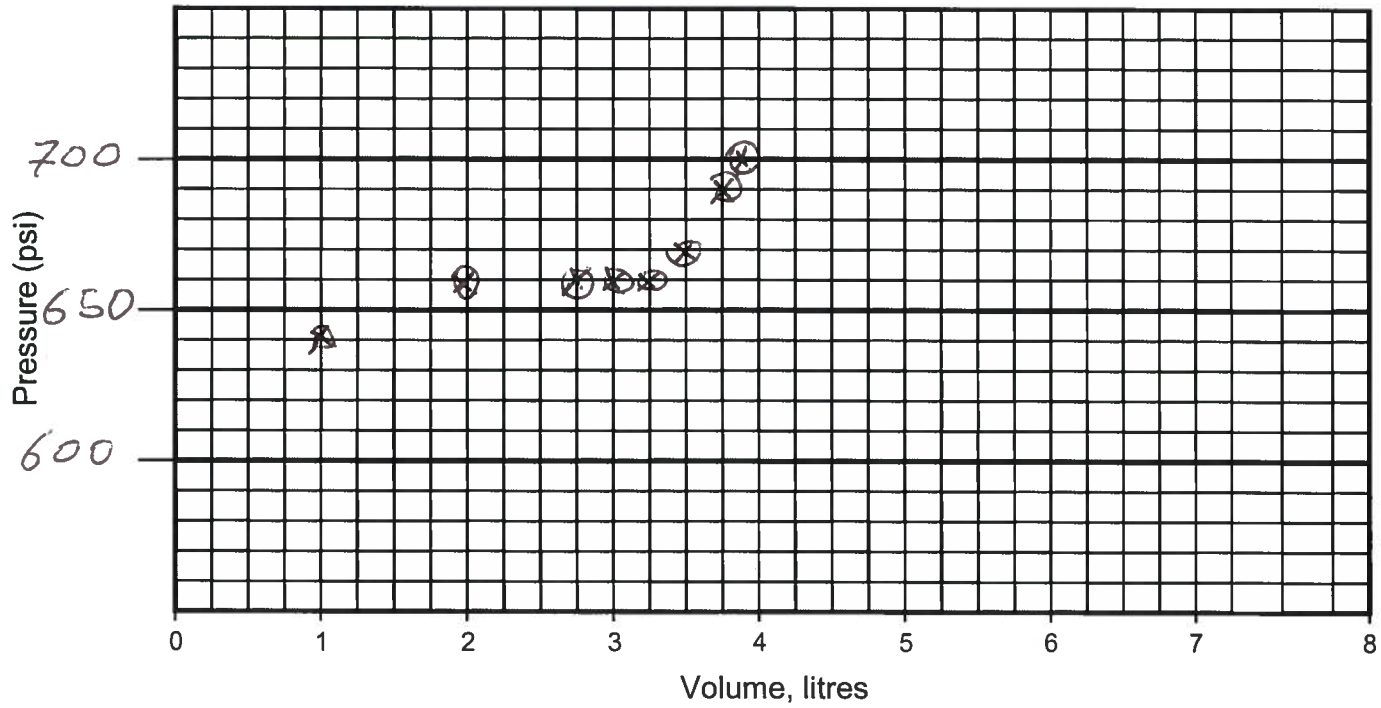
Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 700 psi | Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~/ m) = 0 psi (P_W)

Packer SN# 18300

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 120 psi

Volume, litres	1.0	2.0	2.75	3.0	3.25	3.5	3.75	/	/	4.0
Pressure, psi	640	660	660	660	660	670	690	/	0	700
Volume, litres	/	3.5								
Pressure, psi	/	0								



Comments: Packer #1 | Time - 16 15

Schlumberger
Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 30/13

Packer No. 2, comp. # 30 | Depth (~~ft~~ / m): 695.4 | Inflation Tool No.: TIW 852

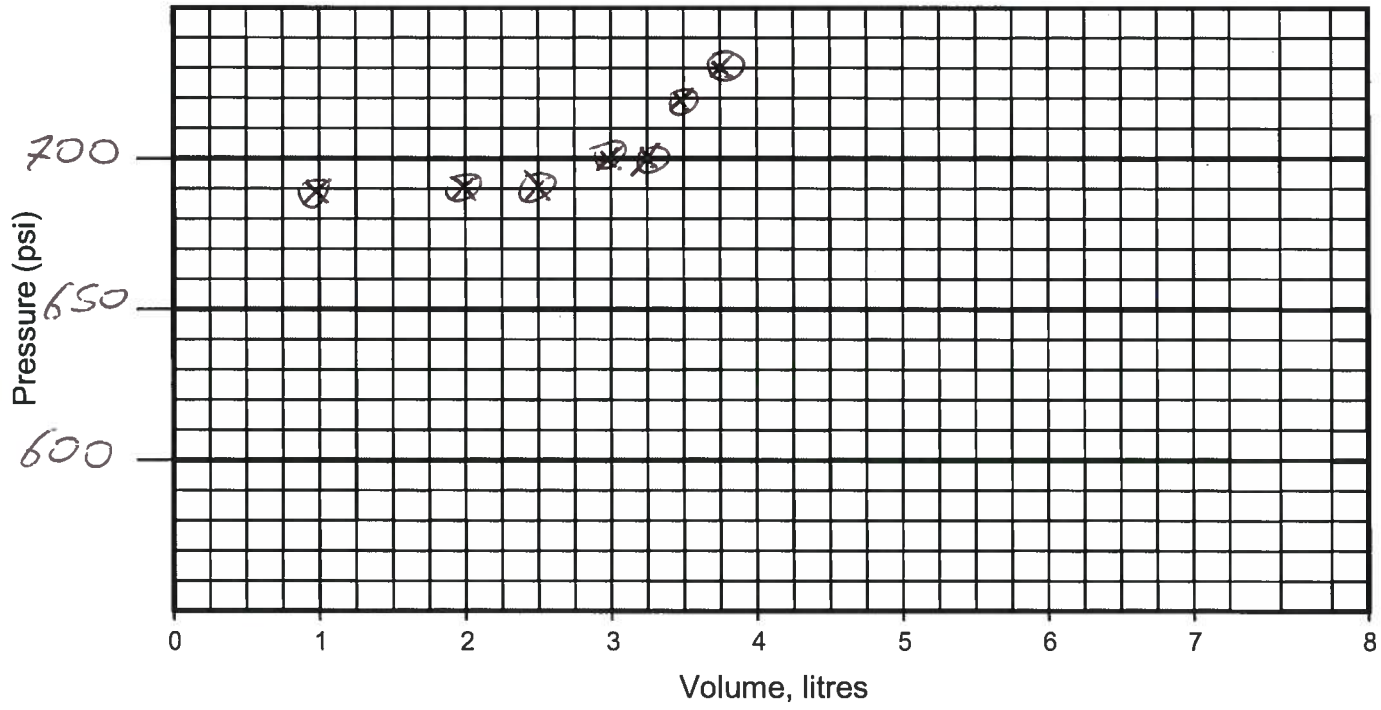
Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 730 psi | Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~ / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 155 psi

Packer SN# 18291

Volume, litres	1.0	2.0	2.5	3.0	3.25	3.5	3.75	/	3.2	
Pressure, psi	690	690	690	700	700	720	730	/	0	
Volume, litres										
Pressure, psi										



Comments: Packer #2

Time - 16 42

Schlumberger Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB 927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/OO | Date Inflated: May 30/13

Packer No. 3, comp 37 | Depth (~~ft~~ m): 675.6 | Inflation Tool No.: TFW 852

Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 740 psi | Tool Pressure, P_T: 430 psi

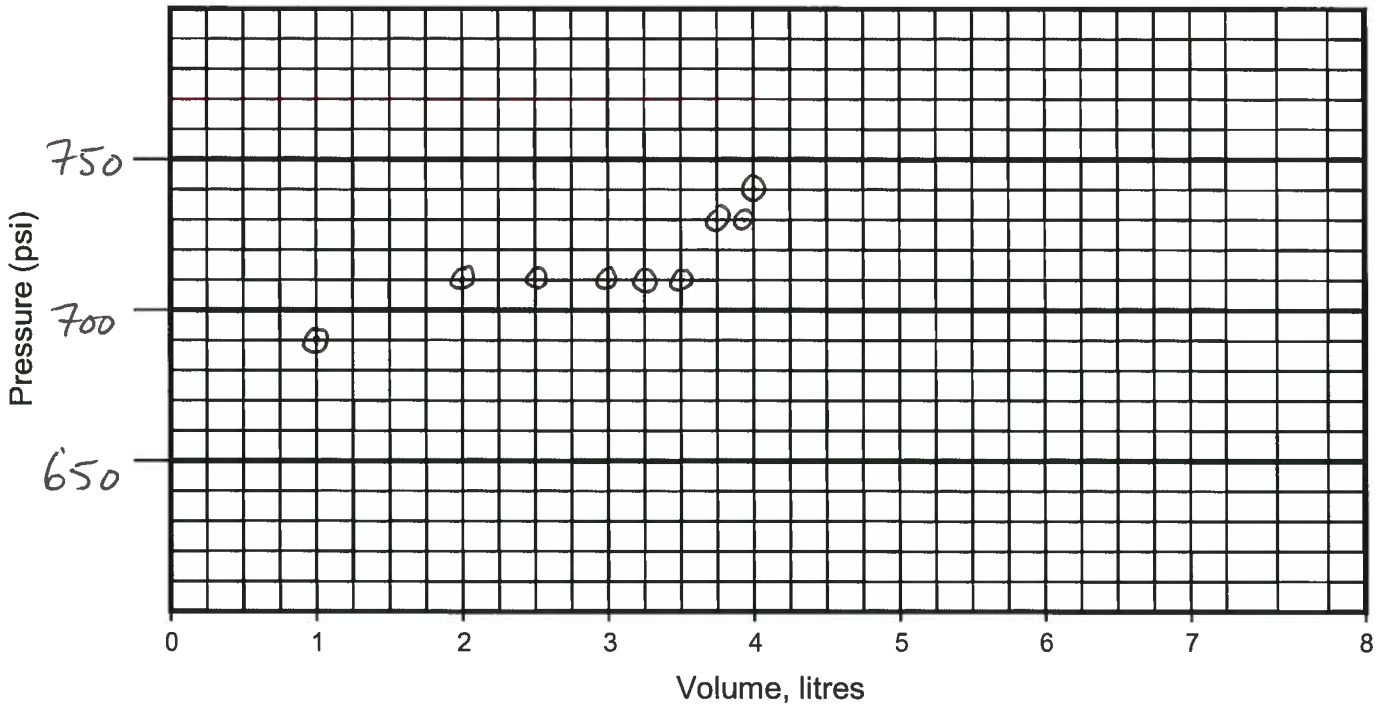
Borehole Water Level: 3 (~~ft~~ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 165 psi

Packer SN# 18293

1:50

Volume, litres	1	2.0	2.5	3.0	3.25	3.5	3.75	3.9	4.0	/
Pressure, psi	690	710	710	710	710	710	730	730	740	/
Volume, litres	3.5									
Pressure, psi	ø									



Comments: Packer #3 Time - 17:14

Schlumberger
Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 30/13

Packer No. 4, comp. #41 | Depth (~~ft~~/m): 669.1 | Inflation Tool No.: TW852

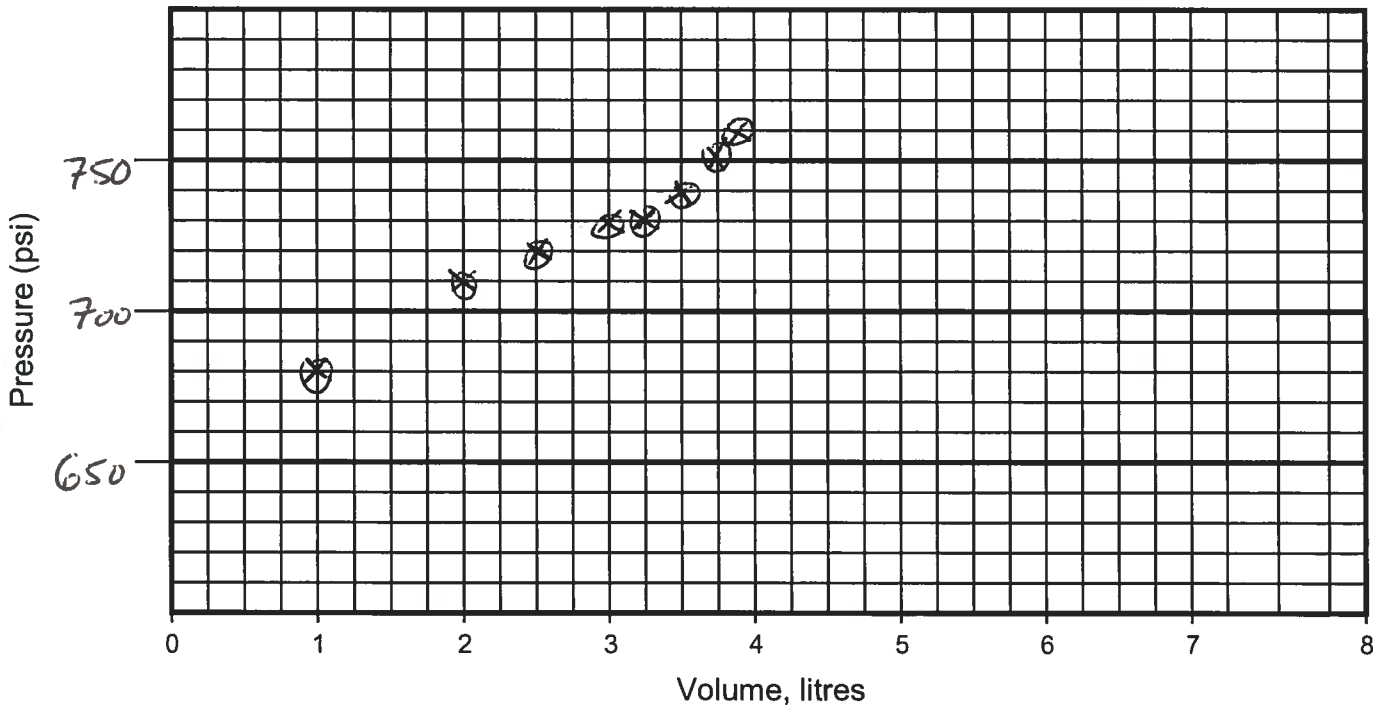
Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 760 psi | Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~/m) = 0 psi (P_W)

Packer SN# 18292 @ 1:50 min

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 180 psi

Volume, litres	1.0	2.0	2.5	3	3.25	3.5	3.75	3.9	/	3.4
Pressure, psi	680	710	720	730	730	740	750	760	/	0
Volume, litres										
Pressure, psi										



Comments: Packer #4 | Time - 17 52

Schlumberger
Water Services

Sheet 6 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 30/2013

Packer No. 5, comp. # 48 Depth (~~ft~~ m): 650.8 Inflation Tool No.: TIW852

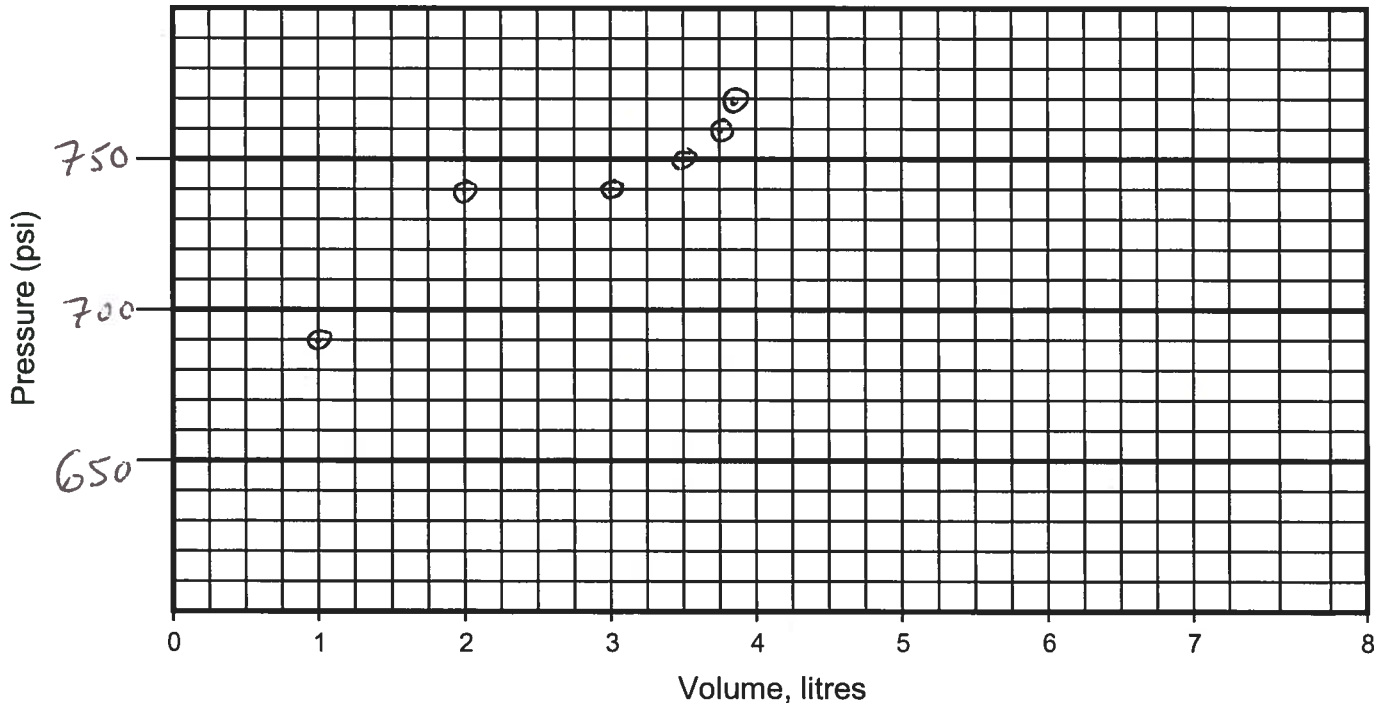
Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 770 psi Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 195 psi

Packer SN# 18294

Volume, litres	1.0	2.0	3.0	3.5	3.75	3.85	/	3.3		
Pressure, psi	690	740	740	750	760	770	/	Ø		
Volume, litres										
Pressure, psi										



Comments: Packer #5 Time - 18:20

Schlumberger
Water Services

Sheet 7 of 17

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 31, 2013

Packer No. 6, comp. # 51 | Depth (ft / m): 646.2 | Inflation Tool No.: TW 852

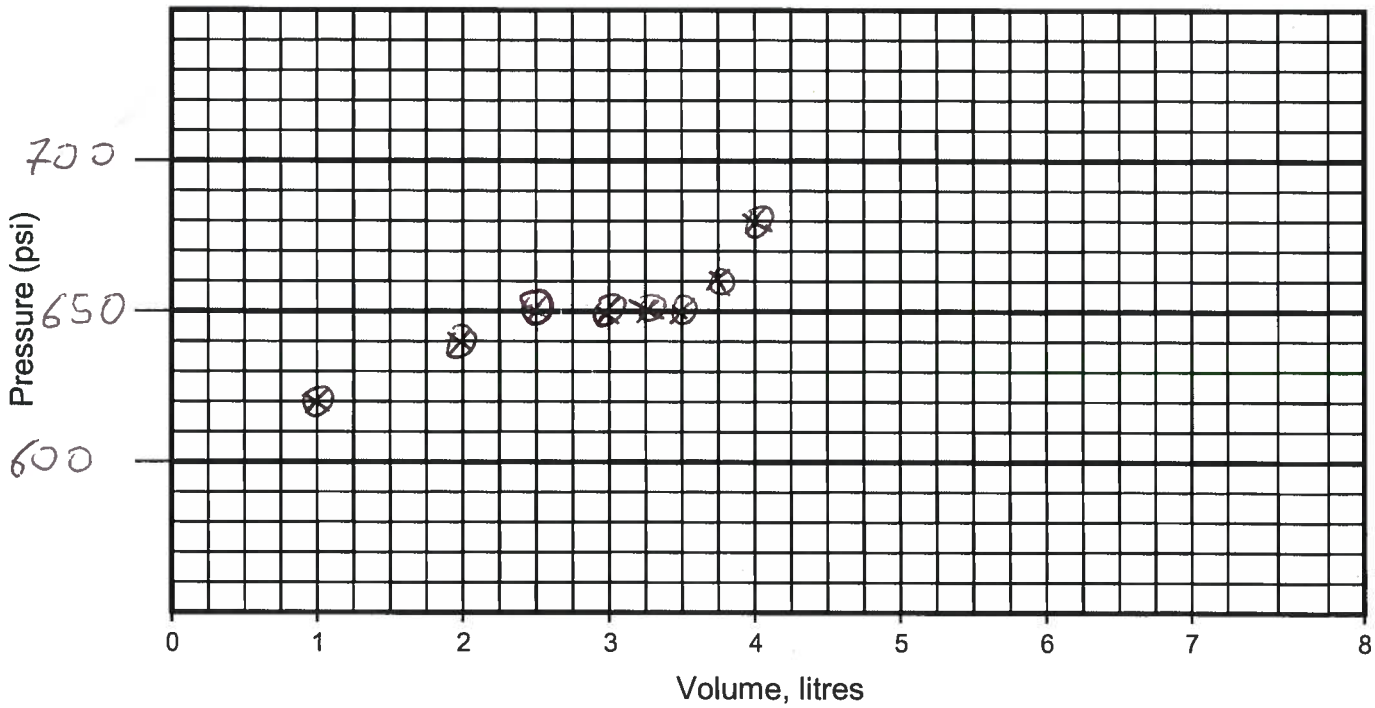
Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 680 psi | Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

Packer SN# 18295

Volume, litres	1	2	2.5	3	3.25	3.5	3.75	4.0	/	3.5
Pressure, psi	620	640	650	650	650	650	660	680	/	0
Volume, litres										
Pressure, psi										



Comments: Packer #6 | Time - 10:42

Schlumberger
Water Services

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 31/2013

Packer No. 7, comp. # 57 Depth (~~ft~~ / m): 629.4 Inflation Tool No.: TW852

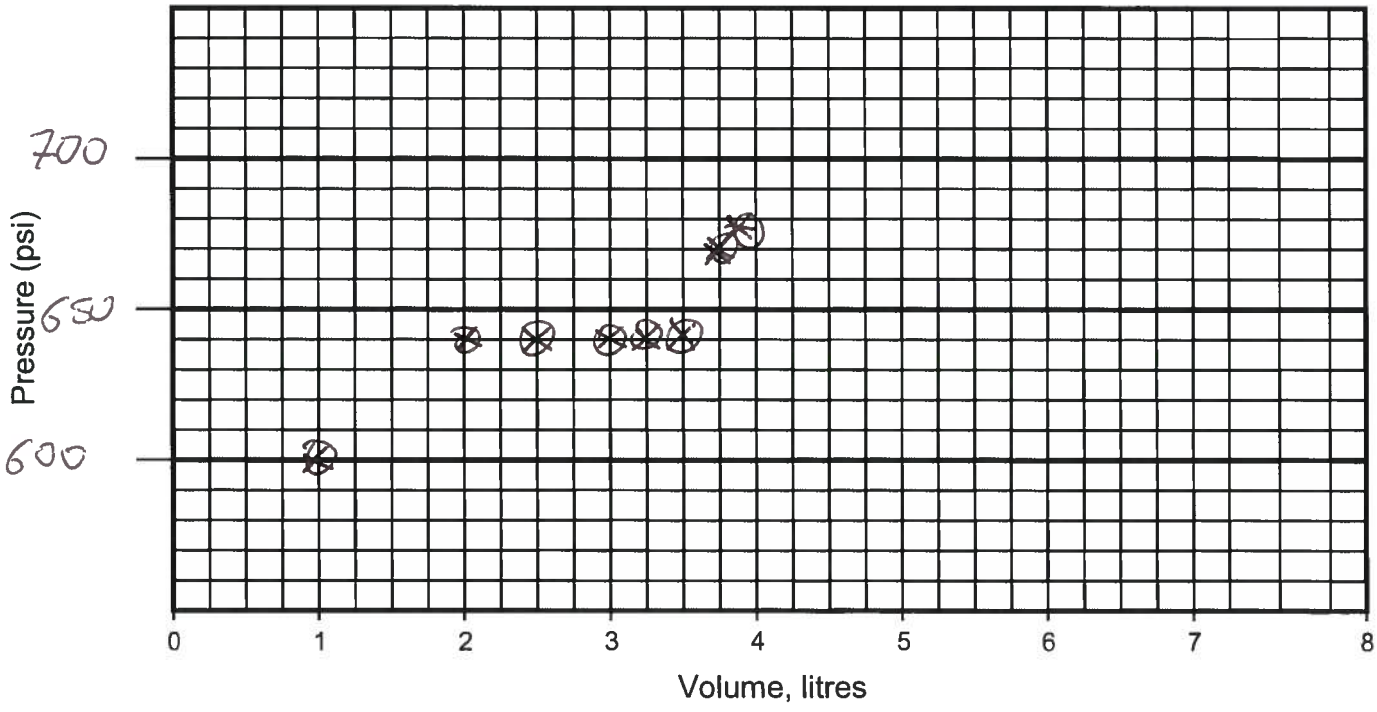
Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 680 psi Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~ / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

Packer SN# 18286

Volume, litres	1.0	2.0	2.5	3	3.25	3.5	3.75	3.85	/	3.4
Pressure, psi	600	640	640	640	640	640	670	680	/	0
Volume, litres										
Pressure, psi										



Comments: Packer #7 Time -

Schlumberger
Water Services

Sheet 9 of 17

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 31/2013

Packer No. 8, comp. # 60 | Depth (~~ft~~/m): 624.8 | Inflation Tool No.: TW 852

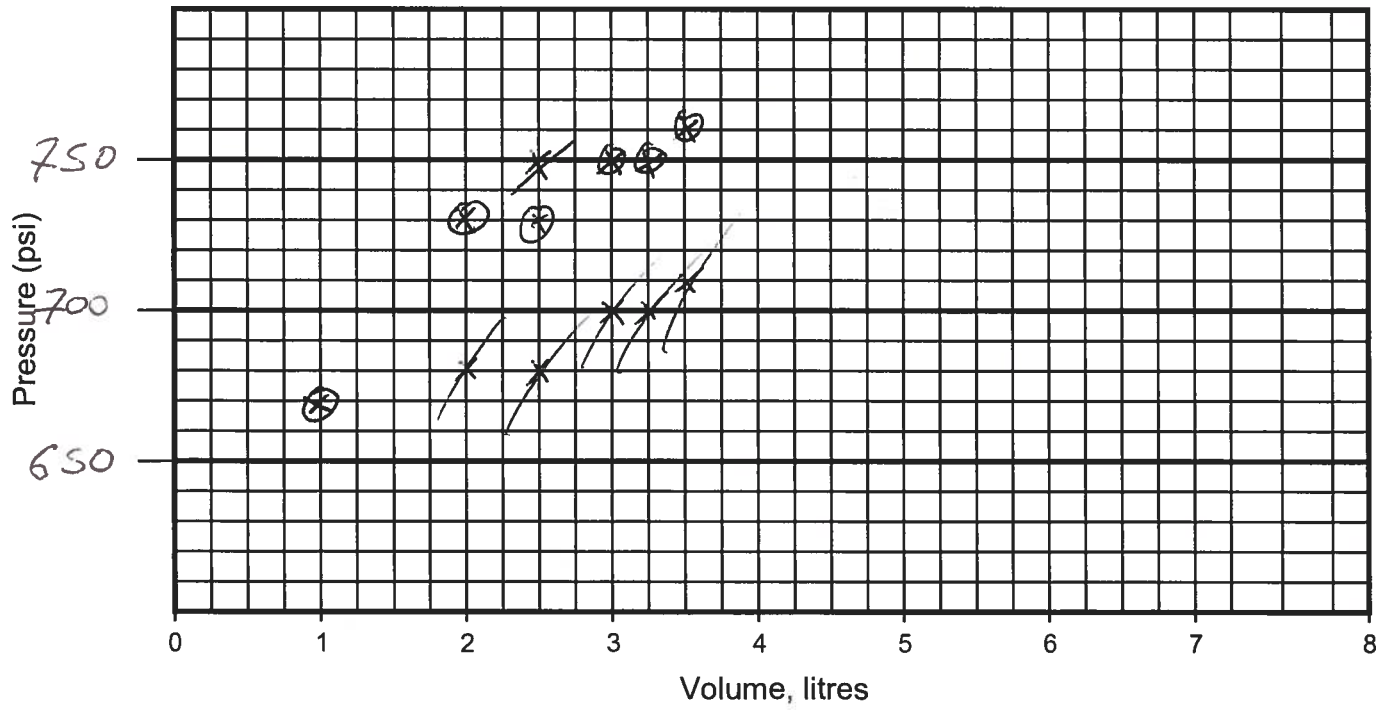
Packer Valve Pressure, P_V: 145 psi | Final Line Pressure, P_L: 850 psi | Tool Pressure, P_T: 430 psi

Borehole Water Level: 3 (~~ft~~/m) = 0 psi (P_W)

Packer SN# 19285

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 275 ⊛ psi

		2 min						Wait 5 min		
Volume, litres	1.0	2.0	2.5	3.0	3.25	3.5	3.75	/	3.25	
Pressure, psi	670	730	730	750	750	760	850	/	⊘	
Volume, litres										
Pressure, psi										



Comments: Packer #8 | Time - 11:40 am

⊛ Higher pressures due to dirty 90 micron filter.

Schlumberger Water Services

Sheet 10 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 31/2013

Packer No. 9, comp. # 89 Depth (~~ft~~/ m): 537.9 Inflation Tool No.: #IW852

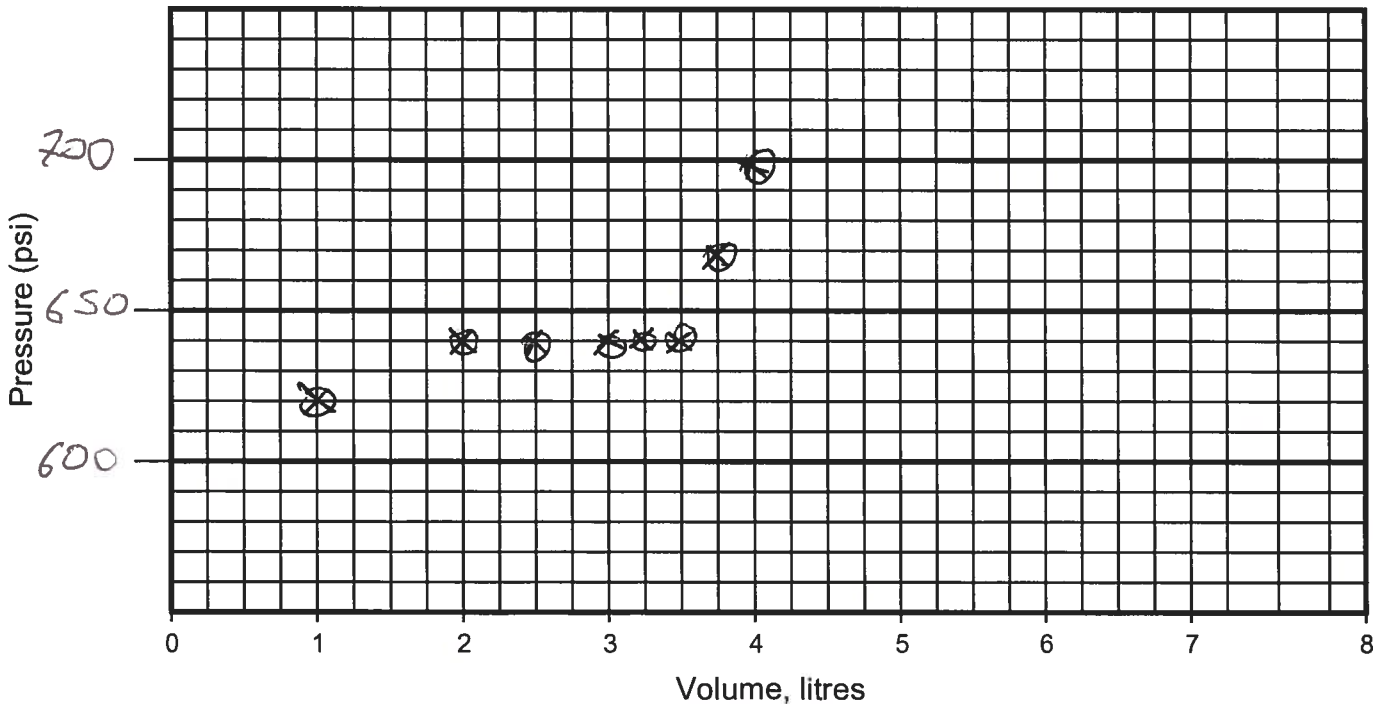
Packer Valve Pressure, P_V: 125 psi Final Line Pressure, P_L: 700 psi Tool Pressure, P_T: 420 psi

Borehole Water Level: 3 (~~ft~~/ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 135 psi

Packer SN# 18288

Volume, litres	1	2	2.5	3.0	3.25	3.5	3.75	3.9	/	3.3
Pressure, psi	620	640	640	640	640	640	670	700	/	0
Volume, litres										
Pressure, psi										



Comments: Packer # 9 Time -

Schlumberger Water Services

Sheet 11 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 31/2013

Packer No. 10, comp. # 92 Depth (~~ft~~ m): 533.3 Inflation Tool No.: TIw 852

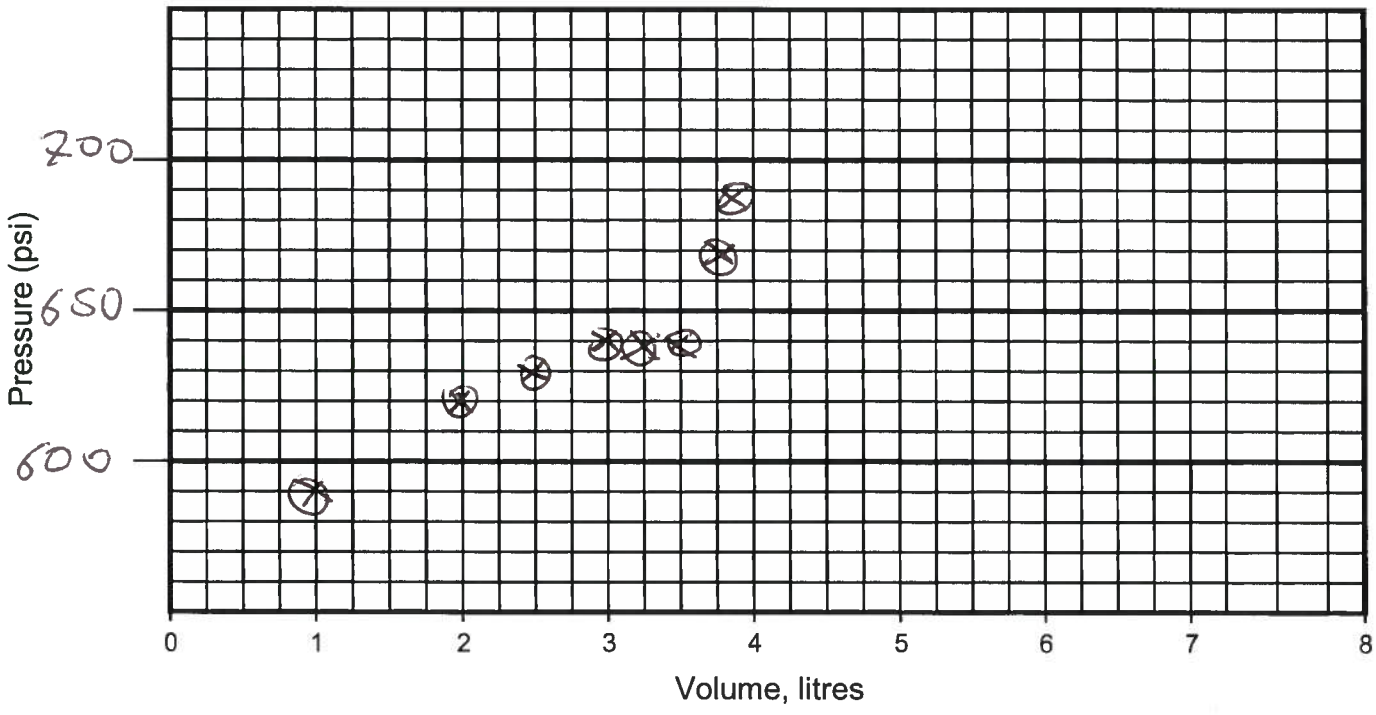
Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 690 psi Tool Pressure, P_T: 420 psi

Borehole Water Level: 3 (~~ft~~ / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 125 psi

Packer SN# 18287

Volume, litres	1.0	2.0	2.5	3.0	3.25	3.5	3.75	3.9	/	3.3
Pressure, psi	590	620	630	640	640	640	670	690	/	0
Volume, litres										
Pressure, psi										



Comments: Packer #10 Time -

Schlumberger
Water Services

Sheet 12 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 27/13

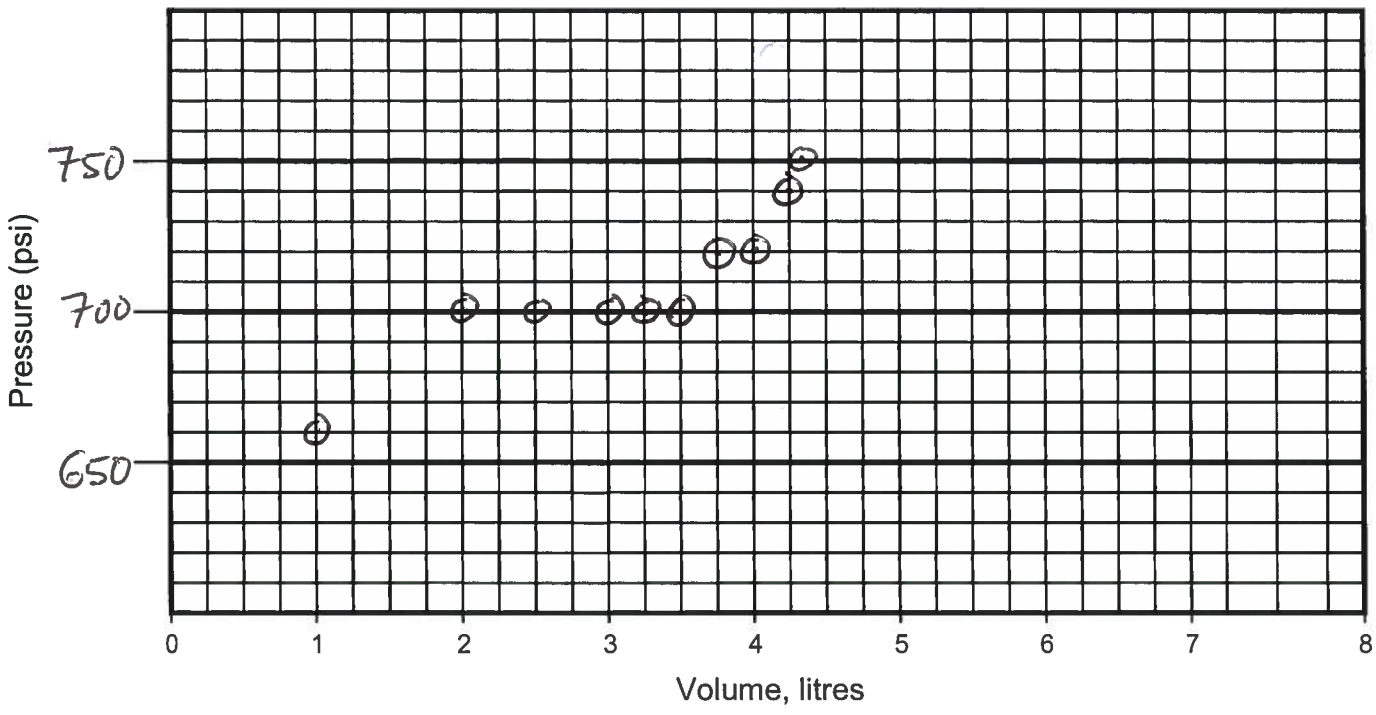
Packer No. 11, comp 118 SN# 18289 Depth (ft / m): 455.5 Inflation Tool No.: IW852

Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 750 psi Tool Pressure, P_T: 450 psi

Borehole Water Level: 3 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 155 psi

Volume, litres	1.0	2.0	2.5	3.0	3.25	3.5	3.75	4.0	4.25	4.35
Pressure, psi	660	700	700	700	700	700	720	720	740	750
Volume, litres	/	3.75								
Pressure, psi	/	Ø								



Comments: Packer inflated properly, Packer at 454.3 m on counter. Time - 11:02 pm

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Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 27/2013

Packer No. 12, comp. # 120 | Depth (ft/ m): 451.0 | Inflation Tool No.: TIW 852

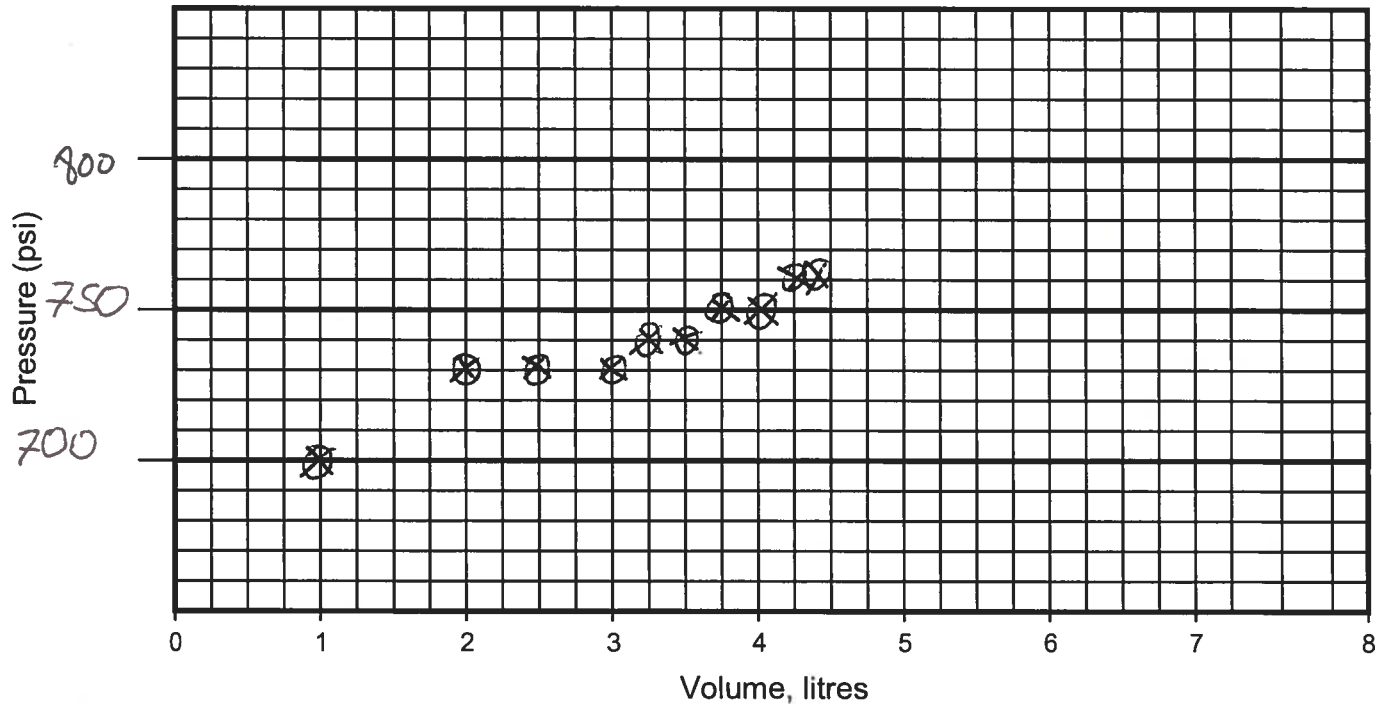
Packer Valve Pressure, P_V: 150 psi | Final Line Pressure, P_L: 760 psi | Tool Pressure, P_T: 450 psi

Borehole Water Level: 3 (ft/ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 160 psi

Packer SN# 18290

Volume, litres	1	2	2.5	3	3.25	3.5	3.75	4	4.25	4.35
Pressure, psi	700	730	730	730	740	740	750	750	760	760
Volume, litres	1	3.8								
Pressure, psi	1	0								



Comments: Packr Inflated properly | Time - 11 38 PM

Schlumberger
Water Services

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 29/13

Packer No. 13, comp.# 144 Depth (~~ft~~/ m): 380.8 Inflation Tool No.: TIW 852

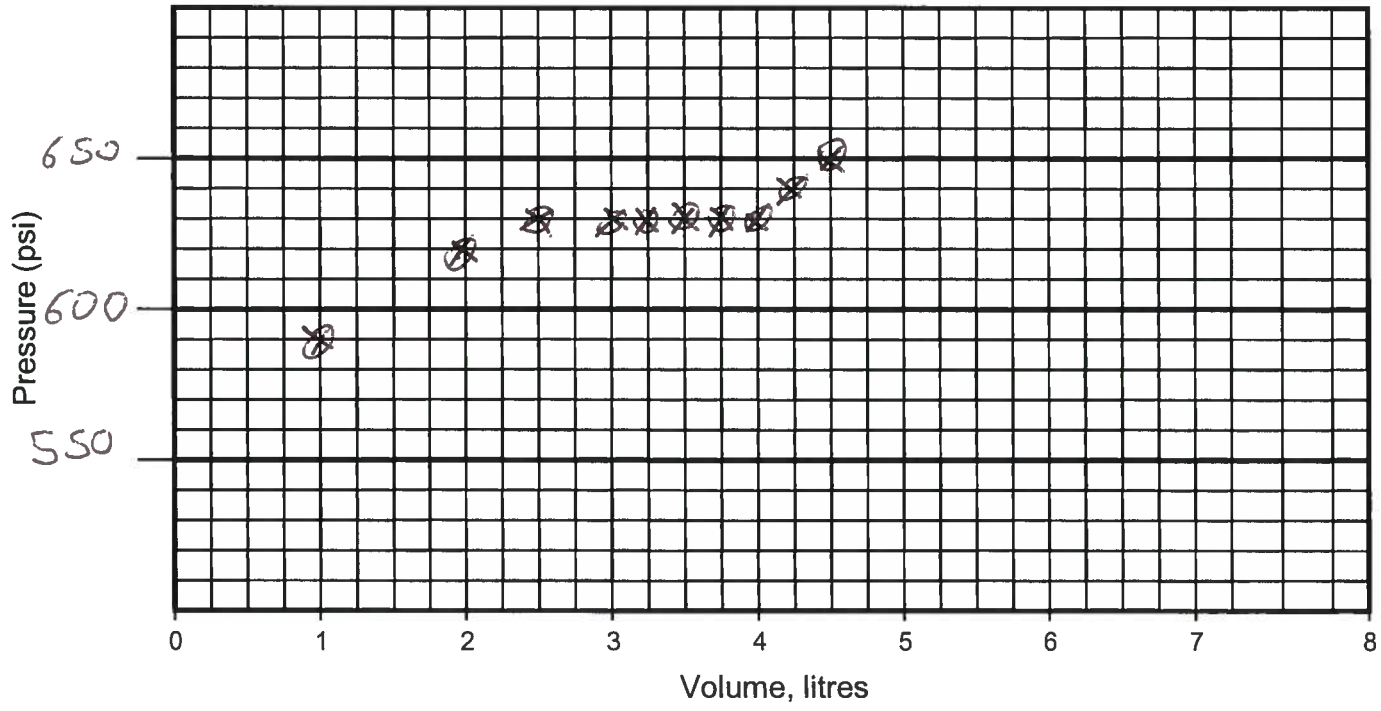
Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 650 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 3 (~~ft~~/ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

Packer SN# 18311

Volume, litres	1	2	2.5	3	3.25	3.5	3.75	4.0	4.25	4.5
Pressure, psi	590	620	630	630	630	630	630	630	640	650
Volume, litres	/	3.8								
Pressure, psi	/	0								



Comments: Packer #13 Time - 1955

Schlumberger
Water Services

Sheet 15 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: WB927 Well No.: 13-GSE-319

Location: Goose Lake Completed by: ML/DO Date Inflated: May 29/2013

Packer No. 14, comp. # 178 Depth (~~ft~~ / m): 280.2 Inflation Tool No.: FIW 852

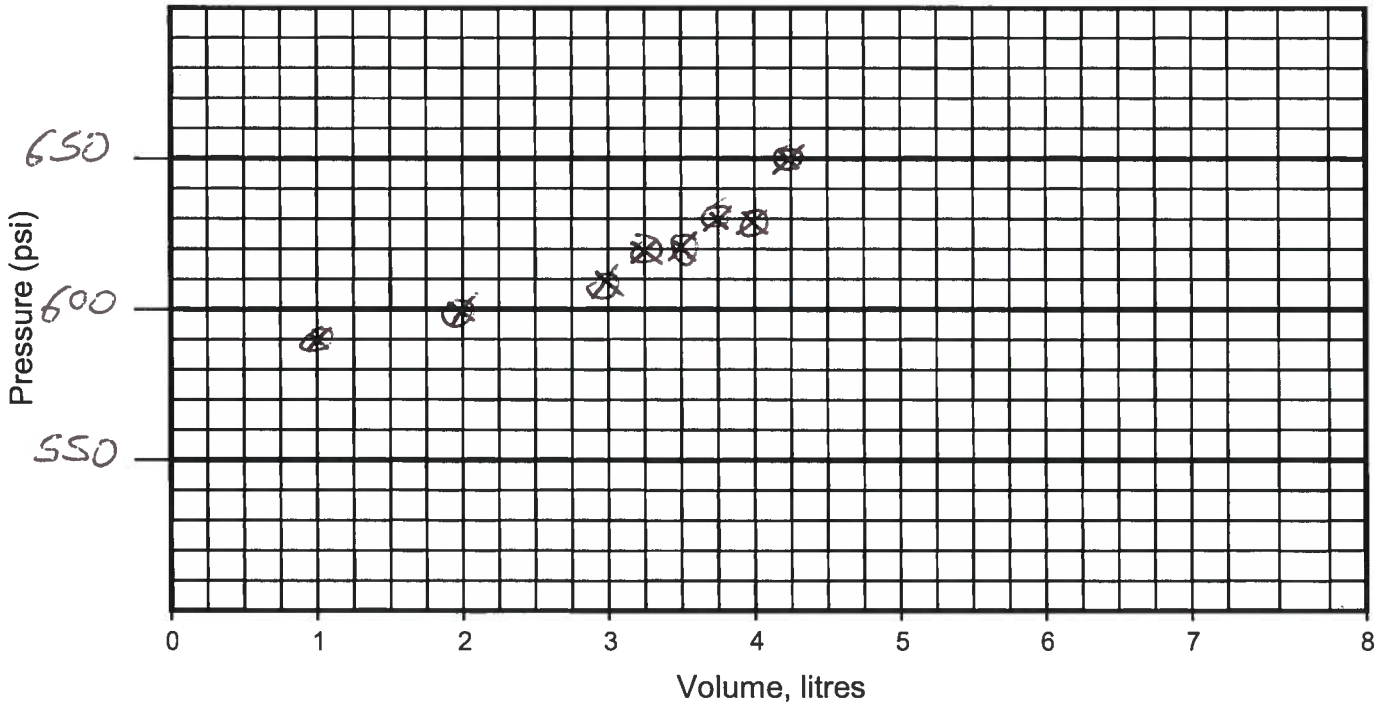
Packer Valve Pressure, P_V: 140 psi Final Line Pressure, P_L: 650 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 3 (~~ft~~ / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 110 psi

Packer SN# 18312

Volume, litres	1	2	3	3.25	3.5	3.75	4.0	4.25	/	3.8
Pressure, psi	590	600	610	620	620	630	630	650	/	0
Volume, litres										
Pressure, psi										



Comments: Packer #14 Time - 8:30 PM

Schlumberger Water Services

Westbay Packer Inflation Record

Project: Rescan | Project No.: WB927 | Well No.: 13-GSE-319

Location: Goose Lake | Completed by: ML/DO | Date Inflated: May 31/13

Packer No. 15, comp. # 212 | Depth (~~ft~~ m): 179.6 | Inflation Tool No.: TIW 852

Packer Valve Pressure, P_V: 140 psi | Final Line Pressure, P_L: 680 psi | Tool Pressure, P_T: 420 psi

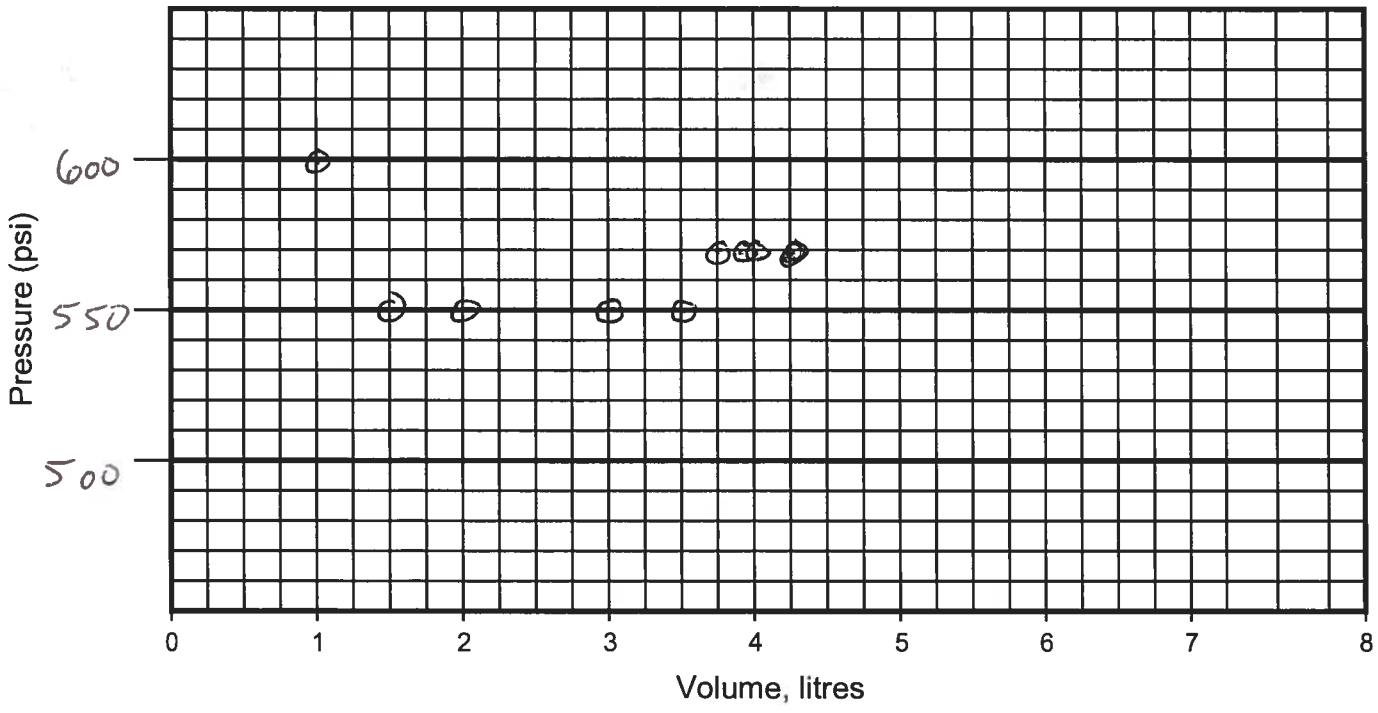
Borehole Water Level: 3 (~~ft~~ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 120 psi

Packer SN# 18313

Volume, litres	1.0	1.5	2.0	3.0	3.5	3.75	3.9	4.0	4.25	4.5
Pressure, psi	600	550	550	550	550	570	570	570	570	680
Volume, litres	/	4.0							550	
Pressure, psi	/	0							@ 80 sec	

4.5-L pressure at 650 psi after 3-min.



Comments: Packer #15 | Time -

	PSF	Time	PSF	Time
2-L mark	750 @	20 sec	550 @	70 sec
	650 @	40 sec		
	600 @	50 sec		

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Water Services

Sheet 17 of 17

Westbay Packer Inflation Record

Project: Rescan Project No.: CJB927 Well No.: 13-GSE-319

Location: Goose Gak Completed by: ML/DO Date Inflated: May 31/2013

Packer No. 16, comp.# 245 Depth (~~ft~~/ m): 82.1 Inflation Tool No.: TW852

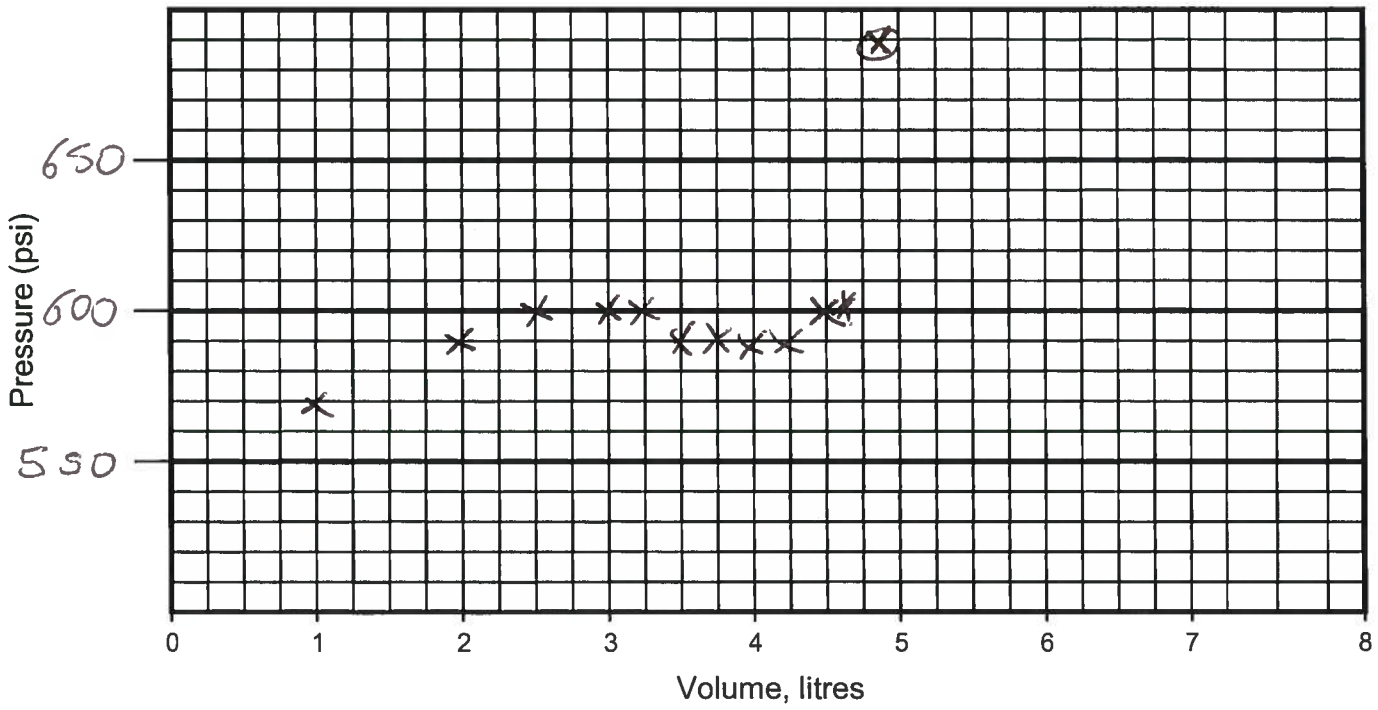
Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 690 psi Tool Pressure, P_T: 420 psi

Borehole Water Level: 3 (~~ft~~/ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 125 psi

Packer SN# 18314

Volume, litres	1.0	2.0	2.5	3	3.25	3.5	3.8	4.0	4.25	4.5
Pressure, psi	570	590	600	600	600	590	590	590	590	606
Volume, litres	4.7	4.9	/	4.2						
Pressure, psi	600	690	/	0						



Comments: Packer #16 Time - 16 45

Appendix V6-2C

2012 Geotechnical and Hydrogeological Drilling Program Factual Data Report

Rescan™
an ERM company

Back River 2012 Geotechnical and Hydrogeological Drilling Program

Factual Data Report

Report Prepared for

Sabina Gold & Silver Corporation



Report Prepared by

SRK Consulting (Canada) Inc.
2CS031.002
November 2012

Back River 2012 Geotechnical and Hydrogeological Drilling Program

Factual Data Report

Sabina Gold & Silver Corporation

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SRK Project Number 2CS031.002

November 2012

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Appendices

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- Appendix A.1: Wireframe Structures (DXF)
- Appendix A.2: Air Photos (digital and physical copies)
- Appendix A.3: Air Photo Interpretation
- Appendix A.4: Electronic Geotechnical Database
- Appendix A.5: SRK Geotechnical Logging Manual
- Appendix A.6: Laboratory Sampling and Testing
- Appendix A.7: Core Photos

Appendix B: Hydrogeology Data

- Appendix B1: Injection Test Theory & Analysis
- Appendix B2: 2012 Packer Test Field Data Sheets
- Appendix B3: 2012 Vibrating Wire / Thermistor Documentation
- Appendix B4: Summary Temperature Results and Pore Pressure
- Appendix B5: Thermistor and Vibrating Wire Data (Electronic)

1 Introduction and Scope of Report

SRK Consulting (Canada) Inc. ("SRK") was selected by Sabina Gold & Silver Corporation ("Sabina") to undertake a geotechnical and hydrogeological site investigation program to support feasibility level design of the proposed open pits and underground operations at the Back River Gold Project ("Back River project") in Nunavut, Canada. This factual report details the data collected from SRK's geotechnical site investigation program carried out from June to September 2012. The program consisted of a field program comprising geotechnical drilling and testing, installations of thermistor strings, and limited laboratory testing.

The mine plan in the Preliminary Economic Assessment ("PEA") (SRK, 2012)) was used as the basis for the geotechnical and hydrogeological study. Both underground and open pit options were considered for the Umwelt and Goose deposits, with open pit mining for the Llama deposit.

This data report does not contain interpretive statements.

1.1 Project Description

The Back River Project site ("site") is located approximately 520 km northeast of Yellowknife, Northwest Territories, and 50 km southeast of the Hackett River Project in the southwestern part of Nunavut, Canada. The site consists of the Llama, Umwelt, and Goose Main deposits (collectively referred to as the Goose Property). The locations of the deposits are seen in Figure 1.

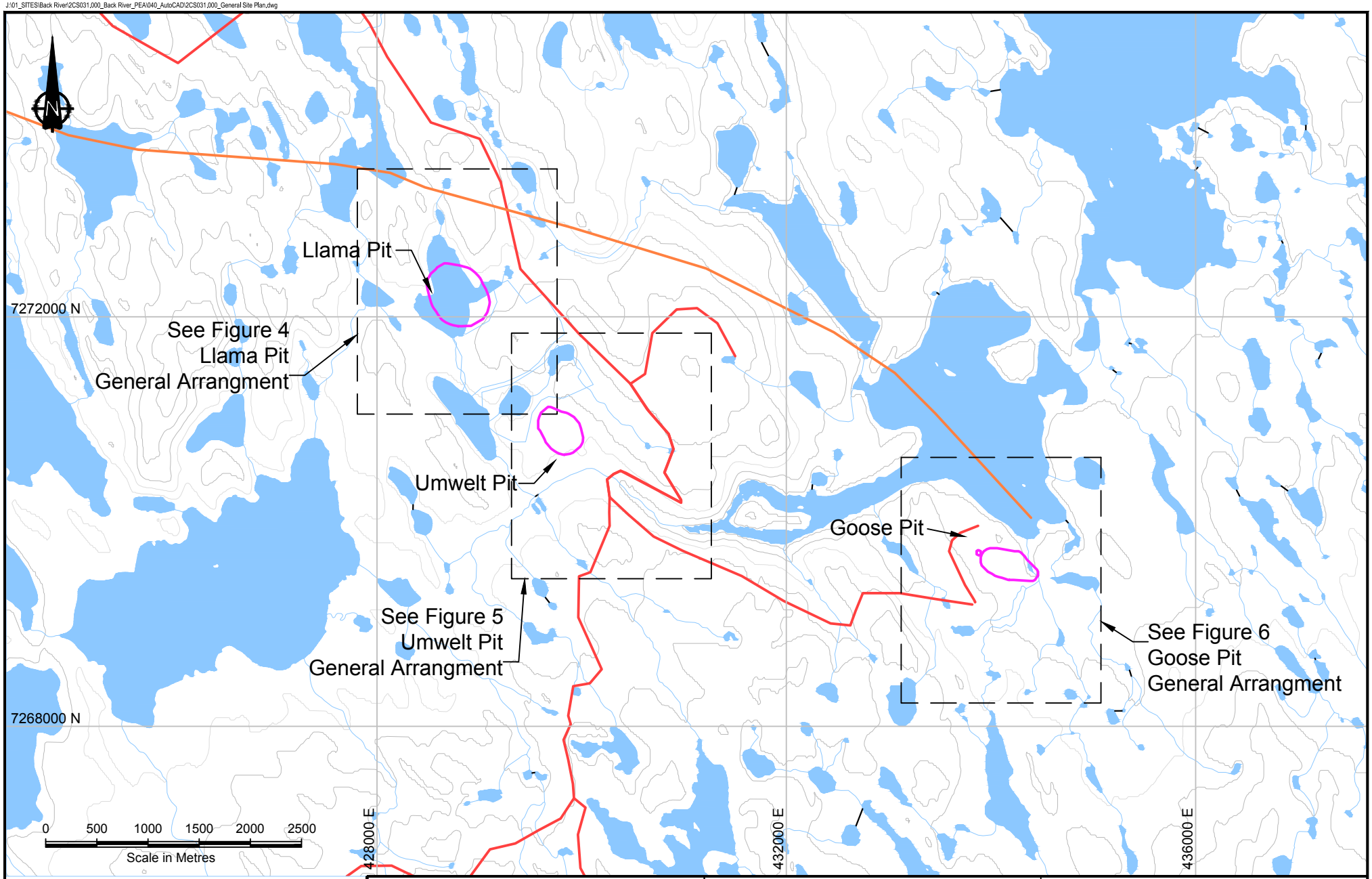
1.1.1 Data Outline

The data presented in this report includes historical data and data collected during the 2011 SRK site investigation program. All data is included as appendices in this report, subdivided into appendices: Appendix A - Geotechnical Data and Appendix B - Hydrogeological Data. An outline of the appendix layout is summarized below:

- Appendix A: Geotechnical Data
  - Appendix A.1: Wireframe Structures (DXF)
  - Appendix A.2: Digital and Physical Air Photos
  - Appendix A.3: Air Photo Interpretation
  - Appendix A.4: Electronic Geotechnical Database
  - Appendix A.5: SRK Logging Manual
  - Appendix A.6: Laboratory Sampling and Testing
  - Appendix A.7: Core Photos

- Appendix B: Hydrogeology Data
  - Appendix B1: Injection Test Theory & Analysis
  - Appendix B2: 2012 Packer Test Field Data Sheets
  - Appendix B3: 2012 Vibrating Wire / Thermistor Documentation
  - Appendix B4: Summary Temperature Results and Pore Pressure
  - Appendix B5 (Electronic Only): Thermistor and Vibrating Wire Data

J:\01_SITES\Back River\2CS031.000_Back River_PEA\040_AutoCAD\2CS031.000_General Site Plan.dwg



LEGEND

- Proposed All-Weathered Road
- Proposed Winter Road
- Pits
- Lakes and Rivers

srk consulting

SRK JOB NO.: 2CS031.000

FILE NAME: 2CS031.000_General Site Plan.dwg

Sabina GOLD & SILVER CORP.

Sabina Gold and Silver Corporation

Back River PEA

Site Wide General Arrangement

DATE:	APPROVED:	FIGURE:
November 2012	BG	1.1

2 Geotechnical Study

SRK was requested by Sabina to complete a geotechnical investigation to bring the various underground and open pit mining areas at Umwelt, Llama Lake, and Goose deposits up to a PFS level of study. The deposits are currently considered to be at a Preliminary Economic Assessment level of study.

SRK's planned geotechnical program considered the pit shells and underground mining shells as detailed in the 2012 PEA issued to Sabina. On-going conversations with Sabina indicated that the geology and mine plans could change from what was understood at the time of proposal. It was noted in SRK's proposal to Sabina that if the geotechnical drill program outlined could not be completed, or if the mine plan changes such that the investigations do not cover all mining areas, SRK could not guarantee that a PFS-level conclusion would be reached for all mining areas.

2.1 Geotechnical Objectives

To enable open pit and underground PFS level design, the geotechnical objectives of the SRK 2012 program include:

- Improved understanding of the rock mass units, particularly related to the presence and spatial location of mudstone and graphitic mudstone units;
- Develop a preliminary structural model and attempt to determine the characteristics of mine scale structures;
- Identify discontinuity characteristics and orientations; and
- Conduct laboratory test work designed to provide baseline estimates of intact rock strength.

2.2 Structural Review

A structural review of the Back River project was undertaken to define brittle structural trends in the Goose, Umwelt, and Llama zones. The structural review consisted of a three day site visit by SRK Consultants Blair Hrabi and Tessa Scott, fault interpretation based on available structural data from Sabina's Gems database, and stereo air photo interpretation.

The site visit allowed the SRK team to review various faults and structures in the drill core as well as Sabina's Gemcom Gems structural data from current and historic holes. Several drillholes from each deposit were reviewed and compared to the Gems database and the geological logs to understand how structures had been identified and described by Sabina's geologists. Overall the structural data in the Gems database was mostly complete and no major discrepancies were found. In some cases structural data was recorded in the lithology codes and in the detailed comments, however in most instances this data was duplicated in the structural tables. Some of the minor structures and sub-parallel structures were not included in the Gems database.

A structural interpretation was completed using Leap Frog 3D geological modelling software. Using the structural data from the Gems database, brittle structures identified from drill core in each mining area have been modeled. The structures were created from a combination of RQD, core recovery, fracture frequency, and structural and lithological tables. Each structure was modeled by snapping to brittle structure data points along a trend. A selection of potential fault intercepts were reviewed in core photos to determine the confidence and characteristics of each fault (Table 2.1, Figure 2.1, 2.2, 2.3). The wireframe models are included electronically in Appendix A1.

Most of the interpreted structural trends are directly related to geological units and folding, and several of the interpreted structures run along axial planes of the folds as well as along fold hinges. Few cross-cutting structures were able to be identified from the drilling as the majority of the drillholes are oriented perpendicular to the fold axis. This creates a bias which does not allow for cross-cutting faults to be defined well enough to model and as a result the faults being modeled are almost exclusively parallel to the trend of the folds. It should be noted that there is a high potential for additional faults which cross-cut the fold trend.

The air photo study was undertaken to delineate structures expressed on the surface to tie into faults modeled from drill core data, and attempt to verify the presence of cross-cutting structures. Air photos at 1:30,000 scale were utilized during the interpretation. The resulting interpretations have been scanned and geo-referenced in ArcGIS and subsequently digitized on the deposits (Figure 2.4) and are included electronically in Appendix A2. Electronic and original copies of the air photos are included in Appendix A3.

Many of the interpreted trends from the air photo study support the known geometry of the deposits and modeled structures. There are numerous cross trend structures that could warrant ground verification. Ideally each deposit would have several geotechnical oriented drillholes at different azimuths to obtain a better understanding of the faults.

Table 2.1: Summary of interpreted fault characteristics and level of confidence

Deposit	Name	Interp. by	Orientation			Description	Confidence			Comments
			Strike	Dip	Dip Dir.		Good	Medium	Low	
Goose	Fault_Goose_1	SRK	120	-39	SW	Fault gouge with broken core	•			This fault cross cuts the geology. The fault shows fault gouge, broken core and low angle fractures. There is no shearing or deformation around the fault.
	Fault_Goose_3	SRK	302	-86	NE	Broken core, shallow fractures, fault gouge		•		Medium to low confidence fault. This fault follows the northern limb of a fold and is following the geological structure. Fault consists of broken core with rubble and gouge.
	Fault_Goose_Sabina	Sabina	323	-77	NE, E	Broken core from low angle fractures			•	Low to medium confidence fault. The fault consists of small zones of broken core with low angle fractures and possible clay gouge. This fault makes sense geologically and should be explored further.
Umwelt	Fault_Umwelt_1	SRK	321	-66	NE	Cohesive thin fault gouge and breccia with graphite and disking	•			High to medium confidence fault. This fault appears thin and compact showing thin 2-10cm cohesive fault gouges and breccias. Faults and surrounding joints are often graphitic. The fault is roughly parallel the granodiorite dyke and follows the overall structural direction.
	Fault_Umwelt_2	SRK	325	-61	NE	Small zones of broken core, disking, and thin fault gouge. Possible graphite on fractures		•		Medium confidence fault. The fault generally consists of small zones of broken core and thin 1 to 5cm fault gouges. Possible graphite on fractures. There could be several small faults instead of one large one. The fault is roughly parallel the granodiorite dyke and follows the overall structural direction.
	Fault_Umwelt_3	SRK	326	-63	NE	Disked core with rubble and fault gouge and graphite		•		Medium confidence fault. The fault consists of disked core to broken core with thin fault gouges. Graphite is visible on several joints. The fault is roughly parallel the granodiorite dyke and follows the overall structural direction.
	Fault_Umwelt_4	SRK	343	-71	NE	Disked core with rubble and fault gouge	•			High confidence fault. The fault consists of disked core and rubble and fault gouge. One hole has 40cm of cohesive fault gouge. The fault is likely offsetting the deposit. There is a lot of faulting activity in this area, likely from several faults. This fault should have further exploration.
	Fault_Umwelt_5	SRK	330	-62	NE	Disked core with rubble and fault gouge. Possible graphite	•			High confidence fault of disked and broken core with rubble and fault gouge. Possible graphite on fractures. The fault is roughly parallel the granodiorite dyke and follows the overall structural direction.
	Fault_Umwelt_6	SRK	357	-57	E	Disked core, rubble, fault gouge, and graphitic fractures	•			High confidence fault. Disked core with broken core, rubble, fault gouge, and graphite on some fractures. The fault crosses geological trend, and passes through two dykes. The trend is similar to Fault_Umwelt_5.
Llama	Fault_Llama_1	SRK	341	-49	NE, E	Disked core, rubble, fault gouge, and graphitic fractures	•			High confidence fault with rubble, disked core, rubble, and graphitic fractures. The fault crosscuts the geological trends and several other Llama faults.
	Fault_Llama_4	SRK	322	-89	NE	Broken core, rubble, with gouge and possible graphitic fractures		•		Medium confidence fault with broken core and rubble with some fault gouge and possible graphitic fractures. The fault is roughly parallel the granodiorite dyke and follows the overall geological trend.
	Fault_Llama_5	SRK	319	-88	NE	Small zones of rubble with possible graphitic fractures			•	Low to medium confidence. This fault consists of mostly solid core with small 5-20cm zones of rubble with possible graphite on several fractures. There may be several small faults running through this since there are many structural intersects. The fault is roughly parallel the granodiorite dyke and follows the geological trend.

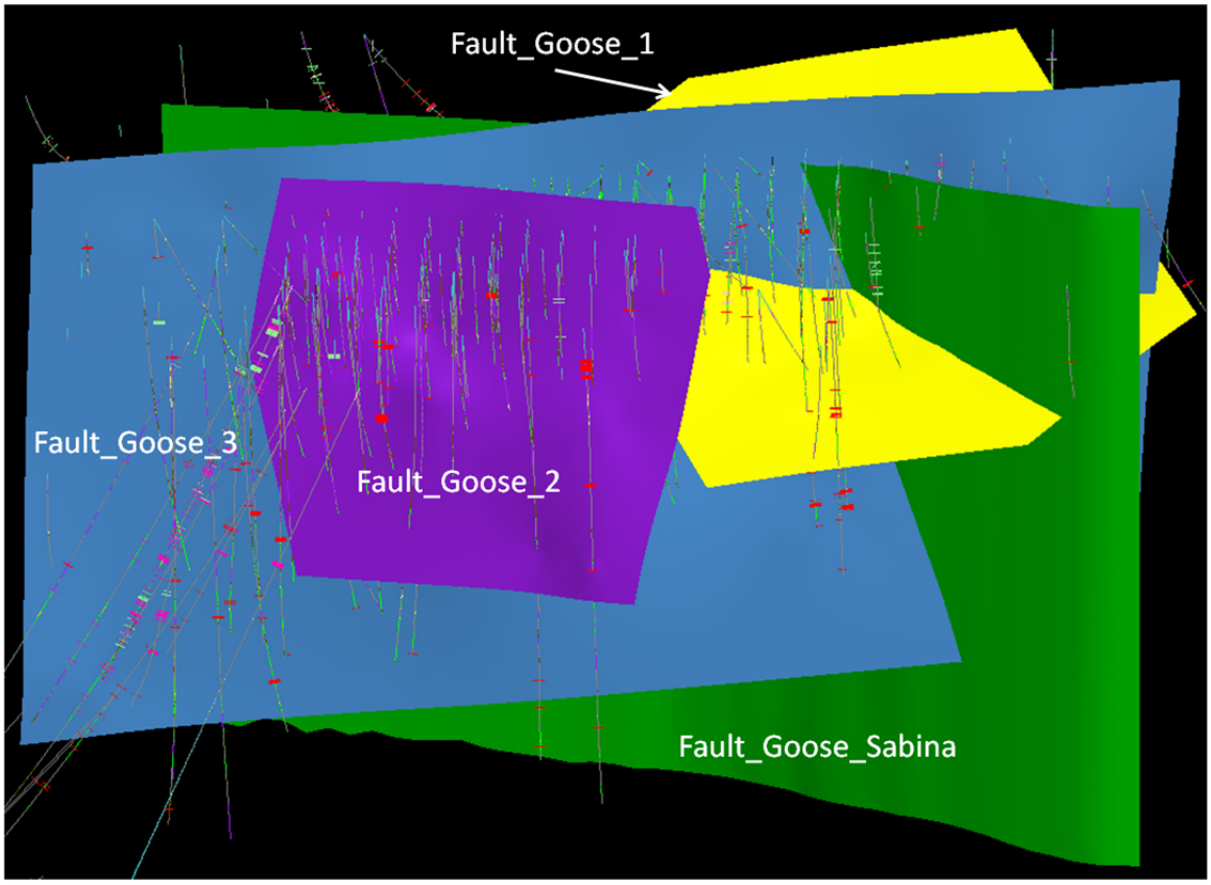


Figure 2.1: Goose deposit fault interpretation

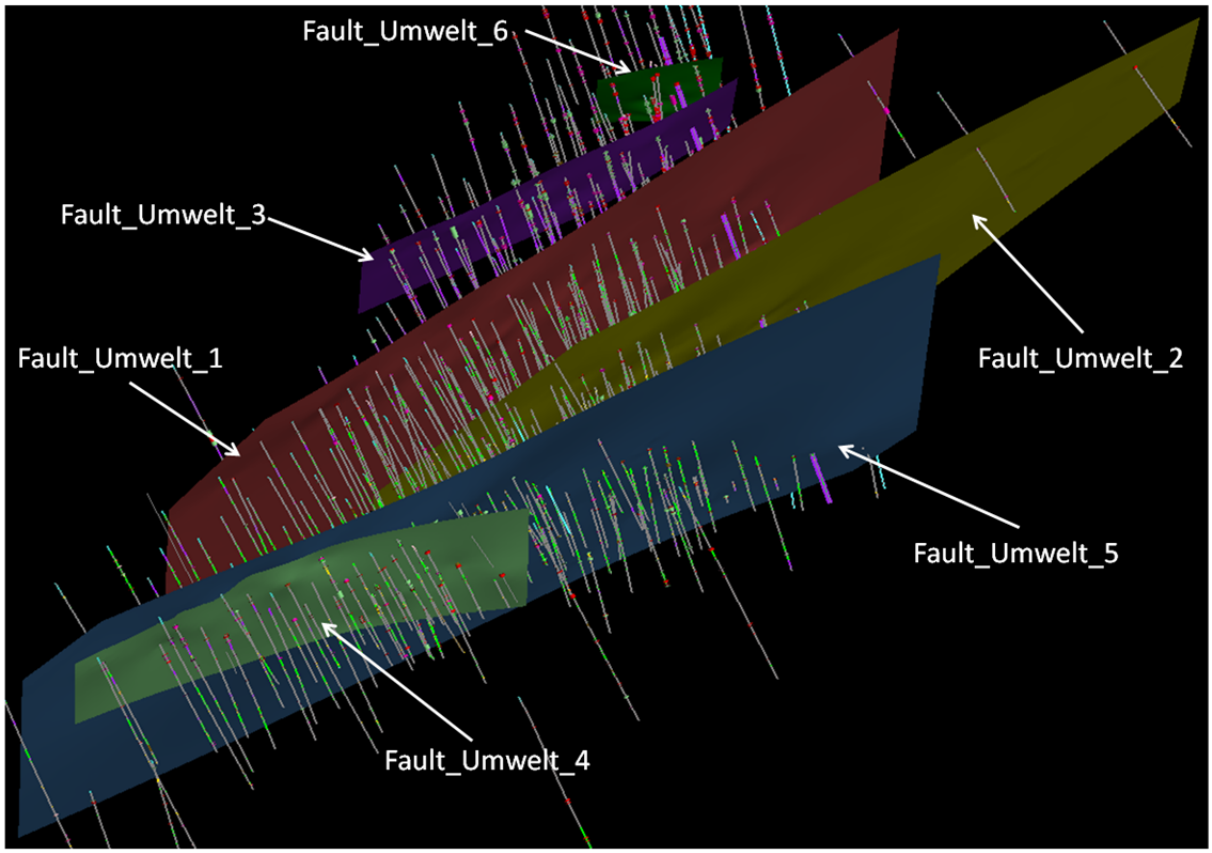


Figure 2.2: Umwelt deposit fault interpretation

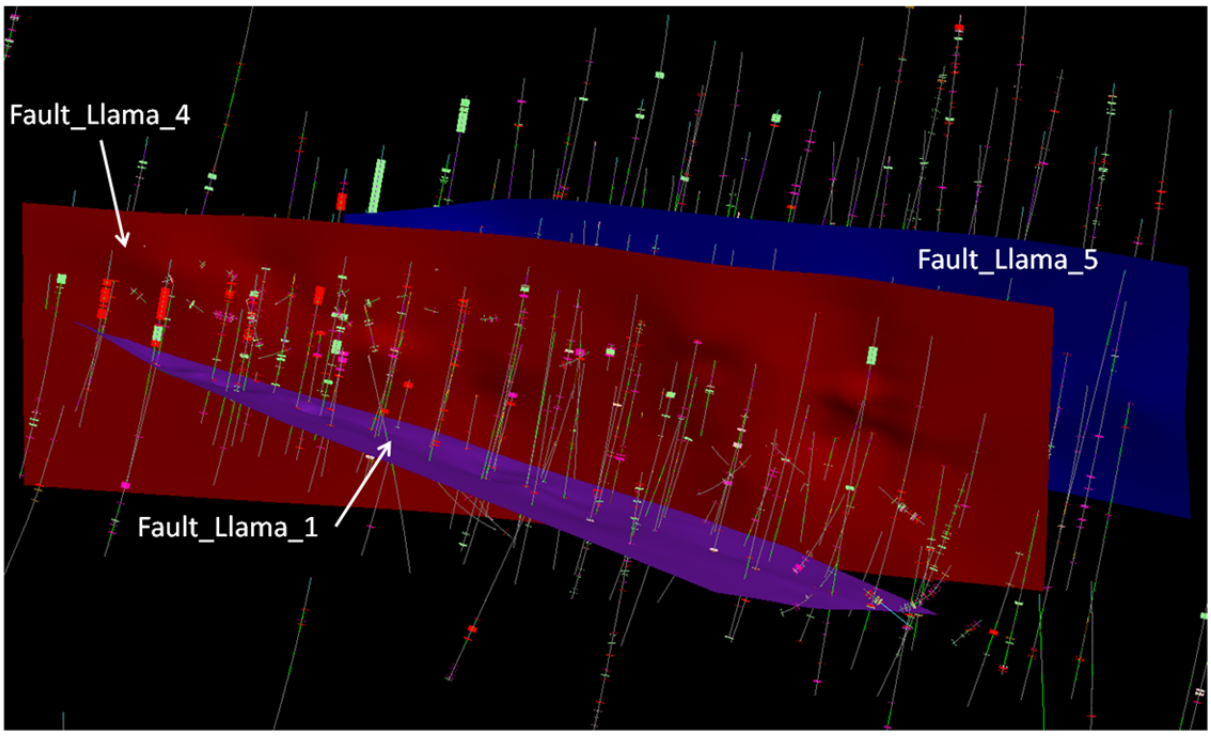


Figure 2.3: Llama deposit fault interpretation

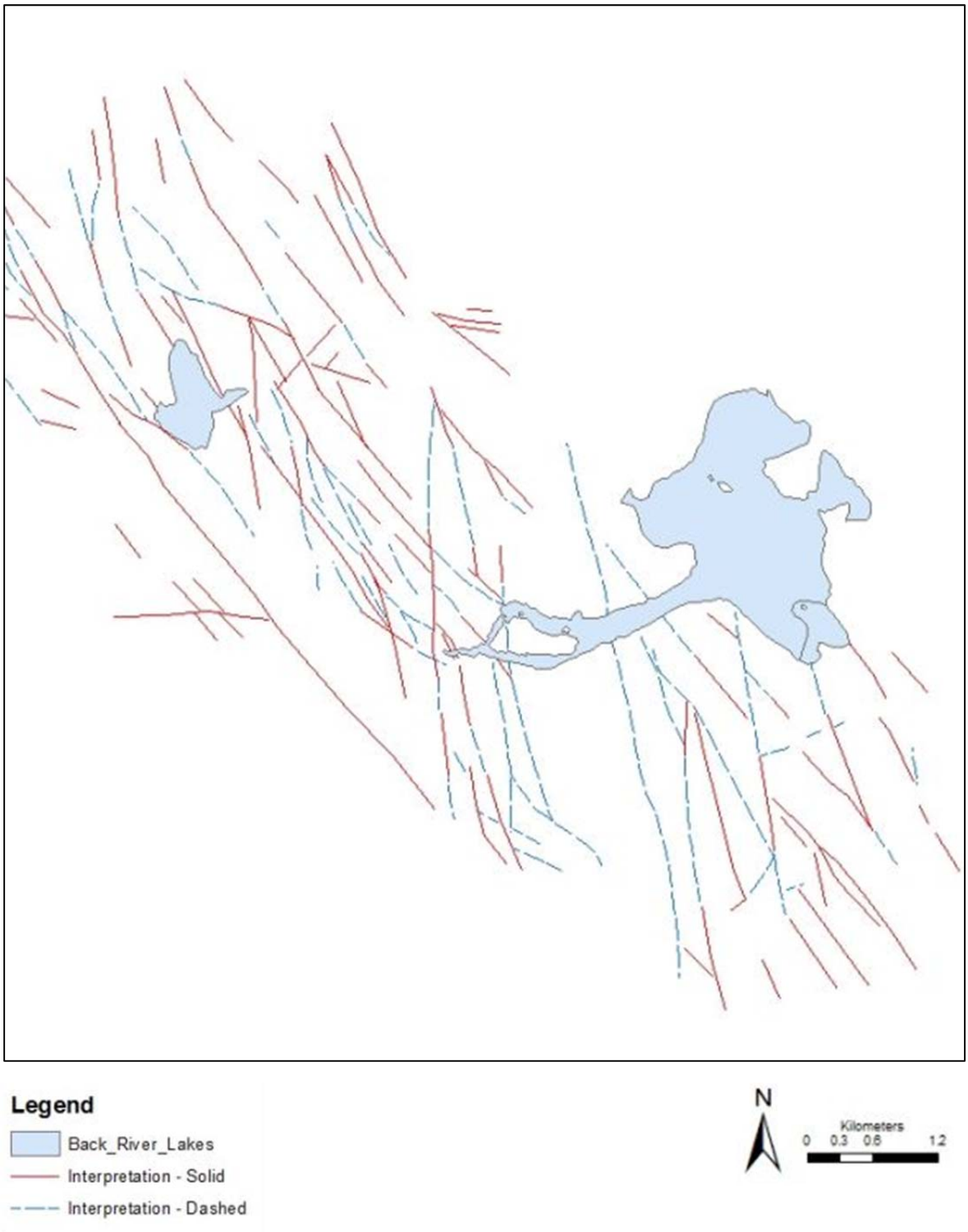


Figure 2.4: Digitized structures from air photo interpretation. High confidence structures indicated by solid red, lower confidence in blue dash.

2.3 2012 Geotechnical Program Summary

The 2012 geotechnical site investigation field work consisted of the following:

- 22 geotechnical drillholes (seventeen piggybacked with resource drilling, five geotechnical specific holes);
- 'On-rig' geotechnical logging of rock mass parameters and collection of oriented discontinuity data by Sabina staff and supervised by SRK's site senior;
- Collect representative drill core samples for the purposes of strength properties laboratory testing;
- Limited laboratory strength testing of selected rock samples;
- Review of available exploration drill core by SRK structural geologists; and
- Structural review to determine potential brittle structures intersecting the various mining areas.

2.4 2012 Geotechnical Drilling Program

Preliminary drill planning was laid out in SRK's proposal to Sabina (April 2011) based around 'piggy-backing' geotechnical data collection on exploration drill holes. Adjustment and planning of additional geotechnical drill holes was completed as the project advanced. Table 2.2 summarizes the estimated and actual drill hole meterage completed per deposit.

Table 2.2: Summary of estimated and actual drill hole coverage per deposit

Deposit	Number of Exploration Holes Selected ('Likely' as Indicated by Sabina)	Number of Additional Geotechnical Specific Holes (Estimated)	Estimated Total Meters	Actual Total Meters
Goose	5 (5)	3	1600	319.0
Llama Lake	11 (11)	3	3000	2655.5
Umwelt	13 (5)	2	1800	3359.6
Total	**29 (21)**	**8**	**6400**	**6334.1**

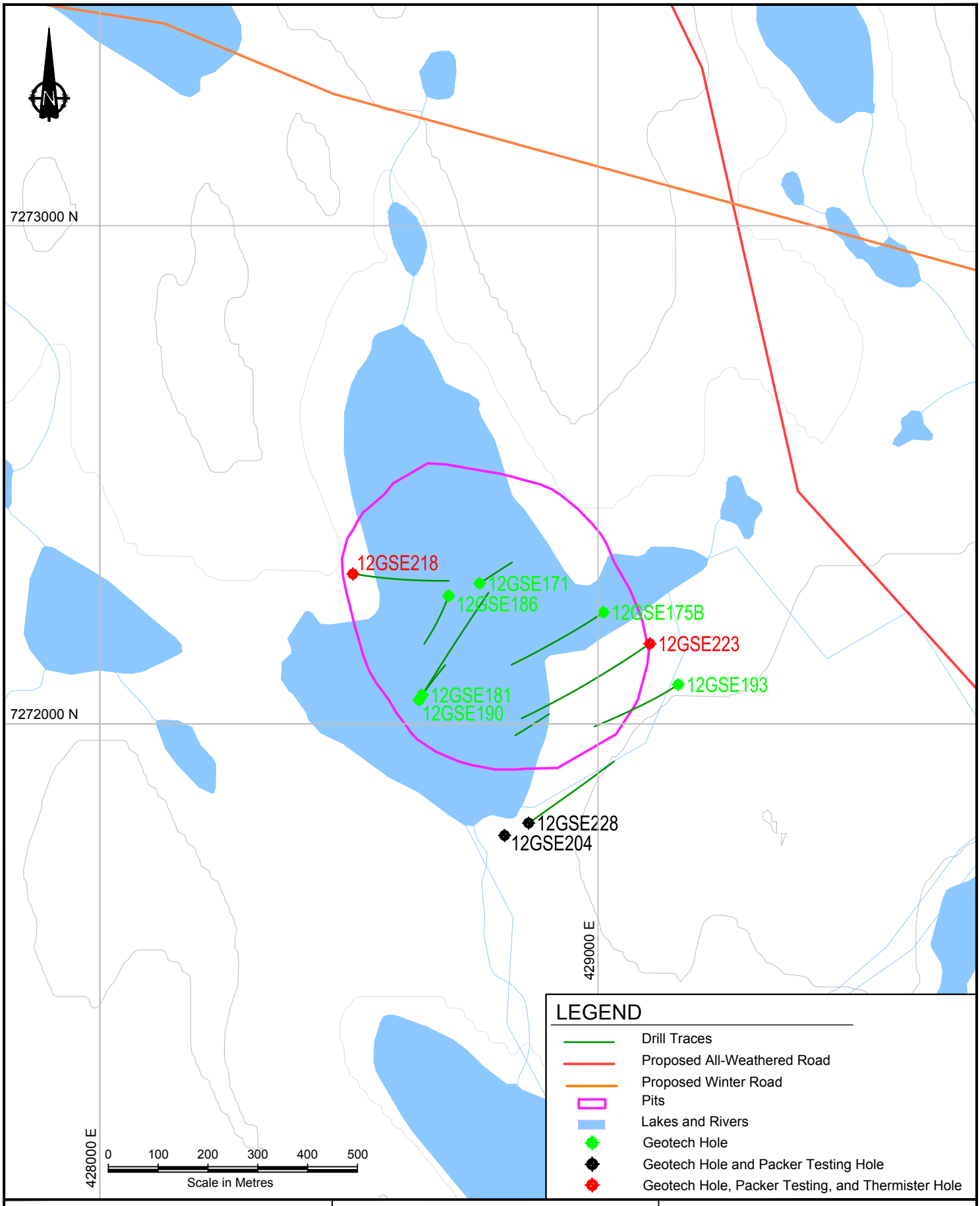
As indicated in Table 2.2, the actual meters completed varied significantly from the estimated.

- At Umwelt, deep holes that Sabina had originally indicated were not likely to be completed were completed toward the end of the program. A number of the holes originally selected by SRK were not completed in the deep underground mining areas based on directives from Sabina's senior management.
- At Goose, due to the significant historical geological drilling coverage there was not significant drilling planned for the 2012 season. As only one drill was available for geotechnical drilling, Umwelt and Llama geotechnical drilling was given priority over data collection at Goose. Historic oriented core data from 2008 drilling is available for Goose to supplement the 2012 data. Note that 8 additional historic holes with core orientation exist at the Goose deposit.

Locations of each drill hole from the 2012 program are shown in Figures 2.5 through 2.7. The location details and purpose for each drill hole is summarized in Table 2.3.

Drilling was undertaken by Major Drilling Group Limited ("Major") over a 24 hour period per day under the supervision of Sabina staff. NQ3 triple tube holes were drilled where possible, however in some cases to control hole deviation NQ2 double tube drilling was employed over the upper portions of the hole. During the program, SRK observed a drilling practice of only using one split tube during drilling. SRK was unable to determine if this was an isolated incident or recurring practice, but resulted in decreasing the confidence of the orientation line due to core spinning in the core barrel.

Drill holes were located on site by Sabina staff, with a ‘heads and tails’ survey completed to confirm dip and azimuth of the drill hole prior to the commencement of diamond coring (typically after casing was set in bedrock). Down hole deviation was surveyed during drilling using a Reflex Ezy-Shot down hole tool, with a Reflex Gyro tool utilized for final down hole survey. The Ezy-Shot is not considered reliable for monitoring of drill hole azimuth due to magnetic interference in the bedrock and is only used to monitor changes in drill hole dip.



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Back River PEA

Llama Pit
General Arrangement

SRK JOB NO.: 2CS031.000

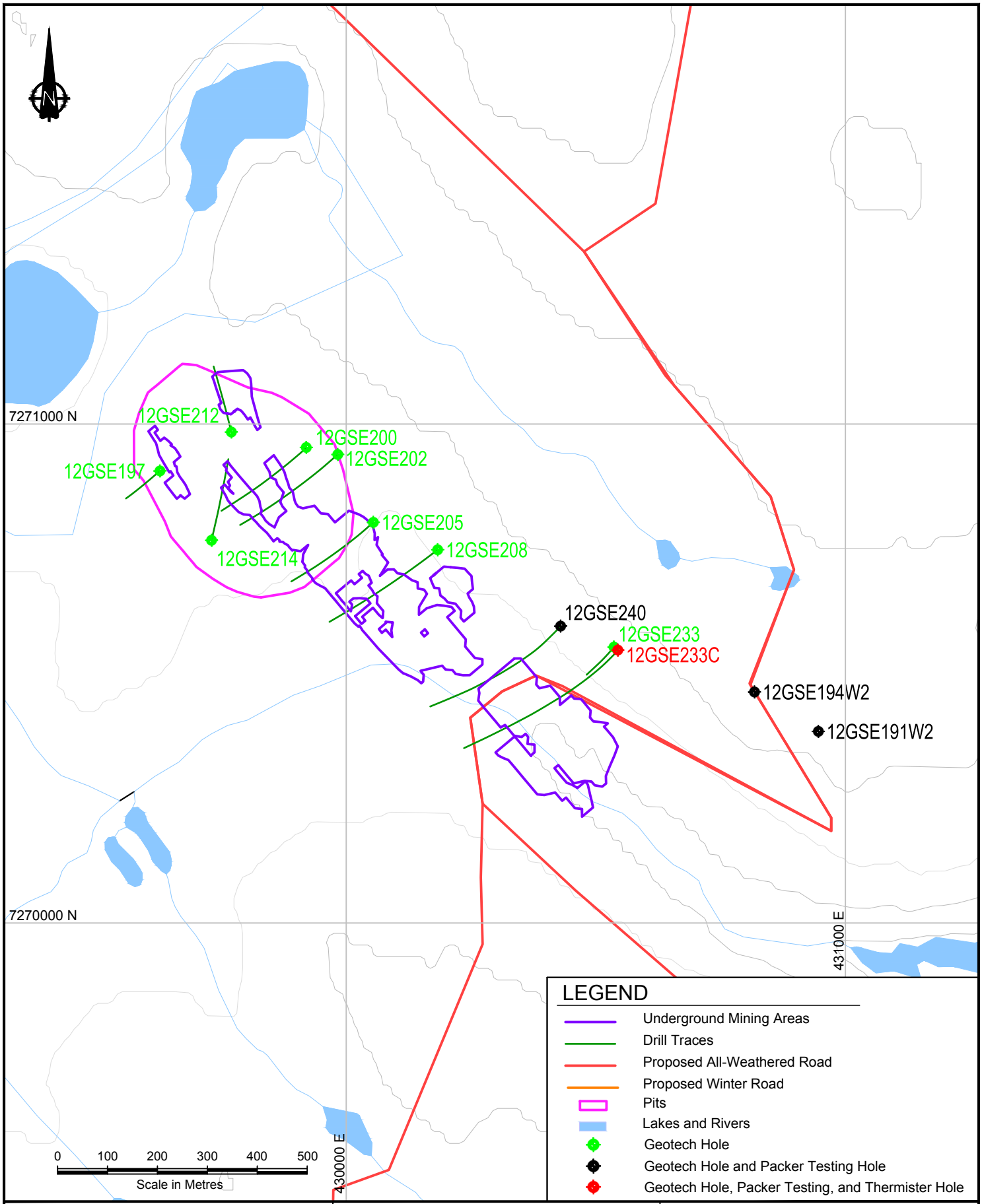
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APPROVED: BG

FIGURE: 2.5

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Back River PEA

Umwelt Pit
General Arrangement

SRK JOB NO.: 2CS031.000

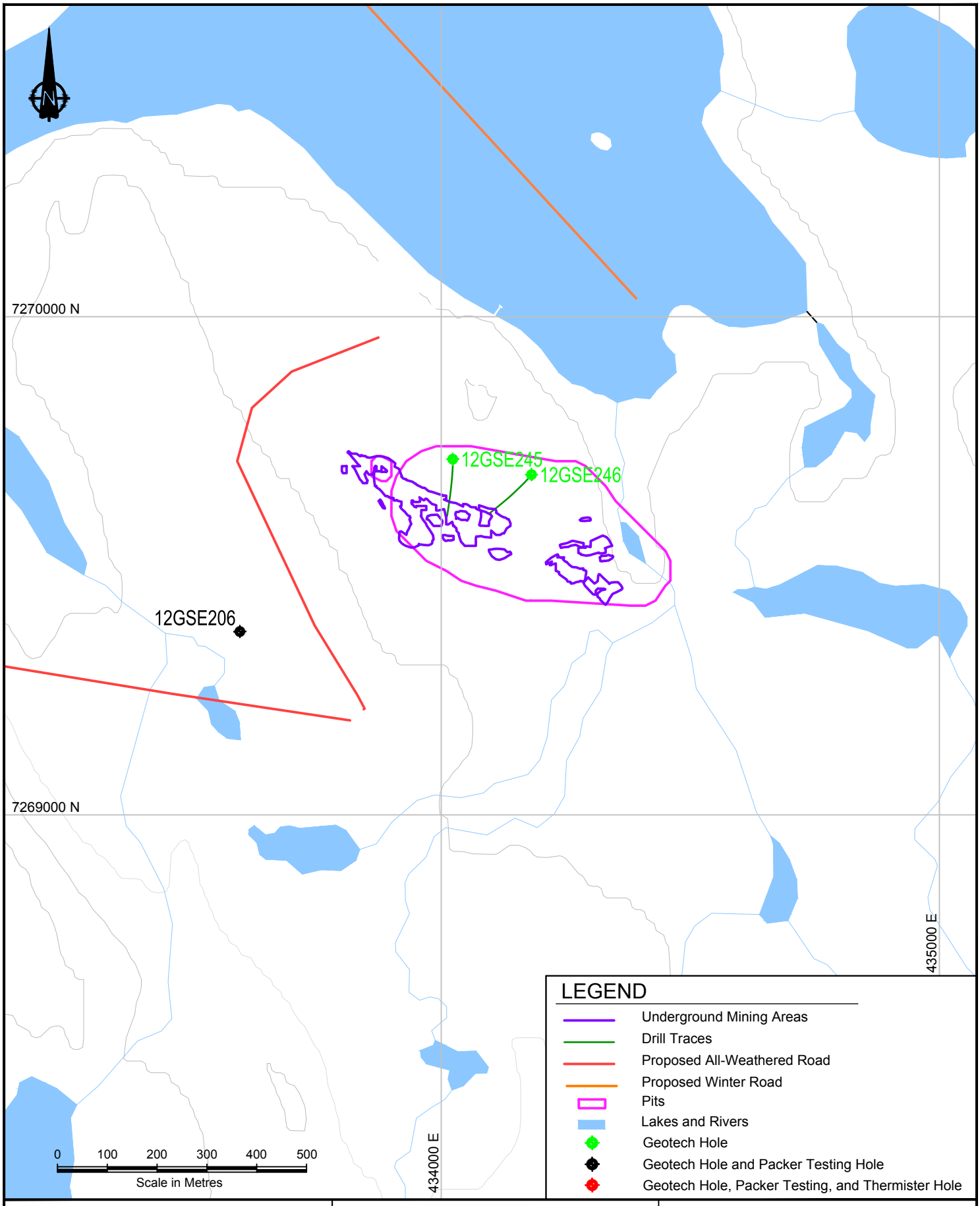
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Back River PEA

Goose Pit
General Arrangement

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Table 2.3: Details of SRK 2012 geotechnical drill holes

Hole-ID	Easting	Northing	Elevation	Length (m)	Azimuth (°)	Dip (°)	Deposit	Core Orientation	Comment/Purpose
12GSE171	428762	7272282	303	122.0	58	-51	Llama	N	Drilled double tube; not logged at drill; structure targeted
12GSE175B	429011	7272224	303	338.0	236	-57	Llama	Y	Open pit rock mass characterization
12GSE181	428647	7272058	303	104.0	34	-47	Llama	Y	Open pit rock mass characterization
12GSE183	428834	7271977	301	153.5	59	-60	Llama	Y	Open pit rock mass characterization
12GSE186	428700	7272257	303	206.0	202	-61	Llama	Y	Open pit rock mass characterization
12GSE190	428641	7272048	303	356.0	33	-46	Llama	Y	Open pit west wall off-axis hole to understand orientation bias
12GSE193	429161	7272079	308	293.0	236	-56	Llama	Y	Open pit rock mass characterization
12GSE197	429627	7270906	303	122.0	229	-47	Umwelt	Y	Open pit structure targeted
12GSE200	429920	7270952	305	305.0	226	-52	Umwelt	Y	Open pit rock mass characterization; shallow underground areas
12GSE202	429983	7270939	304	341.0	228	-50	Umwelt	Y	Open pit rock mass characterization; shallow underground areas
12GSE205	430054	7270803	300	311.0	227	-54	Umwelt	Y	Deep underground mining areas
12GSE208	430183	7270748	305	380.0	232	-50	Umwelt	Y	Deep underground mining areas
12GSE212	429770	7270984	304	230.0	346	-54	Umwelt	Y	Open pit east wall off-axis hole to understand orientation bias; shallow underground areas
12GSE214	429730	7270767	303	254.0	13	-51	Umwelt	Y	Open pit west wall off-axis hole to understand orientation bias
12GSE218	428508	7272301	307	302.0	100	-50	Llama	Y	Open pit west wall off-axis hole to understand orientation bias
12GSE223	429104	7272161	306	401.0	233	-48	Llama	Y	Open pit rock mass characterization
12GSE228	428861	7271801	305	380.0	55	-58	Llama	Y	Open pit potential extension south
12GSE233	430536	7270553	311	161.0	224	-65	Umwelt	Y	Abandoned due to hole deviation
12GSE233C	430544	7270547	311	679.0	224	-68	Umwelt	Y	Deep underground mining areas
12GSE240	430429	7270595	308	576.6	220	-68	Umwelt	Y	Deep underground mining areas
12GSE245	434023	7269714	284	158.0	178	-49	Goose	Y	Open pit north wall characterization
12GSE246	434181	7269683	283	161.0	220	-50	Goose	Y	Targeted major fault structure

2.4.1 Geotechnical Core Logging

Training of four Sabina staff was completed by SRK at the outset of the drilling program, and these staff were on a consistent rotation throughout the duration of the geotechnical program. Core was logged and photographed in the splits by Sabina staff on a run by run basis. A Sabina staff member was at the drill 24 hours per day to supervise drilling and log core prior to placing it in the core boxes.

A site specific geotechnical core logging manual was produced by SRK which details the core logging procedure. This manual is presented in Appendix A5. Data was recorded at the drill digitally in an SRK's proprietary Microsoft Access geotechnical database. The following geotechnical information was recorded for each run where possible:

- Run Length; From, To (m);
- Total Core Recovery (TCR);
- Rock Quality Designation (RQD);
- Fracture Frequency (FF/m);
- Number of discontinuity sets;
- Discontinuity characteristics including discontinuity type; infilling type, infilling properties, roughness, aperture, and wall alteration; and
- Alpha and (where possible) beta angle for each discontinuity.

Lithology data was recorded by Sabina geologists and has not been provided to SRK.

Core Orientation

Core orientation was completed for all geotechnical holes (excluding 12GSE171) using the Reflex ACT II tool. The tool was operated by Major's drillers, who marked the low side of hole location on the core. The purpose of orienting the core is to characterize the orientation of discontinuities in the proposed pit walls and underground mining areas. The following parameters are recorded as part of the oriented core procedures:

- Depth of feature (m);
- Alpha and beta angles (°);
- Discontinuity characteristics including roughness, wall alteration, fill, and aperture.

Only structural features considered to be open in the ground are recorded in the orientation sheet, which includes joints, and joints along foliation. The orientation of veins and features opened during the drilling and handling process are not recorded.

In areas of highly fractured or weak rock, core orientation was rarely possible due to poor recovery, grinding of the core within the core catcher, and also spinning of the rock within the core barrel. If orientation was not possible, then the orientation line would be brought down from the previous run by matching core from the end of the previous run with core from the top of the current run, and where possible utilizing the regionally consistent foliation.

Sabina's staff would note the orientation line offset between each run. This can allow corrections to be made to beta angle measurements along runs with erroneous orientation lines. However as noted previously, the use of only one split tube has affected the confidence of the orientation line due to increased line offsets from core spinning in the core barrel.

Core Photographs

Each core run was photographed in the split tube at the drilling station. Full core box photographs were taken by Sabina at camp and provided to SRK. Both sets of photographs are included in Appendix A7.

2.4.2 Data Quality Assurance and Quality Control

Two stages of quality assurance and quality control ("QA/QC") have been completed for the raw data contained in Appendix A4. The first stage was completed at the project site through the checking of drillhole logs against drilled core by the SRK Site Senior. This process consists of general reviews of the core drilled and the geotechnical log, plus detailed checks on specific runs chosen at random intervals. The purpose of this procedure was to ensure data consistency between loggers and to minimize errors. Alterations to the geotechnical log would then be made as necessary by the Site Senior.

The second stage was completed at SRK's Vancouver office through the review of graphical logs and broad data statistics. Following these checks, the data is considered to be clean of errors and is ready in preparation for data engineering and computation of RMR_{90} or RMR_{89} values. Additional engineering of the data should consider:

- Adjustment of fracture frequency taking into consideration core loss (based on RMR_{90});
- Adjustment of IRS strong values based on UCS results;
- Computation of IRS (measured in MPa) based on RMR_{90};
- Correction for deviation of the orientation line; and
- Correction of alpha and beta measurements to dip and dip direction.

2.4.3 Laboratory Testing Program

A total of 96 core samples were collected for potential laboratory testing from the 2012 geotechnical drillholes. All samples collected were plotted in 3D to understand the spatial distribution of the samples and detailed photos of the samples were reviewed prior to the final selection for testing. UCS samples were chosen based on lithology type, taking into consideration veining intensity, micro-defects, and alteration intensity. 20 selected samples were tested for:

- Basic UCS testing to determine intact rock strength only; and
- UCS with strain gauges to determine intact rock strength, Poisson's ratio (v) and Young's Modulus (E).

At the request of Sabina, the testing program was cancelled and all samples were held awaiting further instruction.

Testing was undertaken by MDH Solutions in Saskatoon. A complete list of all the samples collected is given in Appendix A6. A summary of the UCS testing completed by SRK is presented in Table 2.4, and the laboratory test results as received from MDH Solutions are presented in Appendix A6.

Table 2.4: Summary of UCS testing completed as part of SRK 2012 site investigation

Hole-ID	Sample-ID	From (m)	To (m)	Lithology	Requested Test	UCS (MPa)	Young's Modulus (GPa)
12GSE175B	12GSE175B_UCS-003	176.18	176.37	Interbedded greywacke; siltstone; mudstone	UCS modulus	45.6	9.9
12GSE175B	12GSE175B_UCS-006	261.39	261.64	Felsic dyke	UCS modulus	145.1	14.37
12GSE175B	12GSE175B_UCS-007	296.00	296.30	Oxide Iron formation	UCS modulus	167.1	14.7
12GSE175B	12GSE175B_UCS-008	323.26	323.56	Oxide Iron formation	UCS	221.2	
12GSE186	12GSE186_UCS-001	108.13	108.5	Oxide Iron formation	UCS modulus	213.1	17.1
12GSE186	12GSE186_UCS-002	124.43	124.65	Interbedded greywacke; siltstone; mudstone	UCS	11.1	—
12GSE190	12GSE190_UCS-009	346.20	346.38	Interbedded greywacke; siltstone; mudstone	UCS modulus	12.3	—
12GSE200	12GSE200_UCS_002	120.74	120.97	Greywacke	UCS	156.4	—
12GSE200	12GSE200_UCS_004	170.10	170.28	Sulfide bearing oxide iron formation	UCS modulus	121.12	16.08
12GSE200	12GSE200_UCS_007	255.20	255.45	Massive mudstone; argillite	UCS	56.2	11.8
12GSE200	12GSE200_UCS_008	288.57	288.8	Greywacke	UCS	86.3	—
12GSE202	12GSE202_UCS_001	100.11	100.3	Greywacke	UCS	57.2	—
12GSE202	12GSE202_UCS_004	197.00	197.21	Oxide Iron formation	UCS	315.63	—
12GSE205	12GSE205_UCS_002	127.14	127.32	Interbedded greywacke; siltstone; mudstone	UCS	126.4	—
12GSE205	12GSE205_UCS_003	155.00	155.17	Greywacke	UCS	101.7	—
12GSE205	12GSE205_UCS_005	209.54	209.71	Greywacke	UCS	106.5	—
12GSE208	12GSE208_UCS_001	109.23	109.41	Greywacke	UCS modulus	99.5	9.8
12GSE208	12GSE208_UCS_002	129.01	129.18	Greywacke	UCS	85.9	—
12GSE208	12GSE208_UCS_003	161.43	161.59	Greywacke	UCS	79.5	—
12GSE208	12GSE208_UCS_006	265.20	265.36	Greywacke	UCS modulus	61.7	11.8

3 Hydrogeology Study

3.1 Hydrogeological Objectives

Following SRK's work on the PEA for the Back River deposits (SRK, 2012), a number of hydrogeological uncertainties and associated risks, became apparent. These key areas for consideration are summarized below:

- Thermal characteristics and geothermal gradients for the proposed mining areas.
- Hydraulic conductivity ("K") of the different geologic units and structures.
- Pore pressure at depths of underground development.
- Quality of deep or talik groundwater.

These uncertainties correspond to the following potential risks:

- *Ground temperature and groundwater inflow*. Where mining intersects, connected taliks, or where mining occurs below the base of frozen ground, inflow to the mine workings can be anticipated. Inflowing waters will need to be pumped to the surface or to other storage/management facilities and will be exposed to cold temperatures, requiring consideration for pipeline or storage facility design.
- *Pore pressure*. At depth, below frozen ground, pore pressure may correspond to a potentiometric surface close to the ground surface. Geotechnical assessments will need to take into account the potential for elevated pore pressure, which could affect the design of the openings.
- *Groundwater quality*. Quality of inflowing groundwater and inflow or drilling water that comes into contact with ore or mine developments in ore zones, may not be suitable for discharge without treatment. For the mining areas below the base of the frozen ground, inflowing water should be assumed to be saline. Water treatment may be required and, if so, plans will need to be considered on how the treatment plant waste is managed.

The key objectives for SRK's hydrogeological field data collection studies at Back River corresponded directly to the PEA hydrogeological uncertainties, as described in the above section. SRK proposed a phased approach to the field data collection program.

The initial phase of data collection was to better understand the distribution of permafrost, with respect to depth, temperature and talik characterization. With a better hold on the permafrost, characterisation of hydraulic conductivity (K) of bedrock below the permafrost zone and within taliks could be undertaken.

The second phase was to use the K data to estimate the inflows to open pit or underground workings, as well as pore pressure simulations. A third phase was also discussed with Sabina concerning the collection of groundwater quality samples. The scope of this report covers the first phase of the data collection. The second and third phases of the approach were not undertaken.

3.1.1 Previous Work

SRK carried out a review of the hydrogeology at Back River for the PEA. This report (SRK, 2012) included a conceptualization of the groundwater regime at Back River.

In 2008, a thermistor string was installed in borehole 08-GSE- to the east of the Goose deposit. The data for this thermistor is referenced in the PEA report.

3.2 2011 Hydrogeology Program

Hydrogeological investigations during the SRK 2011 field program comprised of:

- Hydraulic (packer injection) testing in the combined hydrogeological/geotechnical drillholes. Sixteen constant head packer tests were successfully completed within the talik below the permafrost; and
- Installation of multi-bead thermistor strings with integrated vibrating wire piezometer (vibe wire) in three of the geotechnical drillholes.

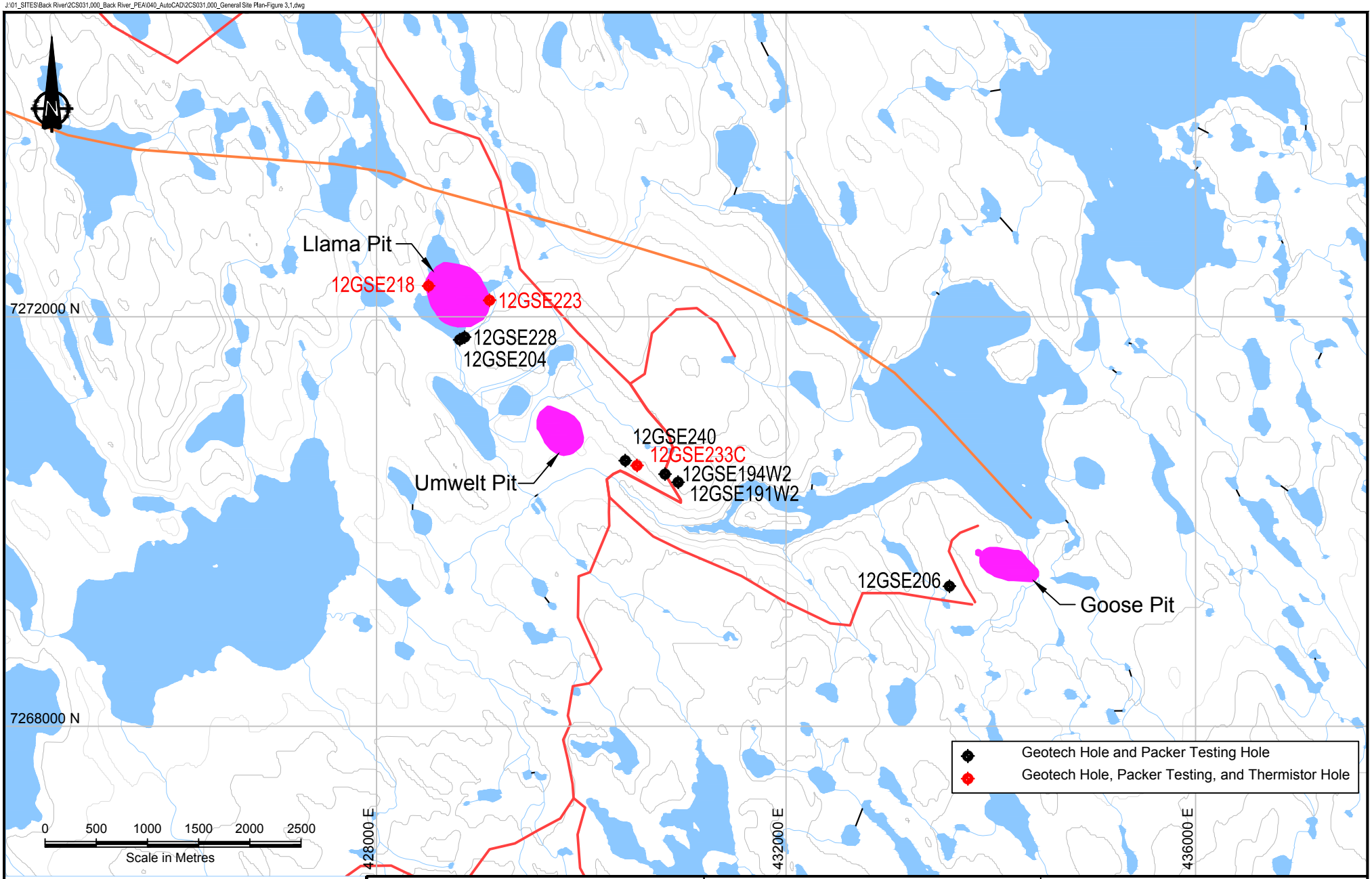
This section describes the methods used to collect hydrogeological data during the 2012 drilling program. The packer injection testing system is described followed by a description of the quality assurance/quality control ("QA/QC") methods and calculations to obtain hydraulic conductivity. This is followed by a summary of the installation methods used for equipping the drillholes with thermistors and vibe wires. Table 1 summarizes the drillhole details for the hydrogeological testing and installations for the 2012 field data collection work. The locations of these drillholes are presented in Figure 3.1. Thermistor traces are shown in Figures 2.5, 2.6 and 2.7.

Table 3.1: Summary of drillholes used for hydrogeological testing and installations

Hole ID	Northing	Easting	Elev.	DIP	LENGTH	AREA	TARGET
12GSE240	430429.47	7270595.33	307.84	56.0	576.6	Umwelt	SRK geotechnical hole
12GSE233C	430544.15	7270546.54	311.02	56.0	679	Umwelt	SRK geotechnical hole-Thermistor Install
12GSE228	428860.58	7271800.54	304.83	55.0	380	Llama	SRK geotechnical hole
12GSE223	429104.06	7272161.44	305.93		401	Llama	SRK geotechnical hole-Thermistor Install
12GSE218	428507.89	7272301.46	307.40	49.7	302	Llama	Geotech hole targeting the NW pit wall rock. Thermistor installation in lake talik
12GSE206	433595.84	7269367.59	291.74	66.7	581	Goose	SRK geotechnical hole
12GSE204	428812.39	7271776.20	303.69	56.7	473	Llama	SRK geotechnical hole
12GSE194W2	430817.94	7270463.34	314.84	75.1	824	Umwelt	SRK geotechnical hole (wedge hole)
12GSE191W2	430945.80	7270383.80	315.56	75.0	905	Umwelt	SRK geotechnical hole (wedge hole)

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Back River\2CS031.002_Geotech & Hydro PFS\!080_Deliverables\081_DataReport\040_tables
Coordinate Datum: NAD83 UTM Zone 13N

J:\01_SITES\Back River\2CS031,000_Back River_PEA\040_AutoCAD\2CS031,000_General Site Plan-Figure 3,1.dwg



LEGEND

- Proposed All-Weathered Road
- Proposed Winter Road
- Pits
- Lakes and Rivers

srk consulting

Sabina GOLD & SILVER CORP.

SRK JOB NO.: 2CS031.000

FILE NAME: 2CS031.000_General Site Plan-Figure 3.1.dwg

Sabina Gold and Silver Corporation

Back River PEA

Drillholes with thermistor installations and packer tests

DATE:	APPROVED:	FIGURE:
November 2012	BG	3.1

3.2.1 Packer Injection Testing

The goal of the packer injection testing in 2012 was to determine the variation of the hydraulic conductivity (K) of the bedrock lithologies below the anticipated permafrost zone, and across any lithological contacts or structures intercepted in the drillhole.

The testing was completed by the SRK Site Senior, with assistance from Sabina geotechnical field staff. In addition, a site visit was made by a SRK Senior Hydrogeologist, to provide QC and supervision of the testing methods, installation procedures and data collection. Appendix B1 details the packer testing procedure and theory.

Planning of the packer tests assumed that permafrost was present to approximately 300 mbgs (extrapolated from historical data from the single existing Goose drillhole 08GSE009 thermistor, Rescan 2012).

A total of 16 tests were completed successfully and accepted after an offsite QA process (electronic pressure data and flow data review). Four attempted tests failed due suspected packer bypass, unsuccessful packer inflation, or problems with the shear pins or the inflation valve not deploying correctly. These test results are not included in the final hydraulic conductivity database. The test results are provided in Table 2. Full details of the testwork are provided in Appendix B2.

Table 3.2: Details and Results of packer testing at Goose, Llama and Umwelt

Hole	Deposit Name	Test No	Successful Test	Elevation	From (m)	To (m)	From Vertical Depth (m)	To Vertical Depth (m)	Length (m)	From (Elevation) (m)	To (Elevation) (m)	Total Drilled Depth (m)	Hydraulic Conductivity (K, m/s)	Lithology	Structure	Field Comments on Lithology	Other Field Comments
12GSE191W1	Umwelt	1	N	315.56	899	920	868.4	888.7	19.8	-552.8	-573.1	920	-	Greywacke		Greywacke. Low fracture frequency, fabric breaks throughout.	Used Cacl and DD2000 while drilling, full return. No test performed because wireline broke and had to pull rods to retrieve
12GSE194W2	Umwelt	1	Y	314.84	794	812	767.3	784.7	16.8	-452.5	-469.9	812	3.55E-10	-		Solid Core, very low fracture frequency	Artesian pressures exist ~ 5psi, 95% return
12GSE204	Llama	1	Y	303.69	383	405	320.1	338.5	20.8	-16.4	-34.8	405	1.20E-09	Greywacke		Greywacke and Iron formation with a graphitic zone	Likely still in permafrost, however drilling beside a lake. 1st attempt IVS opened before leak test, 2nd attempt good test, artesian flow measured.
12GSE206	Goose	1	Y	291.74	518	539	475.6	494.9	19.8	-183.9	-203.2	519	7.60E-09	Greywacke/ Mudstone		IF (rock type) with interbedded mudstone, mudstone contact AT 535.78 m, low fracture frequency.	Good return, Good fluctuating flow rate throughout the injection
12GSE218	Llama	1	Y	307.4	143	203	109.1	154.8	58.8	198.3	152.6	302	5.10E-09	Greywacke		Greywacke, very solid/competent	Poor return at early stages of drilling, lowered casing. Good test quality.
		2	Y	307.4	239	269	182.3	205.2	28.8	125.1	102.2	302	5.80E-09	Greywacke	Fault	Fault between 245 to 248 m tested. Very fractured zone of greywacke, heavy M.O.'s	Good test quality
		3	Y	307.4	269	302	209.1	234.7	31.8	98.3	72.7	302	2.95E-10	Greywacke		Greywacke	EOH test
12GSE228	Llama	1	Y	304.8	160	380	131.1	311.3	218.8	173.7	-6.5	380	2.5E-10	-	Fault @ 175 m	-	Difficult hole, rods stuck around faults @175 m.
12GSE233	Umwelt	1	Y	311	346	394	286.8	326.6	46.8	24.2	-15.6	394	1.45E-11	-	-	Solid, good quality core	Injection test below permafrost. Flow almost the same as leak
		2	Y	311	394	442	314.7	353.0	46.8	-3.7	-42.0	422	1.35E-11	-	-	Good core	Good test quality
		3	Y	311	442	490	338.6	375.4	46.8	-27.6	-64.4	490	1.25E-11	Greywacke	Permafrost	Solid core	Permafrost test, good quality
		4	N	311	490	526	368.7	395.8	34.8	-57.7	-84.8	526	-	Greywacke, interbedded IF	-	-	Test abandoned
		5	Y	311	490	565	365.3	421.2	73.8	-54.3	-110.2	565	4.55E-10	-	Permafrost	Solid, tight rock	Retest permafrost zone, good quality test
		6	N	311	565	625	407.8	451.1	58.8	-96.8	-140.1	625	-	Interbedded IF	Permafrost	-	Permafrost profiling. Failed test, IVA did not open
		7	Y	311	565	679	402.3	483.5	112.8	-91.3	-172.5	679	1.4E-09	Interbedded	Permafrost	-	Permafrost profiling,

Hole	Deposit Name	Test No	Successful Test	Elevation	From (m)	To (m)	From Vertical Depth (m)	To Vertical Depth (m)	Length (m)	From (Elevation) (m)	To (Elevation) (m)	Total Drilled Depth (m)	Hydraulic Conductivity (K, m/s)	Lithology	Structure	Field Comments on Lithology	Other Field Comments
														IF			good quality test
12GSE240	Umwelt	1	N	307.8	317	365	262.8	302.6	46.8	45.0	5.2	365	3.8E-09	Greywacke	Permafrost profiling		Less pressure than 12GSE233C. Not a good test, packer not inflated properly or tool length wrong
		2	Y	307.8	335	413	269.6	332.4	76.8	38.2	-24.6	413	1.9E-10	Greywacke	Permafrost	Solid, tight rock	Permafrost profiling
		3	Y	307.8	413	464	312.6	351.2	49.8	-4.8	-43.4	464	2.8E-09	Greywacke	-	Solid, tight rock	Good test quality, could not deflate packer, pulled through bit inflated
		4	Y	307.8	464	539	332.6	386.4	73.8	-24.8	-78.6	539	1.5E-09	Greywacke, interbedded IF	-	Solid, tight rock	Good test quality
		5	N	307.8	539	575	372.4	397.3	34.8	-64.6	-89.5	575	-	Greywacke, interbedded IF	-	-	Trouble pressuring/inflating the packer

Source: \\van-svr0.van.na.srk.ad\Projects\01_SITES\Back River\2CS031.002_Geotech & Hydro PFS\!080_Deliverables\081_DataReport\040_tables

Quality Assurance/Quality Control of Injection Tests

The test quality was verified by observing the packer tool seal quality prior to inflation, the packer inflation behaviour, and the flow rate history during the test. A Leak Test was also carried out as part of the routine test procedure before the activation of the injection valve, to test for leaks in the rod string, landing ring seal, and flow meter system at the specified pressure (planned test pressure). If significant leaks were observed, the packer tool was reset to obtain a better landing ring seal, or the test zone was moved. If a minor leak was detected, the flow was subtracted from the injection flow rate observed during the test.

Based on SRK's experience, the overall low flow limit of the system is approximately 0.02 L/min. Where no flow was observed in a test, a flow of 0.01 L/min was entered into the calculation sheets, typically producing a result around $1x10^{-11}$ m/s, below the reasonable limit of the system. It is possible that the actual hydraulic conductivity in these test zones is much lower. The results appended to this report are the values generated from the numeric calculation sheets using 0.01 L/min flow for tests with no observable flow.

All test results were reviewed by the Site Senior or a Hydrogeologist in the field and compared to the drill core to ensure the test results were reasonable and the forms were complete. After the field program, a Senior Hydrogeologist reviewed all tests, comparing the field notes and manually recorded flows and pressures to the down hole transducer and pressure records, which were plotted to show test behaviour. The graphs are provided in Appendix B2. After plotting, the digital data were matched to the manual readings, and a correlation factor was calculated to calibrate the digital records.

Manual readings for flow and electronic down hole pressure readings were used to calculate the hydraulic conductivity. Electronic records of flow were useful to determine what happened during a test, and as a comparison and QA/QC check.

3.2.2 2012 Installation of Thermistors with Vibrating Wire Piezometers

A total of three thermistors were installed within the Back River concession. The objective of the installations was to obtain a better understanding of the distribution of ground temperatures through the permafrost and talik across the area, both spatially and to depth, and in particular what the effect the nearby lakes has on the distribution of permafrost. The thermistors used were manufactured by RST Instruments. The datasheet for the thermistors can be viewed at http://www.rstinstruments.com/Thermistor%20Strings.html.

After completion of the hole, the thermistors were attached to a PVC guide tube and lowered into the well. Once the thermistor and PVC were in place and resting on the bottom of hole, the hole was flushed with fresh water through the drill rods until the return water was recorded as having a total dissolved solids (TDS) of <5 g/L. The drill rods were then removed and the datalogger was connected. The thermistors were allowed to freeze in place.

The ground temperature data collected by the dataloggers should be considered 'early time' data, and the sensors have probably not fully settled out to reflect the ambient subsurface conditions. In particular, this is the case with the dataset from the last installed thermistor in 12-GSE-233C.

Table 3 summarizes the installations. Further details on quotes and serial numbers for each thermistor string and datalogger, and calibration records for the vibrating wire piezometers are provided in Appendix B3.

Table 3.3: Summary of thermistor installations at Back River

Drillhole	Deposit	Bead locations (m along hole)	Target/ Objective of Thermistor	Vibe Wire?	Datalogger?
12-GSE-218	Llama (NW)	285, 260, 235, 210, 185, 160, 135, 110, 85, 60, 35	Talik depth below Llama lake	Yes	Yes
12-GSE-223	Llama (SE)	390, 370, 350, 330, 310, 290, 270, 250, 230, 210, 110	Permafrost depth away from Llama lake	Yes	Yes
12-GSE-233C	Umwelt (SE)	565, 515, 465, 415, 65, 315, 265, 215, 65,115, 65	Permafrost depth away from Llama lake	Yes	Yes

3.2.3 Vibrating Wire Piezometers

On the end of each thermistor string, a vibrating wire piezometer (vibe wire) was installed. The vibe wires used were manufactured by RST Instruments. The datasheet for the vibe wires can be viewed at http://www.rstinstruments.com/Vibrating%20Wire%20Piezometer.html.

The objective of the vibe installations was to collect pore pressure information from below the permafrost, in the likely areas for future underground mine operations. The vibe wire sensors were pre-moulded onto the thermistor string.

For vibe wire calibration purposes, readings were taken before installation, after installation in the hole but before grouting, and then on a 6 hour frequency (as per the datalogger program) after grouting to monitor the stabilization of the vibe wire as the grout set. Readings were monitored and recorded on a Campbell Scientific datalogger. Installation data and calibration results are found in Appendix B4.

It should be noted that vibrating wire piezometers are subjected to a number of instrument, density and positional errors, such as cable stretch, surveying errors, PVC buckling and variability in PVC/drill rod length. Therefore, SRK recommends that caution should be taken when using vibrating wire data as a measure of absolute water levels.

3.3 Data Collection

As per the request from Sabina, thermistor and vibe wire data was collected using Flexdaq 1000 dataloggers (Campbell CR1000 Logger) with compact flash card module and PS100 Battery unit. The dataloggers were supplied by RST Instruments. These dataloggers are used as standard across the project site to facilitate data downloads and database formatting.

Details of battery charging checks and procedures are found in Appendix B3.

Date was downloaded (October 5, 2012) just prior to the break-up of the Back River Camp. This data was corrected to vertical depth, and is provided in electrical format in Appendix B5 DVD-1.

4 Summary

4.1 Geotechnical

The geotechnical data collected during the Back River Pre-Feasibility 2012 Data Collection Program included the following:

- Geotechnical and oriented core data collection from 22 diamond core drill holes across the Umwelt and Goose underground and open pit mining areas, and Llama open pit.
- Geotechnical data collection completed at the drill on and 24 hour per day basis.
- Mine scale structural review of the Umwelt, Goose and Llama deposits including modeling of 3D wireframes of interpreted brittle faults and air photo interpretation.
- Limited laboratory testing for intact rock strength parameters.

4.2 Hydrogeology

The hydrogeological data collected during the Back River Pre-Feasibility Summer 2012 Field Data Collection Program included the following:

- 16 injection tests using IPI packer system within the talik zones at the Back River deposits.
- Locations/opportunities for hydraulic testing were limited during the 2012 field program by the lack of ice drilling (for lake talik testing) and by the tight resource drilling planning and schedule.
- Installation of multi-bead thermistor strings in 3 drillholes at the Llama deposit (2 installations), and at the Umwelt deposit), to complement the existing thermistor located at the Goose deposit. Dataloggers programmed to record ground temperature and hydraulic pressure on 6 hour intervals.
- Collection of the early data from dataloggers indicates that thermistors and vibe wires have not yet settled to their ambient conditions.

5 Recommendations

5.1 Geotechnical

- Completion of laboratory testing program utilizing the remaining samples stored at MDH Solutions laboratory in Saskatoon.
- Engineering and computation of geotechnical and oriented core data as described in section 2.4.2.

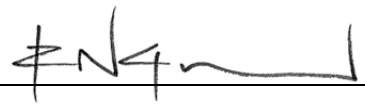
5.2 Hydrogeology

- Data to be downloaded off the datalogger twice a year; once as the dataloggers become accessible in the spring, and once before winter.
- The next phase of hydraulic testing should identify and test key areas such as:
  - Shallow Lake talik (ice drilling) at the Llama deposit.
- Additional thermistor strings should be installed to refine understanding of the presence and distribution of permafrost around proposed developments.
  - One thermistor string between the Goose Pit and Goose Lake to refine the spatial understanding of permafrost interaction with Goose Lake (this was not possible in 2012 field season as no resource drilling was carried out in this area).

This report contains data collected from the SRK 2012 geotechnical and hydrogeological field investigations from the Back River project. If you have any questions regarding this information please do not hesitate to contact the undersigned.

This report, "**Back River 2012 Geotechnical and Hydrogeological Drilling Program - Factual Data Report**", has been prepared by SRK Consulting (Canada) Inc.

Prepared by

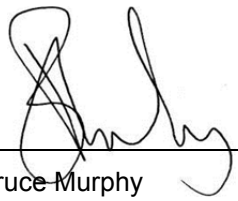


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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering/geoscience and environmental practices.

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (Canada) Inc. (SRK) by Sabina Gold & Silver Corporation (Sabina). These opinions are provided in response to a specific request from Sabina to do so, and are subject to the contractual terms between SRK and Sabina. SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report.

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Rescan 2012: Thermistor Data Summary, Back River Project. Memorandum.

Appendix A:
Geotechnical Data (Provided on DVD)

Appendix B:
Hydrogeology Data

Appendix B1:
Injection Test Theory & Analysis

Appendix B2:
2012 Packer Test Field Data Sheets

Appendix B3:
2012 Vibrating Wire / Thermistor Documentation

Appendix B4:
Summary Temperature Results and Pore Pressure

Appendix B5
Thermistor and Vibrating Wire Data (Provided on DVD)

Appendix V6-2D

2013 Geomechanical and Hydrogeological Site Investigation

Rescan™
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ISO 9001 - FS 64925
ISO 14001 - EMS 550121
OHSAS 18001 - OHS 550122

SABINA GOLD & SILVER CORP.
BACK RIVER PROJECT

2013 GEOMECHANICAL AND HYDROGEOLOGICAL SITE INVESTIGATION SUMMARY
VA101-517/3-1

DRAFT

Rev	Description	Date	Approved
A	Issued in Draft	August 23, 2013	

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CONSULTING

EXECUTIVE SUMMARY

Executive summary will be added in final version.

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Appendix J3 Vibrating Wire Piezometer Data

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ABBREVIATIONS

AMC	AMC Mining Consultants Ltd.
ASTM	American Society for Testing and Materials
DS	Direct Shear
GKM	GKM Consultants
IPI	Inflatable Packers International LLC
KPL	Knight Piésold Ltd.
LIF	Lower Iron Formation
Major	Major Drilling Group International Inc.
masl	metres above sea level
mbgs	metres below ground surface
Q'	Tunneling Quality Index
Rescan	Rescan Environmental Services Ltd.
RMR_{89}	Rock Mass Rating (1989 version)
RQD	Rock Quality Designation
Sabina	Sabina Gold & Silver Corp.
SRK	SRK Consulting (Canada) Inc.
SWiPS	Standard Wireline Packer System
TCR	Total Core Recovery
UCS	Unconfined Compressive Strength
UIF	Upper Iron Formation

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1 – INTRODUCTION

1.1 PROJECT DESCRIPTION

Sabina Gold & Silver Corp. (Sabina) is developing the Back River Gold Project in the Kitikmeot region of Nunavut, Canada. The project is located approximately 520 km northeast of Yellowknife and 75 km southwest of Bathurst Inlet. The property location is shown on Figure 1.1.

Exploration activities have identified a series of gold ore bodies, and Sabina is currently evaluating the feasibility of mining several of these ore bodies using a combination of open pit and underground methods. This study focuses on the Goose Property (containing the Goose Main, Llama, and Umwelt deposits) and the George Property (containing the Locale 1, Locale 2, and Lone Cow Pond deposits). The Goose Property is approximately 60 km southeast of the George Property.

The current mine plan consists of mining the Goose Main, Umwelt, Lone Cow Pond and Locale 1 deposits with a combination of open pit and underground methods, while the Llama and Locale 2 deposits will be mined using open pit methods. The deposits are shown on Figures 1.2 and 1.3.

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1.2 SCOPE OF WORK

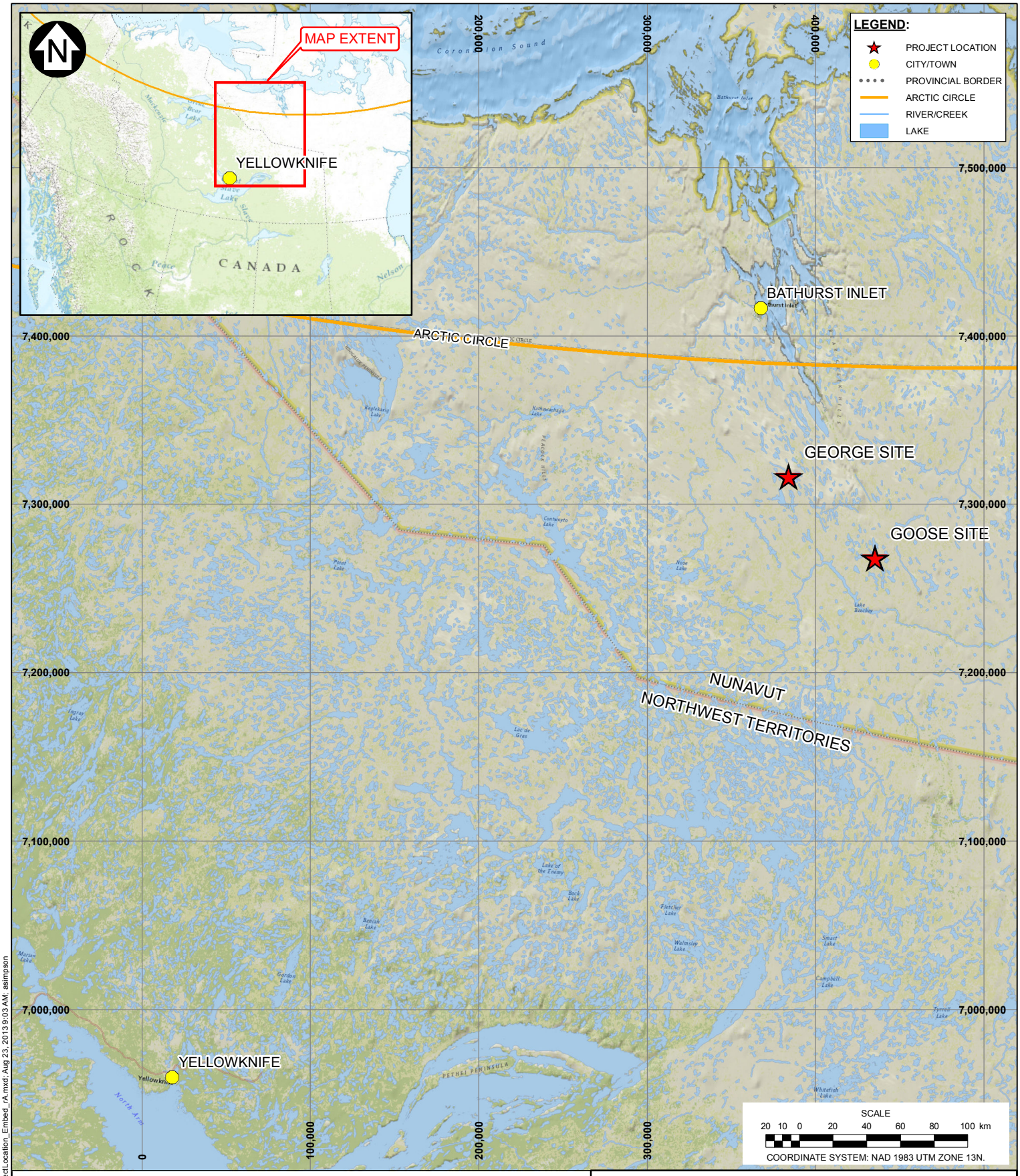
Knight Piésold Ltd. (KPL) was engaged by Sabina in February 2013 to complete the geomechanical and hydrogeological work needed to support the feasibility mine design for the proposed underground and open pit developments. The work completed included:

- A review of all available geological, structural, geomechanical and hydrogeological information
- A geomechanical and hydrogeological site investigation program
- Characterization of the rock mass quality and discontinuity orientations in the vicinity of the deposits
- Characterization of the hydrogeological conditions in the vicinity of the deposits

The information provided by others for this study included:

- 3D geological models for the Goose and George Properties (Sabina, November 2012 and updated March 2013)
- A 3D structural model for the Goose Property (Sabina, November 2012 and updated March 2013). A 3D structural model is not currently available for the George Property.
- Exploration drillhole databases for the Goose and George Properties (Sabina, January 2012)
- Preliminary mine plans (AMC Mining Consultants Ltd., November 2012, updated in April and May, 2013)
- Results of previous site investigation programs completed by SRK Consulting Ltd. (SRK, 2012a and 2012b) and Rescan Environmental Services Ltd. (Rescan, 2010) at the Goose Property

The drillhole details for the site investigation program were provided by AMC Mining Consultants Ltd. (AMC) with input and review from KPL and Sabina.



NOTES:

1. BASE MAP: NATIONAL GEOGRAPHIC TOPOGRAPHIC MAP.

2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 13N.

3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:3,000,000 FOR 8.5x11 (LETTER) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHK'D	APP'D
A	23AUG'13	ISSUED WITH REPORT	CC	CC	AMM	KJB

SABINA GOLD & SILVER CORP.

BACK RIVER PROJECT

PROJECT LOCATION

Knight Piésold CONSULTING

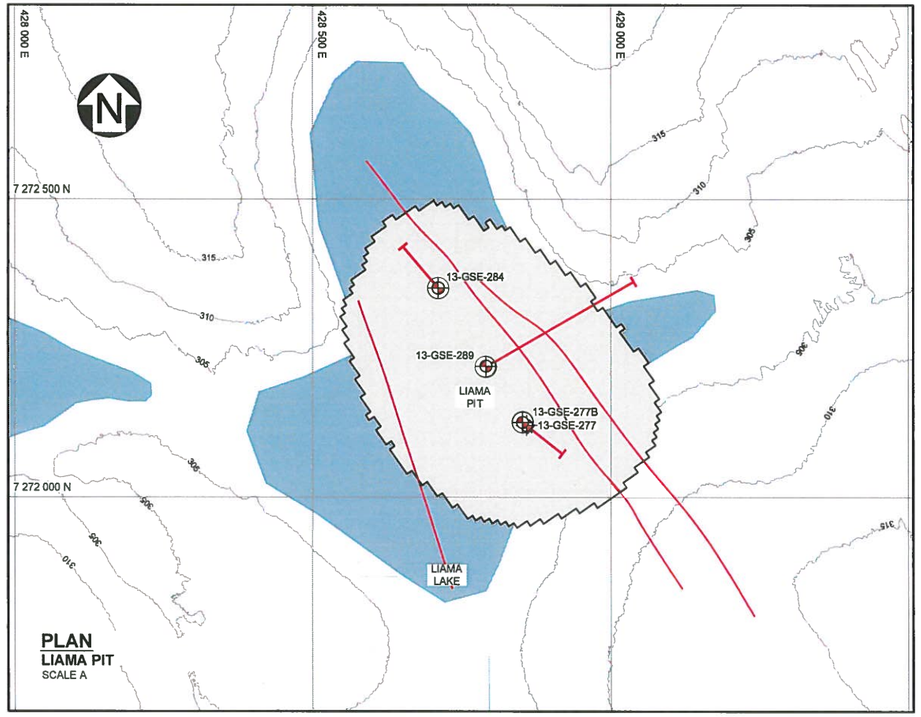
P/A NO. VA101-517/3

REF NO. 1

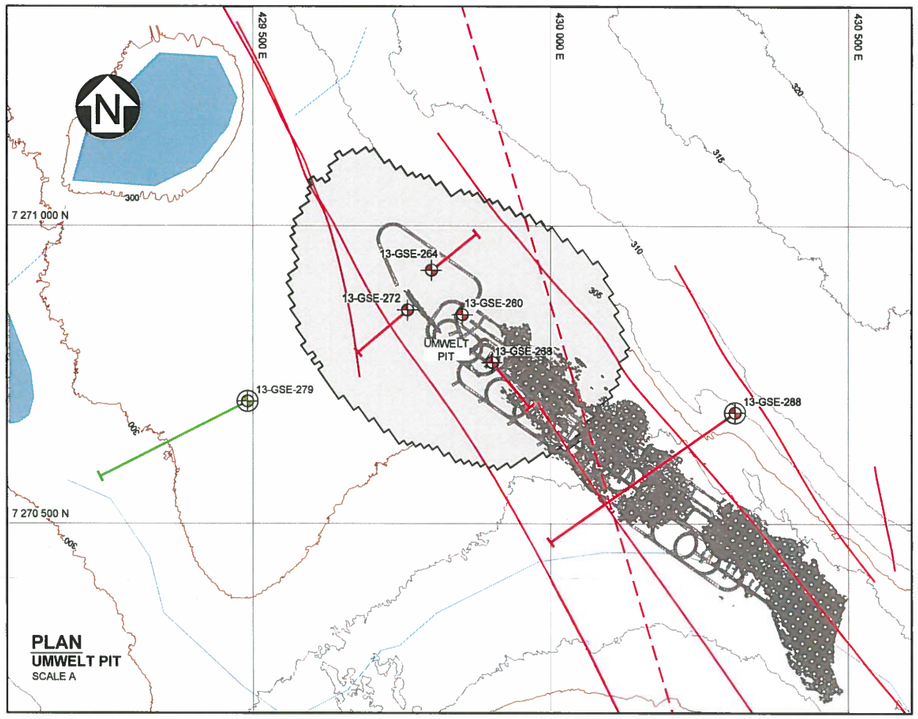
FIGURE 1.1

REV A

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PLAN
LIAMA PIT
SCALE A



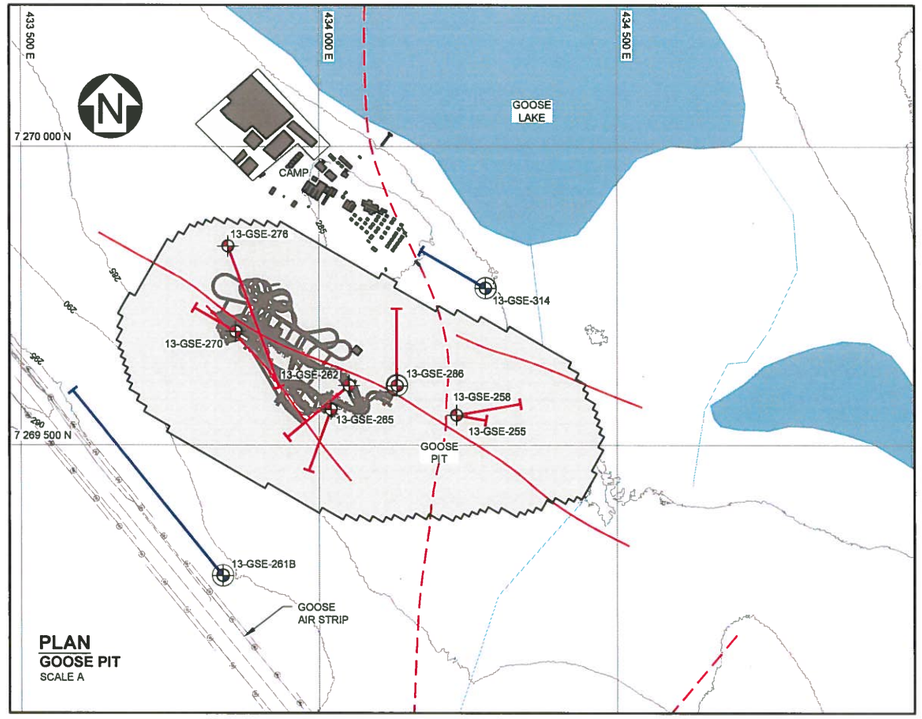
PLAN
UMWELT PIT
SCALE A

LEGEND:

- 2013 GEOMECHANICAL DRILLHOLE
- 2013 HYDROGEOLOGIAL DRILLHOLE OR EXPLORATION DRILLHOLE
- TWINNED WESTBAY ENVIRONMENTAL DRILLHOLE
- INSTRUMENTATION INSTALLED IN DRILLHOLE
- FAULT INTERSECTION WITH SURFACE
- BUILDING / STRUCTURE
- PROPOSED OPEN PIT OUTLINE
- PROPOSED UNDERGROUND MINE

NOTES:

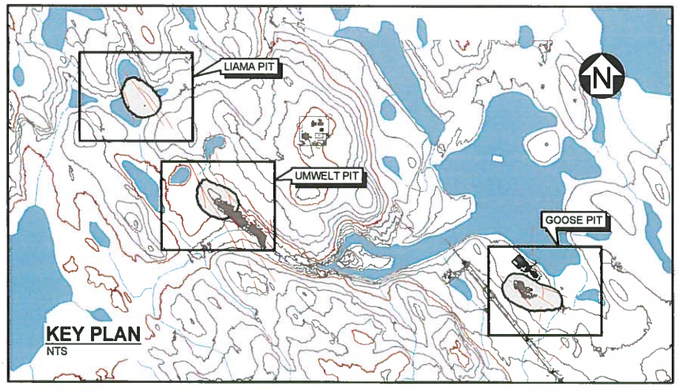
1. COORDINATE GRID IS UTM (NAD83) ZONE 13.
2. LIDAR / TOPOGRAPHY BASED ON INFORMATION PROVIDED BY SABINA, NOVEMBER 9, 2012.
3. CONTOUR INTERVAL IS 5 METRES.
4. APPROXIMATE WATERBODIES FROM RESCAN NTS MAPPING.
5. FAULTS AND BUILDINGS BASED ON INFORMATION PROVIDED BY SABINA, RECEIVED JANUARY 28, 2013 AND MARCH 15, 2013.
6. DRILLHOLE DETAILS BASED ON SURVEY INFORMATION PROVIDED BY SABINA.
7. PROPOSED UNDERGROUND MINE LAYOUT AND OPEN PIT SHELLS PROVIDED BY AMC, DATED MAY 8, 2013.



PLAN
GOOSE PIT
SCALE A

Geomechanical Drillholes - Goose Property

Deposit	Sabina ID	Planning ID	Drillhole Details: Collar Coordinates Northing	Easting	Elevation (masl)	Azimuth (°)	Dip (°)	Length (m)	Abandoned	Instrumentation	Packer Testing	Geomechanical Logging	Comments
Goose	13-GSE-255	GP-GM13-01	7,269,550	434,231	282	101	-51	78.5	X	-	-	X	Limited survey data.
	13-GSE-258	GP-GM13-01B	7,269,551	434,231	283	78	-47	170.0	-	-	-	X	
	13-GSE-286	GP-GM13-02	7,269,612	434,066	283	31	-47	200.0	-	X	X	X	
	13-GSE-262	GP-GM13-03	7,269,599	434,049	281	234	-47	210.5	-	-	-	X	
	13-GSE-265	GP-GM13-04	7,269,558	434,019	282	202	-48	171.5	-	-	-	X	
	13-GSE-276	GP-GM13-05	7,269,832	433,847	283	166	-49	395.5	-	-	-	X	
	13-GSE-270	GP-GM13-06	7,269,691	433,859	282	300	-53	171.5	-	-	-	X	
	13-GSE-314	GP-GM13-07	7,269,764	434,278	280	297	-51	250.0	-	X	X	-	
	13-GSE-261B	-	7,269,381	433,838	289	317	-54	804.0	-	X	X	-	Exploration hole. Not included in total meterage.
Umwelt	13-GSE-260	UP-GM13-01	7,270,850	429,852	303	140	-55	5.0	X	-	-	-	No survey data. Drillhole details approximate.
	13-GSE-268	UP-GM13-01B	7,270,769	429,902	302	145	-55	170.0	-	-	-	X	
	13-GSE-264	UP-GM13-02	7,270,925	429,801	304	51	-54	170.0	-	-	-	X	
	13-GSE-272	UP-GM13-03	7,270,868	429,771	304	232	-46	170.5	-	-	-	X	
	13-GSE-288	UP-GM13-04	7,270,686	430,310	305	251	-42	698.0	-	X	X	X	
	13-GSE-279	WB13-04	7,270,260	430,189	297	243	-68	740.0	-	X	X	-	Westbay tw in hole.
Llama	13-GSE-277	LP-GM13-01	7,272,120	428,859	302	130	-55	15.0	X	-	-	X	No survey data. Drillhole details approximate.
	13-GSE-277B	LP-GM13-01B	7,272,125	428,852	303	128	-58	160.5	-	X	X	X	
	13-GSE-284	LP-GM13-02	7,272,370	428,710	303	318	-57	161.0	-	X	X	X	
	13-GSE-289	LP-GM13-03	7,272,218	428,790	303	56	-50	500.0	-	X	X	X	
Total Meterage: 4437.5													



DRAFT

SCALE A 100 50 0 100 200 300 400 500 m

REV	DATE	DESCRIPTION	DD	SIR/ASM	BDP	RAM
			DESIGNED	DRAWN	CHK'D	APP'D
A	23AUG'13	ISSUED WITH REPORT				

SABINA GOLD & SILVER CORP.

BACK RIVER PROJECT

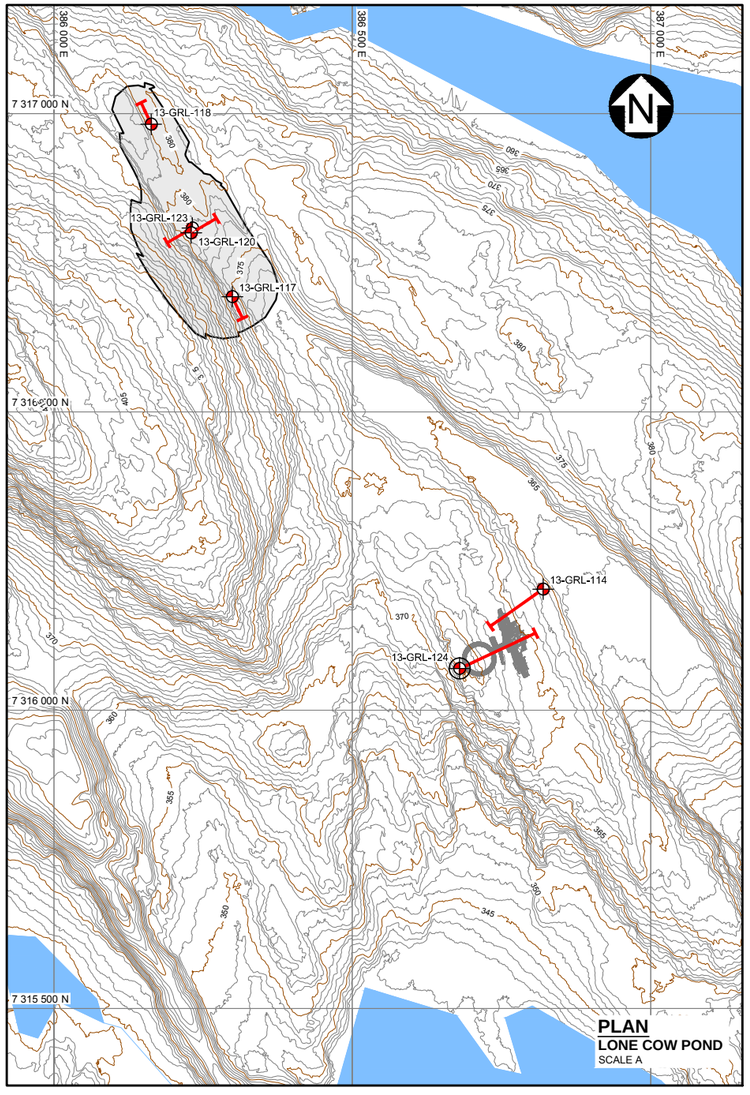
GOOSE PROPERTY
SITE INVESTIGATION PLAN

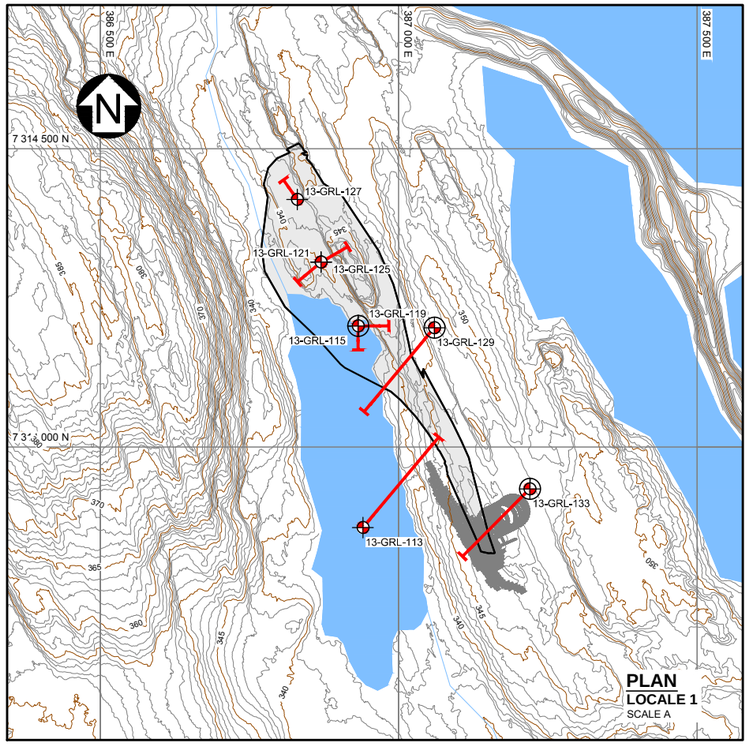
Knight Piésold CONSULTING

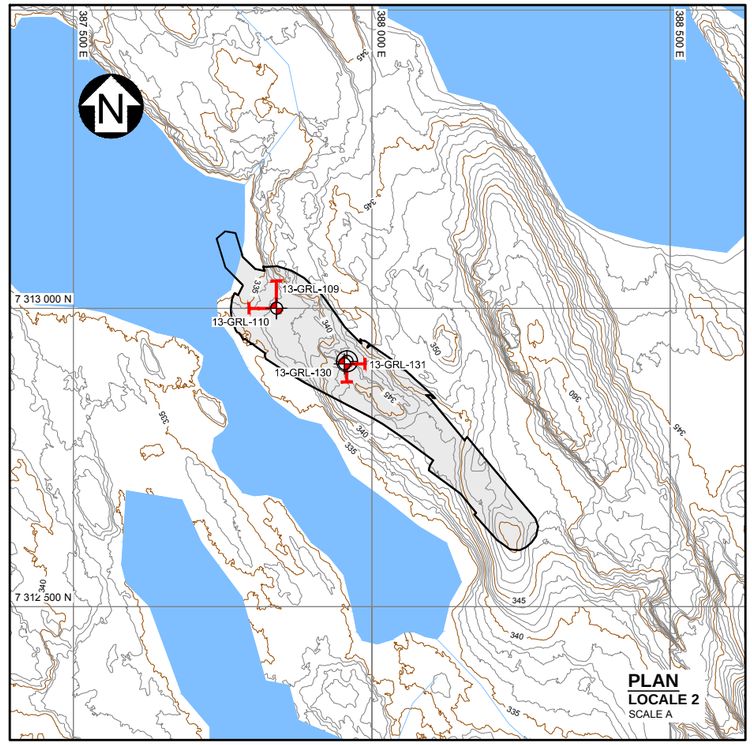
P/A NO. VA101-517/3 | REF NO. 1

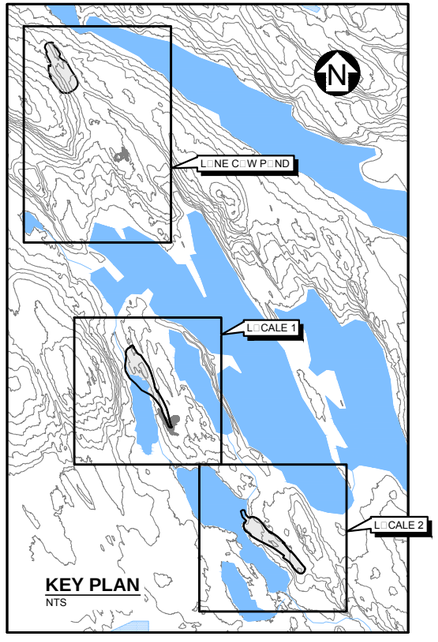
FIGURE 1.2 | REV A

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XREF: FIELDDRT CAMP FALT WATR PLAT (GOOSE MINE).DWG IMAGE: FIELD)









Geomechanical Drillholes - George Property

Deposit	Sabina ID	Planning ID	Drillhole Details: Collar Coordinates Northing	Easting	Elevation (masl)	Azimuth (°)	Dip (°)	Length (m)	Abandoned	Thermistor	Piezometer	Packer Testing	Geomechanical Logging
Locale 1	13-GRL-127	L1-GM13V2-01	7,314,416	386,829	342	327	-55	71.2	-	-	-	-	X
	13-GRL-121	L1-GM13V2-02	7,314,309	386,869	340	231	-53	90.5	-	-	-	X	X
	13-GRL-129	L1-GM13V2-03	7,314,199	387,059	348	220	-52	320.0	-	X	X	X	X
	13-GRL-113	L1-GM13V2-04	7,313,865	386,940	337	44	-51	345.5	-	-	-	X	X
	13-GRL-133	L1-GM13V2-05	7,313,928	387,218	347	227	-50	281.0	-	X	-	-	X
	13-GRL-125	L1-GM13V2-06	7,314,311	386,871	340	59	-53	90.5	-	-	-	-	X
	13-GRL-115	L1-GM13V2-07	7,314,200	386,932	337	179	-52	69.5	-	X	-	X	X
	13-GRL-119	L1-GM13V2-08	7,314,202	386,932	338	88	-53	105.3	-	-	-	X	X
Locale 2	13-GRL-109	L2-GM13V2-01	7,313,000	387,840	337	3	-54	86.0	-	-	-	-	X
	13-GRL-110	L2-GM13V2-02	7,313,001	387,838	337	269	-54	81.5	-	-	-	X	X
	13-GRL-131	L2-GM13V2-03	7,312,905	387,961	344	90	-54	60.5	-	-	-	-	X
	13-GRL-130	L2-GM13V2-04	7,312,904	387,962	344	180	-54	60.5	-	X	X	X	X
Lone Cow Pond	13-GRL-118	LCP-GMV2-01	7,316,984	386,162	379	336	-55	70.0	-	-	-	-	X
	13-GRL-120	LCP-GMV2-02	7,316,804	386,237	379	61	-53	85.0	-	-	-	-	X
	13-GRL-117	LCP-GMV2-03	7,316,691	386,299	377	159	-53	70.0	-	-	-	-	X
	13-GRL-114	LCP-GMV2-04	7,316,212	386,819	365	235	-56	220.0	-	-	-	-	X
	13-GRL-124	LCP-GMV2-05	7,316,085	386,678	376	82	-59	281.0	-	X	-	-	X
	13-GRL-123	LCP-GMV2-06	7,316,807	386,231	379	240	-55	86.0	-	-	-	-	X
						Total Meterage:		2474.0					

LEGEND:

- GEOMECHANICAL DRILLHOLE
- INSTRUMENTATION INSTALLED IN DRILLHOLE
- PROPOSED UNDERGROUND MINE
- PROPOSED OPEN PIT OUTLINE

NOTES:

1. COORDINATE GRID IS UTM NAD83 ZONE 13.
2. LIDAR TOPOGRAPHY BASED ON INFORMATION PROVIDED BY SABINA, DATED NOVEMBER 1, 2012.
3. CONTOUR INTERVAL IS 1 METRE.
4. APPROXIMATE WATERBODIES FROM RESCAN NTS MAPPING.
5. DRILLHOLE DETAILS BASED ON SURVEY INFORMATION PROVIDED BY SABINA.
6. PROPOSED UNDERGROUND MINE LAYOUT AND OPEN PIT SHELLS PROVIDED BY AMC, DATED MAY 8, 2013.

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SCALE A: 200 100 0 200 400 600 800 1000 m

SABINA GOLD & SILVER CORP.

BACK RIVER PROJECT

GEORGE PROPERTY
SITE INVESTIGATION PLAN

Knight Piésold CONSULTING

PA No. VA101-517/3

REV No. 1

FIGURE 1.3

REV A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHKD	APPD
A	23AUG13	ISSUED WITH REPORT	DD	SIRASM	BDP	RAM

SAVED: 01 00617/03/A/cad/GIS/802/rpt, 8/23/2013 06:32 AM, SIRCHARD PRINTED: 8/23/2013 07:33 AM, Layout: 11, SIRCHARD
REF: LES/George Cow/rpt/H/dgs/S 2013-aug-21 P1 IMAGE LES 8.10

2 – GEOLOGICAL SETTING

2.1 GENERAL

The geological setting of the ore bodies is important for open pit and underground mine design. Background information on the main lithologies, mineralization, alteration and large-scale structure is provided below. Unless otherwise noted, the information is summarised from Davis (2005), Sabina (2012, 2013a and 2013b) and AMC (2013).

2.2 MAIN LITHOLOGIES

The Back River Gold project is located within the northeastern corner of the Slave Structural Province. The Back River deposits are hosted by the metamorphosed greywackes, mudstones and banded iron formation of the Beechey Lake Group. These rocks have been subjected to multiple compressive deformation events resulting in the formation of multiple synclines and anticlines. These formations were then intruded by felsic dykes of the Regan Intrusive Suite and younger gabbro dykes.

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The lithologies that make up the deposits at Back River are described below. The identifying codes used by Sabina for each lithology are indicated in brackets.

- **Greywacke (1a)** - The Greywacke is the most common rock type observed and both overlays and underlies the deposits. It is fine to medium grained and massive to poorly bedded. The Greywacke can locally show a weak foliation.
- **Interbedded Sediments (1c)** - The Interbedded Sediments consist of thinly bedded to laminated greywacke, siltstone and mudstone. Individual beds range in thickness from millimetres to centimetres. The interbedded sediments have a similar spatial distribution to the Greywacke.
- **Iron Formation (2d, 2c, 2dc)** - Several different banded iron formations are observed at Back River. The most common formations are as follows:
    - **Silicate Iron Formation (2d)** - Banded unit consisting of chert and iron silicates. Traces of magnetite (<2%) may be present in the iron silicates.
    - **Oxide Iron Formation (2c)** - Banded unit consisting of magnetite (>10%) and chert, with lesser amounts of iron silicate. In some instances, the magnetite bands have been replaced with sulphide mineralization.

  Sabina has grouped the iron formations into two stratigraphic horizons (the Upper and Lower Iron Formations) which are separated by the Middle Mudstone Sequence. The Upper Iron Formation (UIF) largely consists of the Silicate Iron Formation, while the Lower Iron Formation (LIF) largely consists of the Oxide Iron Formation. It should be noted that the UIF - Middle Mudstone - LIF sequence is not as well defined at the George Property, with the Middle Mudstone sequence not always being observed.
- **Mudstone (3a and 3c)** - The Mudstone occurs within the Greywacke and Interbedded Sediments, as well as in a layer separating the Upper and Lower Iron Formations that is referred to as the Middle Mudstone. The Mudstone is fine grained and moderately to strongly foliated. Mudstone that has undergone a significant amount of deformation, such as the Middle Mudstone, has a phyllitic nature and strong foliation.

- **Felsic Dykes and Quartz-Feldspar Porphyry Intrusion (4a)** - At the Goose Property, these dykes cross-cut the Greywacke, Interbedded Sediments, Iron Formation and Mudstone. The dykes are thought to be associated with the mineralization. At the George Property, a quartz-feldspar porphyry intrusion of generally similar composition has been observed immediately to the west of the Lone Cow Pond deposit. Both the intrusion and the dykes are a fine to medium grained.
- **Gabbro/Diorite Dykes (8)** - The Gabbro Dykes cross-cut all of the other lithologies and form the youngest unit observed at the Goose and George Properties. The dykes are fine to coarse grained and commonly display aphanitic chilled margins.

2.3 MINERALIZATION

The mineralization at Back River is primarily hosted by the Oxide and Silicate Iron Formations where they are intersected by the Felsic Dykes and/or quartz veins. Mineral-rich fluids are believed to have been introduced along the dykes and veins and the gold precipitated out when the fluids reached the iron formations. The mineralization has been observed to be most prominent within the Oxide Iron Formation of the LIF and especially where it has been concentrated within an anticline. The mineralization at the Goose Property is typically associated with the Felsic Dykes, while the mineralization at the George Property is typically associated with quartz veining.

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2.4 ALTERATION

The alteration associated with tectonic activity and from hydrothermal fluids is expected have a local impact on the rock mass characteristics. Notable alteration packages observed at the Goose and George Properties include:

- **Chlorite** - Chloritic alteration is pervasive throughout the Greywacke and Interbedded Sediments. It is also found within most of the other lithological units. Chlorite can reduce the intact strength of the rock and can also act as a low-friction surface coating on discontinuities. Both of these influences will reduce the rock mass quality.
- **Graphite** - Predominantly found within the Mudstone. Graphite can act as a low-friction surface coating on discontinuities and reduce the rock mass quality.
- **Silica** - Predominantly found in the vicinity of the Felsic Dykes and Silicate Iron Formation. Silicification can have a positive effect on rock mass quality by increasing the intact rock strength.
- **Actinolite and Grunerite** - Amphiboles that are found in most lithological units and can have a positive effect on rock mass quality by increasing the intact rock strength.

Instances of garnet, hematite and carbonate alteration are also observed throughout the deposit rock masses. The hematitic alteration is typically associated with the iron formations.

2.5 LARGE-SCALE STRUCTURE

2.5.1 Folding of the Deposits

Several deformation events are thought to have occurred at Back River, resulting in the folding of the deposits. The number and sequence of the events is not fully known, but there are thought to be in

the order of two to three deformation events for each property. The current understanding of the deformation events is as follows:

- **Goose Property:**
    - A compressional environment in the northeast-southwest direction resulted in intermediate scale folding with a regional northwest trend.
    - A second compressional environment in the east-west direction resulted in larger-scale folds with a north to northwest trend. These folds were superimposed on the previous deformation.

    As a result of these events, the dominant folds at the Llama and Umwelt deposits trend northwest-southeast, plunge moderately to the southeast and are tight. The folding at Goose Main is more complex. In the immediate vicinity of the current proposed mine at Goose Main, the folds trend southeast-northwest, plunge moderately to the northwest and are tight.
- **George Property:**
    - A compressional environment in the northeast-southwest direction resulted in folding with a northwest trend.
    - A second compressional environment in the northwest-southeast direction resulted in further folding, as well as shearing and drag folding.
    - A third compressional environment in the southeast-northwest direction, resulted in longitudinal folding and the development of a sub-horizontal deformation cleavage. The third event is thought to have been much weaker than the previous events.

As a result of these events, the dominant folds trend southeast-northwest, plunge to the northwest and are tight to isoclinal.

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2.5.2 Faults

Evidence of faulting has been observed at both the Goose and George Properties. This assessment is based on exploration drilling, surface mapping and geophysical surveys. Two main fault orientations have been identified:

- Sub-parallel to the ore bodies (northwest-southeast to north-south) and steeply dipping
- Perpendicular to the ore bodies (northeast-southwest) and steeply dipping. At Goose Main, faulting has offset the limbs of the anticline.

2.5.3 Dykes

As previously described, the following dykes have been observed at Back River:

- **Felsic Dykes** - These dykes strike sub-parallel to the ore bodies in each deposit and are steeply dipping. At Goose Main, the dykes have been folded with the ore body.
- **Gabbro Dykes** - These dykes strike southeast-northwest and are steeply dipping to sub-vertical.

3 – SITE INVESTIGATION PROGRAM

3.1 GENERAL

The geomechanical site investigation program was designed to support the design of the proposed open pits and underground mines. The field program was completed between February 2013 and June 2013 and included the following:

- Thirty-four (34) oriented and triple-tubed diamond drillholes with associated geomechanical logging. This included 18 drillholes at the George Property and 16 drillholes at the Goose Property. Select drillholes were used for hydraulic conductivity testing and/or the installation of instrumentation.
- One (1) dedicated hydrogeology diamond drillhole (13-GSE-314) was used for hydraulic conductivity testing and the installation of instrumentation. This drillhole was specifically intended to determine if a thawed zone (talik) existed between the Goose Main deposit and Goose Lake.
- One (1) exploration diamond drillhole (13-GSE-261B) was used for hydraulic conductivity testing and the installation of instrumentation.
- One (1) Westbay Twin diamond drillhole (13-GSE-279) was used for hydraulic conductivity testing and installation of instrumentation. This drillhole was used to collect ground temperature and hydrogeological data to support the installation of a Westbay well by Rescan.

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Three drillholes (13-GSE-255, 13-GSE-160, and 13-GSE-277) had to be abandoned and re-drilled during the program due to various complications. In the end, the program (not including exploration drillhole 13-GSE-261B) totalled 6,911 m (4,437 m drilled at the Goose Property, and 2,474 m drilled at the George Property).

The drilling was carried out by Major Drilling Group International Inc. (Major) under the direct supervision of KPL and Sabina site staff. The triple-tubed geomechanical drillholes were NQ3 diameter, while all other drillholes were NQ diameter. Core photos and geology logs for all of the drillholes in the geomechanical program were provided by Sabina and are included as Appendices A1 and A2, respectively. The drillholes associated with the geomechanical and hydrogeological site investigation program are shown on Figures 1.2 and 1.3.

3.2 ORIENTED CORE DRILLING AND LOGGING

3.2.1 Program Design

The site investigation program was designed by AMC and KPL, with assistance from Sabina exploration staff. The objective of the program was to characterize the encountered rock masses and determine their engineering characteristics through detailed geomechanical logging, hydraulic conductivity testing and the installation of instrumentation. It should be noted that the site investigation program was initially designed using the November 2011 mine design and was adjusted to accommodate changes to the design in March and April 2013.

3.2.2 Oriented Core Drilling

Core orientation was undertaken on each geomechanical drillhole to determine discontinuity orientations within all encountered rock units. Core orientation was completed with the electronic Reflex ACT III tool. Difficulties in obtaining consistent orientation data can arise when drilling in

highly fractured, broken or poor quality rock. Orientation statistics (such as the percentage of each run oriented and the angular difference between orientation lines) were compiled for each geomechanical drillhole and are summarized in Appendix B. Overall, the core orientation parameters met KPL's targets throughout the program.

3.2.3 Drill Supervision

Seven (7) Sabina technicians were trained as drill supervisors by KPL staff. These technicians supervised the geomechanical drilling and were responsible for orienting the drill core. The technicians also collected the orientation statistics and measured total core recovery (TCR), Rock Quality Designation (RQD) and discontinuity orientations at the drill. Time permitting, the drill supervisors also completed basic geomechanical logging.

3.2.4 Geomechanical Logging

The detailed geomechanical logging was completed at a centralized location by KPL staff. Rock mass parameters were input directly into KPL's electronic logging spreadsheet. Standard logging procedures were modified to meet the specific project conditions and requirements. Detailed logging parameters were collected to characterize downhole variations in the rock mass quality using both the Rock Mass Rating (RMR_{89}) system (Bieniawski, 1989) and the Tunnelling Quality Index (Q) system (Barton et. al., 1974). Background information on the RMR_{89} and NGI-Q systems is included in Appendices C1 and C2 respectively.

Field estimates of Uniaxial Compressive Strength (UCS) were made by KPL staff with the assistance of a Schmidt Hammer. The Schmidt Hammer values were collected using procedures adapted from ASTM standards (ASTM D5873).

The final geomechanical logs are included in Appendix A3.

3.3 LABORATORY TESTING

Core samples were collected from the geomechanical drillholes to allow for laboratory strength testing. Samples were collected for the following types of testing:

- **Uniaxial Compressive Strength (UCS) -** UCS tests are used to determine intact rock strength.
- **Triaxial Compressive Strength -** Triaxial compression tests are used to determine the intact rock strength under prescribed levels of confinement.
- **Brazilian (Indirect) Tensile Strength -** Brazilian tests are used to estimate the intact tensile strength of the rock.
- **Direct Shear (DS) Strength -** DS testing is undertaken to determine the shear strength of representative joints or discontinuities in the rock mass.

Laboratory samples were collected based on recommended quantities provided by AMC for each of the main lithologies. Standard procedure was to collect, prepare, and ship more samples then were required. This type of oversampling accommodates sample substitutions, breakage and/or changes in the planned testing program. In the case of the Felsic Dykes and Gabbro Dykes, the sample goals were not met due to the limited occurrences of these lithological units.

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Sample selection for lab testing involved the following:

- Identifying samples that were representative of the overall rock mass
- Selecting samples that do not have any obvious weaknesses or features that are likely to cause anomalous results (i.e., planar fabrics, large clasts, voids, etc.)
- Selecting samples from a range of drillholes and depths
- Selecting DS samples with a typical range of joint roughness and discontinuity orientations

The final sample selection process was completed by AMC. The laboratory testing was carried out by the accredited rock mechanics lab at Queen's University in Kingston, Ontario and the lab report is included in Appendix D1.

3.4 HYDROGEOLOGY

3.4.1 General

The hydrogeological component of the site investigation program was designed to improve the understanding of the hydrogeological regime in the vicinity of the proposed open pits and underground mines. The program was designed by KPL and expanded upon previous studies completed at the Goose Property (described in Section 3.4.2). The objectives of the hydrogeological investigations were to characterize the following:

- The hydraulic conductivity of the encountered geological units and structures
- The distribution and depth of permafrost, including identifying regions of thawed ground (taliks) associated with surface water bodies
- Piezometric pressures within potential taliks and below the base of the permafrost

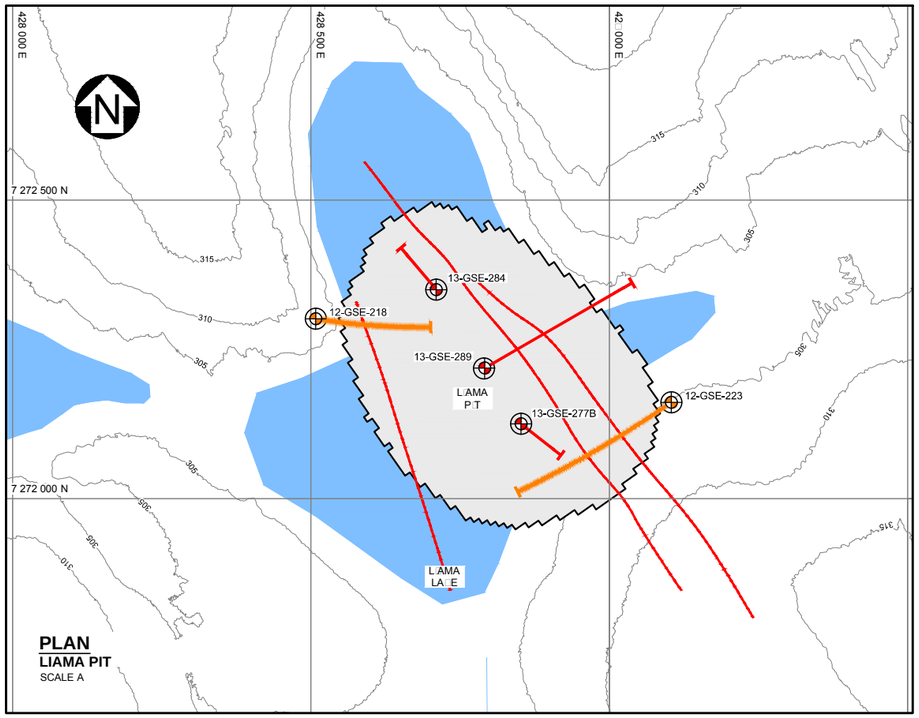
In order to accomplish these objectives, KPL completed hydraulic packer testing and installed multi-point thermistor strings and vibrating wire piezometers. More extensive testing and instrumentation was completed at the Goose Property than the George Property due to the greater depth of the proposed mining there and the presence of larger lakes that increase the potential for talik zones.

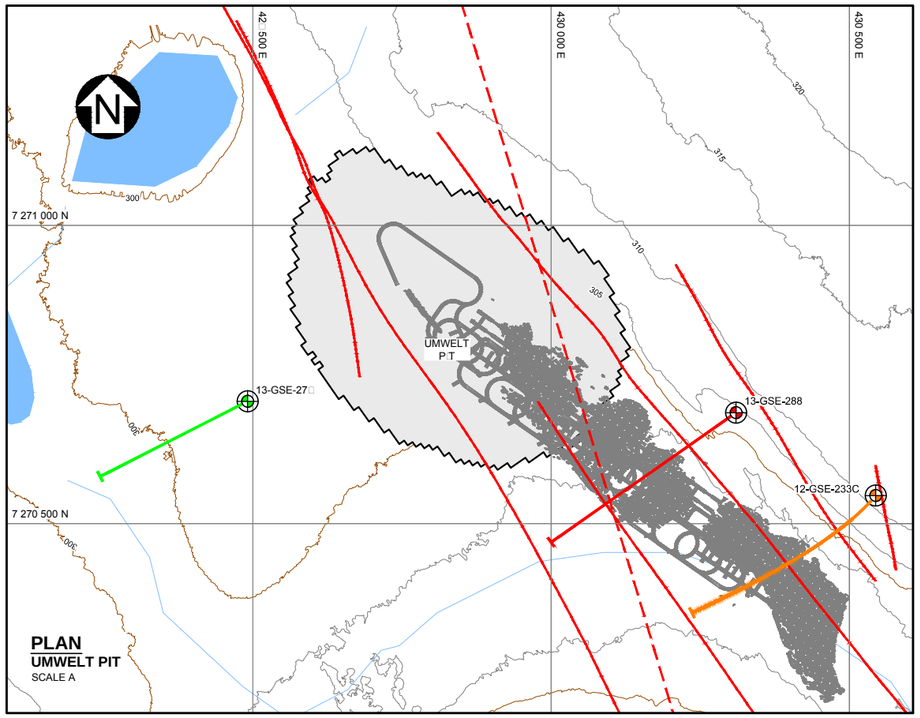
3.4.2 Background and Previous Hydrogeological Investigations

Hydrogeological site investigations have been completed at the Goose Property as part of previous studies. These investigations have included:

- **1997** - A shallow multi-point thermistor string (approximately 20 m long) was installed at the Goose Main Deposit in drillhole 97GO-14 (Rescan, 2010).
- **2008** - A multi-point thermistor string to evaluate the depth of the permafrost was installed in the southern portion of the Goose Main deposit in drillhole 08-GSE-009 (SRK, 2012a).
- **2010** - A shallow multi-point thermistor string was installed by SRK at the Goose Main deposit in drillhole 11-SRK-GL-010 (SRK, 2011).
- **2012** - Multi-point thermistor strings and single point vibrating wire piezometers were installed by SRK in two drillholes (12-GSE-218 and 12-GSE-223) at the Llama deposit and in one drillhole (12-GSE-233C) at the Umwelt deposit (SRK, 2012b). Packer testing was also conducted on select drillholes at all of the deposits on the Goose Property (SRK, 2012b).

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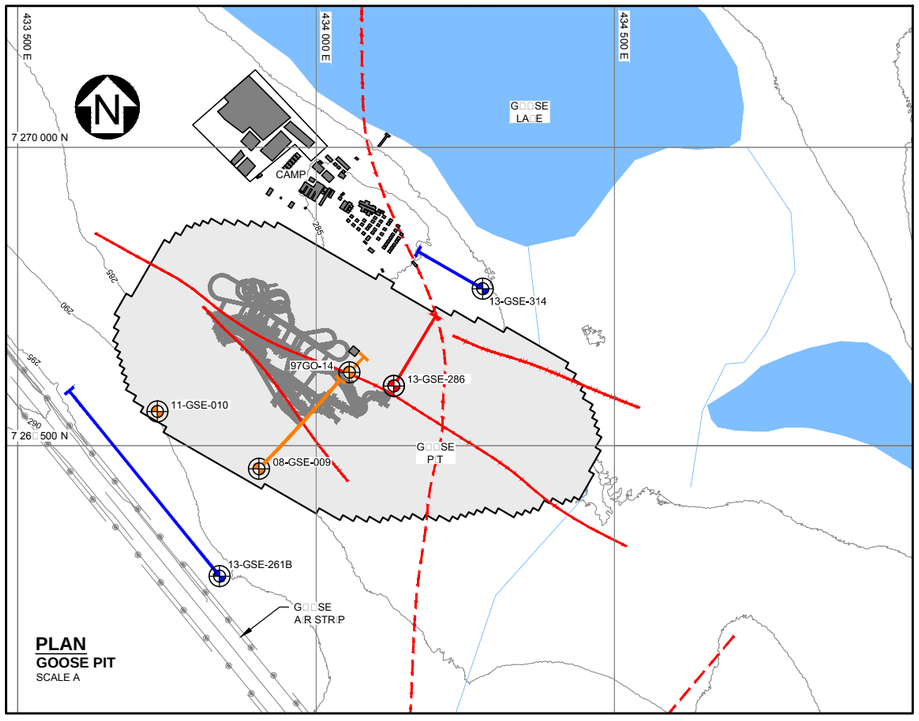


LEGEND:

- 2013 GE□MECHAN□CAL DR□LLH□LE
- 2013 H□DR□GE□L□G□AL DR□LLH□LE □R E□PL□RAT□N DR□LLH□LE
- TW□NNED WESTBA□EN□□R□NMENTAL DR□LLH□LE
- H□ST□R□CAL GE□MECHAN□CAL □R E□PL□RAT□N DR□LLH□LE
- □NSTRUMENTAT□N □NSTALLED □N DR□LLH□LE
- □AULT □NTERSECT□N W□TH SUR□ACE
- BU□LD□NG □STRUCTURE
- PR□P□SED □PEN P□T □UTL□NE
- PR□P□SED UNDERGR□UND M□NE

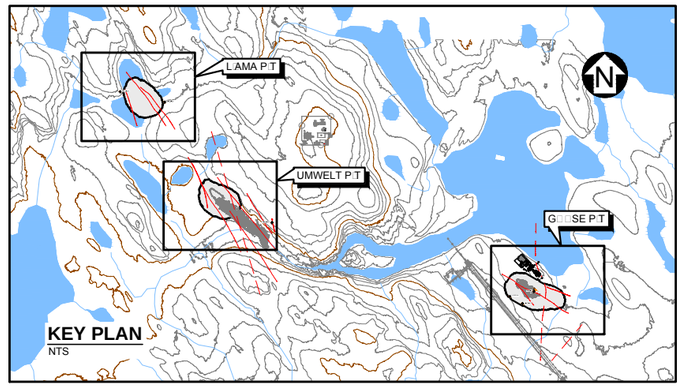
NOTES:

1. C□□RD□NATE GR□D □S UTM □NAD83□□□NE 13.
2. L□DAR □T□P□GRAPH□ BASED □N □N□□RMAT□□N PR□□□DED B□ SAB□NA, N□□EMBER □, 2012.
3. C□NT□UR □NTER□AL □S 5 METRES.
4. APPR□□□MATE WATERB□□D□ES □R□M RESCAN NTS MAPP□NG.
5. □AULTS AND BU□LD□NGS BASED □N □N□□RMAT□□N PR□□□DED B□ SAB□NA, RECE□□ED □ANUAR□ 28, 2013 AND MARCH 15, 2013.
6. DR□LLH□LE DETA□LS BASED □N SUR□E□ □N□□RMAT□□N PR□□□DED B□ SAB□NA.
7. PROPOSED OPEN PIT SHELLS PROVIDED BY AMC, DATED MAY 8, 2013.



Historical Instrumentation - Goose Property

Deposit	Drillhole ID	Drillhole Details					
		Collar Coordinates					
		Northing	Easting	Elevation (masl)	Azimuth (°)	Dip (°)	Length (m)
Goose	97G0-14	7,269,623	434,056	282	43	-45	50.9
	08-GSE-009	7,269,461	433,904	286	41	-57	383.0
	11-SRK-GL-010	7,269,557	433,734	294	-	90	~ 20.0
	13-GSE-261B	7,269,381	433,838	289	317	-54	804.0
	13-GSE-286	7,269,612	434,066	283	31	-47	200.0
	13-GSE-314	7,269,764	434,278	280	297	-51	250.0
Umwelt	12-GSE-233C	7,270,547	430,544	311	236	-57	679.0
	13-GSE-279	7,270,260	430,189	297	243	-68	740.0
	13-GSE-288	7,270,686	430,310	305	251	-42	698.0
Llama	12-GSE-218	7,272,301	428,508	307	94	-50	302.0
	12-GSE-223	7,272,161	429,104	306	239	-42	401.0
	13-GSE-277B	7,272,125	428,852	303	128	-58	160.5
	13-GSE-284	7,272,370	428,710	303	318	-57	161.0
	13-GSE-289	7,272,218	428,790	303	56	-50	500.0



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100 50 0 100 200 300 400 500 m
SCALE A

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	CHKD	APPD
A	23AUG13	ISSUED WITH REPORT	DD	SIRASM	BDP	RAM

SAVED: I:\01\0051703\A\acad\GIS\803\A_8.23.2013_10647 AM_SRICHARD PRINTED: 8.23.2013 11:11:11 AM, La o :11, SRICHARD
REFLES: \\P\TCAMP\ALT\WATR\PNT P P_5m.MAE.GO 'IMGE 'LES':

SABINA GOLD & SILVER CORP.

BACO RIVER PROJECT

GOOSE PROPERTY
HISTORICAL INSTRUMENTATION

Knight Piésold CONSULTING

PAN: □A101-517/3 | REV: 1

FIGURE 3.1 | REV: A

As part of the preparations for the hydrogeological site investigations, the available data from the thermistors installed in 2008 and 2012 were reviewed. The data suggested that the base of the permafrost was at a depth of approximately 400 meters below ground surface (mbgs), and this depth was used for planning purposes.

3.4.3 Packer Testing

Hydraulic packer testing was undertaken to characterize the hydraulic conductivity of the encountered lithologies and large-scale structures. As the permafrost is considered impermeable, the packer testing targeted potential talik zones and unfrozen ground below the expected base of the permafrost. These regions were identified based on experience, a review of the available data from previous investigations and observations made by the drillers and drill supervisors.

A total of 34 packer tests were completed as follows:

- **Goose Property** - Packer testing was completed in eight (8) drillholes. Targets included the unfrozen ground below the base of the permafrost, a potential talik below Llama Lake and a potential talik between the Goose Main deposit and Goose Lake. A total of 23 tests were completed.
- **George Property** - Packer testing was completed in seven (7) drillholes adjacent or passing under lakes in the vicinity of the deposits. A total of 11 tests were completed.

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The packer testing was completed under the supervision of KPL staff using a hydraulic Standard Wireline Packer System (SWiPS) supplied by Inflatable Packers International (IPI). The tests were completed while advancing the drillhole. Brine (with an approximate concentration of 20% $CaCl_2$) was used as the predominant drilling fluid for all drillholes. A polymer based drilling additive (AMC 1300) was also used in several drillholes due to the encountered drilling conditions. In all cases, the drillhole was flushed with brine for at least 15 minutes prior to testing in an attempt to remove any drilling additives (if used) or debris that could potentially influence the test results. Even so, the effects of drilling may still result in estimated hydraulic conductivities lower than the true values.

Prior to testing, the packer was assembled on surface and visually inspected to check all components were present and in good working order. After packer insertion, a test was performed to confirm the packer was seated properly and that a seal sufficient for testing had been achieved. Any leakage that could not be eliminated was recorded and accounted for during the analysis of the collected data.

Constant head tests and a single Lugeon test were completed over intervals typically ranging from approximately 20 m to 100 m in length. A mechanical flow meter with an accuracy of 2% over the flow range of 0.5 to 83 L/min was used to measure the injection rate for the constant head tests. The injection rate was calculated based on the volume of water discharged from a small graduated container when the flow rates were too low to measure reliably with the flow meter. A pressure transducer (manufactured by In-Situ Inc.) was installed in a housing unit below the packer tool to monitor the pressure during testing. Manual water level readings were taken prior to and following testing to monitor the water level recovery from drilling and testing.

3.4.4 Thermistor and Vibrating Wire Piezometer Installations

Multi-point thermistors and vibrating wire piezometers were installed in select drillholes at each deposit. The thermistors were intended to characterise the ground temperature profile, while the piezometers were intended to observe the piezometric pressures in the unfrozen ground below the base of the permafrost. In several instances, additional vibrating wire piezometers were installed to confirm the presence of permafrost by recording the pressure increase associated with the piezometer freezing.

A total of 13 thermistors and piezometers were installed:

- **Goose Property** - Instrumentation was installed in eight (8) drillholes. A multi-point thermistor was installed in each drillhole with a single piezometer at the base of each installation. A second piezometer was installed in the three deep installations (one at each deposit) to confirm the presence of permafrost.
- **George Property** - Instrumentation was installed in five (5) drillholes. A multi-point thermistor string was installed in each drillhole. A single piezometer was installed at the base of two of the installations.

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The locations of the installations are shown on Figures 1.2 and 1.3 and the installation details are summarized in Table 3.1. The depths at which the thermistors and vibrating wire piezometers were installed were selected based on observations made during drilling, the results of the packer testing and the expected depth of permafrost.

The thermistors and vibrating wire piezometers were installed using 1-inch PVC pipe as a guide and tremie pipe. After the instrumentation was lowered into the drillhole, a validation check was performed to confirm that the transducers were working as expected. The drillhole was then flushed with fresh water through the PVC pipe in order to reduce the salinity of the drillhole fluid and reduce the time required to freeze the installation in place. For installations with a vibrating wire piezometer, the lower 20 m to 30 m of the drillhole was also filled with a cement grout to seal the piezometer in place. In the case of drillhole 13-GRL-115, the entire installation was grouted due to its shallow location beneath a lake.

The thermistors and vibrating wire piezometers were manufactured by Geokon Inc. and supplied by GKM Consultants Inc. (GKM). The specifications and calibration forms for the thermistors and vibrating wire piezometers are included in Appendix E. Each installation was connected to a CR800 data logger in a fibreglass enclosure to allow for the collection of data at regular intervals. The data loggers were manufactured by Campbell Scientific (Canada) Corp. and supplied by GKM.

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TABLE 3.1

SABINA GOLD & SILVER CORP.
BACK RIVER PROJECT

2013 GEOMECHANICAL AND HYDROGEOLOGICAL SITE INVESTIGATION SUMMARY
SUMMARY OF INSTRUMENTATION INSTALLATION DETAILS

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Property	Deposit	Sabina Hole ID	Planning Hole ID	Datalogger ID	Date Installed	Depth of Installation	Thermistors			Piezometers		
						mbgs	ID	Length (m)	No. Sensors	ID	Serial Number	Length (m)
Goose	Goose	13-GSE-261B	-	DL13	29-Mar-13	652.1	TH13	560	25	Pz06a	1146011	660
										Pz13a	1302358	560
		13-GSE-286	GP-GM13-02	DL01	07-Apr-13	199.9	TH01	210	10	Pz01	1302370	210
		13-GSE-314	GP-GM13-07	DL02	06-May-13	200.2	TH02	210	10	Pz02	1302371	210
	Umwelt	13-GSE-279	WB13-04	DL12	13-Apr-01	524.6	TH12	560	25	Pz12a	1146013	560
										Pz12b	1302357	560
		13-GSE-288	UP-GM13-04	DL03	29-Apr-13	549.3	TH03	560	25	Pz03a	1302355	560
	Llama	13-GSE-277B	LP-GM13-01B	DL04	01-Apr-13	157.6	TH04	265	10	Pz04	1302369	265
		13-GSE-284	LP-GM13-02	DL05	09-Apr-13	158.2	TH05	390	10	Pz05	1302368	390
		13-GSE-289	LP-GM13-03	DL06	28-Apr-13	499.9	TH06	660	25	Pz06b	1146012	660
										Pz13b	1302359	560
George	Locale 1	13-GRL-115	L1-GM13-07	DL09	17-May-13	64	TH09	210	10	-	-	-
		13-GRL-129	L1-GM13-03	DL08	05-Jun-13	196.7	TH08	390	10	Pz08	1302367	390
		13-GRL-133	L1-GM13-05	DL11	11-Jun-13	196.5	TH11	210	10	-	-	-
	Locale 2	13-GRL-130	L2-GM13-04	DL10	02-Jun-13	57.9	TH10	210	10	Pz10	1302372	210
	Lone Cow Pond	13-GRL-124	LCP-GM13-05	DL07	30-May-13	196.55	TH07	210	10	-	-	-

I:\1\01\00517\03\A\Report\Report 1, Rev A - SI Report\Tables\[Table 3.1 Summary of Installation Details.xlsx]Table 3.1

NOTES:

1. DEPTH OF INSTALLATION REFERS TO THE DISTANCE FROM GROUND SURFACE ALONG HOLE TO THE DEEPEST THERMISTOR OR PEIZOMETER SENSOR.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	23AUG'13	ISSUED WITH REPORT VA101-517/3-1	RGM	CHS	RAM

4 – ROCK MASS CHARACTERISTICS

4.1 GENERAL

One of the main objectives of the site investigation program was to obtain information on the geomechanical characteristics of the encountered rock masses. Rock mass characteristics are divided between intact material properties and the characteristics of the discontinuities. This section describes the work completed to characterize the geomechanical properties of the rock masses in the vicinity of the proposed open pits and underground mines.

4.2 INTACT ROCK STRENGTH

UCS tests were completed as part of the laboratory testing coordinated by AMC. The laboratory testing report, including the results of the UCS testing, is included as Appendix D1. The results of the laboratory testing will be reported by AMC.

The Schmidt hammer rebound number for each tested UCS sample was compared to the laboratory result and a correlation between the two was developed for both the Goose and the George Properties. The Schmidt hammer correlations are included as Appendix D2, and were was used to calibrate the rebound numbers collected during logging. The calibrated values were used to provide a continuous UCS estimate along each drillhole. This estimate was also used to update the RMR_{89} values determined during the detailed geomechanical logging.

The laboratory UCS results suggest that the intact rock strengths at Back River generally range from 50 to >250 MPa.

4.3 DISCONTINUITY ORIENTATIONS

4.3.1 Oriented Core Drillholes

Prior to analysis, the drillhole orientation data collected during the program were corrected for any significant drillhole deviation (> 5°) using the results of multi-shot non-magnetic deviation surveys completed by Sabina. The drillhole orientation data were filtered to exclude discontinuities from runs with run-on-run consistency in the FAIR (± 20 to 35°) or POOR (> ± 35°) ranges. In addition, all discontinuities flagged as possible mechanical breaks were removed from the data set.

The drillhole orientation data were also reviewed for directional bias. Despite deliberate efforts to limit the potential for directional bias during the program, some bias is inevitable due to the limited number of drillholes at each deposit. As a result, a Terzaghi correction was applied to the data.

The filtered data represents the majority of the orientation data and stereonets organized by property and deposit are presented in Appendix F. All orientation data has been summarized and presented using DIPS (Rocscience Inc., 2012a).

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4.3.2 Dominant Discontinuity Orientations

In general, similar trends are observed in the discontinuity data from the Goose and George Properties, though there are local variations between the different deposits. Three main joint sets are identifiable in the filtered orientation data:

- A joint set striking southeast-northwest and dipping moderately to steeply to the northeast. The dip of the discontinuities often varies through the vertical, resulting in concentrations of poles on both sides of the stereonets. This effect is most pronounced at the George Property. This set corresponds to the dominant large-scale structural trends (e.g. the trend of the synclines/anticlines, ore bodies and some faults).
- A joint set striking northeast-southwest and dipping sub-vertically. The dip of the discontinuities varies through the vertical, resulting in concentrations of poles on both sides of the stereonets. This set corresponds to the orientation of the cross-cutting faults, but it is not present in some drillholes and is not always well-defined.
- A flat-lying joint set.

Notable variations to the above trends include:

- **Umwelt Deposit** - The southeast-northwest striking joint set is shallower dipping than at the other deposits. The northeast-southwest striking joint set was not observed.
- Llama Deposit - The orientation data from this deposit is more scattered than the data from other deposits and the joint sets are not as well defined. This is likely a result of the reduced rock mass quality encountered below Llama Lake. The northeast-southwest striking joint set was not observed.
- Locale 2 Deposit - The northeast-southwest striking joint set is more prominent than at the other deposits.

4.4 ROCK MASS QUALITY

The geomechanical logging and estimates of intact rock strength were used to determine the quality of the encountered rock masses using the RMR_{89} and NGI-Q rock mass classification systems. Plots illustrating the downhole variation in recovery, RQD, RMR_{89} and Q' are included in Appendix G. Distributions of the individual RMR_{89} and Q' parameters for each drillhole are included in Appendix H. The typical rock mass characteristics for each of the major lithological units encountered are summarized below and detailed in Appendix I:

- **Greywacke** - The greywacke is generally of GOOD quality (*i.e.,* RMR_{89} values typically ranging from 60 to 75) with a mean UCS of 120 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 600 mm apart. Most have thin infill (commonly chlorite or calcite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.

- **Interbedded Sediments** - The interbedded sediments unit is generally of FAIR to GOOD quality (*i.e.,* RMR_{89} values ranging from 55 to 75) with a mean UCS of 110 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 600 mm apart. Most have thin infill (mostly chlorite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.

- **Mudstone** - The rock mass quality of the mudstone is highly variable, and ranges from POOR to GOOD (*i.e.,* RMR_{89} values ranging from 35 to 70). The mudstone has a mean UCS of 60 MPa.

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Discontinuities typically have rough to smooth surfaces spaced <60 to 600 mm apart. Most have thin infill (commonly graphite or chlorite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.

- **Lower Iron Formation -** The lower iron formation is generally of GOOD to VERY GOOD quality (*i.e.,* RMR_{89} values typically ranging from 65 to 85) with a mean UCS of 260 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 2000 mm apart. Most have thin infill (commonly chlorite or calcite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1mm to 1.0 mm.
- **Upper Iron Formation -** The upper iron formation is generally of FAIR to GOOD quality (*i.e.,* RMR_{89} values typically ranging from 55 to 80) with a mean UCS of 190 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 600 mm apart. Most have thin infill (commonly chlorite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.
- **Felsic Dykes -** The felsic dyke units are generally of GOOD (*i.e.,* RMR_{89} values typically ranging from 60 to 75) with a mean UCS of 130 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 600 mm apart. Most have thin infill (commonly chlorite or iron oxide) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.
- **Gabbro Dykes -** The gabbro dykes are generally of FAIR to GOOD (*i.e.,* RMR_{89} values typically ranging from 55 to 75) with a mean UCS of 120 MPa. Discontinuities typically have rough to smooth surfaces spaced 60 to 600 mm apart. Most have thin infill (commonly chlorite or calcite) or no infill and show slight to no weathering. Aperture typically ranges from <0.1 mm to 1.0 mm.

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5 – HYDROGEOLOGY

5.1 GENERAL

The site investigation program was designed to obtain information on the hydrogeological regime in the vicinity of the proposed open pits and underground mines. This section describes the work completed to characterize the hydrogeological regime at the Goose and George Properties.

5.2 HYDRAULIC CONDUCTIVITY

The results of the packer testing are summarized below, in Tables 5.1 and 5.2 and on the downhole plots included in Appendix G. The individual test results are included in Appendix J1.

- **Goose Property:**
  - The results of the packer testing below the suspected base of the permafrost indicate low rock mass permeabilities, with recorded hydraulic conductivities ranging from less than $1x10^{-9}$ to $2x10^{-8}$ m/s. The results are consistent with those obtained during previous programs.
  - The results of the packer testing within the potential talik between Goose Lake and the Goose Main deposit indicate low rock mass permeabilities, with estimated hydraulic conductivity values less than $1x10^{-9}$ m/s.
  - The results of the packer testing within the potential talik below Llama Lake indicate moderate permeability below the lake that decreased with depth. The estimated hydraulic conductivity values ranged from less than $1x10^{-9}$ m/s to $4x10^{-6}$ m/s. The increased hydraulic conductivity values closer to the lake bottom are likely due to the more fractured rock mass in this area.
- **George Property:** The results of the packer testing within the potential taliks in the vicinity of the deposits indicate low rock mass permeabilities, with recorded hydraulic conductivities ranging from less than $1x10^{-9}$ to $4x10^{-9}$ m/s.

It should be noted that a hydraulic conductivity value of $1x10^{-9}$ m/s was considered the lower bound for reliable measurements. Calculated hydraulic conductivity values less than then this lower bound were assigned a value of $<1x10^{-9}$ m/s.

5.3 STATUS OF INSTRUMENTATION

A total of thirteen multi-point thermistor strings and vibrating wire piezometer installations were completed. Data from each instrument are collected by Sabina staff and sent to KPL for review.

It should be noted that, at the time of writing, a relativity short period of time has elapsed since the instrumentation was installed at the Goose and George Properties (in approximately April and June 2013, respectively). As such, the vibrating wire piezometers may still be coming to equilibrium with their surrounding conditions and a longer data set will be required to confirm the results presented in this report.

A review of the collected data suggests that individual thermistor sensors or their leads were either damaged during installation or subsequently malfunctioned. These sensors are reporting temperatures beyond the expected range. The drillholes most affected are 13-GSE-261B, 13-GSE-279, 13-GSE-288 and 13-GSE-289 at the Goose Property (shown on Figure 1.2). In all cases, it is still possible to recognize trends in the data.

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TABLE 5.1

SABINA GOLD & SILVER CORP.
BACK RIVER PROJECT

2013 GEOMECHANICAL AND HYDROGEOLOGICAL SITE INVESTIGATION SUMMARY
GOOSE PROPERTY - HYDRAULIC CONDUCTIVITY TESTING SUMMARY

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Deposit	Drillhole	Date of Testing	Test #	Test Interval (m along hole)		Test Interval[1] (masl)		Calculated Hydraulic Conductivity	Notes
				From	To	From	To		
Llama	13-GSE-277B	29-Mar-13	1	22.3	45.0	284	265	3E-07	
		29-Mar-13	2	44.8	75.0	265	239	3E-08	
		30-Mar-13	3	71.8	120.0	242	201	1E-08	
		31-Mar-13	4	119.8	160.5	201	166	1E-08	5
	13-GSE-284	05-Apr-13	1	28.7	51.4	278	259	4E-06	
		05-Apr-13	2	46.8	81.5	263	234	2E-06	
		09-Apr-13	3	81.5	161.0	234	167	3E-06	
		10-Apr-13	4	130.8	161.0	192	167	5E-08	
	13-GSE-289	13-Apr-13	1	16.8	56.0	289	257	2E-06	
		14-Apr-13	2	55.8	86.0	257	232	7E-07	
		16-Apr-13	3	85.8	112.6	232	211	3E-08	
		18-Apr-13	4	109.8	234.5	213	116	1E-09	
		28-Apr-13	5	235.8	500.0	115	-77	< 1E-09	4
Umwelt	13-GSE-279	09-Apr-13	1	498.0	569.0	-173	-237	1E-08	2, 6
		10-Apr-13	2	567.0	632.0	-235	-293	1E-08	
		12-Apr-13	3	626.0	749.0	-288	-394	< 1E-09	4
	13-GSE-288	25-Apr-13	1	559.3	660.1	-90	-141	<1E-09	3, 4
Goose	13-GSE-261B	23-Mar-13	1	622.3	651.0	-217	-240	2E-08	
		24-Mar-13	2	652.3	705.0	-241	-281	1E-09	
	13-GSE-286	07-Apr-13	1	150.3	200.0	171	136	-	7
	13-GSE-314	03-May-13	1	9.3	83.0	272	211	<1E-09	2, 3, 4
		04-May-13	2	81.3	155.0	212	156	<1E-09	2, 4
		06-May-13	3	153.3	251.0	157	87	<1E-09	2, 3, 4

I:\1\01\00517\03\A\Report\Report 1, Rev A - SI Report\Tables\[Table 5.1 Goose Property Hydraulic Conductivity Testing Summary.xlsx]Table 1

NOTES:

1. ELEVATIONS OF TEST INTERVALS CALCULATED BASED ON GYRO SURVEY DATA PROVIDED BY SABINA GOLD & SILVER CORP.
2. AMC 1300 (A POLYMER BASED DRILLING ADDITIVE) USED DURING DRILLING AND/OR TO REMOVE CUTTINGS FROM DRILL HOLE.
3. THE APPLIED PRESSURE FOR THE TEST EXCEEDED THE TYPICALLY RECOMMENDED PRESSURE RANGE OF 0.98 TO 1.64 PSI/M BASED ON THE TOP OF THE TEST INTERVAL (READ AND STACEY, 2009). THE HYDRAULIC CONDUCTIVITY VALUE DOES NOT APPEAR TO BE AFFECTED BY THE HIGHER APPLIED PRESSURE.
4. HYDRAULIC CONDUCTIVITY VALUES CALCULATED AS LESS THAN 1E-09 M/S WERE CONSIDERED TOO LOW TO RELIABLY MEASURE AND WERE ASSIGNED < 1E-09 M/S.
5. TEST RESULTS UNCERTAIN BECAUSE OF SMALL HEAD APPLIED AND NOISE IN TRANSDUCER DATA.
6. HEAD APPLIED DURING TEST WAS NOT WELL CONSTRAINED.
7. TEST RESULTS NOT CONCLUSIVE.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	23AUG'13	ISSUED WITH REPORT VA101-517/3-1	CHS	BDP	RAM

Knight Piésold CONSULTING

TABLE 5.2

SABINA GOLD & SILVER CORP.
BACK RIVER PROJECT

2013 GEOMECHANICAL AND HYDROGEOLOGICAL SITE INVESTIGATION SUMMARY
GEORGE PROPERTY - HYDRAULIC CONDUCTIVITY TESTING SUMMARY

Print Aug/23/13 9:55:31

Deposit	Drillhole	Date of Testing	Test #	Test Interval (m along hole)		Test Interval[1] (masl)		Calculated Hydraulic Conductivity	Notes
				From	To	From	To		
Locale 1	13-GRL-113	09/05/2013	1	13.8	48.5	326	298	4E-09	2,3
		09/05/2013	2	49.8	80.0	297	273	2E-09	
		14/05/2013	3	73.8	345.5	278	68	< 1E-09	2,4
	13-GRl-115	16/05/2013	1	16.8	42.5	324	304	2E-09	3
		17/05/2013	2	40.8	69.5	305	283	2E-09	2
	13-GRL-119	20/05/2013	1	10.8	105.3	329	254	1E-09	2,3
	13-GRL-121	25/05/2013	1	31.8	90.5	314	268	< 1E-09	3,4
Locale 2	13-GRL-110	05/05/2013	1	13.8	57.5	326	291	< 1E-09	3,4
		06/05/2013	2	19.8	81.5	321	271	< 1E-09	3,4
	13-GRL-129	02/06/2013	1	16.8	320.0	334	96	< 1E-09	3,4
	13-GRL-130	05/06/2013	1	13.8	60.5	333	295	<1E-09	4

I:\1\01\00517\03\A\Report\Report 1, Rev A - SI Report\Tables\[Table 5.2 George Property Hydraulic Conductivity Testing Summary.xlsx]Table 1

NOTES:

1. ELEVATIONS OF TEST INTERVALS CALCULATED BASED ON GYRO SURVEY DATA PROVIDED BY SABINA GOLD & SILVER CORP.

2. AMC 1300 (A POLYMER BASED DRILLING ADDITIVE) USED DURING DRILLING AND/OR TO REMOVE CUTTINGS FROM DRILL HOLE.

3. THE APPLIED PRESSURE FOR THE TEST EXCEEDED THE TYPICALLY RECOMMENDED PRESSURE RANGE OF 0.98 TO 1.64 PSI/M BASED ON THE TOP OF THE TEST INTERVAL (READ AND STACEY, 2009). THE HYDRAULIC CONDUCTIVITY VALUE DOES NOT APPEAR TO BE AFFECTED BY THE HIGHER APPLIED PRESSURE.

4. HYDRAULIC CONDUCTIVITY VALUES CALCULATED AS LESS THAN 1E-09 M/S WERE CONSIDERED TOO LOW TO RELIABLY MEASURE AND WERE ASSIGNED < 1E-09 M/S.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	23AUG'13	ISSUED WITH REPORT VA101-517/3-1	DBR	CHS	RAM

In addition, the data available to date from the vibrating wire piezometers installed in drillholes 13-GSE-277B and 13-GSE286 suggests that these sensors or their leads were either damaged during installation or subsequently malfunctioned. The sensor in 13-GSE-277B indicates values that are not believed to be representative based on the available temperature and packer testing data. The sensor in 13-GSE-286 indicates values that are outside the range of the sensor and are not representative of the site conditions.

During the breakup of the ice on Llama Lake in mid-June 2013, the cables for the instrumentation at 13-GSE-284 and 13-GSE-289 were damaged beyond repair and these installations were decommissioned. The data obtained from these installations prior to the damage still provided insight on the site conditions.

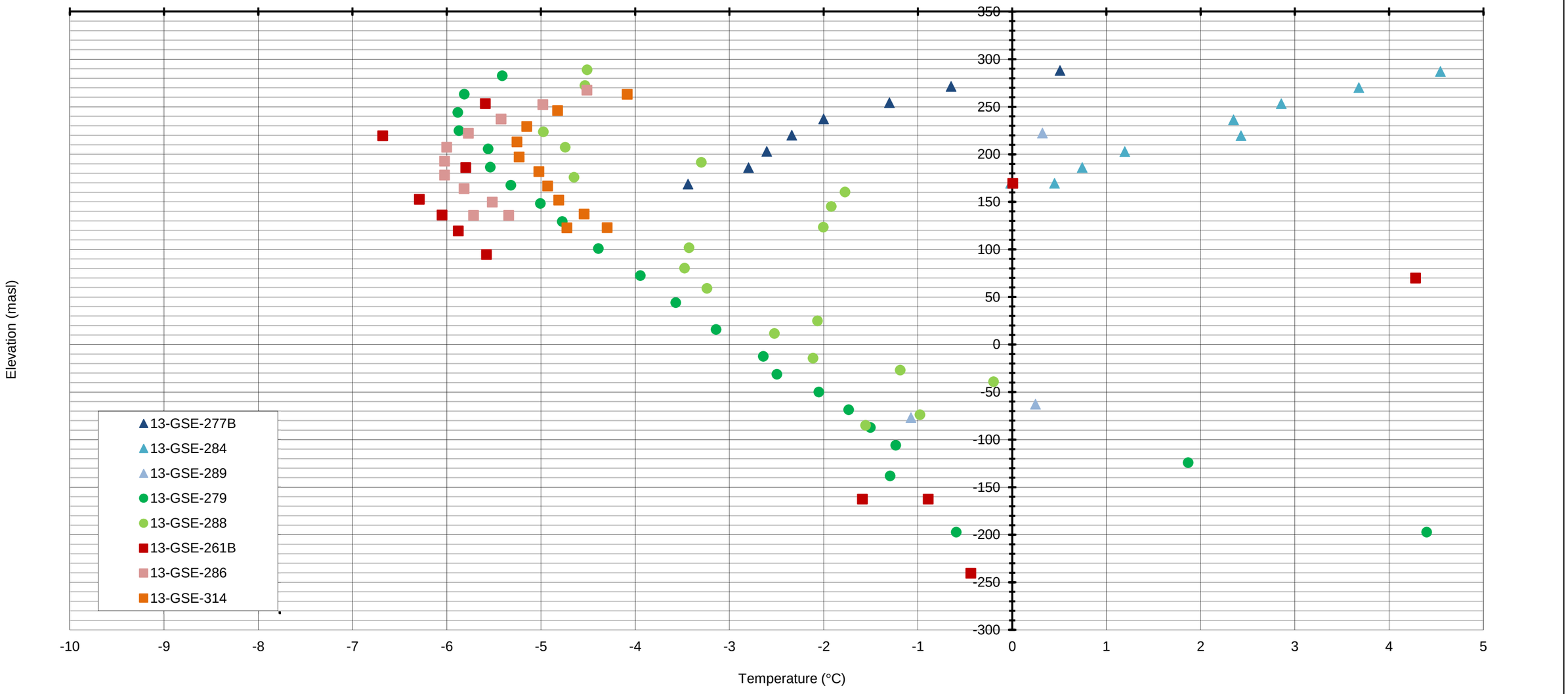
5.4 TEMPERATURE PROFILES

The temperature data from the installations are summarized below and on Figures 5.1 and 5.2. Time series data from each individual installation are included in Appendix J2.

- **Goose Property:**
  - In general the thermistor data at the Goose Property indicate continuous permafrost to an elevation of about -100 to -200 meters above sea level (masl) or approximately 400 mbgs to 500 mbgs. These depths are based on an extrapolation of the data to the zero degree isotherm. The vibrating wire piezometers installed within drillholes 13-GSE-288 and 13-GSE 314 reported piezometric levels above ground surface. These values are likely a result of the sensors freezing and support the depth of permafrost estimates from the thermistors.
  - The thermistor data from drillhole 13-GSE-314 at the Goose Main deposit indicate continuous permafrost between the deposit and Goose Lake. The vibrating wire piezometer data from this drillhole supports the depth of permafrost estimate.
  - The thermistor data from the installations at the Llama deposit indicate the presence of unfrozen ground below Llama Lake to an elevation of about 150 masl or approximately 150 mbgs. The data from the uppermost of the two vibrating wire piezometer installed in drillhole 13-GSE-289 support the assertion that there is a talik below the lake.
  - The results are consistent with those obtained during previous programs.
- **George Property:**
  - The thermistor data indicate continuous permafrost conditions to depths greater than 200 mbgs (the depth of the deepest sensors). An extrapolation of the data to the zero degree isotherm suggests that the permafrost extends to more than 500 mbgs. Talik zones were not observed based on the thermistor data.
  - The data from the vibrating wire piezometer installed in drillholes 13-GRL-129 and 13-GRL-130 support the depth of permafrost estimates from the thermistors.

It should be noted that the actual permafrost boundary will vary from the zero degree isotherm depending on the salinity of the groundwater. The deep groundwater at Back River is expected to have a high concentration of total dissolved solids (salinity), which will lower the freezing point of the water. Groundwater quality will be evaluated by Rescan based on sampling from a Westbay installation at the Umwelt deposit.

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NOTES:
1. THE MEASUREMENT INTERVAL IS 6 HOURS.
2. SUMMARY PLOT OF THERMISTOR DATA FOR GOOSE PROPERTY INSTALLATIONS BASED ON SELECTED DATE WITH CONCURRENT DOWNLOADED MEASUREMENTS.
3. TEMPERATURE BOUNDS DISPLAYED WERE CONSTRAINED FROM -10ºC TO 5ºC FOR PLOT. COMPLETE PLOTS OF THERMISTOR DATA PROVIDED IN APPENDIX J2.
4. THERMISTOR ELEVATIONS BASED ON MEASURED DOWNHOLE DEPTHS AND GYRO SUREY DATA FOR DRILLHOLES PROVIDED BY SABINA GOLD & SILVER CORP.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	23AUG'13	ISSUED WITH REPORT	RGM	BDP	RAM

SABINA GOLD & SILVER CORP.

BACK RIVER PROJECT

GOOSE PROPERTY - SUMMARY OF TEMPERATURE DATA
ELEVATION VS. TEMPERATURE (MAY 23, 2013)

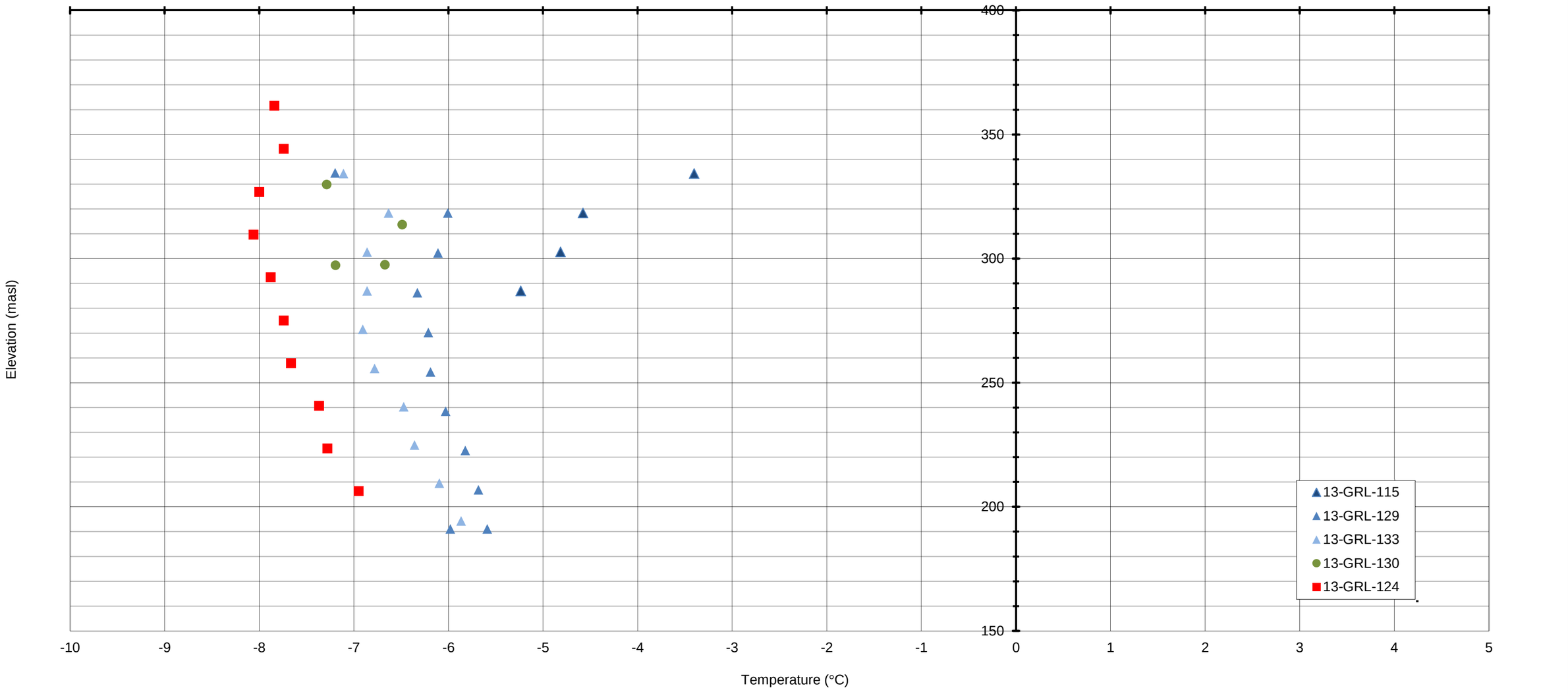
Knight Piésold CONSULTING

P/A NO. VA101-517/3

REF. NO. 1

FIGURE 5.1

REV A



NOTES:

1. THE MEASUREMENT INTERVAL IS 6 HOURS.
2. SUMMARY PLOT OF THERMISTOR DATA FOR GOOSE PROPERTY INSTALLATIONS BASED ON SELECTED DATE WITH CONCURRENT DOWNLOADED MEASUREMENTS.
3. TEMPERATURE BOUNDS DISPLAYED WERE CONSTRAINED FROM -10ºC TO 5ºC FOR PLOT. COMPLETE PLOTS OF THERMISTOR DATA PROVIDED IN APPENDIX J2.
4. THERMISTOR ELEVATIONS BASED ON MEASURED DOWNHOLE DEPTHS AND GYRO SUREY DATA FOR DRILLHOLES PROVIDED BY SABINA GOLD & SILVER CORP.

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
A	23AUG'13	ISSUED WITH REPORT	RGM	BDP	RAM

SABINA GOLD & SILVER CORP.

BACK RIVER PROJECT

GEORGE PROPERTY - SUMMARY OF TEMPERATURE DATA
DEPTH VS. TEMPERATURE (JULY 21, 2013)

Knight Piésold CONSULTING

P/A NO. VA101-517/3

REF. NO. 1

FIGURE 5.2

REV A

5.5 PIEZOMETRIC LEVELS

The data from the piezometer installations is summarized below. The data from each individual installation are included in Appendix J3.

- **Goose Property:**
  - The uppermost of the two sensors installed in drillholes 13-GSE-261B and 13-GSE-279 report piezometric levels close to ground surface. These results are consistent with other permafrost areas where the deep groundwater flow is controlled by the water levels of the larger lakes that are connected to unfrozen ground below the permafrost though talik zones.
  - The piezometric levels recorded at the deeper of the two sensors installed in drillholes 13-GSE-261B, 13-GSE-279 and 13-GSE-289 reported pressures that gradually declined with time to levels that are not considered representative and may indicate sensor damage. Ongoing monitoring will be carried out to further assess this data.
  - The shallower of the two vibrating wire piezometers installed in 13-GSE-289 at the Llama deposit reports piezometric levels close to ground surface and are thought to be located within a talik below Llama Lake.
  - The vibrating wire piezometers installed in 13-GESE-284, 13-GSE-288 and 13-GSE-314 report piezometric levels higher than ground surface. These piezometric levels are likely a result of the sensors being installed within the permafrost.
- **George Property:**
  - The vibrating wire piezometer in drillhole 13-GRL-130 reports piezometric levels higher than ground surface. These piezometric levels are likely a result of the sensor being installed within the permafrost.
  - The vibrating wire piezometer in drillhole 13-GRL-129 is currently reporting a value close to ground surface, however the temperature of the thermistor for the vibrating wire piezometer is reported as about -6^{o}C. Ongoing data review is required to better constrain the interpretation of the data from this installation.

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6 – CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Knight Piésold Ltd. was engaged by Sabina to complete the geomechanical and hydrogeological work needed to support the feasibility mine design for the proposed underground and open pit developments. A geomechanical and hydrogeological site investigation program was completed between February and June, 2013. General comments are provided below.

- The encountered rock masses were classified using the RMR_{89} and NGI-Q classification systems. The deposit rock masses were generally observed to be of FAIR to GOOD quality. The Mudstone was observed to be of lower and more variable quality than the other lithologies, while the Lower Iron Formation was observed to be of higher quality.
- The discontinuity data suggests an orthogonally jointed rock mass with three joint sets. However, all of the joint sets are not present or well defined in each of the drillholes. The observed joint sets are:
  - A set striking southeast-northwest and dipping moderately to steeply to the northeast
  - A set striking northeast-southwest and dipping sub-vertically
  - A flat-lying joint set
- Hydraulic packer tests were completed to assess the hydraulic conductivity of the encountered rock masses. The rock masses in the unfrozen ground below the permafrost were observed to be have low hydraulic conductivities. The near-surface rock mass within the talik beneath Llama Lake was observed to have moderate hydraulic conductivities.
- Multi-point thermistor strings were installed to measure the temperature profile of the rock mass. The permafrost was observed to be continuous to a depth of approximately 400 to 500 mbgs at the Goose Property and more than 200 mbgs at the George Property. A talik was observed below Llama Lake. Taliks were not observed between the Goose Deposit and Goose Lake or at any of the deposits at the George Property.
- Vibrating wire piezometers were installed to measure piezometric pressures. The piezometric levels within the deep groundwater below the permafrost were observed to be near surface. These results are consistent with other permafrost areas where the deep groundwater flow is controlled by the water levels of the larger lakes that are connected to unfrozen ground below the permafrost though talik zones.

6.2 RECOMMENDATIONS

Recommendations for future work include:

- Developing a structural model for the George Property
- Continuing to collect data from the thermistor and vibrating wire piezometer installations on a quarterly basis. The installations should be maintained and the batteries charged as required. The collected data should be reviewed to confirm the preliminary conclusions presented in this report.
- Additional rock mass and hydrogeological characterization may be required to support the next level of design or in response to any significant changes to the mine plan or geological models.

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8 – CERTIFICATION

This report was prepared, reviewed and approved by the undersigned.

DRAFT

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Prepared:

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Project Engineer

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Managing Principal, North Bay

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GEOMECHANICAL AND HYDROGEOLOGICAL DRILLHOLES

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Appendix A2 Core Photos
Appendix A2 Geomechanical Drillhole Logs

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APPENDIX A1

GEOLOGY DRILLHOLE LOGS

(Attached Electronically)

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APPENDIX A2

CORE PHOTOS

(Attached Electronically)

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APPENDIX A3

GEOMECHANICAL DRILLHOLE LOGS

(Attached Electronically)

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Appendix C1 Introduction to Rock Mass Classification (RMR)
Appendix C2 Introduction to Rock Mass Classification (NGI-Q)

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INTRODUCTION TO ROCK MASS CLASSIFICATION (RMR)

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Appendix E1 Instrumentation Details
Appendix E2 Thermistor Specifications
Appendix E3 Vibrating Wire Piezometer Calibration Forms

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APPENDIX E2

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ROCK MASS PARAMETER HISTOGRAMS BY DRILLHOLE

Appendix H1 RMR Parameter Histograms by Drillhole
Appendix H2 Q' Parameter Histograms by Drillhole

DRAFT

APPENDIX H1

RMR PARAMETER HISTOGRAMS BY DRILLHOLE

(Pages H1-1 to H1-33)

DRAFT

APPENDIX H2

Q' PARAMETER HISTOGRAMS BY DRILLHOLE

(Pages H2-1 to H2-33)

DRAFT

APPENDIX I

ROCK MASS PARAMETER HISTOGRAMS BY LITHOLOGY

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Q' PARAMETER HISTOGRAMS BY LITHOLOGY

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DRAFT

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HYDROGEOLOGY

Appendix J1 Summary of Packer Testing Results
Appendix J2 Thermistor Data
Appendix J3 Vibrating Wire Piezometer Data

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VIBRATING WIRE PIEZOMETER DATA

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Appendix V6-3A

Back River Project: 2010 Lake Water and Sediment Quality Baseline Report

Rescan™
an ERM company

Sabina Gold and Silver Corporation

BACK RIVER PROJECT
2010 Lake Water and Sediment Quality Baseline Report

Sabina GOLD & SILVER CORP.



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February 2011

BACK RIVER PROJECT

2010 LAKE WATER AND SEDIMENT QUALITY BASELINE REPORT

February 2011
Project #0833-002-03

Citation:
Rescan. 2011. *Back River Project: 2010 Lake Water and Sediment Quality Baseline Report*. Prepared for Sabina Gold and Silver Corporation by Rescan Environmental Services Ltd.: Vancouver, British Columbia.

Prepared for:

Sabina GOLD & SILVER CORP.

Prepared by:

Rescan™ Engineers and Scientists

Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

Rescan™
Engineers and Scientists

Executive Summary

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. The Project consists of several different properties, one of which is the Back River property. An exploration camp is located near Back River (Back River Camp), and Sabina conducted a drilling program out of this camp during 2010.

Several exploration targets exist in the Back River area, including the Goose deposit, and the Llama deposit. For 2010, select baseline studies were conducted in the areas that could be influenced by the future development of the Llama deposit (Goose Lake Property). This report presents the results from the Lake Bathymetry, Limnology, Water and Sediment Quality Baseline Program that was carried out in 2010.

Baseline data on bathymetry, limnology, water and sediment quality was collected from five lakes in the Llama deposit area during August 2010. The five lakes included one lake that could be directly impacted by the Project (Llama Lake), a second lake from the same watershed (Umwelt), two lakes from a neighbouring watershed (Mam and Chair), and a reference lake (Reference Lake B). The reference lake was selected based on its size and drainage basin area, as well as having a greater than 10 km buffer from the potential Project to negate any effects of dustfall from Project activities.

Bathymetric and limnological measurements showed that Umwelt and Mam lakes were relatively shallow, clear, cold, and had the highest dissolved oxygen levels of the five lakes. Llama and Chair lakes were deeper lakes, with slightly warmer water than Umwelt and Mam lakes, and lower levels of dissolved oxygen. Reference Lake B had intermediate depth, temperature, dissolved oxygen, and water clarity. Sufficient light for photosynthesis reached the entire benthic region in all five lakes.

Where possible, water quality was sampled at two depths (1 m and mid-depth). Overall, the water quality concentrations were similar between depths, likely due to the lack of stratification or weak stratification found at lake sites during the sampling period. All five lakes were oligotrophic, with low nutrient concentrations, as is typical in Arctic and subarctic lakes. Umwelt and Llama lakes, located within the Llama Watershed where two known deposits are located, had the highest concentrations for most total metals, pH, conductivity, and hardness. Chair and Mam Lakes had intermediate concentration of most metals, turbidity, and total phosphorus, but had the highest levels iron. Reference Lake B was generally metal-poor, with low levels of conductivity and total dissolved solids, although it did have had the highest levels of turbidity and total phosphorus.

A comparison of baseline water quality with CCME guidelines indicated that Llama and Umwelt lakes had total copper concentrations higher than guideline values.

Sediment quality samples were collected from the five Project lakes at the same time as the limnology and water quality samples. Where possible, sediment samples were collected from shallow, mid-, and deep depth zones. Overall, the chemistry of the sediments was largely determined by its particle composition. Mam, Chair, and Llama lakes all contained high proportions of silt and were naturally enriched with several metals. Reference Lake B and Umwelt Lake sediments were largely composed of sand-sized particles, with much lower metal concentrations. Umwelt Lake sediments were largely nutrient-poor, with little organic material.

Llama and Mam lakes had baseline sediment quality higher than the CCME Interim Sediment Quality Guideline (ISQG) for arsenic, chromium and copper. Umwelt Lake had baseline sediment quality higher than the CCME ISQG for arsenic and copper, while Chair Lake had baseline sediment quality higher than the CCME ISQG for arsenic, cadmium, chromium, copper and zinc. Reference Lake B had baseline sediment quality higher than the CCME ISQG for arsenic and copper. All lakes, except the reference lake, had baseline sediment quality that exceeded the CCME Probable Effects Level (PEL) for arsenic.

Acknowledgements

Rescan™
Engineers and Scientists

Acknowledgements

This report was prepared for Sabina Gold and Silver Corporation by Rescan Environmental Services Ltd. This report was written by Pamela Reece (M.Sc., R.P. Bio), and was reviewed by Michael Henry (Ph.D.) and Deborah Muggli (Ph.D., M.Sc., R.P.Bio.). Field work was conducted by Tonia Robb (Ph.D.), Ryan Kaiyogana, Michael Soloducha (B.Sc.), and Gary Kelloguk. Dan Russel assisted with logistics and Doug Caters managed the Goose Lake camp. Deborah Muggli (Ph.D., M.Sc., R.P.Bio.) was the Rescan Project Manager for this project.

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Rescan™
Engineers and Scientists

BACK RIVER PROJECT
2010 LAKE WATER AND SEDIMENT QUALITY BASELINE REPORT

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1. Introduction

1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. The Project consists of several different properties, one of which is the Back River property (Figure 1-1). An exploration camp is located near Back River (Back River Camp), and Sabina conducted a drilling program out of this camp during 2010.

Several exploration targets exist in the Back River area, including the Goose deposit, and the Llama deposit. For 2010, select baseline studies were conducted in the areas that could be influenced by the future development of the Llama deposit (Goose Lake Property). Rescan Environmental Services (Rescan) was contracted by Sabina, to conduct the following baseline studies in 2010:

- Hydrology Baseline Program;
- Lake Bathymetry, Water & Sediment Baseline Program;
- Fish & Fish Habitat Baseline Program;
- Archaeological Survey Program; and
- Regional Wildlife Program.

In addition, Sabina continued to operate a meteorological station on site as well as collect data on permafrost temperatures.

This report presents the results from the Lake Bathymetry, Limnology, Water and Sediment Quality Baseline Program that was carried out in 2010. The report describes the methods used to collect the data, and the results. Analytical results from all samples collected as part of the 2010 aquatic baseline program are provided as appendices to this report.



General Back River Project Location Map

Figure 1-1

2. Methods

2. Methods

2.1 STUDY AREA

The Back River Project is located in the Southern Arctic Ecozone. It is characterized by short, cool summers (mean temperature: 5°C) and long cold winters (mean temperature: -28°C). Vegetation in the Southern Arctic Ecozone and around the study lakes consists of predominantly dwarf shrub vegetation, including *Betula* spp. (birch), *Salix* spp. (willow), and grasses. There is a continuous permafrost layer under the landscape, which prevents water from penetrating deep into the soils. This creates surface run-off from precipitation, and waterlogged soils that freeze regularly. There are numerous depressions, kettle lakes, ponds, and deposits in the study area that were left by retreating glaciers.

Baseline data on bathymetry, limnology, water and sediment quality was collected from five of the lakes in the Project area. The five lakes included one lake that would be directly impacted by the Project (Llama Lake), a second lake immediately downstream and from the same watershed (Umwelt), two lakes from a neighbouring watershed (Mam and Chair), and a reference lake (Reference Lake B). The reference lake was selected based on its size and drainage basin area, and was placed more than 10 km from the potential Project to avoid potential dustfall issues. Figure 2.1-1 shows the relative locations of the study lakes. Plate 2.1-1 presents photographs of four of the project study lakes, surface run-off, and surrounding landscape. Table 2.1-1 summarizes the lake locations and rationale for including the lakes in the baseline study.

Table 2.1-1. Sample Location, Samples Collected, and Rationale for Lakes Sampled as Part of the Back River Project Baseline Study, August 2010

Lake	UTM Zone	Easting	Northing	Data Collected	Rationale for Inclusion
Umwelt	13W	428927	7270960	SQ, WQ, Ba, Lim	Immediately downstream of potential impact site within the same watershed
Llama	13W	428572	7272571	SQ, WQ, Ba, Lim	Potential impact site
Mam	13W	427976	7272192	SQ, WQ, Ba, Lim	Potential impact site and/or close proximity to potential impact site.
Chair	13W	427604	7273392	SQ, WQ, Ba, Lim	Potential impact site and/or close proximity to potential impact site.
Reference Lake B	13W	442019	7258465	SQ, WQ, Ba, Lim	Reference lake. Similar in size, and size of watershed to other lakes. Over 10 km away.

SQ = Sediment Quality, WQ = Water Quality, Ba = Bathymetry, Lim = Limnology

2.2 PHYSICAL LIMNOLOGY

All sampling was done with the use of a 12-foot aluminum boat that was slung from lake to lake by a Northern Air Support helicopter. For safety, all field work was conducted by two-person crews.



a) b)

c) d)

Plate 2.1-1. Back River Project study area lakes: a) Llama Lake, b) Mam Lake, c) Umwelt Lake, and d) Reference Lake B.

2.2.1 Bathymetry Methods

Each lake was surveyed in late August, 2010 using a Garmin 526s Depth Sounder/GPS attached to the stern of an aluminum boat. Depth readings were taken every two seconds at an approximate cruising speed of 5 km/h. Initial bathymetric readings were taken along the perimeter of the lakes to establish an electronic outline of the lake on the view screen of the depth sounder. An Exploratory-line (E-line) was then completed along the (estimated) deepest section of the lake. If depths were fairly uniform, the E-line should run along the middle of the water body. Once the perimeter and the E-line were completed, transects were run back and forth across the lake from one end to the other, perpendicular to the E-line and parallel to each other. The distance between transects was determined by the size of the lake and the uniformity of the bottom. Water bodies with irregular or complex bottoms required that transects were run closer together to accurately capture the bathymetry. At Mam Lake, the shallow depth over the southwest part of the lake required that manual depth readings be taken using a handheld GPS and a stadia rod.

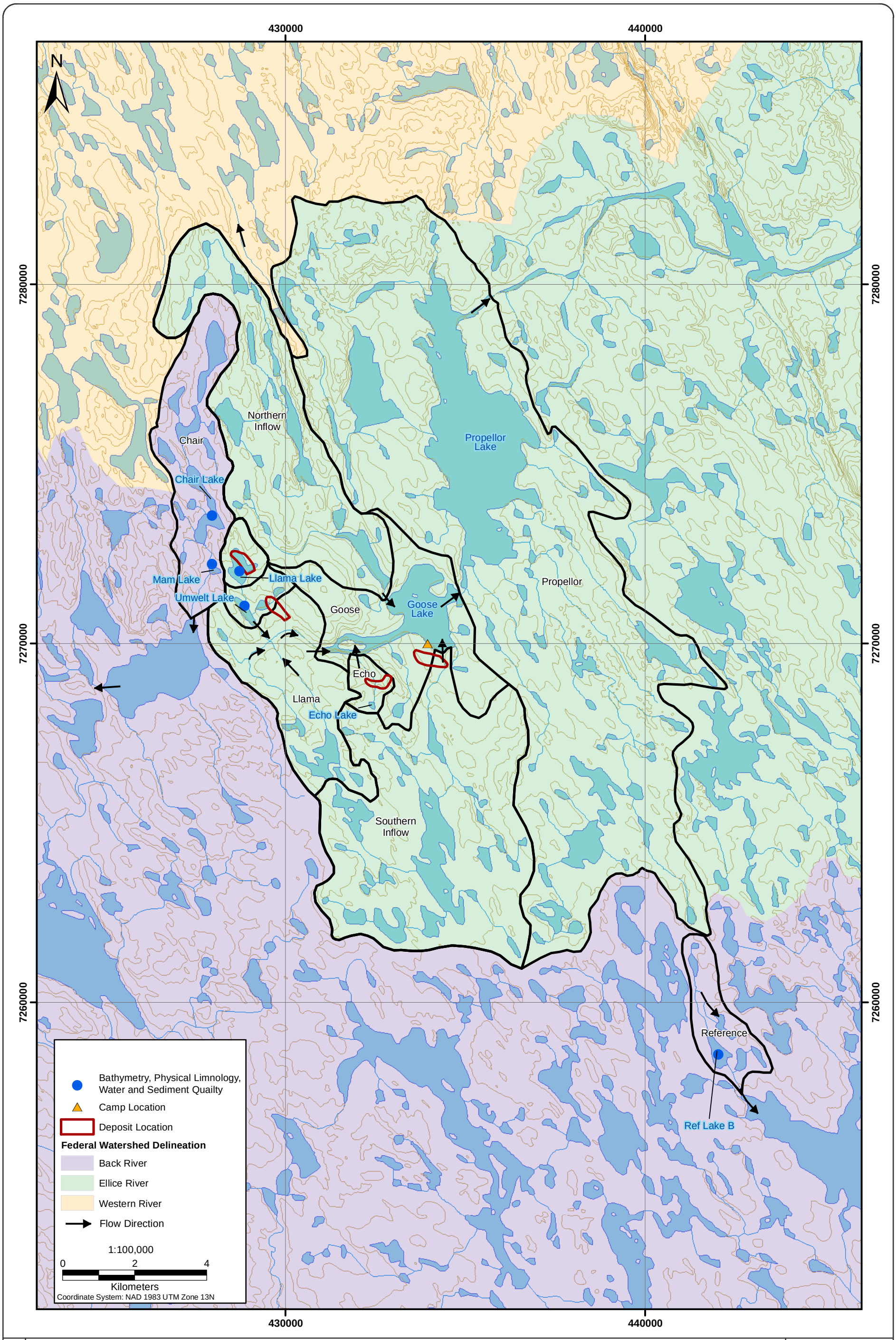


Figure 2.1-1

Sabina GOLD & SILVER CORP.

Back River Project Sampling Locations, August 2010

Figure 2.1-1

Rescan™ Engineers & Scientists

2.2.2 Physical Limnology

Physical limnology measurements were collected from the lakes in late August, 2010, during the open water season. At the deepest area of the lake, vertical profiles of temperature and dissolved oxygen were recorded using a YSI probe and meter. The YSI probe was lowered on a metred cable to approximately 1 m above the lake bottom. The probe was allowed to equilibrate for a few minutes then brought to the surface at half-metre intervals, and measurements were recorded. As the probe consumes oxygen while taking a reading, it was gently agitated to ensure a continual flushing of 'new' water.

Water transparency was measured using a Secchi disk at the deepest point of each lake. The 30 cm-diameter Secchi disk was lowered over the shaded side of the boat using a metred line. The Secchi disk was weighted to keep it as vertical as possible, and lowered until it disappeared. The disk was then raised slowly until it could just be seen, and the depth of the disk was recorded. This is known as the Secchi depth (Ds). A Light attenuation coefficient (or extinction coefficient) (k) was calculated by dividing 1.7 by the Secchi depth (Ds, m), where 1.7 is a widely accepted value for non-turbid waters (Parsons et al. 1984). From this, the 1% euphotic zone depth (EZD) was calculated. The 1% EZD ($Z_{1\%}$, m), calculated as 4.6/k, is the depth of the water column where 1% of the surface irradiance reaches. It represents the depth where the integrated gross water column photosynthetic production is the equivalent of the integrated gross water column respiration; thus, there is net production of carbon above this depth. It is often known as the compensation depth.

2.3 WATER QUALITY

Water quality samples were collected along with the physical limnology and sediment samples in late August 2010. The samples were collected from the deepest area at each of the five lakes. For the deeper lakes, (Chair, Reference Lake B, and Llama) samples were collected at two depths: 1 m below the surface and at mid-depth. In the shallow lakes (Umwelt and Mam), samples were collected at a depth of 1 m which was close to mid-depth for those lakes. Samples were collected with a 5 L Teflon-lined GO-FLO bottle using metal-clean techniques. All water samples were collected in acid-washed, triple-rinsed sample bottles with the scientist wearing nitrile gloves. Samples were preserved as required, kept cold, and sent to ALS Environmental Services in Yellowknife on the first available flight out of camp. Samples were then transferred to ALS's Burnaby, BC laboratory.

Lake water samples were analyzed for general physical parameters, nutrients, total organic carbon (TOC), and total and dissolved metals at the lowest possible detection limit. Preservatives were added at the time of sample collection to total metals (ultra-pure nitric acid), TOC (hydrochloric acid), and total kjeldahl nitrogen (TKN) (sulphuric acid) sample containers. Dissolved metal samples were filtered under trace-metal clean conditions at the laboratory to avoid contamination associated with field filtration and to achieve the lowest possible detection limits.

Table 2.3-1 presents the water quality parameters analyzed and their analytical detection limits. Detection limits were the lowest achievable by the lab, and lower than, or equal to, the CCME guidelines for the protection of aquatic life (CCME 1999). Detection limits were occasionally higher than the theoretical minimum presented in Table 2.3-1 for some samples. This occurred when dilution of a sample was required to compensate for high concentrations of other, interfering parameters. All realized detection limit ranges are indicated on graphs.

Values of pH differed between the measurements taken in the field (at the sampling site) (see Table 3.1-1), and values determined in the lab by ALS (Appendix 2a). In the field, the pH meter was calibrated and held in the water until the meter had equilibrated. Lab values for pH were determined after sample collection and transport to the lab. British Columbia Environmental Laboratory Methods Manual (BCMOE 2009) recommends immediate analysis for pH and a maximum holding time of 15 minutes.

Transportation to the lab exceeded the recommended holding time. During the transportation from the field to the lab, organisms in the water would have respired generating hydrogen ions and lowering the pH. The water samples had low alkalinity and therefore a low ability to buffer the pH against the production of hydrogen ions, potentially resulting in a pH lower than that determined in the field. This is consistent with previous studies that found lakes within the Shield area of the Northwest Territories to be sensitive to acidification and to have low buffering abilities (Padgham and Fyson 1992). Values of pH based on field measurements were used for water quality analysis and graphing purposes.

Table 2.3-1. Water Quality Parameters and Method Detection Limits, Back River Project, August 2010

Parameter	Detection Limit	Parameter	Detection Limit
Physical Tests		**Metals (Total and Dissolved)** *(continued)*	
Conductivity	2 µS/cm	Barium (Ba)	0.00005
Hardness (as $CaCO_3$)	0.5	Beryllium (Be)	0.0002
pH	0.1 pH	Bismuth (Bi)	0.0005
Total Suspended Solids	3	Boron (B)	0.001
Total Dissolved Solids	10	Cadmium (Cd)	0.00001
Turbidity	0.1 NTU	Calcium (Ca)	0.02
		Chromium (Cr)	0.0001
Anions and Nutrients		Cobalt (Co)	0.0001
Alkalinity, Bicarbonate (as $CaCO_3$)	2	Copper (Cu)	0.0001
Alkalinity, Carbonate (as $CaCO_3$)	2	Iron (Fe)	0.01
Alkalinity, Hydroxide (as $CaCO_3$)	2	Lead (Pb)	0.00005
Alkalinity, Total (as $CaCO_3$)	2	Lithium (Li)	0.005
Bromide (Br)	0.05	Magnesium (Mg)	0.005
Chloride (Cl)	0.5	Manganese (Mn)	0.00005
Fluoride (F)	0.02	Mercury (Hg)	0.00001
Sulphate (SO_4)	0.5	Molybdenum (Mo)	0.00005
Ammonia (as N)	0.005	Nickel (Ni)	0.0001
Nitrate (as N)	0.005	Phosphorus (P)	0.05
Nitrite (as N)	0.001	Potassium (K)	0.0001
Total Kjeldahl Nitrogen	0.05	Selenium (Se)	0.05
Ortho Phosphate (as P)	0.001	Silicon (Si)	0.00001
Total Phosphorus	0.002	Silver (Ag)	0.01
		Sodium (Na)	0.0001
Organic / Inorganic Carbon		Strontium (Sr)	0.0001
Total Organic Carbon	0.5	Thallium (Tl)	0.0001
		Tin (Sn)	0.01
Metals (Total and Dissolved)		Titanium (Ti)	0.00001
Aluminum (Al)	0.001	Uranium (U)	0.00005
Antimony (Sb)	0.0001	Vanadium (V)	0.001
Arsenic (As)	0.00003	Zinc (Zn)	0.001

Detection limits are mg/L unless otherwise indicated.

2.3.1 Quality Assurance and Quality Control (QA/QC)

To determine sources of potential contamination during water quality sampling, a separate set of bottles for travel, field, and equipment blanks were included as part of the field QA/QC program. The travel blank bottles were filled with distilled deionized water in the lab and remained closed throughout the field trip. This allowed assessment of contamination associated with sample transit and lab procedures. The field blank bottles were also filled with distilled deionized water, but were opened in the field for 30 seconds, and preserved as required for respective analyses. This allowed assessment of contamination associated with field sampling (airborne contamination, contamination of the lid/bottle, etc.) and preservation procedures.

Equipment blanks were collected in the field by first rinsing an acid-washed GO-FLO with double de-ionized water (DDI water; provided by ALS), filling the GO-FLO bottle with DDI water, allowing the water to sit for a few minutes (as would occur with a real sample), and then drawing sub-samples from the bottle. Equipment blanks were preserved and handled the same as regular samples.

All QA/QC data for field, travel, and equipment blanks are reported in Appendix 2. The frequency of detection of a concentration for a water quality variable greater than the analytical detection limit was noted for travel, field, and equipment blanks, indicating possible contamination.

Also as part of the QA/QC program, 25% of the water samples were collected in duplicate to assess the magnitude and potential causes of variability between samples. Duplicate water samples were randomly taken at 25% of the stations.

2.3.2 Principal Components Analysis

Principal Components Analysis (PCA) was used to objectively summarize the water quality data, facilitating easy interpretation of the spatial pattern of the data. PCA reduces the number of variables to a small number of indices (the principal components) that are linear combinations of the original variables. Each principal component accounts for a percentage of the variation in the data set. The first principal component accounts for the majority of the variation in the data set, and subsequent principal components account for successively less. Eigenvectors or loadings represent the direction and magnitude of correlation of between the variables and the principal components.

PCA was conducted using STATISTICA software. The PCA was run on physical parameters, dissolved anions, nutrients, and total metals. Variables were excluded from the PCA if more than 80% of their values for samples were below the method detection limit (MDL). For the remaining variables, any values below MDL were replaced with one half of the MDL value. All variables except pH (already in log units) were then log-transformed to normalize their distribution.

2.3.3 Water Quality Parameters in Relation to Guidelines

All water quality parameters that have CCME water quality guidelines for the protection of freshwater aquatic life, as well as other parameters of interest, were graphed for all study lakes, unless values were consistently below analytical detection limits. For analysis and graphing purposes, any values below analytical detection limits were replaced with half of the realized sample detection limit. The water quality data was presented to allow comparisons of samples collected from shallow and deep depths.

2.4 SEDIMENT QUALITY

Sediment quality samples were collected at each of the five Project lakes and were analyzed for moisture, particle size, nutrients, organic carbon, and total metal concentrations. A list of the analyzed sediment quality variables and their respective detection limits are presented in Table 2.4-1.

The lowest analytical detection limit possible was used for all analysis. These were always below CCME guideline concentrations.

Table 2.4-1. Sediment Quality Parameters and Method Detection Limits, Back River Project, August 2010

Parameter	Detection Limit	Parameter	Detection Limit
% Moisture	0.1	**Metals** *(continued)*	
pH	0.1	Cadmium (Cd)	0.1
		Cadmium (Cd)	0.1
Particle Size		Calcium (Ca)	50
% Gravel (> 2 mm)	0.1	Chromium (Cr)	0.5
% Sand (2.0 mm - 0.063 mm)	0.1	Cobalt (Co)	0.1
% Silt (0.063 mm – 4 µm)	0.1	Copper (Cu)	0.5
% Clay (<4 µm)	0.1	Iron (Fe)	50
		Lead (Pb)	0.5
Nutrients		Lithium (Li)	1
Available Ammonium-N	1	Magnesium (Mg)	20
Available Nitrate-N	2.5	Manganese (Mn)	1
Available Nitrite-N	0.5	Mercury (Hg)	0.005
Available Phosphate (as P)	2	Molybdenum (Mo)	0.5
		Nickel (Ni)	0.5
Organic / Inorganic Carbon		Phosphorus (P)	50
$CaCO_3$ Equivalent (%)	0.8	Potassium (K)	100
Inorganic Carbon (%)	0.1	Selenium (Se)	0.2
Total Carbon (%)	0.1	Silver (Ag)	0.1
Total Organic Carbon (%)	0.1	Sodium (Na)	100
		Strontium (Sr)	0.5
Metals		Sulphur (S)	100
Aluminum (Al)	50	Thallium (Tl)	0.05
Antimony (Sb)	0.1	Tin (Sn)	2
Arsenic (As)	0.05	Titanium (Ti)	1
Barium (Ba)	0.5	Uranium	0.05
Beryllium (Be)	0.2	Vanadium (V)	2
Bismuth (Bi)	0.2	Zinc (Zn)	1

**All units are in mg/kg dry weight unless otherwise noted.*

Sediment samples were collected using an Ekman grab sampler and were collected from the following depth zones in each lake: shallow (0–5 m), mid-depth (5–10 m), and deep (>10 m). At each sampling site, three replicate Ekman grab samples were collected a minimum of 5 to 25 m apart (depending on the size of the site). Each sediment sample was carefully transferred onto a white tray, photographed (Plate 2.4-1), and described for colour, texture, and organic content. The sample was then divided into two equal parts. From each part, the top 2 cm of sediment was collected and placed into a clean, pre-labelled Whirl-Pak bag, sealed (no air bubbles), and kept cold and dark until the samples were sent to ALS, Yellowknife, NWT, before being forwarded to ALS, Burnanby, BC for analysis. One part of the sample was analyzed for particle size, and the second was analyzed for sediment chemistry.



Plate 2.4-1. Sediment sample from the shallow depth zone of Chair Lake, August 2010.

For data interpretation and graphing purposes, values below the detection limit ("non-detects") were considered to be half of the detection limit. Data were summarized by site and depth and compared to CCME sediment quality guidelines (CCME 2002).

2.4.1 Principal Components Analysis

Principal Components Analysis (PCA) was used to objectively summarize the sediment quality data, facilitating easy interpretation of the spatial pattern of the data (see Section 2.3.2 for explanation). The PCA was run on physical parameters, nutrients, and metals. Variables were excluded from the PCA if more than 20% of their values for samples were below the method detection limit (MDL). A cut-off level of 20% was selected, because most metals were detected in the sediments. For the remaining variables, any values below MDL were replaced with one half of the MDL value. All variables were log-transformed to normalize their distribution.

3. Results

3. Results

3.1 BATHYMETRY, LIMNOLOGY, AND LIGHT PENETRATION

Results of the lake bathymetry measurements and the locations of the sampling stations are presented in Figures 3.1-1 to 3.1-5. Temperature and dissolved oxygen profiles were taken at the deepest point in each lake (Figures 3.1-1 to 3.1-5). Appendix 1 contains the temperature and dissolved oxygen profile data and Figure 3.1-6 graphically illustrates the data. Table 3.1-1 summarizes Secchi depth, the calculated light attenuation coefficient, euphotic zone depth, and pH measurements taken at the site where the profile data and water quality samples were collected.

Table 3.1-1. Lake Characteristics and Euphotic Zone Depth, Back River Project, 2010

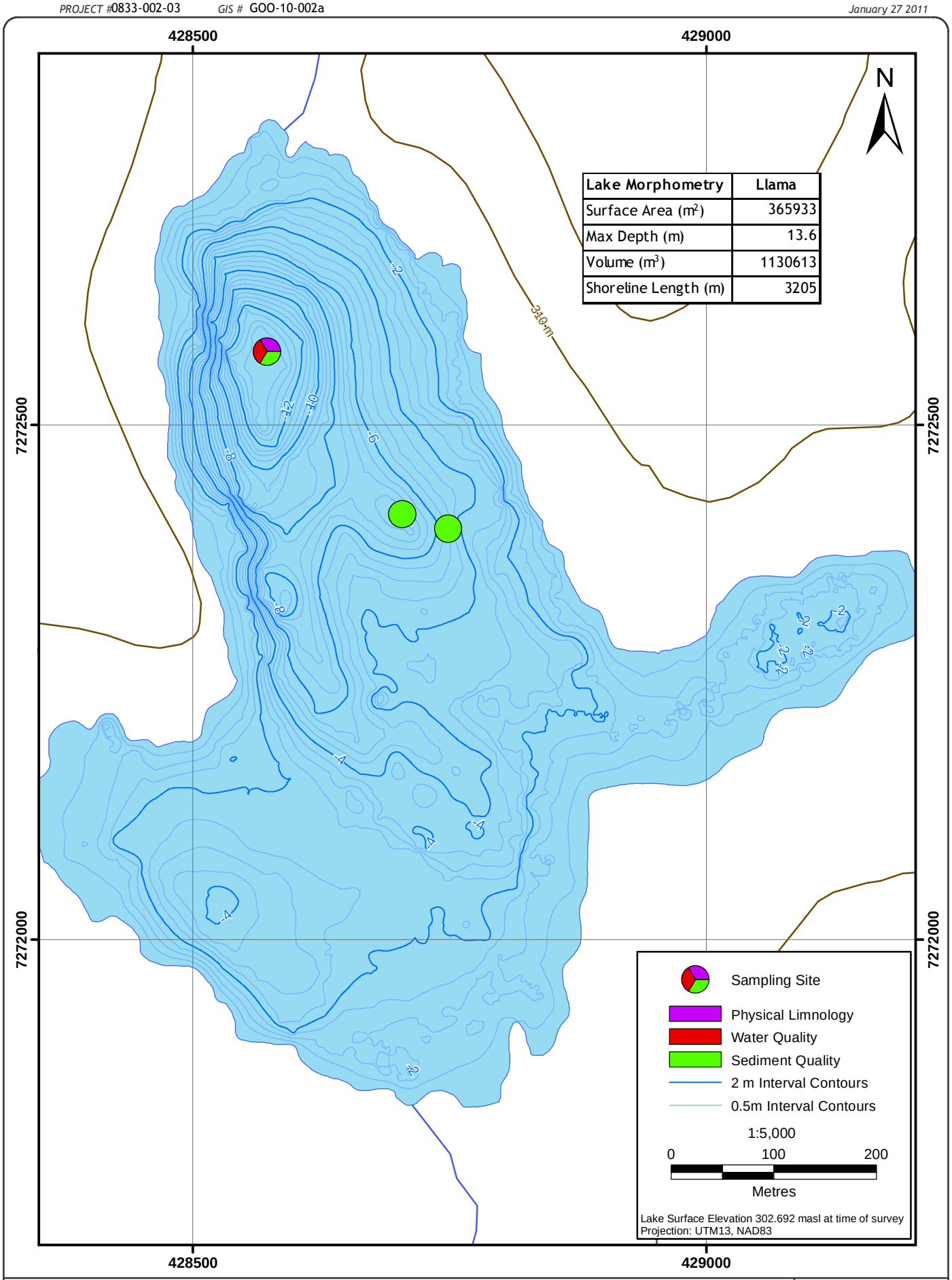
Watershed	Lake	Surface Area (m^2)	Maximum Depth (m)	Secchi Depth (m)	Euphotic Zone Depth ($Z_{1\%}$) (m)
Llama Watershed	Umwelt	193,603	2.7	2.7 (bottom)	bottom (11)
	Llama	365,933	13.6	5.5	bottom (22.3)
Chair Watershed	Mam	76,928	3.8	3.8 (bottom)	bottom (15.3)
	Chair	706,275	10.3	4.9	bottom (19.3)
Reference Watershed	Reference Lake B	322,402	5.1	4.3	bottom (17.3)

In general, Umwelt and Mam lakes were relatively shallow, clear, cold, and had the highest dissolved oxygen levels (Table 3.1-1, Figure 3.1-6). Llama and Chair lakes were deeper lakes, with slightly warmer water than Umwelt and Mam lakes, and had lower levels of dissolved oxygen. Reference Lake B had intermediate depth, temperature, dissolved oxygen, and light penetration. In all lakes, dissolved oxygen concentrations and saturation levels were greatest at the surface and decreased towards the sediment layer (Figure 3.1-6 Appendix 1), likely due to elevated photosynthesis near the surface and enhanced microbial activity in the sediments. Dissolved oxygen levels were nearly saturated in all five lakes (~95% in the surface; Appendix 1).

The calculated 1% euphotic zone depth was greater than the actual lake depth for all lakes. As a result, more than 1% of the surface irradiance reaches the bottom of the lakes, and there is sufficient light penetration for net primary production (photosynthesis exceeds respiration) throughout the lakes. This includes benthic primary producers such as macrophytes and microscopic periphyton.

3.2 WATER QUALITY

All raw water quality data can be found in Appendix 2a. Water quality parameters that have CCME water quality guidelines for the protection of aquatic life (CCME 2007), as well as other parameters of interest, were graphed for all study lakes unless values were consistently below analytical detection limits (Figures 3.2-2 to 3.2-17). Any values below analytical detection limits were replaced with half of the realized sample detection limit. The average determined for duplicate samples is presented where applicable. For water quality parameters with CCME guidelines, the guideline levels were included in the figures.

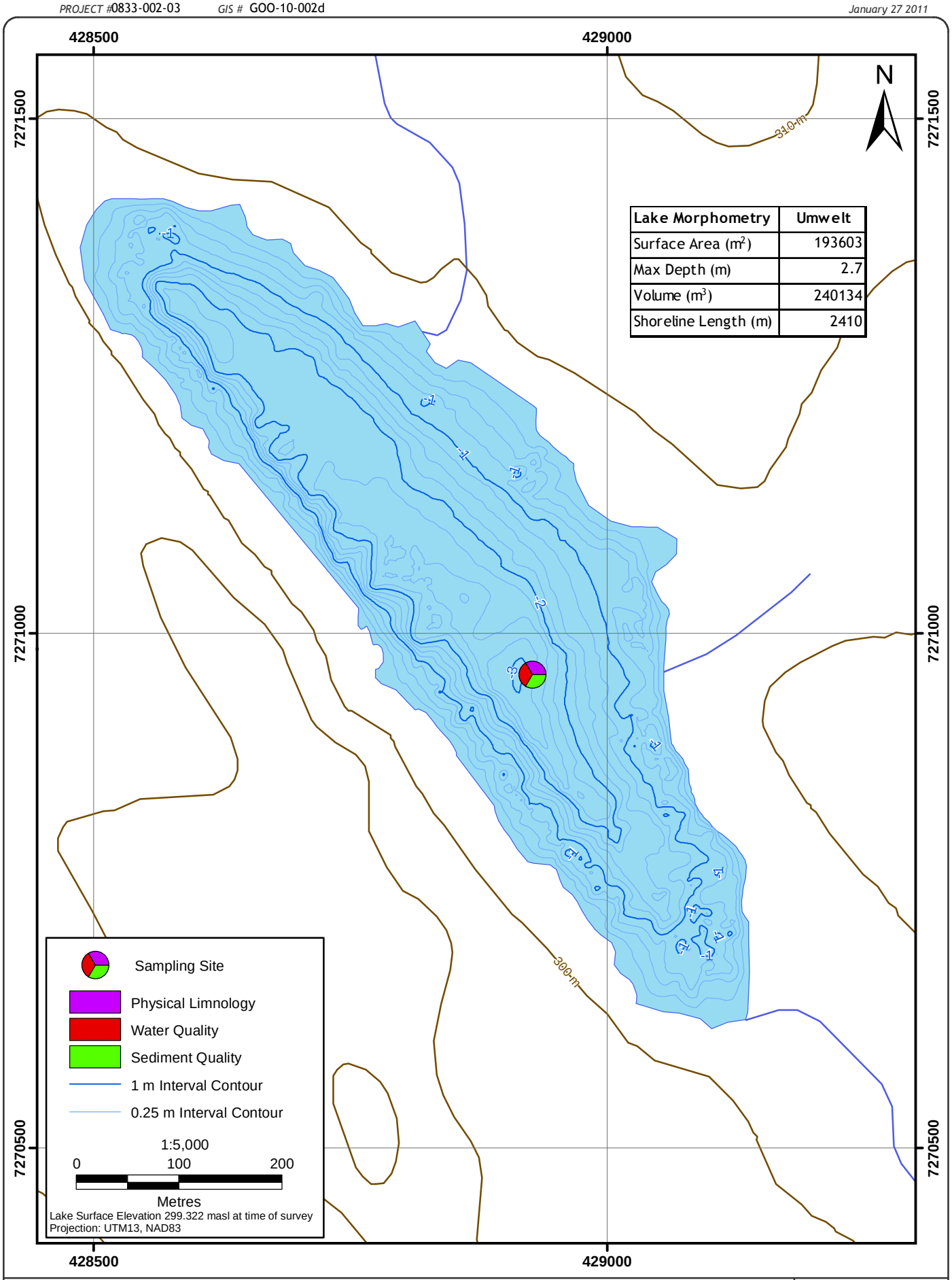


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Llama Lake
Bathymetry and Sampling Locations, August, 2010

Figure 3.1-1

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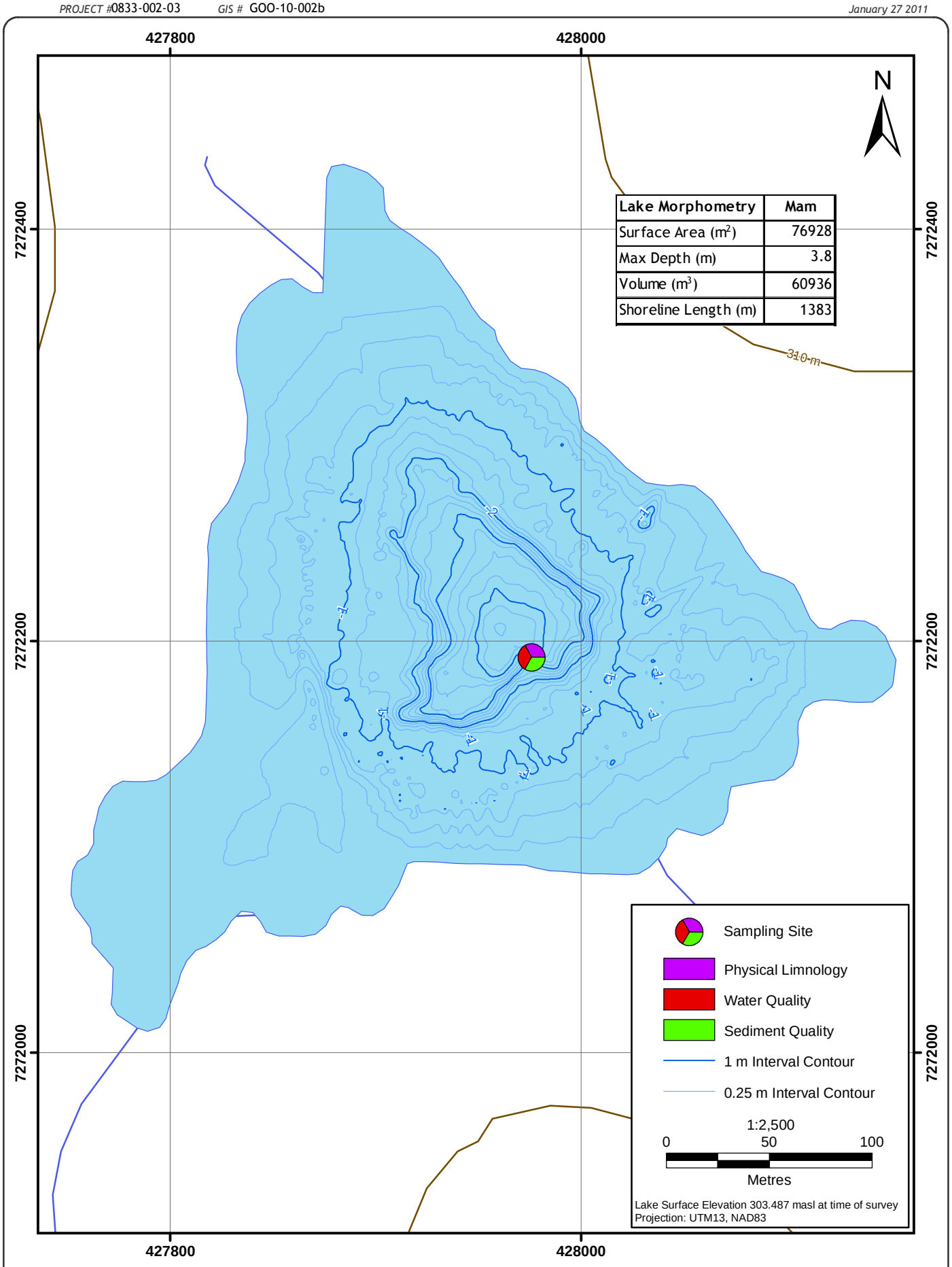


Sabina GOLD & SILVER CORP.

Umwelt Lake
Bathymetry and Sampling Locations, August, 2010

Figure 3.1-2

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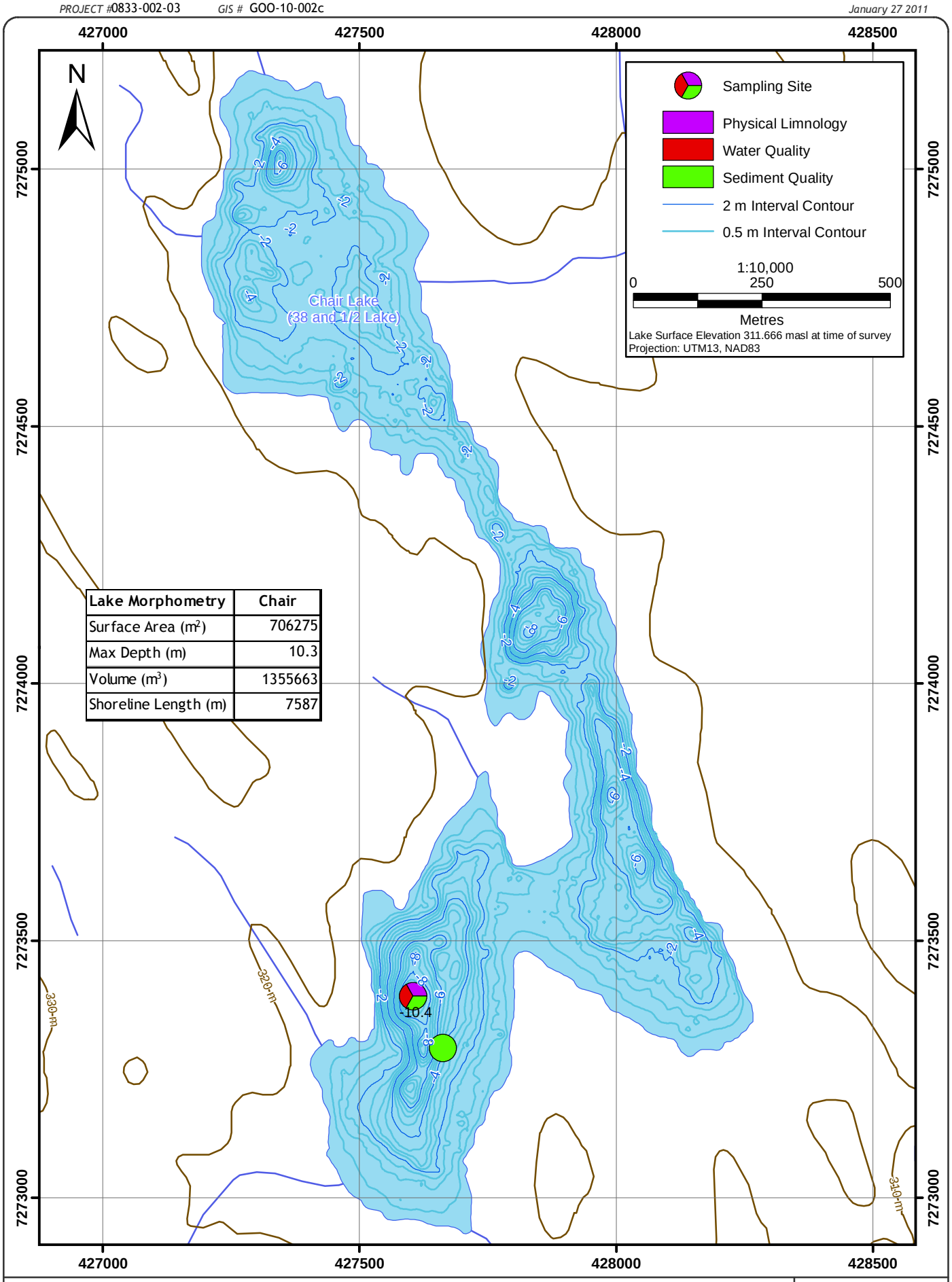


Sabina GOLD & SILVER CORP.

Mam Lake
Bathymetry and Sampling Locations, August, 2010

Figure 3.1-3

Rescan™ Engineers & Scientists



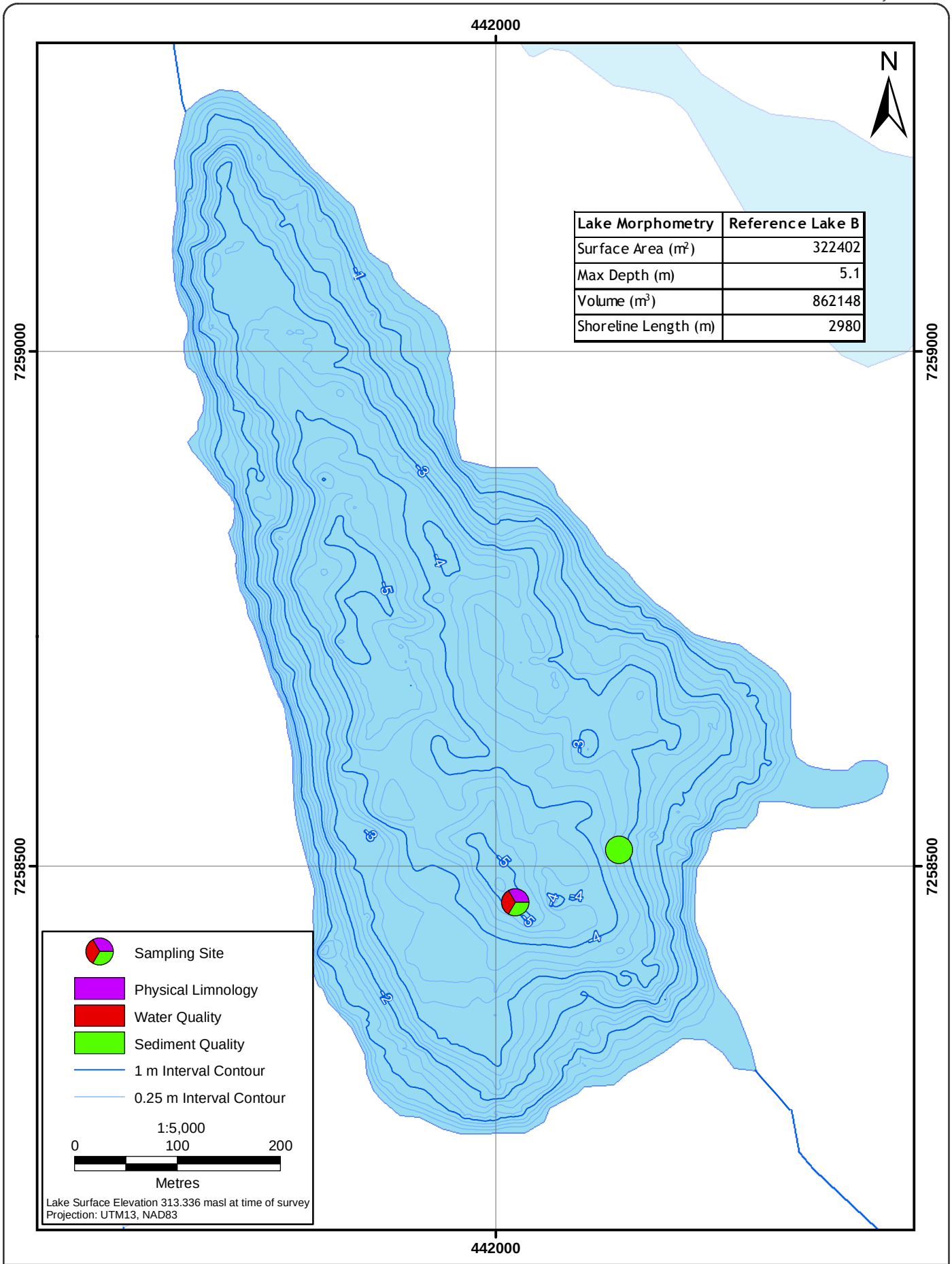
Lake Morphometry	Chair
Surface Area (m^2)	706275
Max Depth (m)	10.3
Volume (m^3)	1355663
Shoreline Length (m)	7587

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Chair Lake
Bathymetry and Sampling Locations, August, 2010

Figure 3.1-4

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Reference Lake B
Bathymetry and Sampling Locations, August, 2010

Figure 3.1-5

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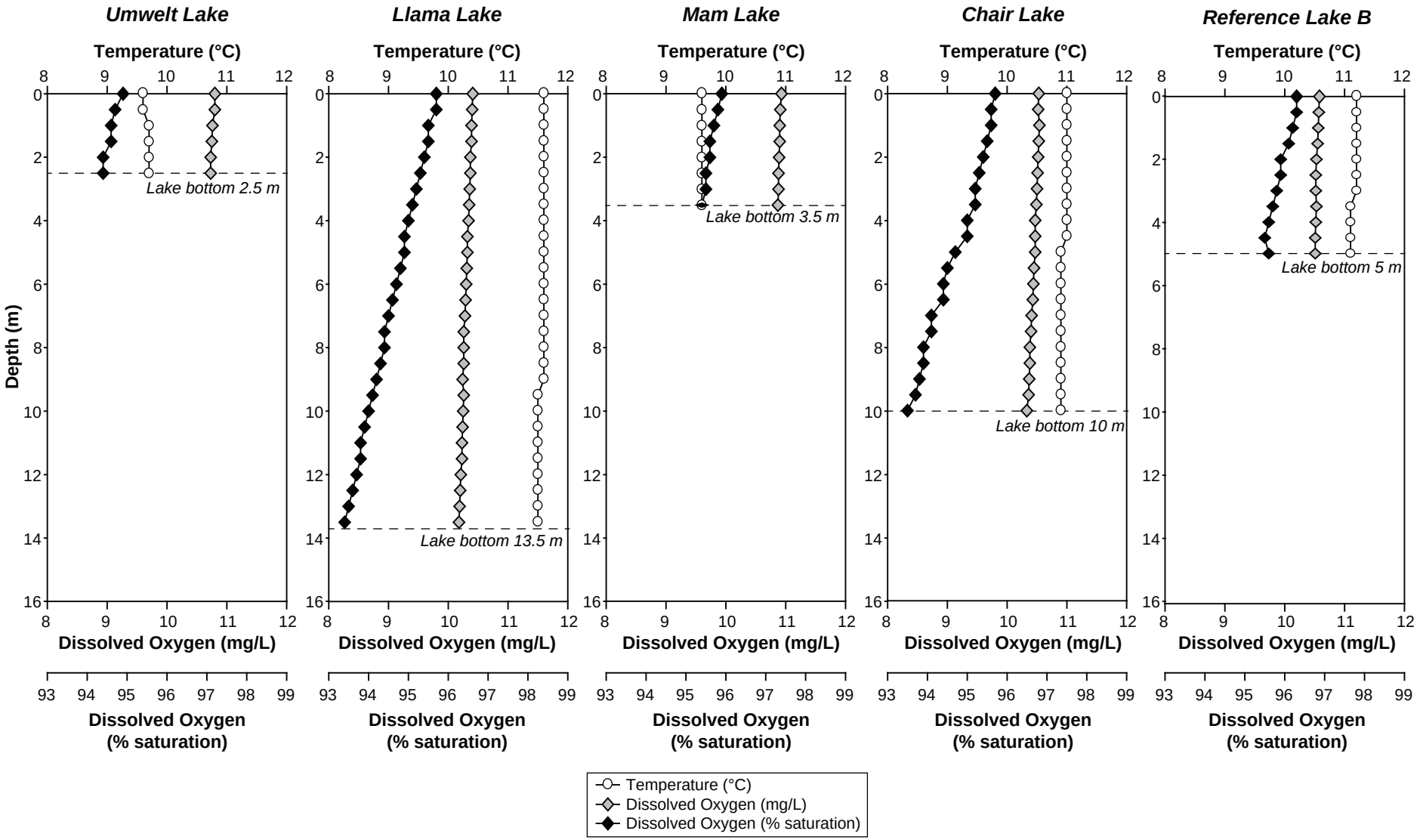


Figure 3.1-6

Lake Temperature and Dissolved Oxygen Profiles, Back River Project, August 2010

Figure 3.1-6

3.2.1 Principal Components Analysis Results

Results of the water quality PCA are presented in Figure 3.2-1 and Appendix 2b. The plots were created to illustrate the relative location of the sites in ordination space, the loadings of the water quality parameters, and the variation in the data explained by the principal components. The sites were separated in ordination space based on the water quality parameters used in the analysis. Thus, the site locations in Figure 3.2-1b can be superimposed over the environmental variables in Figure 3.2-1a indicating the dominant environmental features in each lake.

Overall, principal components 1 (x-axis) and 2 (y-axis) explained 74.2% of the variation in the data set (Appendix 2b). Umwelt and Llama lakes, located on top of and near the ore zone, had the highest levels of most total metals, pH, conductivity, and hardness. Notably, Llama Lake was situated in ordinal space near several ions and metals that suggest a marine influence (e.g., sodium, chloride, magnesium, calcium, sulphate, etc.), potentially through groundwater inputs. This is possible since ancient seabed does underlay this region. Umwelt Lake showed some marine influence, but with higher concentrations of several metals than Llama Lake (e.g., copper, chromium, nickel, and zinc). Chair and Mam lakes had intermediate levels of most metals, turbidity, and total phosphorus compared to the other lakes, but did have the highest iron concentrations. Reference Lake B was generally metal-poor, with the highest turbidity and total phosphorus levels of the five lakes.

3.2.2 General Parameters and Anions

Arctic lakes are often soft water, poorly buffered systems (0–30 mg $CaCO_3$), with relatively low levels of hardness, alkalinity, total dissolved solids, and conductivity (Pienitz et al. 1997; Ruhland and Smol 1998). Water quality samples collected from the five lakes in the Back River area confirm these characteristics, as the hardness and total alkalinity ranged from 6.2 to 14.7 mg/L and 4.1 to 5.1 mg $CaCO_3$/L, respectively. The highest levels of each were found in Llama Lake (Figure 3.2-2).

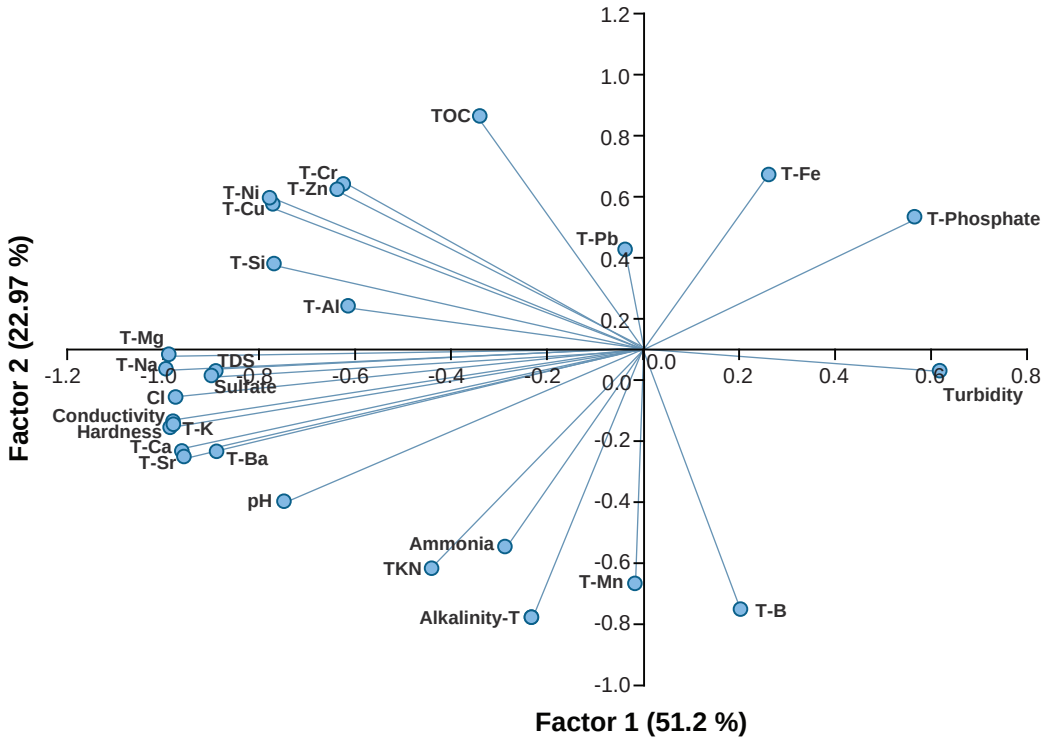
Despite the poor buffering capacity, each of the lakes was slightly basic, ranging from 7.4 in Chair Lake to 8.4 in Umwelt Lake, and changed little with depth (Figure 3.2-3). These were within the limits recommended by the CCME guidelines (pH: 6.5–9.0). The sampled lakes had limited conductivity, ranging from 15.6 (Reference Lake B) to 37.9 µS/cm (Llama Lake; Figure 3.2-3), and low levels of total dissolved solids (TDS) and sulphate concentrations (Figure 3.2-4). Concentrations of TDS ranged from below detection limits (10 mg/L; Reference Lake B) to 31 mg/L (Llama Lake), while sulphate ranged between 1.6 mg/L (Reference Lake B) and 3.7 mg/L (Llama Lake).

The general trend of these physical parameters was the highest levels were found in Llama and Umwelt lakes, intermediate levels in Chair and Mam lakes, with the lowest levels furthest away at Reference Lake B.

3.2.3 Suspended Material and Nutrients

Suspended material, whether dissolved or particulate, absorbs or reflects incoming irradiation, thereby affecting the light quantity and quality available to aquatic primary producers. The lakes in this sampling program were relatively free of suspended material, with no detectable levels of total suspended solids (TSS), and very low levels of turbidity in each lake (Figure 3.2-5). The absence of TSS suggests that particulate and dissolved organic material, as well as dissolved inorganic material, largely influence the light regime. The low levels of light attenuating substances give the high water clarity observed in the lakes, as seen by the deep Secchi depths and 1% light levels that reach the sediment surface (Table 3.1-1). This indicates that benthic primary production is possible over the entire portion of each lake. Reference Lake B had the highest turbidity of the sampled lakes (0.67 NTU), which corresponded to the shallowest Secchi depth measured (Table 3.1-1).

a) PCA biplot showing loadings for water quality parameters included in analysis



b) PCA of Back River sites based on August 2010 water quality data

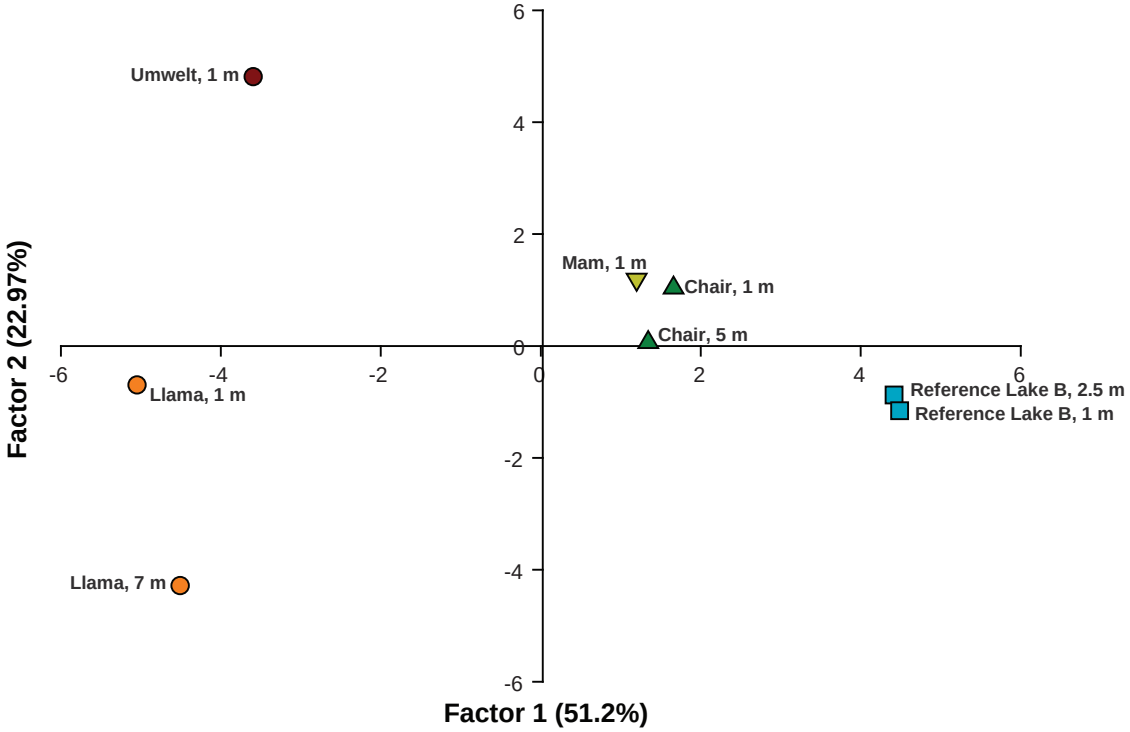
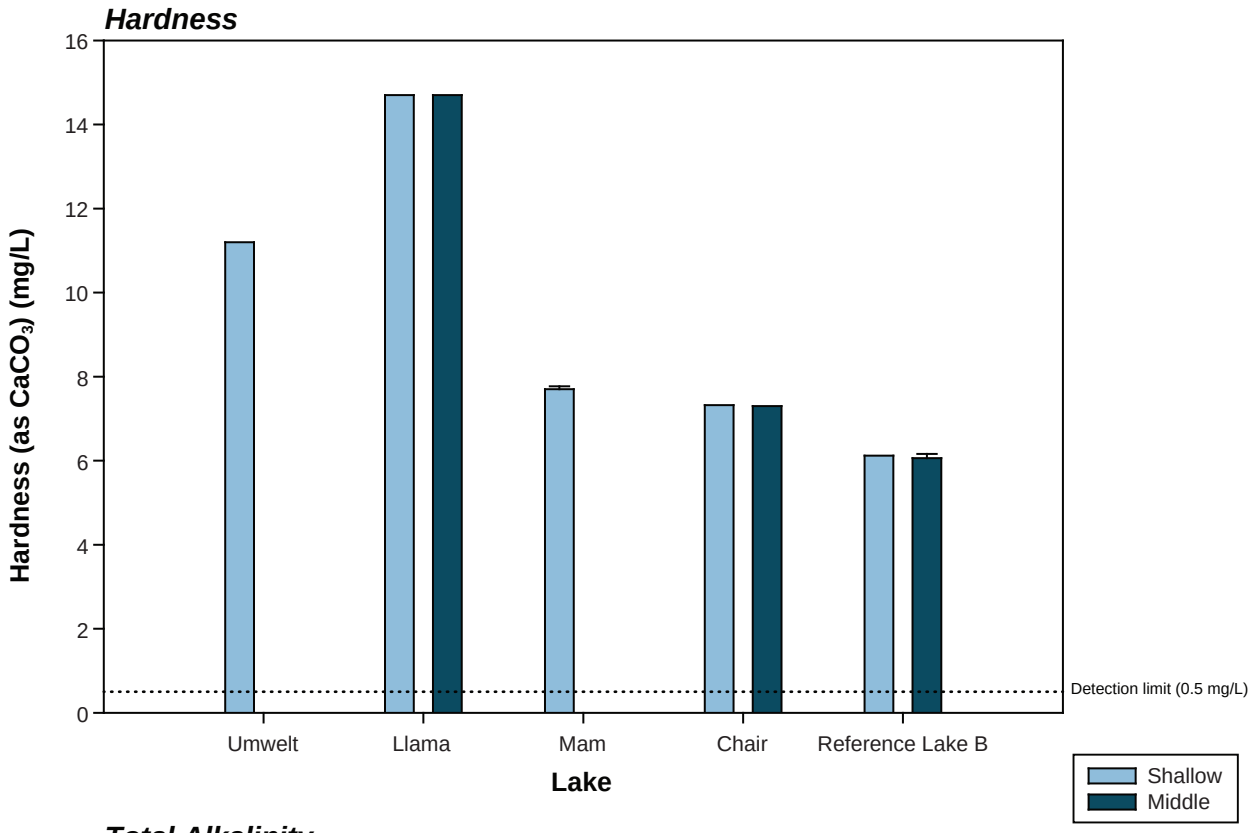
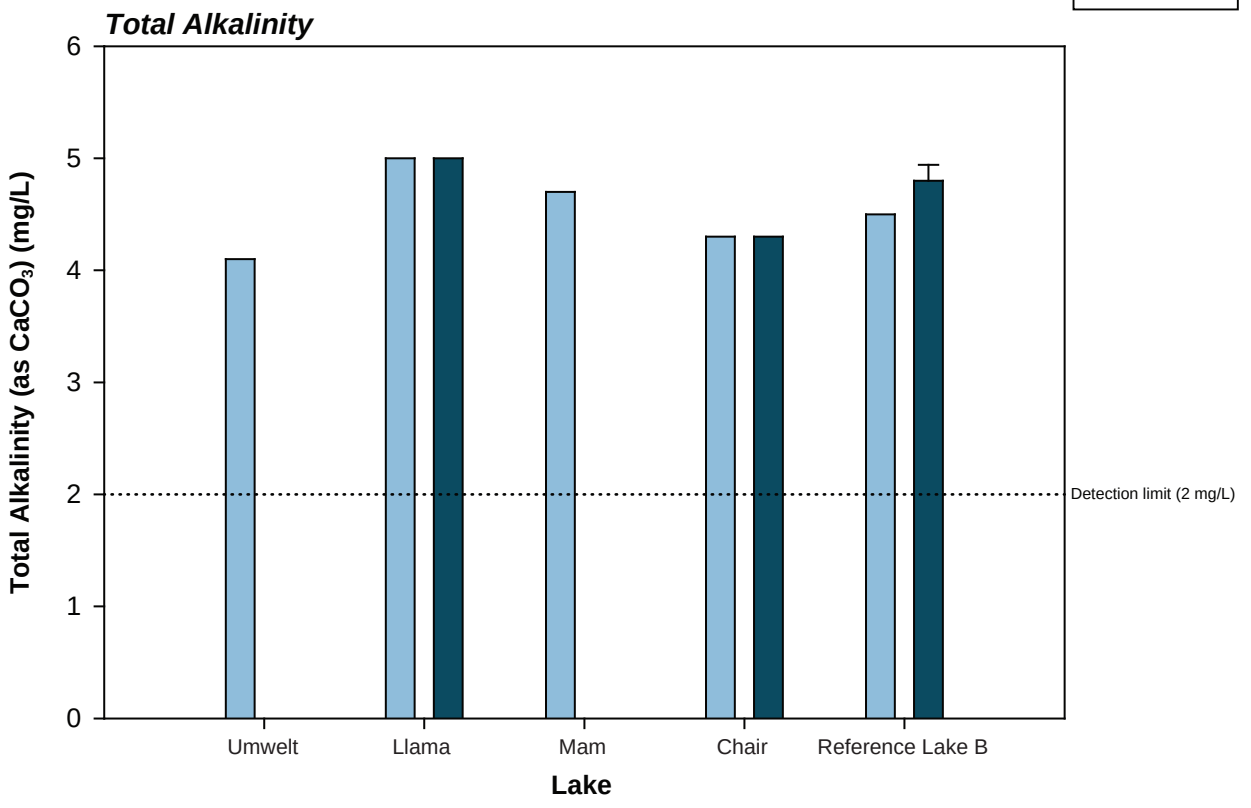


Figure 3.2-1

Principal Component Analysis of Back River Project Water Quality Sites





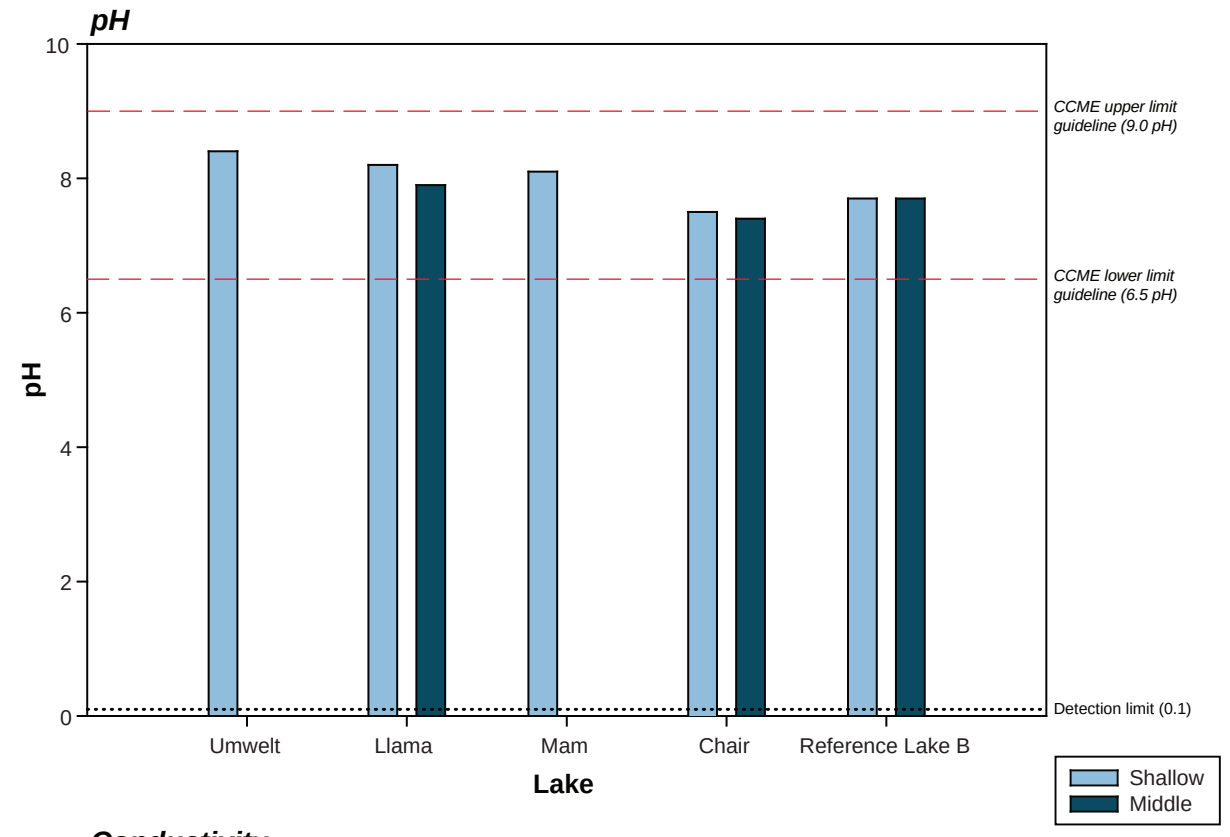
Note: Error bars represent standard error of the mean.

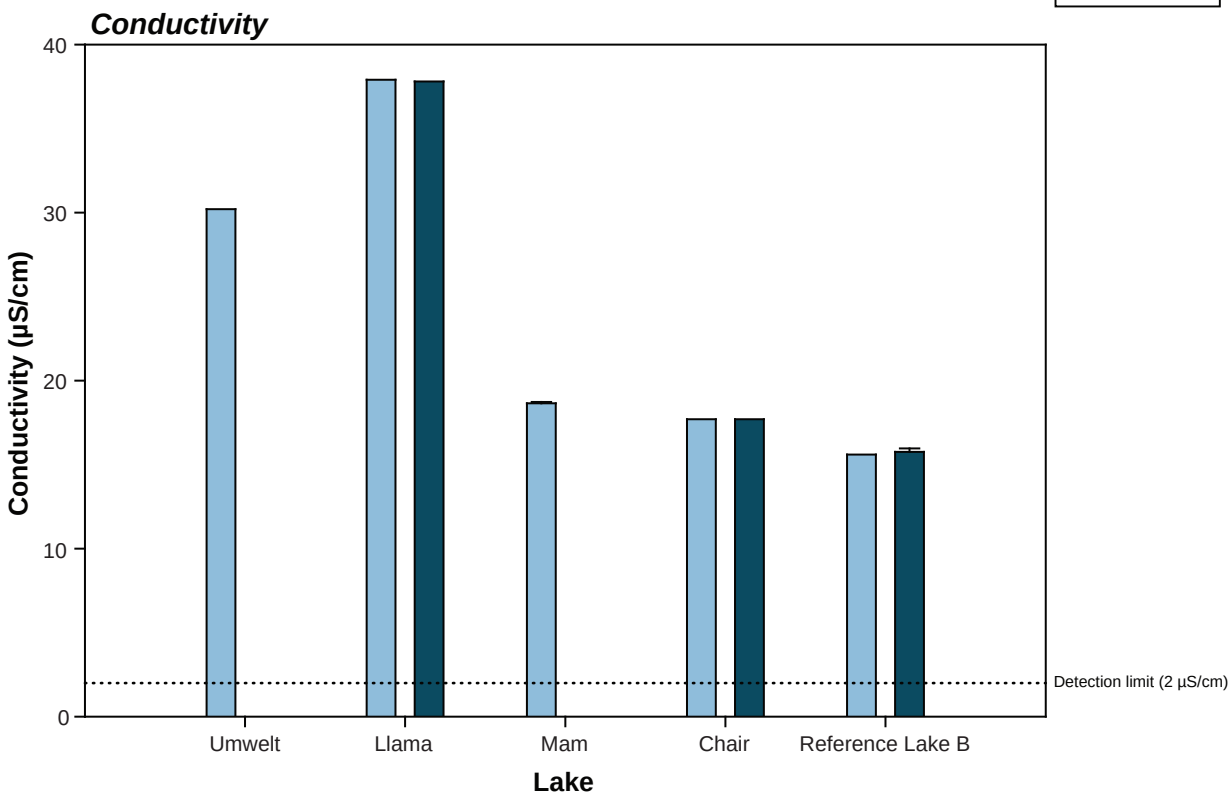
Sabina GOLD & SILVER CORP.

Hardness and Total Alkalinity Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-2

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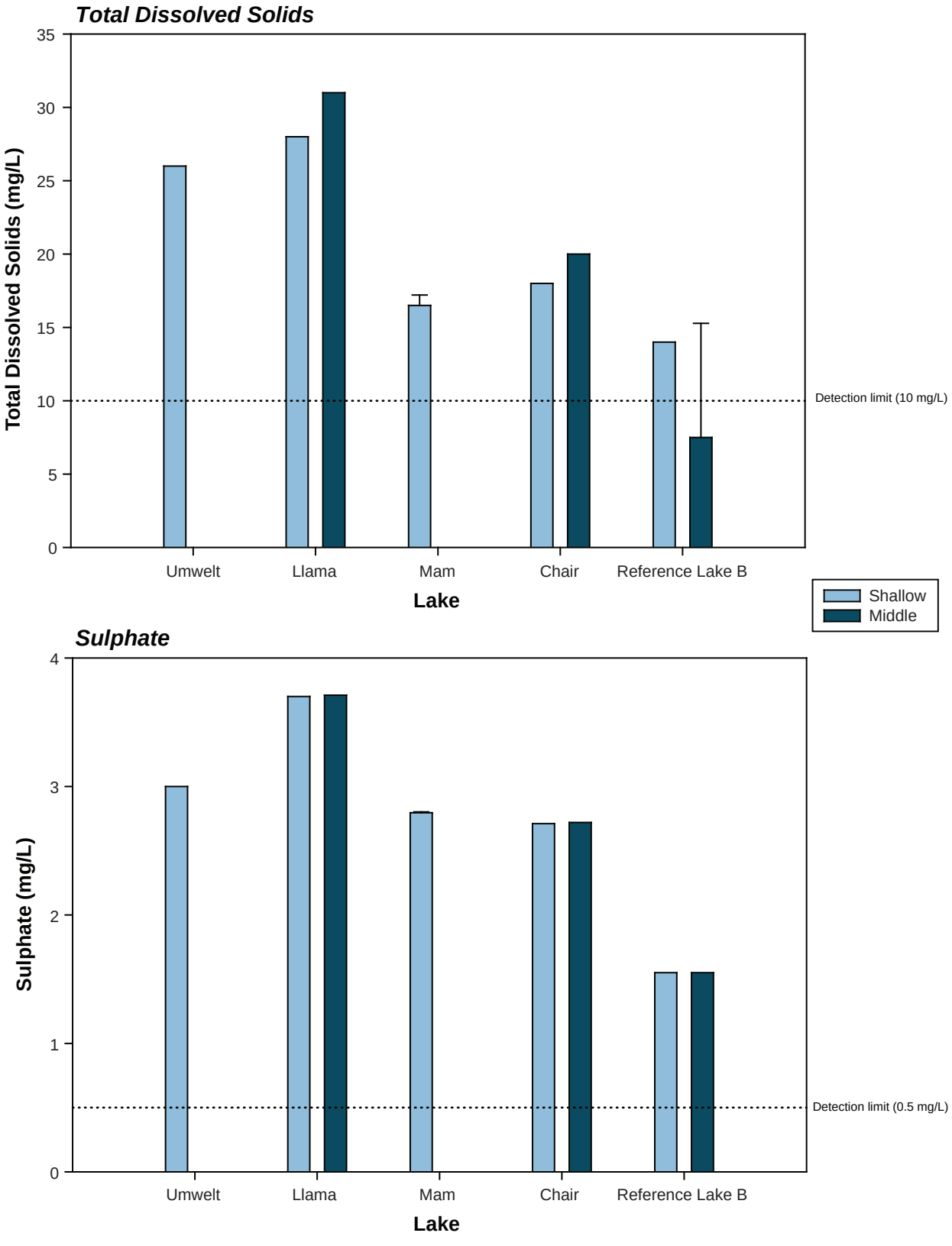
Note: Error bars represent standard error of the mean.

Sabina GOLD & SILVER CORP.

pH and Conductivity in the Lakes of the Back River Project Area, August 2010

Figure 3.2-3

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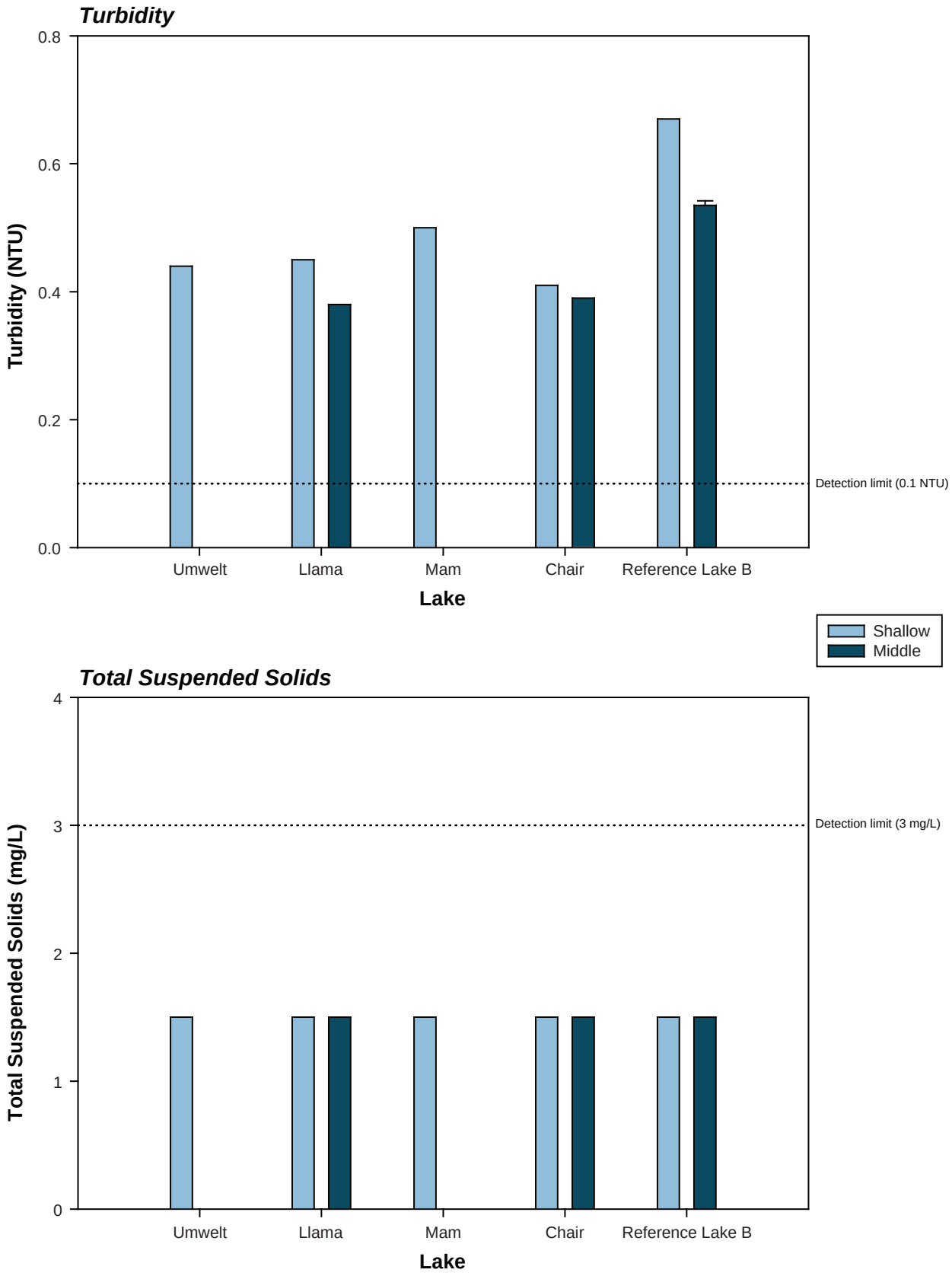
Note: Error bars represent standard error of the mean.

Sabina GOLD & SILVER CORP.

Total Dissolved Solids and Sulphate Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-4

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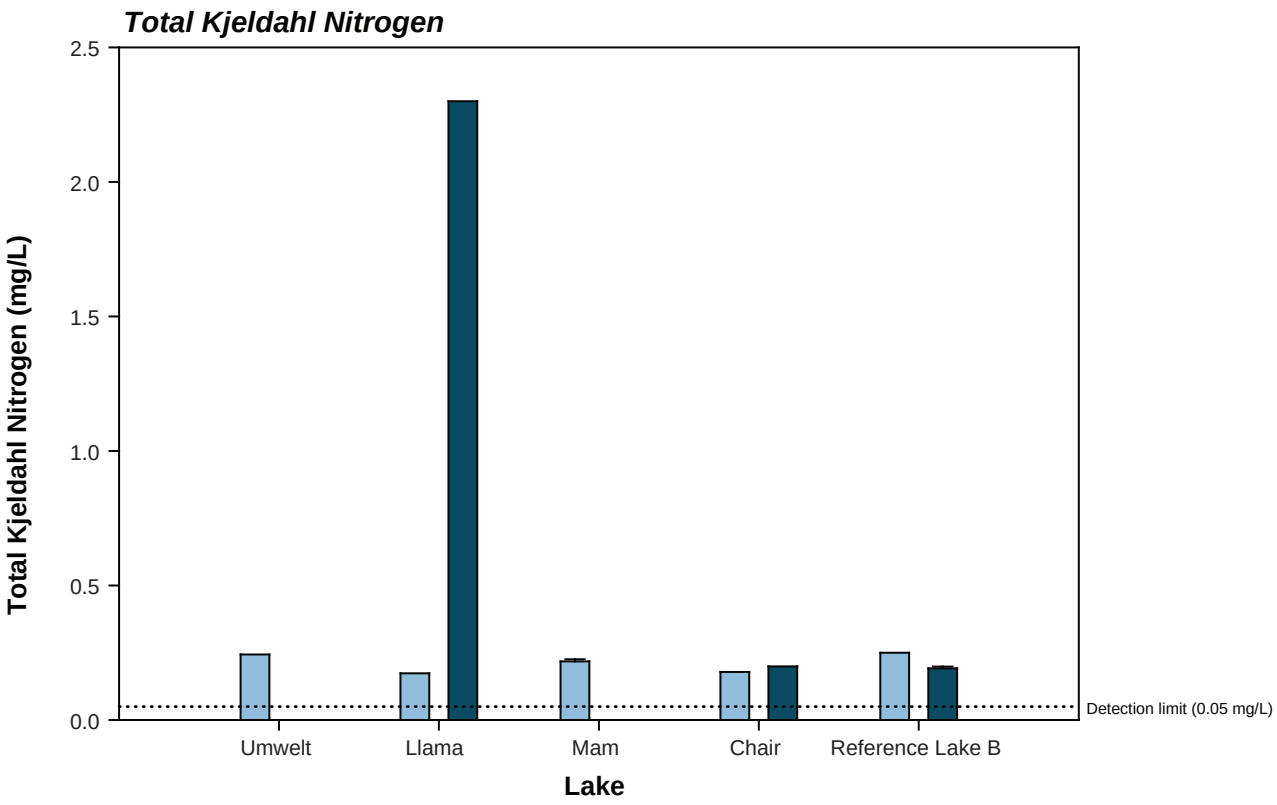
Note: Error bars represent standard error of the mean.

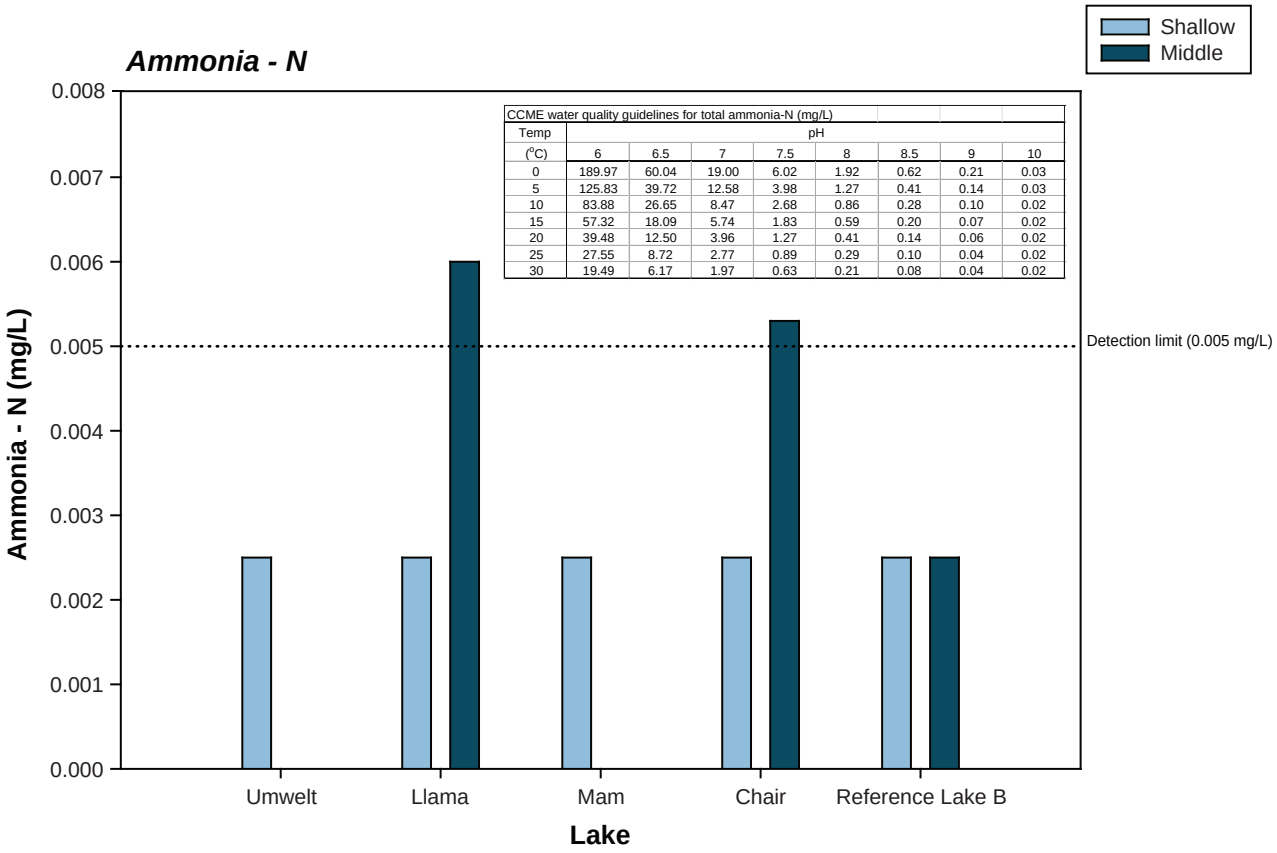
Sabina GOLD & SILVER CORP.

Turbidity and Total Suspended Solids in the Lakes of the Back River Project Area, August 2010

Figure 3.2-5

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CCME water quality guidelines for total ammonia-N (mg/L)

Temp	pH							
(°C)	6	6.5	7	7.5	8	8.5	9	10
0	189.97	60.04	19.00	6.02	1.92	0.62	0.21	0.03
5	125.83	39.72	12.58	3.98	1.27	0.41	0.14	0.03
10	83.88	26.65	8.47	2.68	0.86	0.28	0.10	0.02
15	57.32	18.09	5.74	1.83	0.59	0.20	0.07	0.02
20	39.48	12.50	3.96	1.27	0.41	0.14	0.06	0.02
25	27.55	8.72	2.77	0.89	0.29	0.10	0.04	0.02
30	19.49	6.17	1.97	0.63	0.21	0.08	0.04	0.02

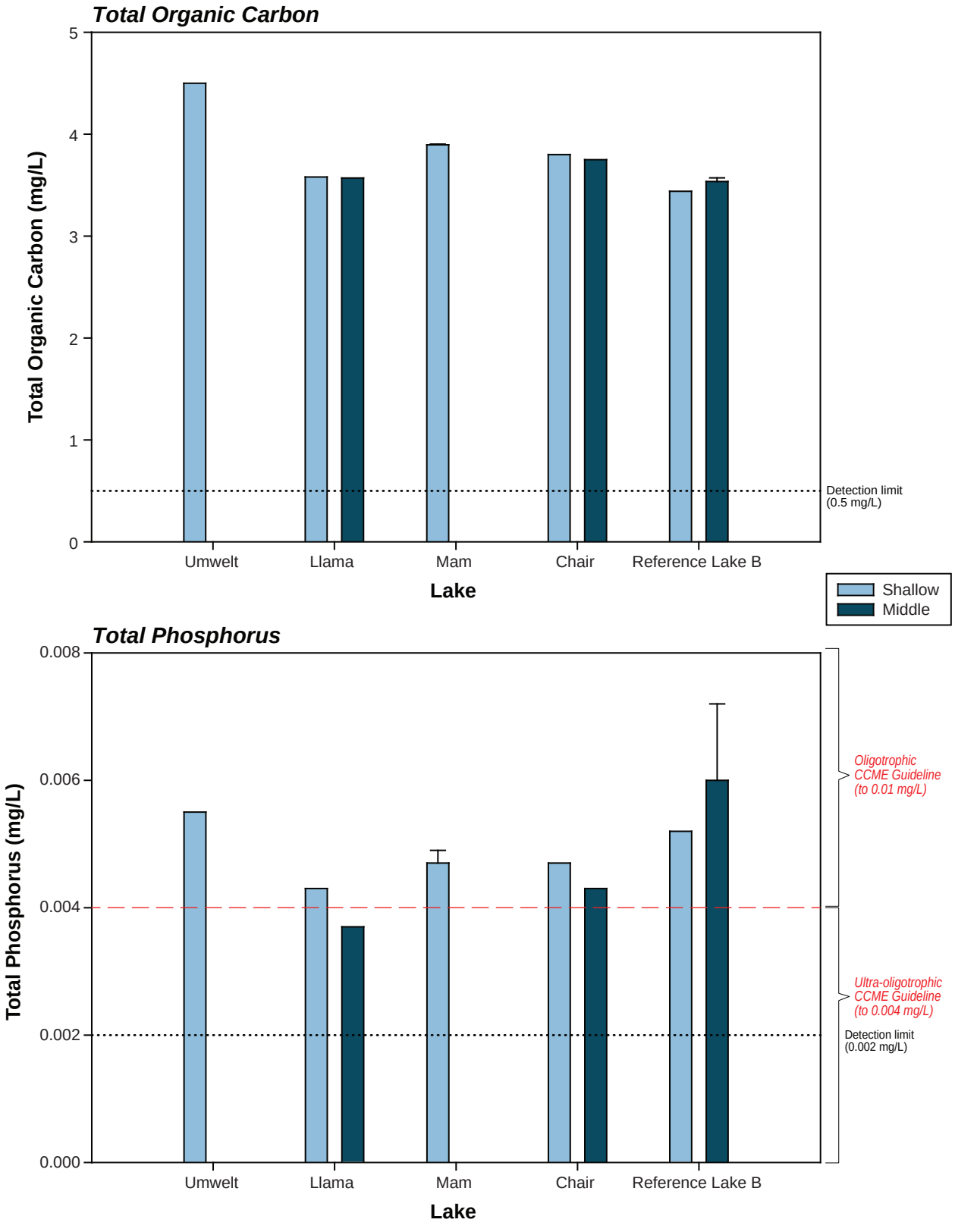
Note: Error bars represent standard error of the mean.
CCME guidelines are for the protection of freshwater aquatic life.
No CCME guideline listed for Total Kjeldahl Nitrogen.

Sabina GOLD & SILVER CORP.

Total Kjeldahl Nitrogen and Ammonia Nitrogen Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-6

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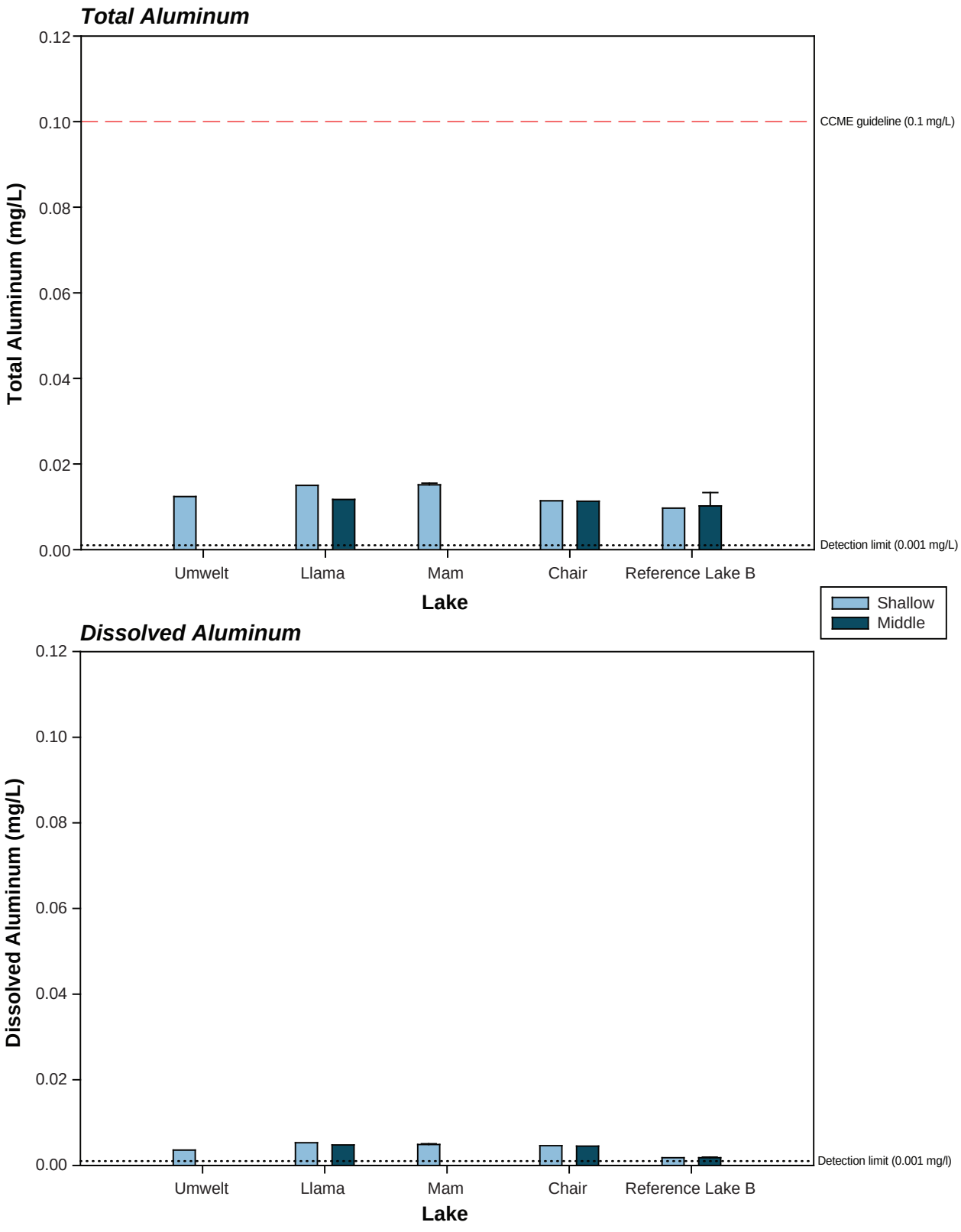
Note: Error bars represent standard error of the mean.
No CCME guideline exists for Total Organic Carbon.

Sabina GOLD & SILVER CORP.

Total Organic Carbon and Total Phosphorus Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-7

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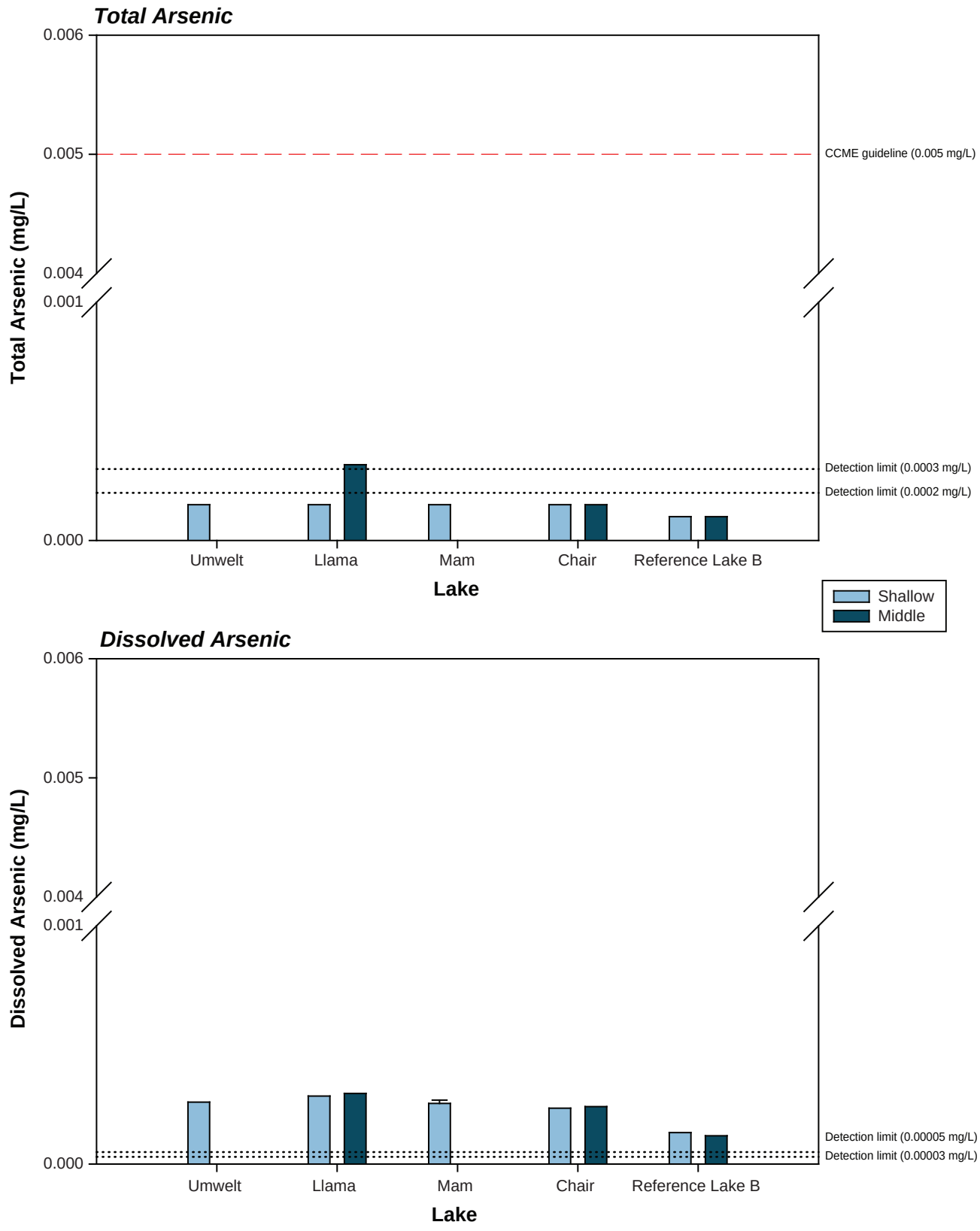
Notes: Error bars represent standard error of the mean.
Red dashed line represents CCME guideline and is pH-dependent: 0.005 mg/L, at pH less than 6.5 or 0.1 mg/L, at pH greater than or equal to 6.5.
pH values were greater than 6.5 for all samples and sites (based on field measurements).
** Indicates values that are higher than their sample guideline.*
CCME guidelines are for Total Metal concentrations.

Sabina GOLD & SILVER CORP.

Total and Dissolved Aluminum Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-8

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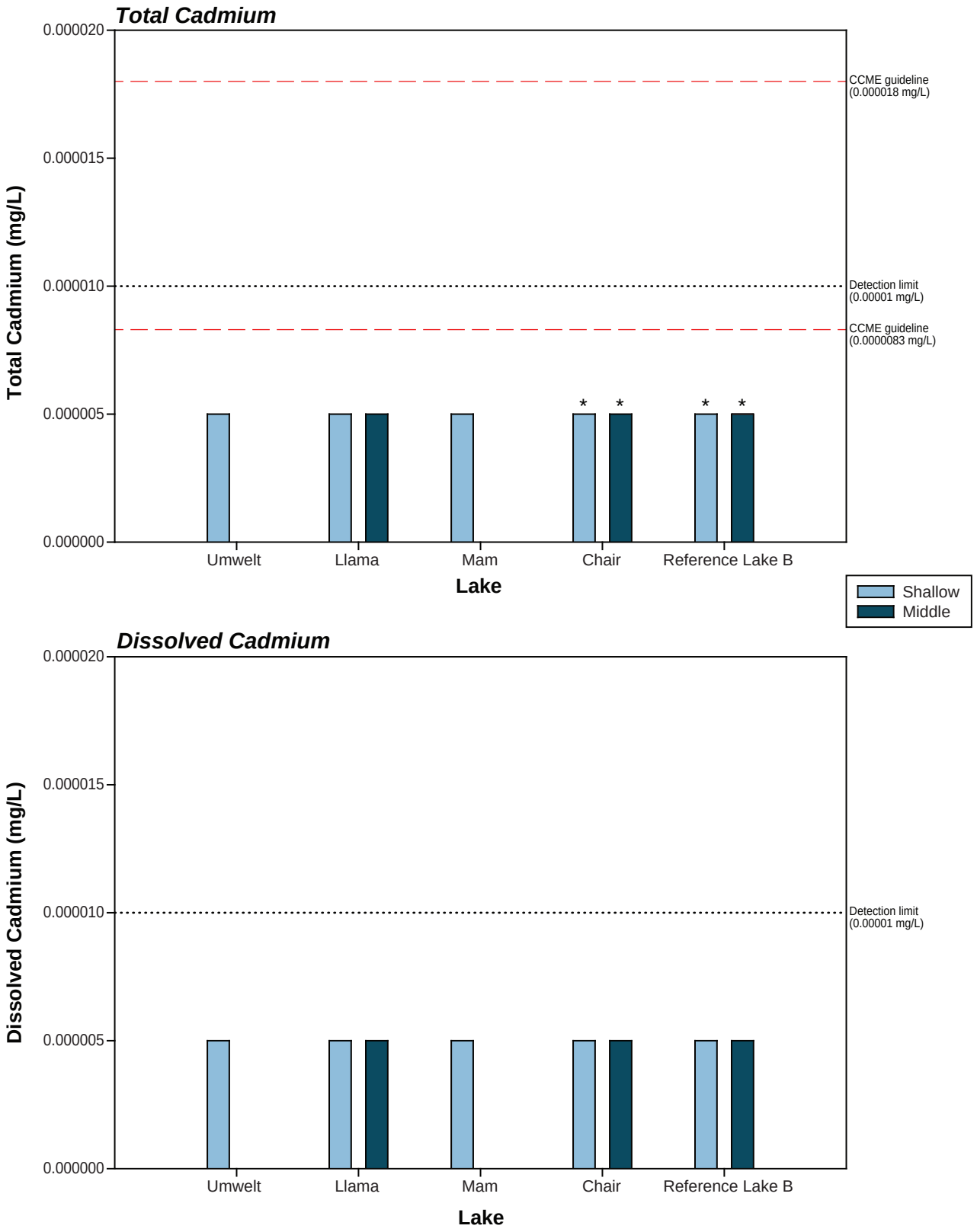
Notes: Error bars represent standard error of the mean.
Red dashed line represents CCME guideline.
CCME guidelines are for Total Metal concentrations.
Detection limits within and between analysis for total and dissolved arsenic concentration.

Sabina GOLD & SILVER CORP.

Total and Dissolved Arsenic Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-9

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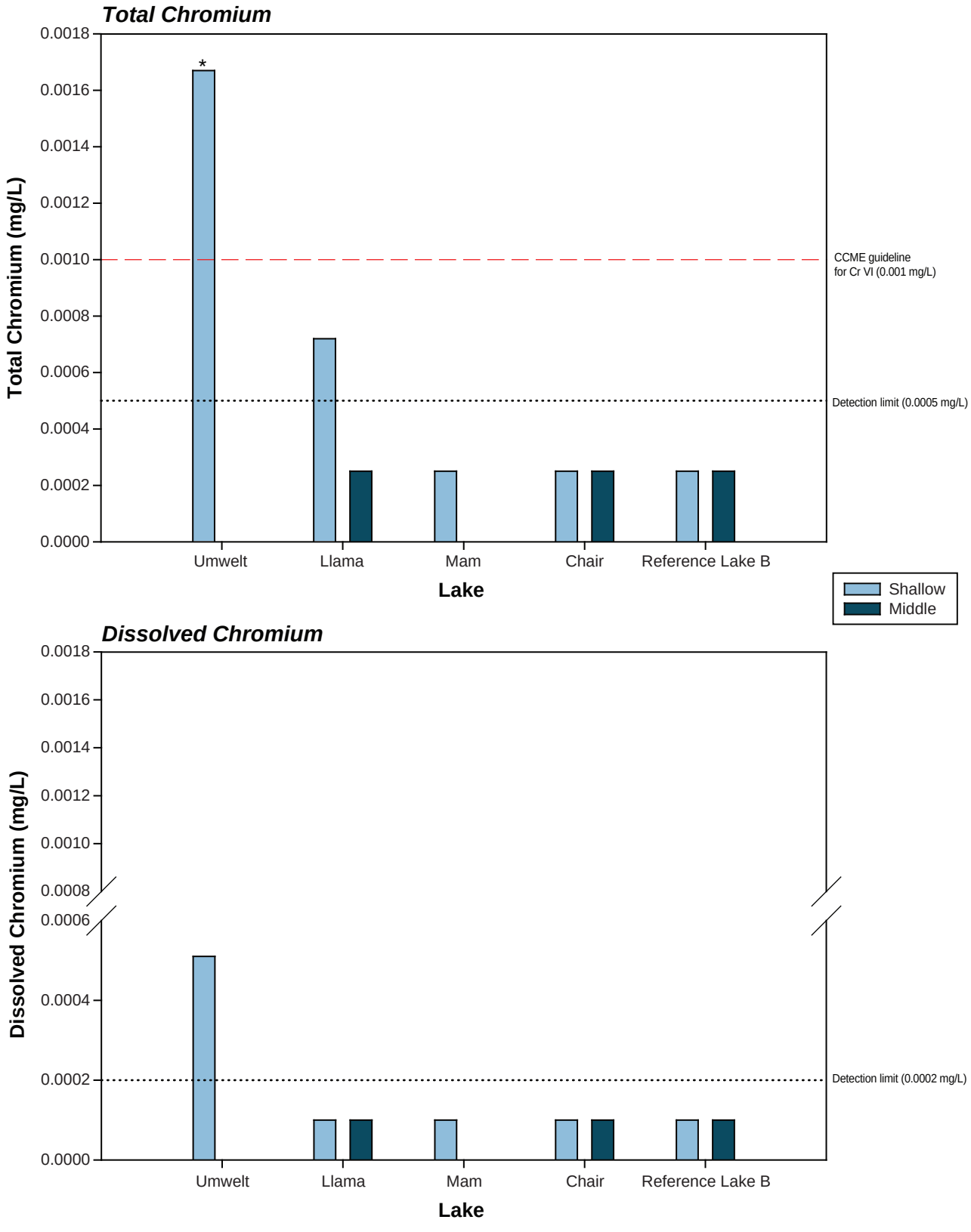
Notes: Error bars represent standard error of the mean.
CCME guideline for Total Metal concentrations is hardness-dependent
(CCME guideline = $0.001*10^{(0.86[\log(\text{hardness})]-3.2)}$ mg/L) and ranged from 0.0000083 to 0.000018.
The range is indicated in the figures.
**indicates total cadmium detection limit that is higher than hardness-corrected CCME guideline.*

Sabina GOLD & SILVER CORP.

Total and Dissolved Cadmium Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-10

Rescan™ Engineers & Scientists



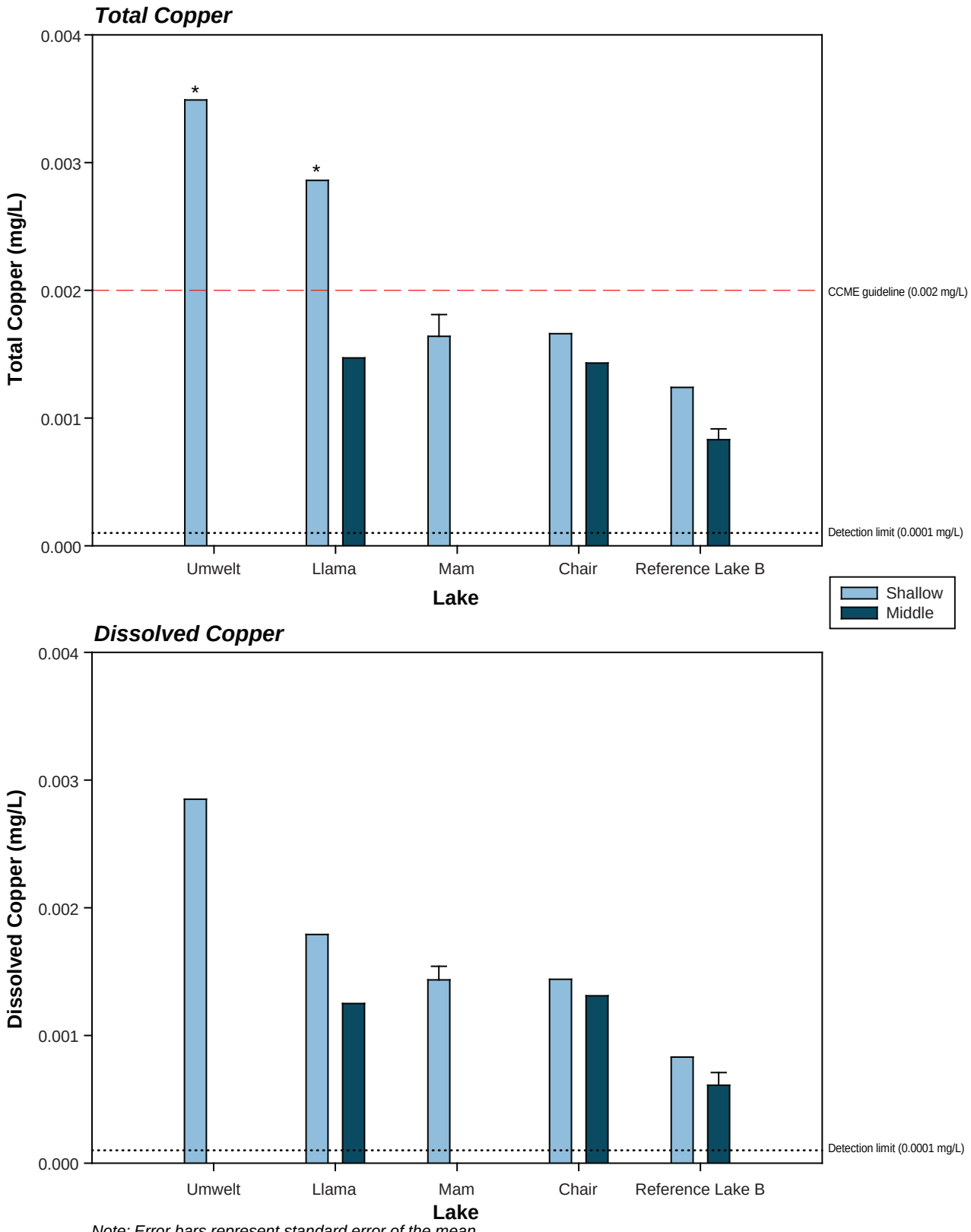
Note: Error bars represent standard error of the mean.
** Indicates values that are higher than their sample guideline.*
CCME guidelines are for Total Metal concentrations.

Sabina GOLD & SILVER CORP.

Total and Dissolved Chromium Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-11

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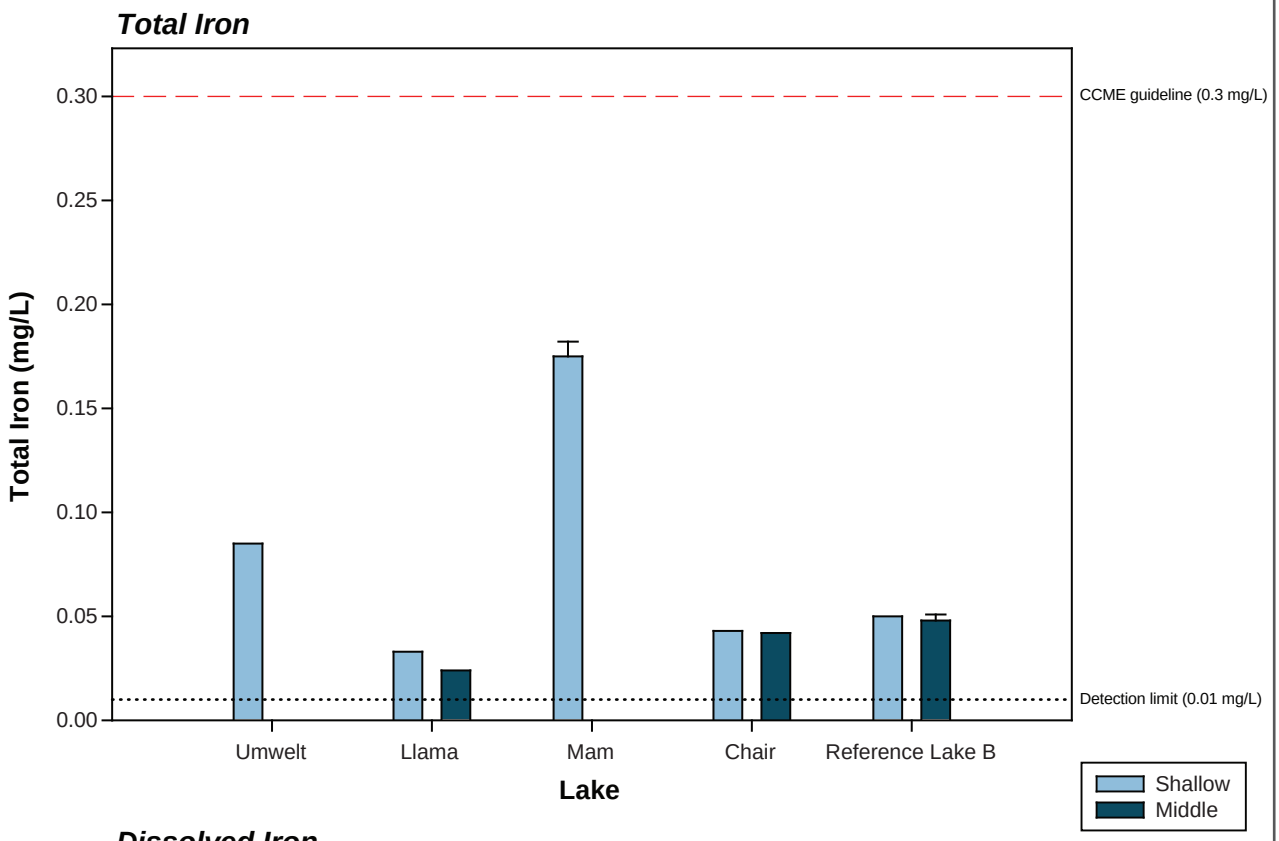
Note: Error bars represent standard error of the mean.
Red dashed line represents CCME guideline for total metals (0.002 mg/L at [$CaCO_3$] = 0-120 mg/L; 0.003 mg/L at [$CaCO_3$] = 120-180 mg/L; 0.004 mg/L at [$CaCO_3$] = >180 mg/L).
** Indicates values that are higher than their sample guideline.*
CCME guidelines are for Total Metal concentrations.

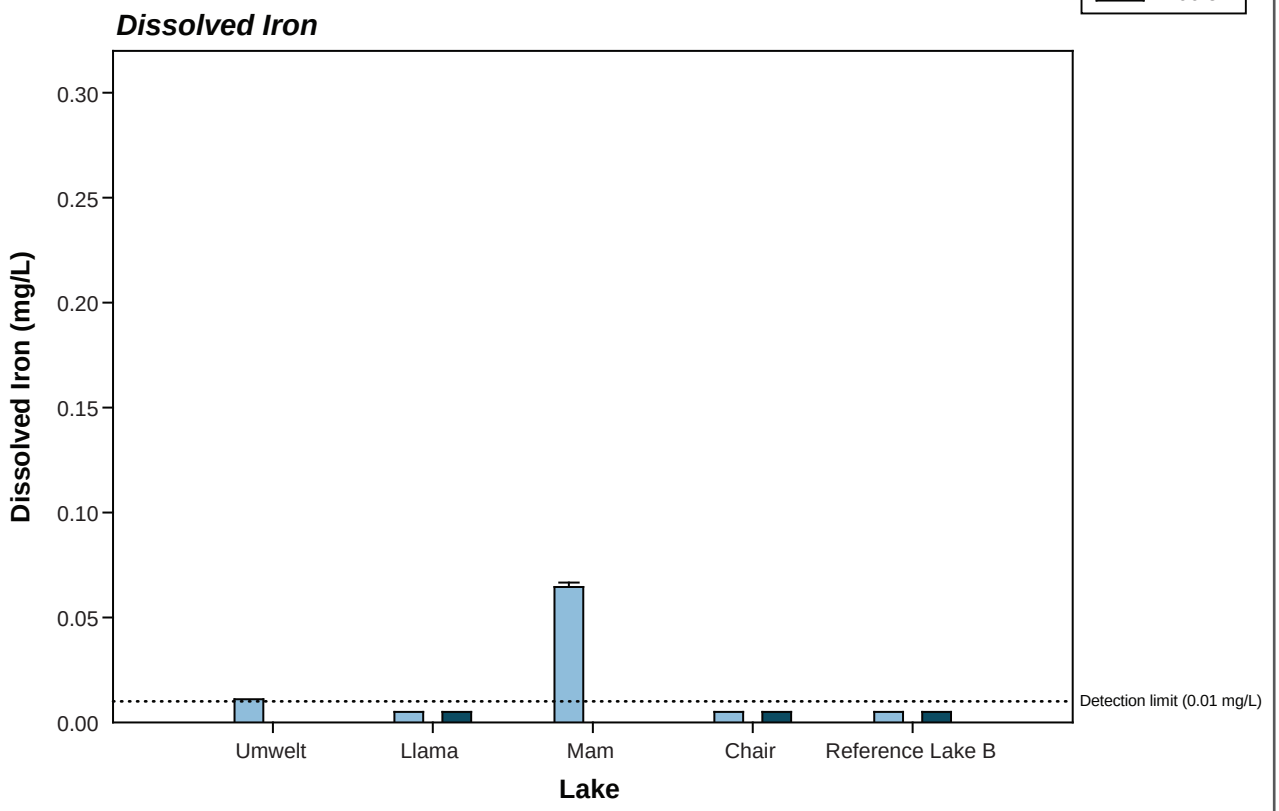
Sabina GOLD & SILVER CORP.

Total and Dissolved Copper Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-12

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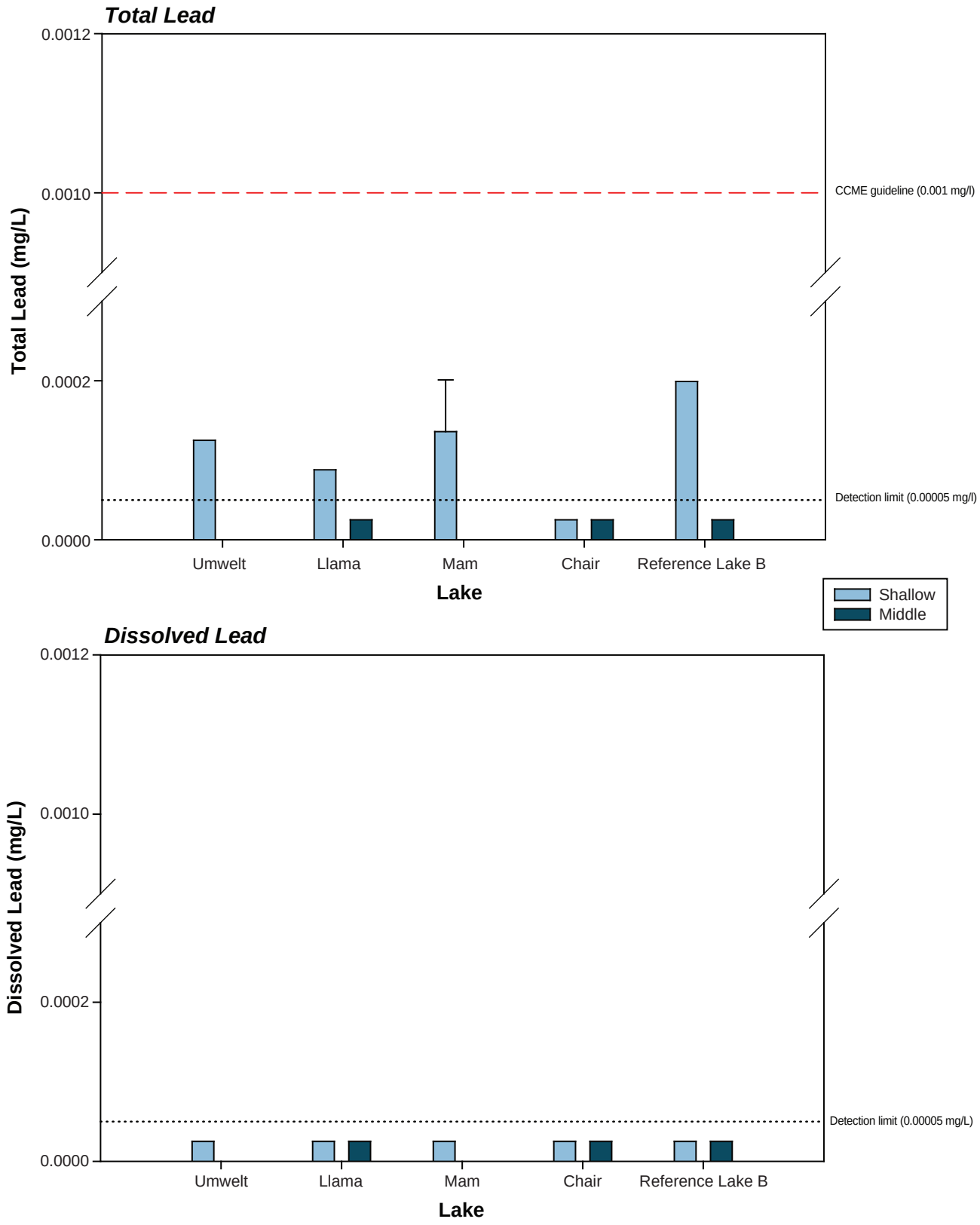
Note: Error bars represent standard error of the mean.
CCME guidelines are for Total Metal concentrations.

Sabina GOLD & SILVER CORP.

Total and Dissolved Iron Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-13

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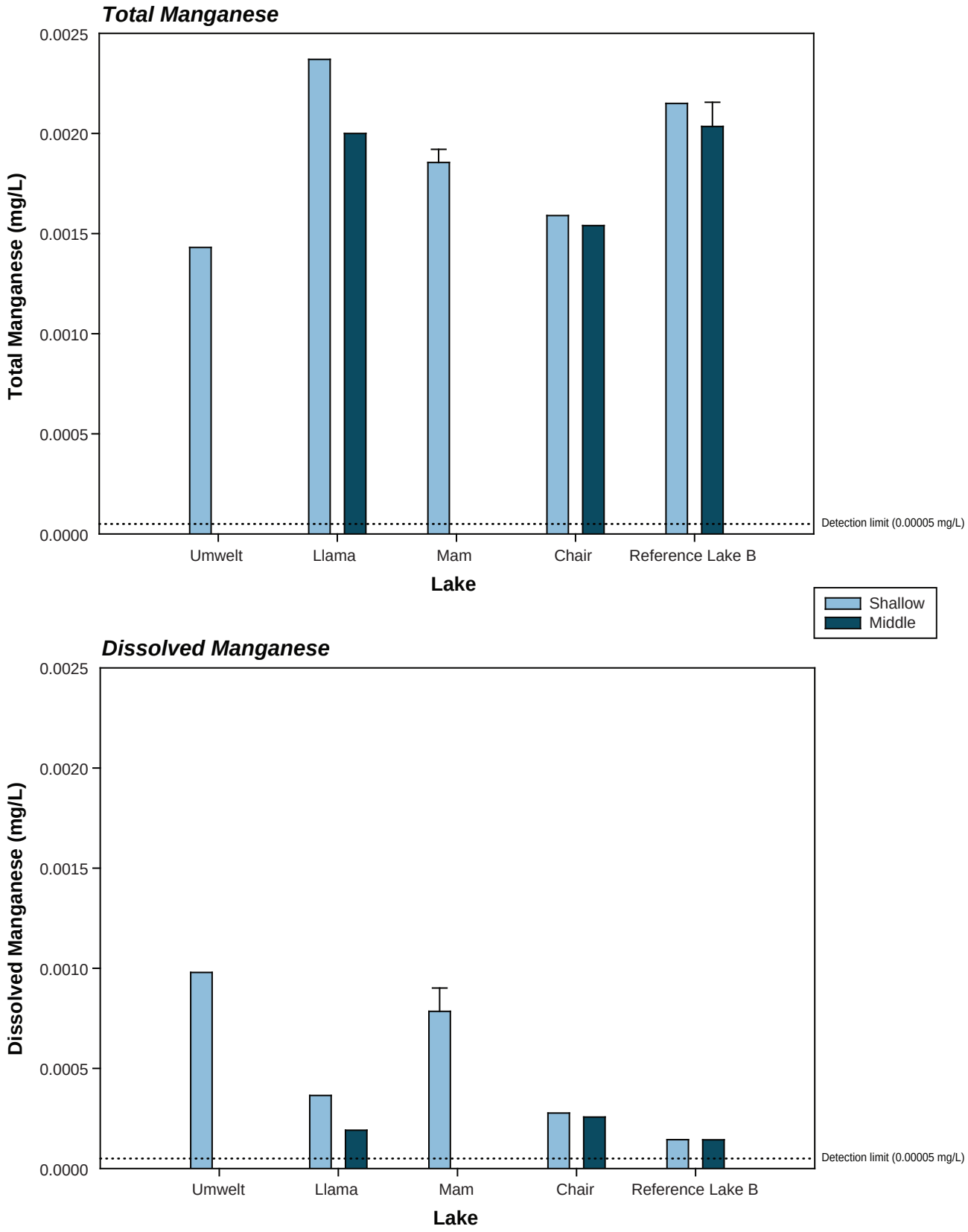
Notes: Error bars represent standard error of the mean.
Red dashed line represents CCME guideline and are for Total Metal concentrations (0.001 mg/L at [$CaCO_3$] = 0-60 mg/L; 0.002 mg/L at [$CaCO_3$] = 60-120 mg/L; 0.004 mg/L at [$CaCO_3$] = 120-180 mg/L; 0.007 mg/L at [$CaCO_3$] = > 180 mg/L).
** Indicates values that are higher than their sample guideline.*

Sabina GOLD & SILVER CORP.

Total and Dissolved Lead Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-14

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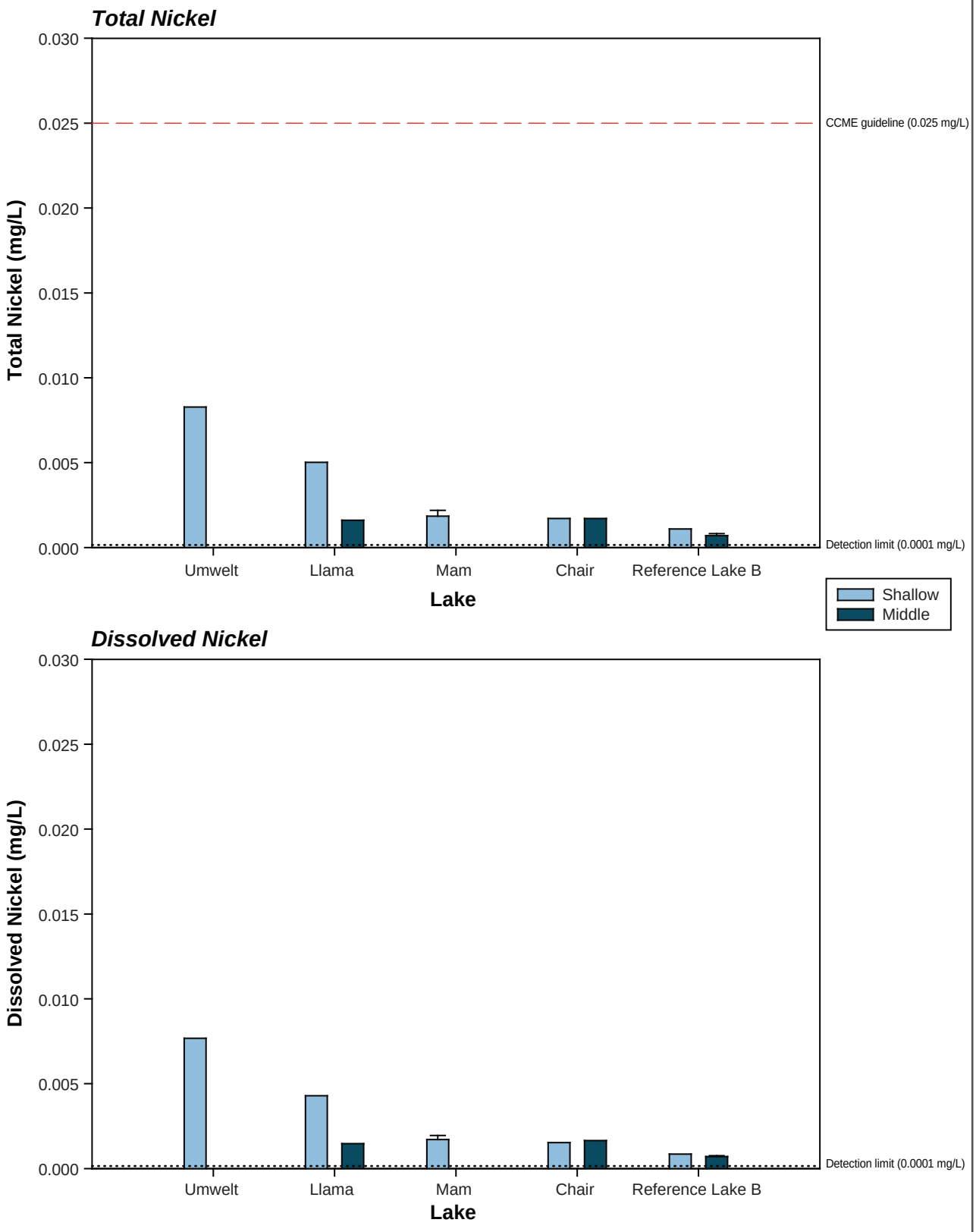
Note: Error bars represent standard error of the mean.
No CCME guideline exists for manganese.

Sabina GOLD & SILVER CORP.

Total and Dissolved Manganese Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-15

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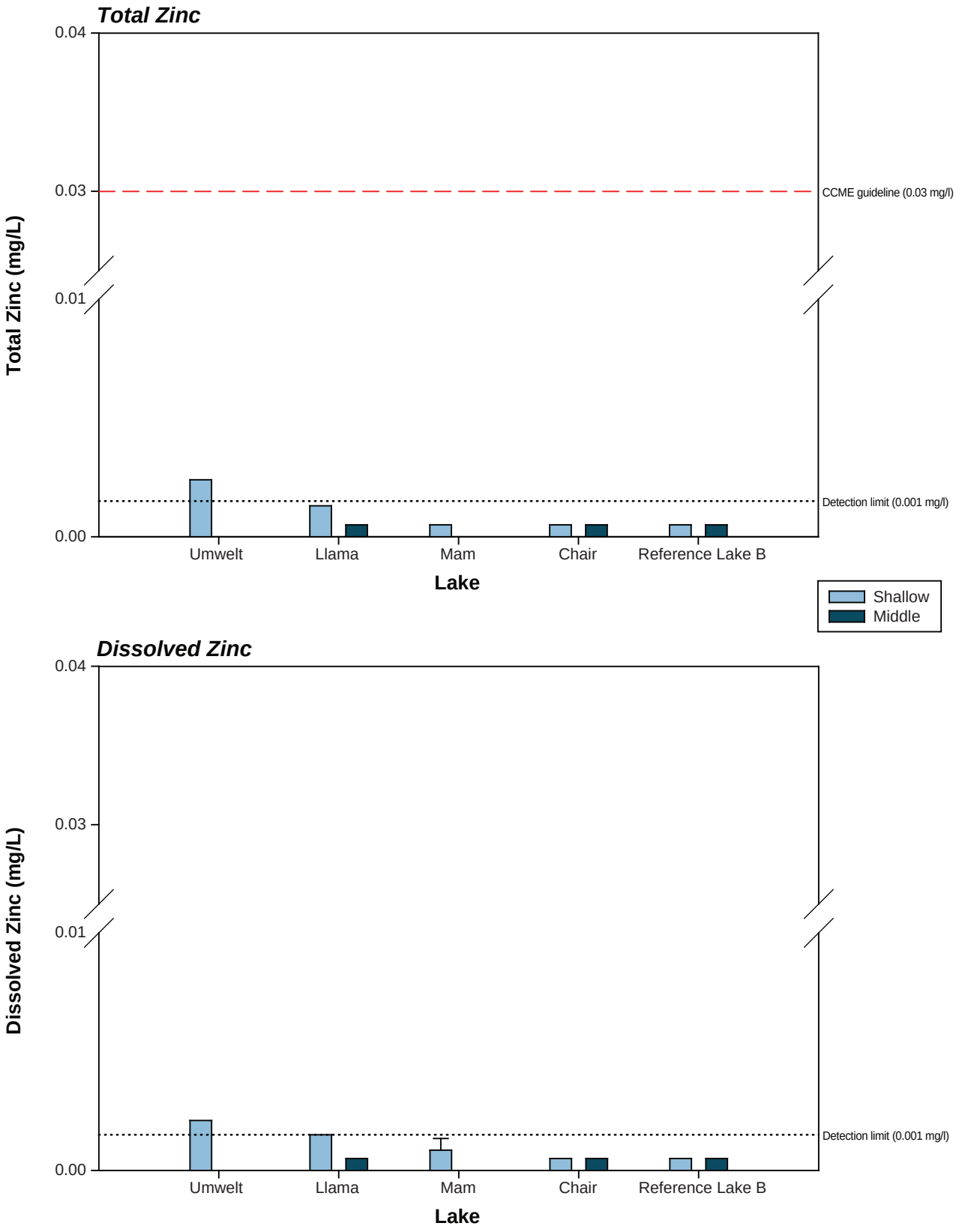
Notes: Error bars represent standard error of the mean.
CCME guideline is hardness-dependent (0.025 mg/L at [$CaCO_3$ = 0-60 mg/L; 0.065 mg/L at [$CaCO_3$] = 60-120 mg/L; 0.110 mg/L at [$CaCO_3$] = > 180 mg/L).
CCME guidelines are for Total Metal concentrations

Sabina GOLD & SILVER CORP.

Total and Dissolved Nickel Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-16

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Notes: Error bars represent standard error of the mean.
CCME guidelines are for Total Metal concentrations.

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Total and Dissolved Zinc Concentrations in the Lakes of the Back River Project Area, August 2010

Figure 3.2-17

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Nitrogen and phosphorus are always present in aquatic ecosystems, and the availability of various forms of these nutrients can limit aquatic plant growth. In general, the five Back River Project lakes can be considered nutrient-poor, particularly in nitrogen. Nitrate and nitrite levels were below detection limits in all five lakes, while ammonia was only detectable in the deeper depths of Llama (0.006 mg/L) and Chair lakes (0.0053 mg/L) and not elsewhere. Total Kjeldahl Nitrogen (TKN), which represents the sum of organic nitrogen and ammonia, ranged from 0.17 mg/L (Llama Lake - surface) to 0.25 mg/L (Reference Lake B - surface), except in the deep water of Llama Lake (7 m), where it jumped to 2.3 mg/L (Figure 3.2-6). Thus, the vast majority of nitrogen in the five lakes is tied up in the dissolved and particulate organic fraction, which is not as easily accessed by growing plants (as ammonia or nitrate are).

Like nitrogen, phosphorus is a critical macronutrient for plant growth in Arctic lakes. Ortho-phosphate levels were undetectable in all five lakes (Appendix 2a), while total phosphorus (TP) concentrations were low and largely similar between the five lakes, ranging from 0.0037 mg/L in the deep waters of Llama Lake to 0.0068 mg/L in the mid-water column of Reference Lake B (Figure 3.2-7). Thus, these lakes can be considered ultra-oligotrophic to oligotrophic based on the CCME trigger ranges for phosphorous levels in freshwater systems (CCME 2007).

Total Organic Carbon (TOC) is made of dissolved and particulate components, with dissolved organic carbon generally related to surrounding vegetation in Arctic lakes (e.g., Pienitz et al. 1997). Overall, the TOC in August varied little between the five lakes, ranging from 3.4 mg/L in Reference Lake B to 4.5 mg/L in Umwelt Lake (Figure 3.2-7).

3.2.4 Total and Dissolved Metals

The Back River lakes had low levels of several metals in their water as many of the metals had more than 75% percent of their samples below analytic detection limits. This included several biologically important metals that were always below detection, such as: cadmium, cobalt, mercury, molybdenum, and selenium. The others were antimony, beryllium, bismuth, lithium, silver, thallium, tin, titanium, uranium, and vanadium. Except for cadmium, no graphs were prepared for the aforementioned metals; however, they were created for aluminum, arsenic, chromium, copper, iron, lead, manganese, nickel, and zinc, which were often or occasionally above analytic detection limits (Figures 3.2-8 to 3.2-17).

Based on their metal concentrations, the five lakes generally fell into three categories: those with the highest metal concentrations near the ore zone (Llama and Umwelt lakes), those with intermediate concentrations (Chair and Mam lakes), and that with the lowest concentrations (Reference Lake B). Both Llama and Umwelt lakes appeared to have some deep groundwater influence due to the higher levels of the seawater constituents: sodium, calcium, magnesium, chloride, and sulphate. In addition to any groundwater influence, Umwelt Lake also had elevated dissolved and total concentrations of chromium (Figure 3.2-11), copper (Figure 3.2-12), nickel (Figure 3.2-16), and zinc (Figure 3.2-17) relative to the other lakes. This is not unusual due to its proximity to the ore zone. Llama Lake, also near the ore zone, was the only other lake with detectable levels of chromium (total) and zinc (total). It also had the highest total manganese concentrations (0.0024 mg/L; Figure 3.2-15) and the only detectable levels of arsenic of the five sampled lakes (0.00032 mg/L - surface; Figure 3.2-9).

In the other lakes, Mam Lake was unique regarding its iron content (Figure 3.2-13), with the highest levels of dissolved (0.066 mg/L) and total iron (0.18 mg/L). Although Reference Lake B generally had the lowest metal concentrations, it did have the highest lead level of the five lakes, with a concentration of 0.0002 mg/L in its surface waters (Figure 3.2-14).

3.2.5 CCME Guidelines

All water quality data collected in Back River lakes were compared to the CCME water quality guidelines for the protection of freshwater aquatic life (CCME 2007). In general, the water column metal concentrations in the five sampled lakes were quite low, as there were very few exceedances of CCME guidelines. Umwelt Lake had naturally elevated concentrations of total copper and chromium with concentrations being higher than CCME guidelines. Llama Lake also had naturally elevated concentrations of total copper. All other water quality paramaters in the 5 lakes sampled were below CCME guidelines for the protection for freshwater aquatic life.

Table 3.2-1 shows the percentage of water quality samples in which parameter concentrations were higher than water quality guidelines, and the factor by which concentrations were higher than guidelines. For the Back River Project lakes, total and dissolved copper concentrations were greatest near the ore zone and decreased with increasing distance from the deposit zone. In Umwelt and Llama lakes, total copper concentrations exceeded the CCME guideline of 0.002 mg/L (for 0–120 mg/L $CaCO_3$) (Figure 3.2-12; Table 3.2-1). Total copper exceeded the guideline by less than twice the recommended concentration (Table 3.2-1). In Umwelt Lake, the dissolved copper concentration (0.00285 mg/L) was also higher than the CCME guideline for total copper concentration.

In Umwelt Lake, the total chromium concentration (0.0017 mg/L) exceeded the CCME guideline of 0.001 mg/L for hexavalent chromium (Cr^{6+}), but was below the trivalent chromium (Cr^{3+}) guideline of 0.0089 mg/L (Figure 3.2-11). Total chromium concentrations were below detection levels for Mam Lake, Chair Lake, and Reference Lake B. Dissolved chromium levels were below the CCME guideline for chromium in all Project lakes, as all concentrations, with the exception of Umwelt Lake (0.0051 mg/L), were below detection limits.

3.2.6 Quality Assurance and Quality Control (QA/QC)

Results for the travel, field and equipment blanks are presented in Appendix 2c. Possible sources of contamination could be revealed if specific water quality parameters in the respective blanks have concentrations greater than the analytical detection limit. There were no concentrations greater than the realized detection limit for the travel or field blanks, and therefore no contamination from the shipping or handling of the samples. For the equipment blank, conductivity, nitrate, TOC, total barium, boron, chromium, lead, magnesium, zinc, and dissolved boron, chromium, lead, magnesium, and zinc were slightly above the analytical detection limit, and well within five times the detection limit (the range of analytical error), or the realized detection limit for field and travel blanks. The equipment blank for total and dissolved nickel was more than five times the detection limit; however, this does not appear to be an issue as total and dissolved nickel concentrations in the lake water quality samples typically fell below the equipment blank concentration and are well below CCME guidelines. Total and dissolved manganese and dissolved copper in the equipment blank samples were more than five times the analytical and realized detection limits. All three occurred in detectable concentrations in the field samples. There is no CCME guideline for total or dissolved manganese or dissolved copper.

3.3 SEDIMENT QUALITY

In August, 2010, sediment quality samples were collected from five lakes in the Back River Project area. Sediment samples were collected from the same lakes as the bathymetry and water quality samples. Umwelt and Mam lakes have a maximum depth of 2.7 and 3.8 m, respectively, so sediment samples were collected from only the shallow zone in these lakes. Chair Lake and Reference Lake B have maximum depths of 10.3 and 5.1 m, respectively, so sediment samples were collected from the shallow (0–5 m) and mid-depth (5–10 m) zones. Llama Lake has a maximum depth of 13.6 m, and sediment samples were collected from each of the shallow (0–5 m), mid-depth (5–10 m), and deep zones (>10 m).

Table 3.2-1. Lake Water Quality, Samples Which Exceed CCME Guidelines, Back River Project, August 2010

		Percent of Samples in which Concentrations Exceed CCME Guidelines					Factor by Which Concentrations Exceed CCME Guidelines				
Lake		**Umwelt Lake**	**Llama Lake**	**Mam Lake**	**Chair Lake**	**Reference Lake B shallow**	**Umwelt Lake**	**Llama Lake**	**Mam Lake**	**Chair Lake**	**Reference Lake B shallow**
Total Number of Samples Collected		1	2	2	2	3	1	2	2	2	3
CCME Guideline Value[a]:											
pH	6.5-9.0	0	0	0	0	0	-	-	-	-	-
Ammonia (as N)	pH- and temperature-dependent	0	0	0	0	0	-	-	-	-	-
Nitrate (as N)	2.93 mg/L	0	0	0	0	0	-	-	-	-	-
Nitrite (as N)	0.06 mg/L	0	0	0	0	0	-	-	-	-	-
Total Phosphorus	Trophic Status[b]	Oligotrophic	Ultra-oligotrophic	Ultra-oligotrophic	Ultra-oligotrophic	Oligotrophic	-	-	-	-	-
Aluminum (Al)-Total	0.005 or 0.1[c] mg/L	0	0	0	0	0	-	-	-	-	-
Arsenic (As)-Total	0.005 mg/L	0	0	0	0	0	-	-	-	-	-
Cadmium(Cd)-Total	0.000017 mg/L	0	0	0	0	0	-	-	-	-	-
Chromium (Cr)-Total	0.001 or 0.0089[d] mg/L	100[i]	0	0	0	0	1.67[i]	-	-	-	-
Copper (Cu)-Total	0.002-0.004[e] mg/L	100	50	0	0	0	1.75	1.08	-	-	-
Iron (Fe)-Total	0.3 mg/L	0	0	0	0	0	-	-	-	-	-
Lead (Pb)-Total	0.001-0.007[f] mg/L	0	0	0	0	0	-	-	-	-	-
Mercury	0.000026[g] mg/L	0	0	0	0	0	-	-	-	-	-
Molybdenum (Mo)-Total	0.073 mg/L	0	0	0	0	0	-	-	-	-	-
Nickel (Ni)-Total	0.025-0.110[h] mg/L	0	0	0	0	0	-	-	-	-	-
Selenium (Se)-Total	0.001 mg/L	0	0	0	0	0	-	-	-	-	-
Silver (Ag)-Total	0.0001 mg/L	0	0	0	0	0	-	-	-	-	-
Thallium (Ag)-Total	0.0008 mg/L	0	0	0	0	0	-	-	-	-	-
Zinc (Zn)-Total	0.03 mg/L	0	0	0	0	0	-	-	-	-	-

a) Canadian water quality guidelines for the protection of aquatic life (CCME 2007)

b) Trophic categories from CCME 2007): <0.004 mg/L = ultra-oligotrophic; 0.004-0.010 mg/L = oligotrophic; 0.01-0.02 mg/L = mesotrophic; 0.02-0.035 mg/L = meso-eutrophic; 0.35-0.1 mg/L = eutrophic; >0.1 mg/L = hyper-eutrophic

c) 0.005 mg/L at pH <6.5; 0.1 mg/L a pH ≥6.5

d) 0.001 mg/L for hexavalent chromium (Cr(VI)); 0.0089 mg/L for trivalent chromium (Cr(III))

e) 0.002 mg/L at [$CaCO_3$] = 0-120 mg/L; 0.003 mg/L at [$CaCO_3$] = 120-180 mg/L; 0.004 mg/L at [$CaCO_3$] = >180 mg/L

f) 0.001 mg/L at [$CaCO_3$] = 0-60 mg/L; 0.002 mg/L at [$CaCO_3$] = 60-120 mg/L; 0.004 mg/L at [$CaCO_3$] = 120-180 mg/L; 0.007 mg/L at [$CaCO_3$] = >180 mg/L

g) Guideline refers to inorganic mercury.

h) 0.025 mg/L at [$CaCO_3$] = 0-60 mg/L; 0.065 mg/L at [$CaCO_3$] = 60-120 mg/L; 0.110 mg/L at [$CaCO_3$] = 120-180 mg/L; 0.150 mg/L at [$CaCO_3$] = >180 mg/L

i) Assumes that all chromium in sample is in the form of hexavalent chromium.

Sediment samples were evaluated for particle size, nutrients, total organic carbon, and metals. Results, detection limits, and sediment quality guidelines are provided in Appendix 3a.

3.3.1 Particle Size

In general, lake sediments were dominated by silt (Figure 3.3-1), with Mam, Chair, and Llama lakes composed of over 75% silt at all depths. Umwelt Lake had the coarsest sediments as it was dominated by sand (68%), with the largest proportion of gravel of the lakes (7.8%), and had almost no clay (average of 0.5% clay). Reference Lake B also had coarser sediments, with approximately 50–60% sand and 40–50% silt and clay.

3.3.2 Principal Components Analysis

Results of the sediment quality PCA data are presented in Figure 3.3-2 and in Appendix 3b. Plots were created to illustrate the relative location of the lakes and sampling depths in ordination space, the loadings of the sediment quality parameters, and the variation in the data explained by the principal components. Principle components 1 and 2 explained 86.3% of the variation.

In general, Umwelt and Reference Lake B separated from the other lakes in ordination space because they had more sand, less silt and clay, and lower concentrations of nutrients, organic carbon, and metals than the other lakes (Figures 3.3-2 to 3.3-8). Reference Lake B and Umwelt Lake separated from each other based on the higher concentrations of TOC, total nitrogen (TN), and ammonium in Reference Lake B. Chair Lake, Mam Lake, and Llama Lake had predominantly silt and clay sediments at mid-depth, and had the higher concentrations for most nutrients and metals (TOC, TN, total sulphur, strontium, and calcium). Chair Lake had the largest percentage of clay in its sediments, and had the highest concentrations of metals. This included cadmium, chromium, copper, lead, iron, magnesium, manganese, nickel, potassium, selenium, uranium, and zinc among others (Appendix 3).

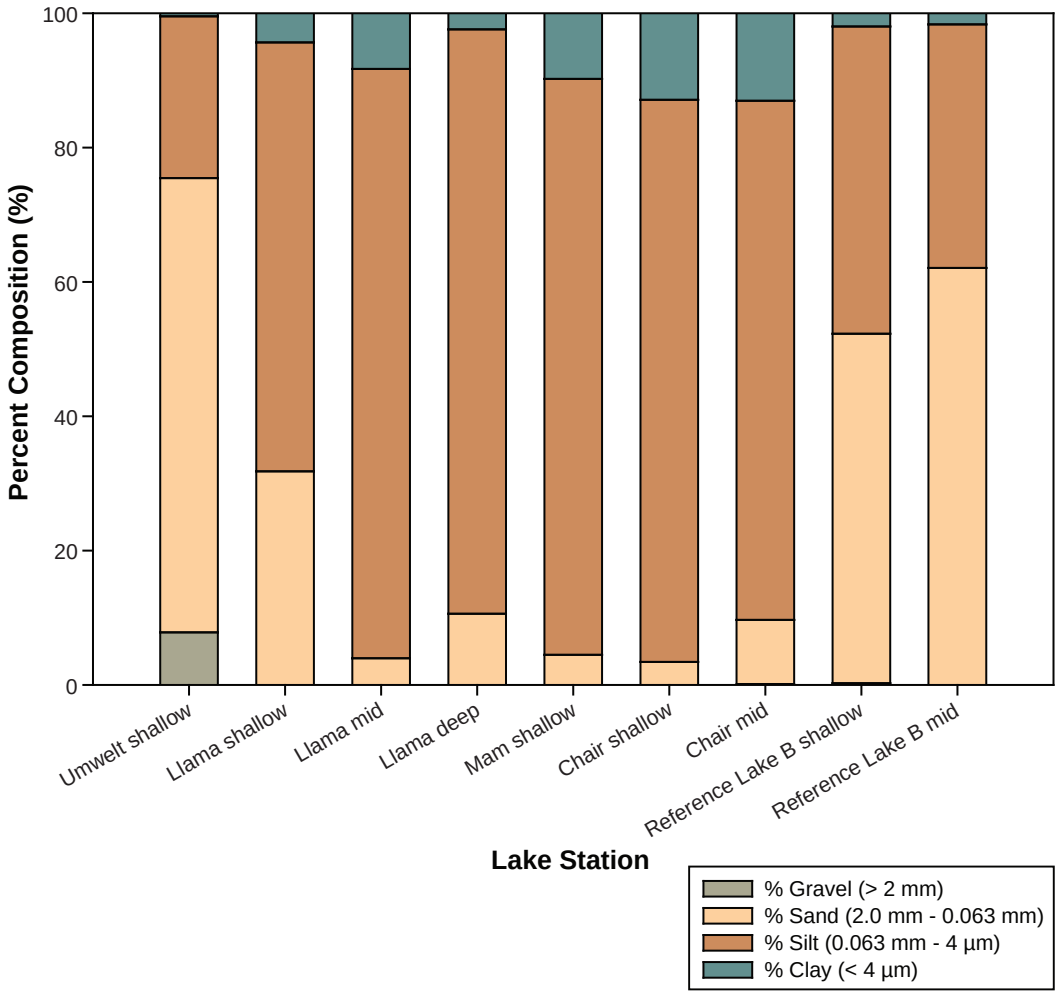
3.3.3 Nutrients and Total Organic Carbon

Total organic carbon and total nitrogen content followed similar patterns in the lake sediments, with the highest concentrations in the shallow areas of Reference Lake B, Mam Lake, and Chair Lake, and in the mid-depth zone of Llama Lake (Figure 3.3-3). The lowest levels were found in the deep sections of Llama and Chair lakes, and in Umwelt Lake. Overall, organic carbon made up the majority of the carbon content in the lakes, since the inorganic carbon content was below the method detection limit (Appendix 3). Nitrogen was predominantly in the form of ammonium. Nitrite and nitrate were below their detection limit, which suggests the lake sediments may have been mildly reducing in the upper few centimetres (Appendix 3).

Unlike TN and TOC, available phosphate concentrations were greatest in the deep and mid-depth samples from Llama and Chair lakes, and decreased in the shallower samples (Figure 3.3-4). The deep Llama Lake sediment samples had the highest available phosphate concentrations (7 mg/kg) of all lakes and depths. Available phosphate concentrations were below method detection limits in the mid-depth sediments of both Llama Lake and Reference Lake B.

3.3.4 Total Metals

Thirty-two metals were analyzed from each of the lake sediment samples collected in 2010. Seven of those have CCME working sediment quality guidelines. Figures were created to show the mean metal concentration and standard error of the mean for metals with guidelines, and concentrations in relation to the interim sediment quality guideline (ISQG) and the probable effect level (PEL) (Figures 3.3-5 to 3.3-8). Only metals with guidelines are presented and discussed. All other metal concentrations are listed in Appendix 3a.



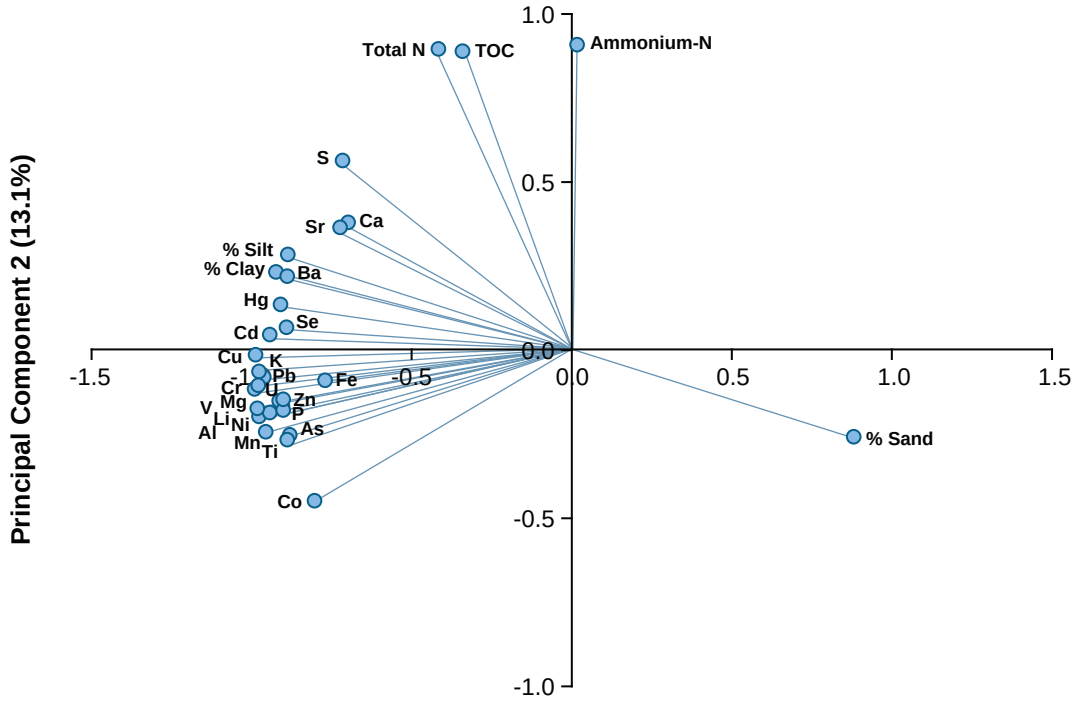
Sabina GOLD & SILVER CORP.

Sediment Particle Size Distribution for Lakes of the Back River Project Area, August 2010

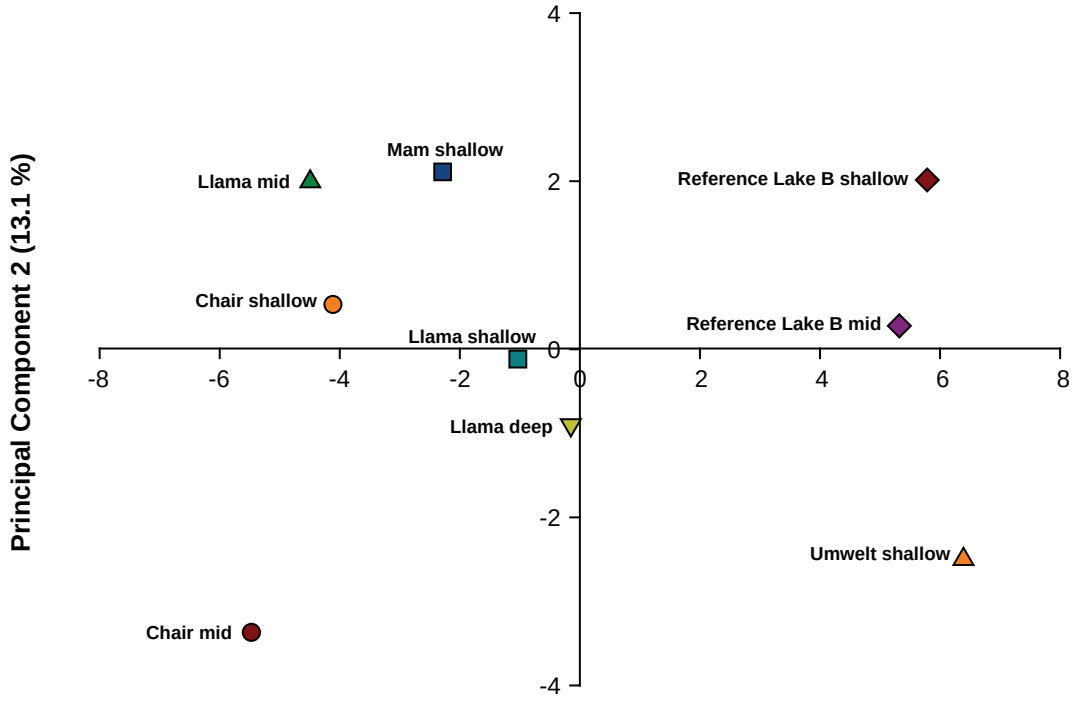
Figure 3.3-1

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a) PCA biplot of loadings for sediment quality parameters used in analysis



b) PCA of Goose Lake sites and sample depth for August 2010 sediment quality data

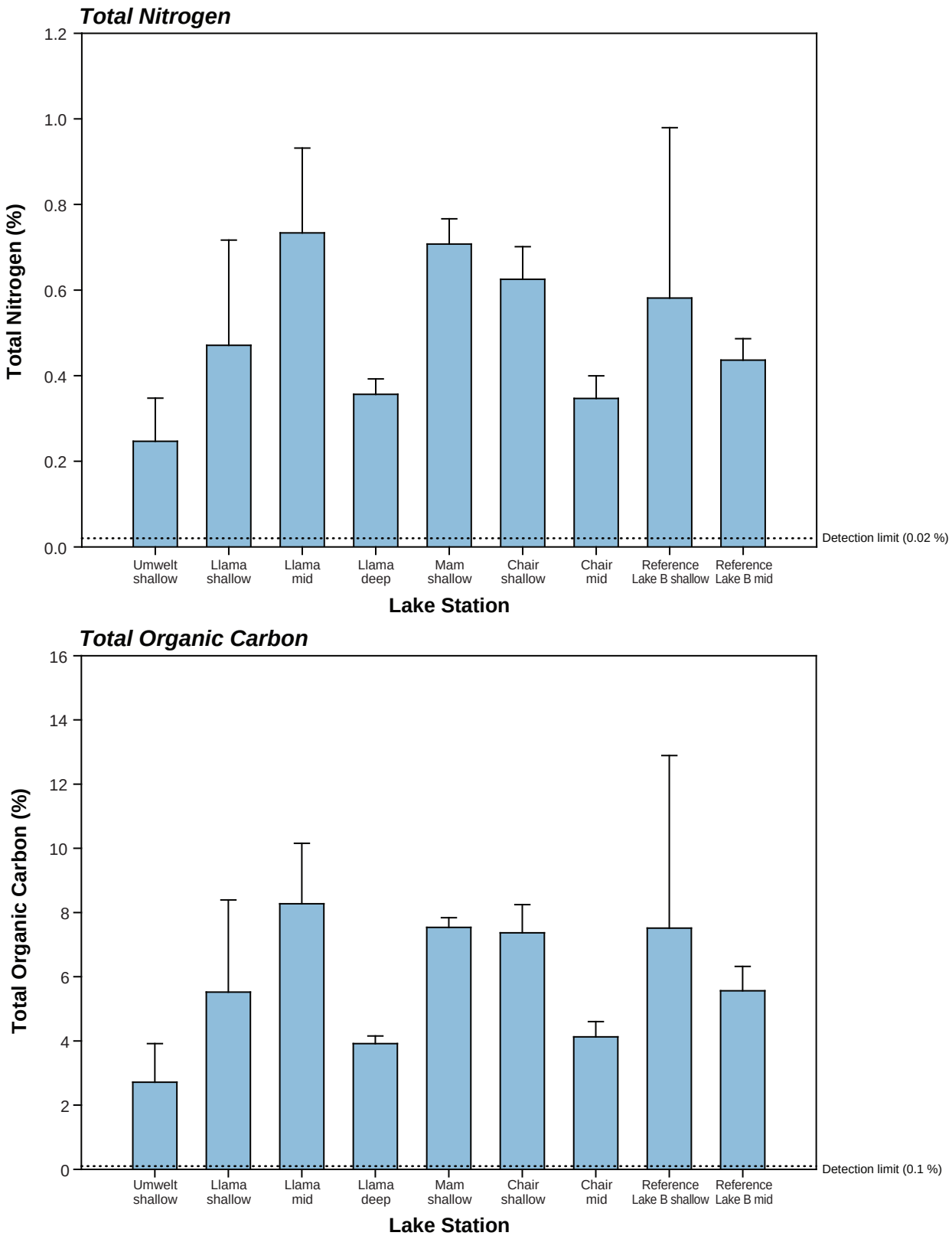


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Principal Component Analysis of Sediment Quality Data for Lakes of the Back River Project Area, August 2010

Figure 3.3-2

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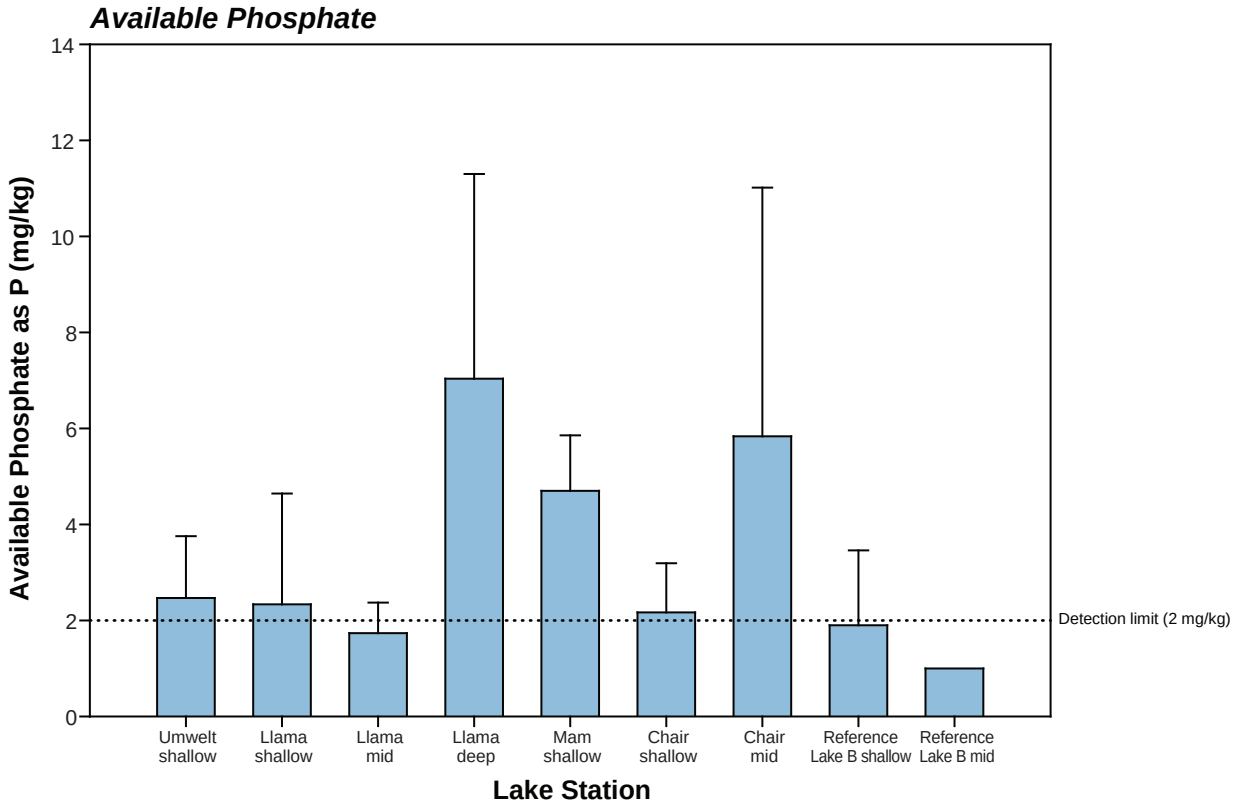
Note: Dotted line represents analytical detection limit
Error bars represent standard error of the mean.

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Percent Total Organic Carbon and Total Nitrogen (by LECO) in Lake Sediments from Lakes in the Back River Project Area, August 2010

Figure 3.3-3

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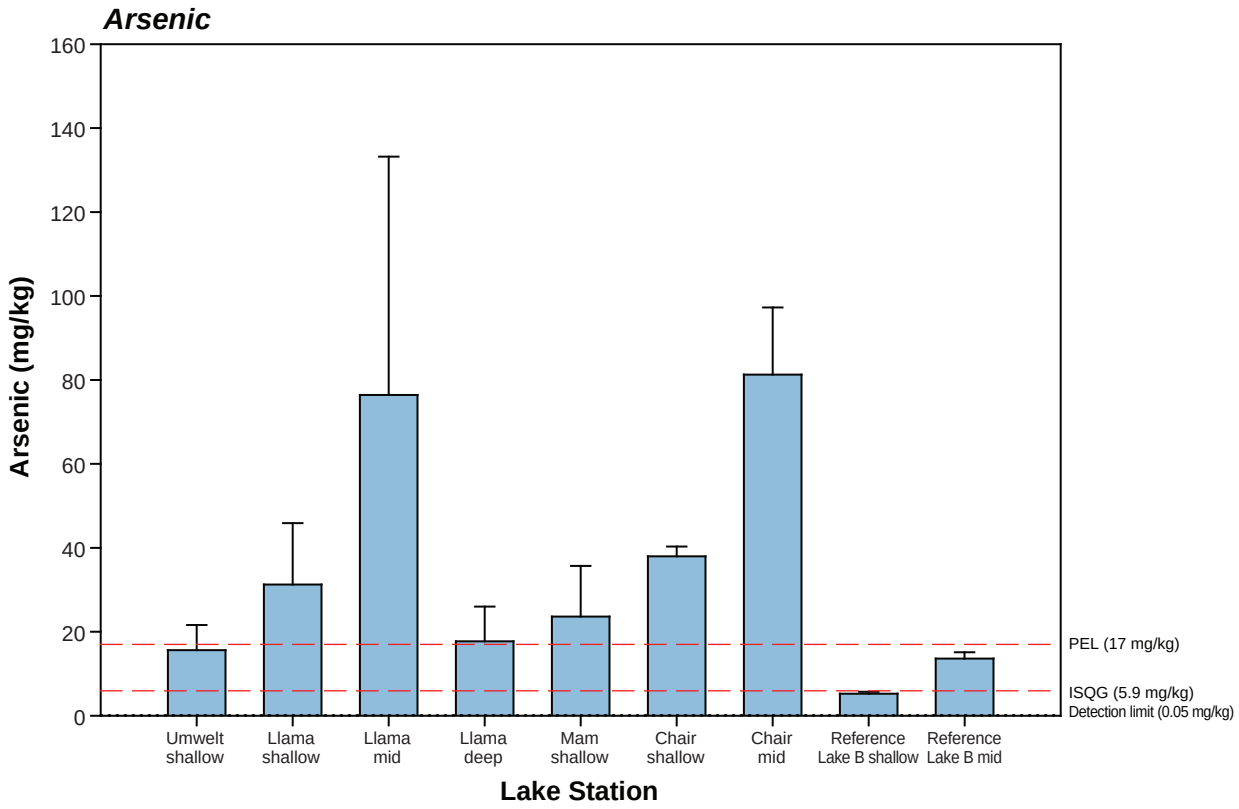
Note: Dotted line represents analytical detection limit
Error bars represent standard error of the mean.

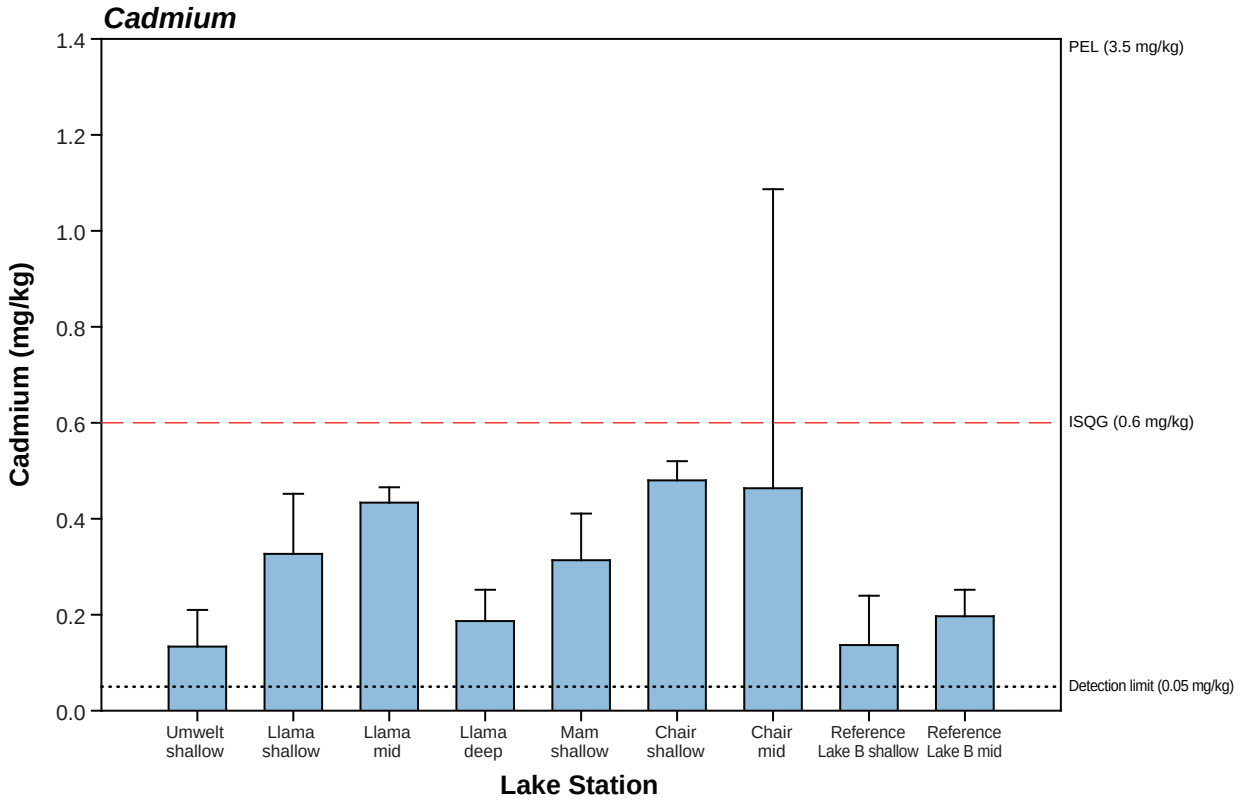
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Available Phosphate Concentrations in Lake Sediments in the Back River Project Area, August 2010

Figure 3.3-4

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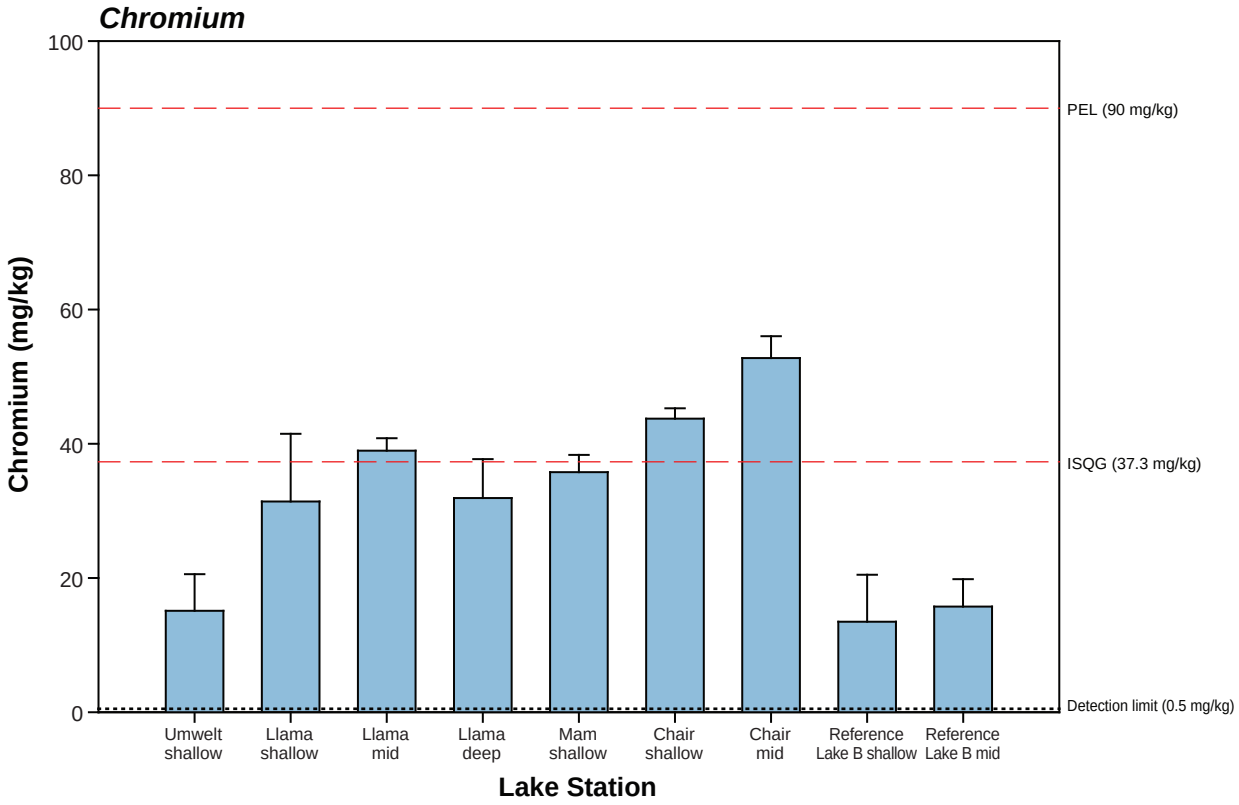
Note: Dotted line represents analytical detection limit
Dashed lines represent CCME Sediment Quality Guidelines
Error bars represent standard error of the mean.

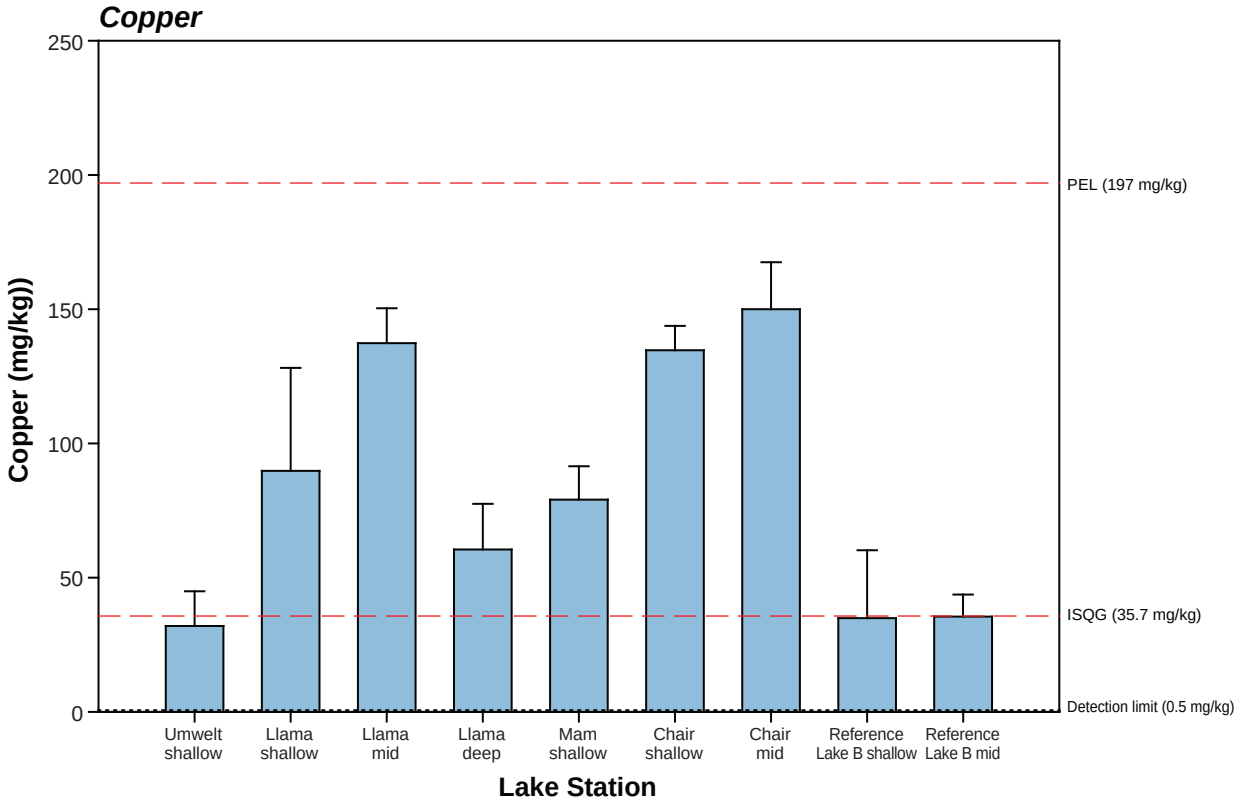
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Arsenic and Cadmium Concentrations in Lake Sediments in the Back River Project Area, August 2010

Figure 3.3-5

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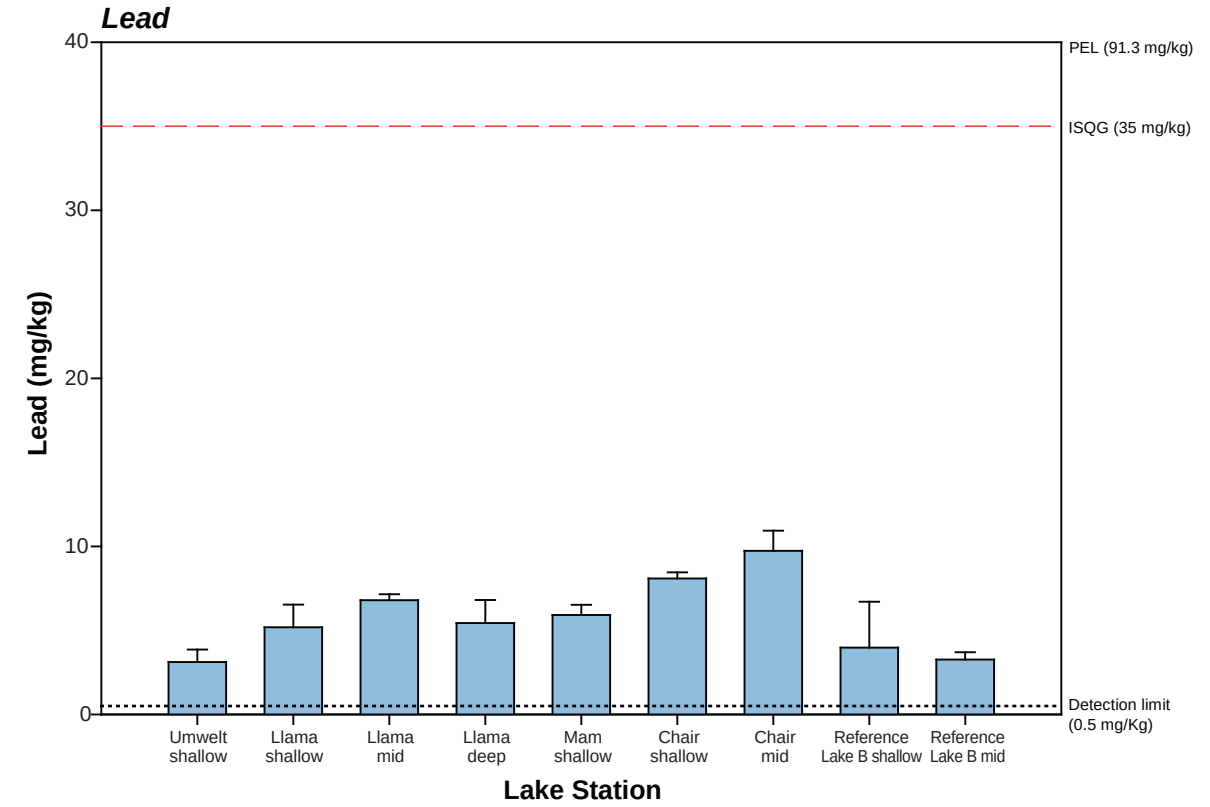
Note: Dotted line represents analytical detection limit
Dashed lines represent CCME Sediment Quality Guidelines
Error bars represent standard error of the mean.

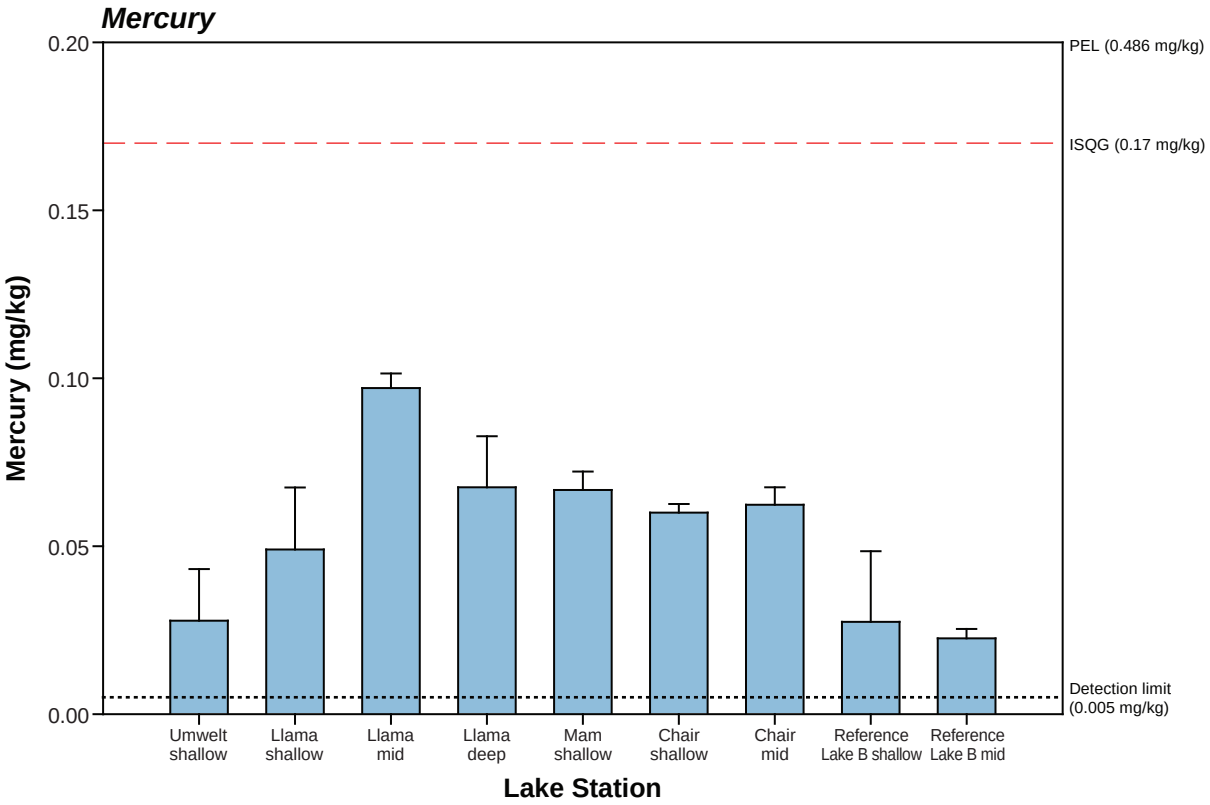
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Chromium and Copper Concentrations in Lake Sediments in the Back River Project Area, August 2010

Figure 3.3-6

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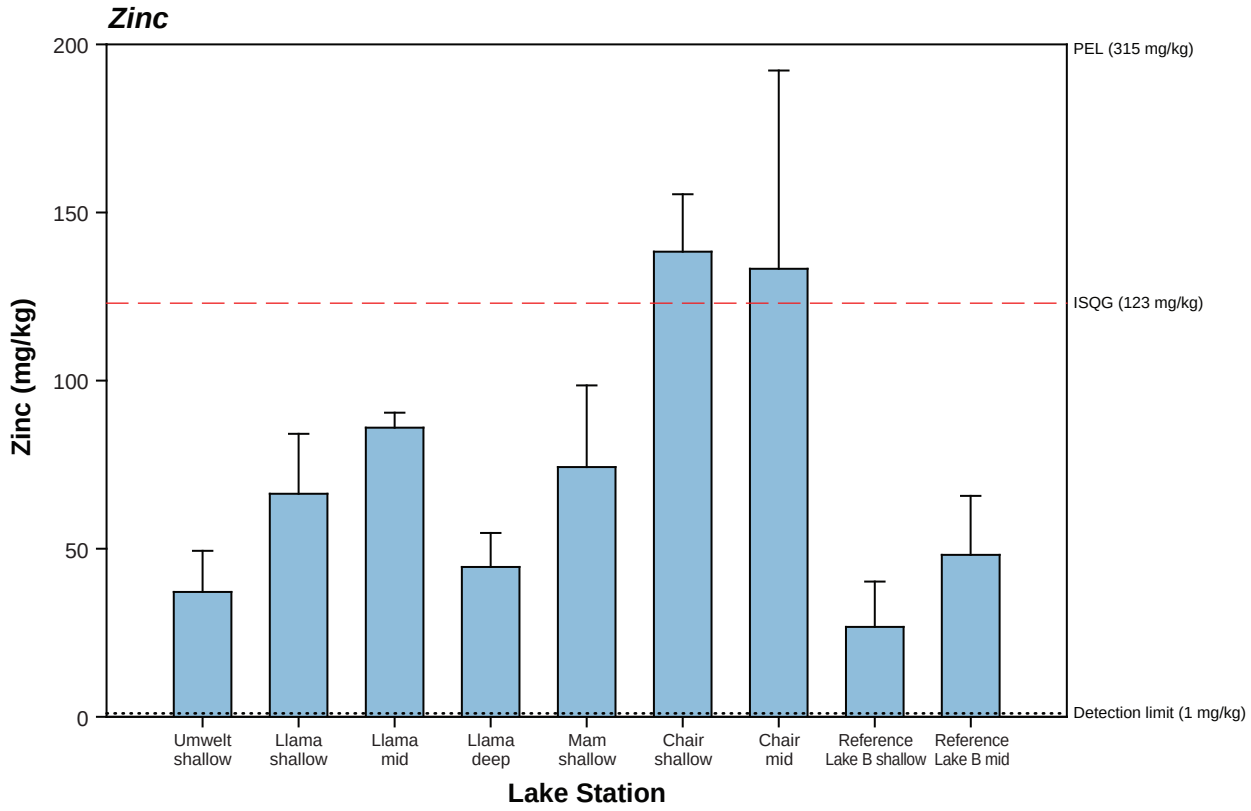
Note: Dotted line represents analytical detection limit
Dashed lines represent CCME Sediment Quality Guidelines
Error bars represent standard error of the mean.

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Lead and Mercury Concentrations in Lake Sediments in the Back River Project Area, August 2010

Figure 3.3-7

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Note: Dotted line represents analytical detection limit
Dashed lines represent CCME Sediment Quality Guidelines
Error bars represent standard error of the mean.

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Zinc Concentrations in Lake Sediments in the Back River Project Area, August 2010

Figure 3.3-8

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Overall, the metal concentrations in the sampled lake sediments co-varied with their fine particle composition. Sites with finer sediments consisting of mostly silts and clays (e.g., Chair, Llama, and Mam lakes) tended to contain the highest concentrations of arsenic (Figure 3.3-5), cadmium (Figure 3.3-5), chromium (Figure 3.3-6), copper (Figure 3.3-6), lead (Figure 3.3-7), mercury (Figure 3.3-7), and zinc (Figure 3.3-8), among others (Appendix 3a) The Chair Lake sediments generally had the highest concentrations of most metals compared to the other sites, while Umwelt Lake and Reference Lake B typically had the lowest metal concentrations, largely due to the high sand content in these lakes.

3.3.5 CCME Guidelines

All sediment samples collected were compared to CCME guidelines for the protection of aquatic life. These include the interim sediment quality guidelines (ISQGs) and the probable effects levels (PELs; CCME 2002). The more conservative ISQGs are levels below which adverse biological effects are rarely observed. The higher PELs correspond to concentrations above which negative effects frequently occur.

Lakes in the Back River Project area contained naturally elevated sediment metal concentrations, as every lake had metal concentrations that exceeded ISQG levels. The lakes were particularly enriched with arsenic as all lakes, except the reference lake, had arsenic concentrations that surpassed the PEL guideline limit (Table 3.3-1), and all surpassed the ISQ guideline of 5.9 mg/kg by more than 2- to 13-fold. (Table 3.3-2). In Chair, Llama, and Mam lakes, arsenic concentrations exceeded the PEL guideline (17 mg/kg) with a maximum exceedance factor approaching 5-fold. In all lakes, copper concentrations were higher than their ISQ guideline levels in at least one sample replicate, but their magnitude of exceedance was much less than that observed for arsenic. No PEL guidelines for copper were exceeded. Llama, Mam, and Chair lakes had chromium concentrations that exceeded ISQ guidelines by a factor of 1 to 1.4. Chair Lake was the only lake that exceeded cadmium and zinc ISQ guidelines.

Metal concentrations in Chair Lake sediments exceeded the CCME guidelines the most frequently (Table 3.3-1). Metals that exceeded ISQG in Chair Lake sediments include arsenic, cadmium, chromium, copper, and zinc. The mid-depth section of Chair Lake had the most guideline exceedances and surpassed the guidelines by the greatest factor.

Lead and mercury concentrations were not exceeded in any of the sediment samples from the Back River Project Lakes.

Table 3.3-1. Lake Sediment Quality, Percent of Samples in which Concentrations are Higher than CCME Guidelines, Back River Project, August 2010

Lake and Sample Depth:		Percent of samples exceeding ISQG[b] guidelines									Total Sites where Guideline Naturally Exceeded
		Umwelt shallow	Llama shallow	Llama mid	Llama deep	Mam shallow	Chair shallow	Chair mid	Reference Lake B shallow	Reference Lake B mid	
Total Number of Samples Collected:		3	3	3	3	3	3	3	3	3	
CCME Guideline Value[a]	(mg/kg):										
Arsenic (As)	5.9	100	100	100	100	100	100	100	0	100	**8**
Cadmium (Cd)	0.6	0	0	0	0	0	0	33	0	0	**1**
Chromium (Cr)	37.3	0	33	67	0	33	100	100	0	0	**5**
Copper (Cu)	35.7	33	100	100	100	100	100	100	33	67	**9**
Lead (Pb)	35	0	0	0	0	0	0	0	0	0	**0**
Mercury (Hg)	0.17	0	0	0	0	0	0	0	0	0	**0**
Zinc (Zn)	123	0	0	0	0	0	67	33	0	0	**2**
		Percent of samples exceeding PEL[c] guidelines									
Arsenic (As)	17	33	67	100	33	67	100	100	0	0	**7**
Cadmium (Cd)	3.5	0	0	0	0	0	0	0	0	0	**0**
Chromium (Cr)	90	0	0	0	0	0	0	0	0	0	**0**
Copper (Cu)	197	0	0	0	0	0	0	0	0	0	**0**
Lead (Pb)	91.3	0	0	0	0	0	0	0	0	0	**0**
Mercury (Hg)	0.486	0	0	0	0	0	0	0	0	0	**0**
Zinc (Zn)	315	0	0	0	0	0	0	0	0	0	**0**

Values represent precentages of samples collected at each site that are higher than CCME guidelines.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME 2002)

b) ISQG = Interim Sediment Quality Guidelines

c) PEL = Probable Effects Level

Table 3.3-2. Lake Sediment Quality, Factor by which Average Concentrations are Higher than CCME Guidelines, Back River Project, August 2010

Lake and Sample Depth:		Umwelt shallow	Llama shallow	Llama mid	Llama deep	Mam shallow	Chair shallow	Chair mid	Reference Lake B shallow	Reference Lake B mid	Total Sites where Guideline Naturally Exceeded
		Factor by which replicate averages exceed ISQG[b] guidelines									
Total Number of Samples Collected:		3	3	3	3	3	3	3	3	3	
CCME Guideline Value[a]	(mg/kg):										
Arsenic (As)	**5.9**	2.6	5.3	12.9	3.0	4.0	6.4	13.8	-	2.3	**8**
Cadmium (Cd)	**0.6**	-	-	-	-	-	-	-	-	-	**0**
Chromium (Cr)	**37.3**	-	-	1.0	-	-	1.2	1.4	-	-	**3**
Copper (Cu)	**35.7**	-	2.5	3.9	1.7	2.2	3.8	4.2	-	-	**6**
Lead (Pb)	**35**	-	-	-	-	-	-	-	-	-	**0**
Mercury (Hg)	**0.17**	-	-	-	-	-	-	-	-	-	**0**
Zinc (Zn)	**123**	-	-	-	-	-	1.1	1.1	-	-	**2**
		Factor by which replicate averages exceed PEL[c] guidelines									
Arsenic (As)	**17**	-	1.8	4.5	1.0	1.4	2.2	4.8	-	-	**6**
Cadmium (Cd)	**3.5**	-	-	-	-	-	-	-	-	-	**0**
Chromium (Cr)	**90**	-	-	-	-	-	-	-	-	-	**0**
Copper (Cu)	**197**	-	-	-	-	-	-	-	-	-	**0**
Lead (Pb)	**91.3**	-	-	-	-	-	-	-	-	-	**0**
Mercury (Hg)	**0.486**	-	-	-	-	-	-	-	-	-	**0**
Zinc (Zn)	**315**	-	-	-	-	-	-	-	-	-	**0**

Values represent the factor by which replicate averages are higher than CCME guidelines.

Even though a percentage of replicates may be higher than a guideline amount, the calculate average of replicates may not be higher that a guideline amount.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME 2002)

b) ISQG = Interim Sediment Quality Guidelines

c) PEL = Probable Effects Level

4. Summary

4. Summary

Five lakes were sampled in late August 2010 for the Back River Project. Bathymetry surveys were conducted, and maps illustrating the lake profiles were created. Limnological measurements determined that Umwelt and Mam lakes were relatively shallow, clear, cold, and had the highest levels of dissolved oxygen. Llama and Chair lakes were deeper lakes, and were slightly warmer than Umwelt and Mam lakes, with lower levels of dissolved oxygen. Reference Lake B had intermediate depth, temperature, dissolved oxygen, and water clarity (Secchi depth). There is sufficient light penetration for primary production to exceed respiration throughout the lakes.

Where lakes were sufficiently deep, water quality was sampled at two depths (1 m and mid-depth). General variables, nutrients, organics, and metals were analyzed. Concentrations of water quality variables were similar between depths. This was probably due to the lack of stratification or weak stratification found at lake sites during the sampling period. All five lakes had low nutrient concentrations, which is typical in Arctic and subartic regions (Pienitz 1997; Ruhland and Smol 1998). Umwelt and Llama lakes, which are located in the Llama Watershed where two known deposits are located, had highest concentrations of most total metals, pH, conductivity, and hardness. Chair and Mam lakes had intermediate concentrations of most metals, turbidity, and total phosphate, and had the highest levels of iron. Reference Lake B had the highest turbidity and total phosphate, and was generally low in nitrogen and metals.

All water quality parameters were below the CCME guidelines for the protection of freshwater aquatic life with the following exceptions: Umwelt Lake had naturally elevated total copper and chromium concentrations, and Llama Lake had naturally elevated total chromium concentrations.

Sediment quality samples were collected from the five lakes at the same time as the limnology and water quality samples. Sediment samples were collected from shallow, mid-, and deep depth zones as permitted by the lake depth. The sediment samples were analyzed for particle size distribution, nutrients, and metals. Overall, lakes with higher clay and silt content (Llama, Chair, and Mam lakes) had higher organic content, nutrients, and metal concentrations than that measured in sediments with higher sand content (Umwelt Lake and Reference Lake B).

Each lake had sediment metal concentrations that naturally exceeded CCME ISQ guideline levels (Table 4-1). Llama and Mam lakes had baseline sediment quality higher than the CCME Interim Sediment Quality Guideline (ISQG) for arsenic, chromium and copper. Umwelt Lake had baseline sediment quality higher than the CCME ISQG for arsenic and copper, while Chair Lake had baseline sediment quality higher than the CCME ISQG for arsenic, cadmium, chromium, copper and zinc. Reference Lake B had baseline sediment quality higher than the CCME ISQG for arsenic and copper. All lakes, except the reference lake, had baseline sediment quality that exceeded the CCME Probable Effects Level (PEL) for arsenic.

Table 4-1 provides a summary of the general characteristics of each lake sampled in 2010.

Table 4-1. Summary of Back River Project Lake Characteristics

Watershed	Lake	Maximum Depth (m)	Euphotic Zone Depth ($Z_{1\%}$)	pH	Conductivity and TSS	Nutrient Status	Water Quality Parameters that Exceed CCME WQ Guidelines[1]	Sediment Quality Parameters that Exceed CCME ISQ Guidelines[1]
Llama	Umwelt	2.7	to sediments	slightly alkaline	low	oligotrophic	Cr[2], Cu	As, Cu
	Llama	13.6	to sediments	slightly alkaline	low	ultra-oligotrophic	Cu	As, Cr, Cu
Chair	Mam	3.8	to sediments	slightly alkaline	low	ultra-oligotrophic	-	As, Cu
	Chair	10.3	to sediments	slightly alkaline	low	ultra-oligotrophic	-	As, Cd, Cr, Cu, Zn
Reference Lake	Reference Lake B	5.1	to sediments	slightly alkaline	low	oligotrophic	-	As, Cu

As = arsenic, Cd = cadmium, Cr = chromium, Cu = copper, Zn = zinc.

[1] *CCME guidelines for the protection of aquatic life.*

[2] *when compared to the CCME water quality guideline for Cr VI.*

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Appendix 1

Temperature and Dissolved Oxygen Profiles from the Back River Project Study Lakes, August 2010

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Appendix 1. Temperature and Dissolved Oxygen Profiles from the Back River Project Study Lakes, August 2010

Site	Site Depth (m)	Depth (m)	Temperature (˚C)	DO (mg/l)	DO (% sat)
Llama Lake	13.6	0	11.6	10.41	95.7
20-Aug		0.5	11.6	10.4	95.7
		1	11.6	10.39	95.5
		1.5	11.6	10.39	95.5
		2	11.6	10.37	95.4
		2.5	11.6	10.37	95.3
		3	11.6	10.36	95.2
		3.5	11.6	10.35	95.1
		4	11.6	10.34	95
		4.5	11.6	10.32	94.9
		5	11.6	10.32	94.9
		5.5	11.6	10.31	94.8
		6	11.6	10.3	94.7
		6.5	11.6	10.29	94.6
		7	11.6	10.28	94.5
		7.5	11.6	10.26	94.4
		8	11.6	10.26	94.4
		8.5	11.6	10.26	94.3
		9	11.6	10.24	94.2
		9.5	11.5	10.26	94.1
		10	11.5	10.25	94
		10.5	11.5	10.24	93.9
		11	11.5	10.23	93.8
		11.5	11.5	10.23	93.8
		12	11.5	10.21	93.7
		12.5	11.5	10.2	93.6
		13	11.5	10.19	93.5
		13.5	11.5	10.18	93.4
Umwelt Lake	2.7	0	9.6	10.8	94.9
20-Aug		0.5	9.6	10.8	94.7
		1	9.7	10.76	94.6
		1.5	9.7	10.75	94.6
		2	9.7	10.73	94.4
		2.5	9.7	10.73	94.4

Site	Site Depth (m)	Depth (m)	Temperature (˚C)	DO (mg/l)	DO (% sat)
Mam Lake	3.8	0	9.6	10.93	95.9
21-Aug		0.5	9.6	10.91	95.8
		1	9.6	10.9	95.7
		1.5	9.6	10.9	95.6
		2	9.6	10.89	95.6
		2.5	9.6	10.88	95.5
		3	9.6	10.88	95.5
		3.5	9.6	10.87	95.4
Chair Lake	10.3	0	11	10.53	95.7
21-Aug		0.5	11	10.52	95.6
		1	11	10.54	95.6
		1.5	11	10.53	95.5
		2	11	10.52	95.4
		2.5	11	10.51	95.3
		3	11	10.5	95.2
		3.5	11	10.49	95.2
		4	11	10.47	95
		4.5	11	10.47	95
		5	10.9	10.47	94.7
		5.5	10.9	10.45	94.5
		6	10.9	10.44	94.4
		6.5	10.9	10.43	94.4
		7	10.9	10.41	94.1
		7.5	10.9	10.4	94.1
		8	10.9	10.38	93.9
		8.5	10.9	10.38	93.9
		9	10.9	10.37	93.8
		9.5	10.9	10.36	93.7
		10	10.9	10.33	93.5
Reference Lake B	5.1	0	11.2	10.58	96.3
22-Aug		0.5	11.2	10.57	96.3
		1	11.2	10.56	96.2
		1.5	11.2	10.55	96.1
		2	11.2	10.53	95.9
		2.5	11.2	10.52	95.9
		3	11.2	10.52	95.8
		3.5	11.1	10.53	95.7
		4	11.1	10.52	95.6
		4.5	11.1	10.51	95.5
		5	11.1	10.51	95.6

Appendix 2

Water Quality Data from the Back River Project Study Lakes, August 2010

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Appendix 2a. Water Quality Data from the Back River Project Study Lakes, August 2010

Sample ID			UMWELT, 1M	LLAMA, 1M	LLAMA, MID, 7M	MAM, 1M	CHAIR, 1M	CHAIR, MID, 5M	REFERENCE B, 1M	REFERENCE B, MID, 2.5 M	DUPLICATE 1 MAM 1M	DUPLICATE 2 Ref Lk B, 2.5M
Date Sampled			20-AUG-10	20-AUG-10	20-AUG-10	21-AUG-10	21-AUG-10	21-AUG-10	22-AUG-10	22-AUG-10	21-AUG-10	22-AUG-10
ALS Sample ID	Units	Realized detection limit	L923641-2	L923641-3	L923641-4	L923641-5	L923641-7	L923641-8	L923641-10	L923641-11	L923641-6	L923641-12
Physical Tests												
Conductivity	µS/cm	2.0	30.2	37.9	37.8	18.7	17.7	17.7	15.6	15.6	18.6	15.9
Hardness (as $CaCO_3$)	mg/L	0.50	11.2	14.7	14.7	7.65	7.32	7.30	6.12	6.13	7.75	5.99
pH	pH	0.10	6.60	6.69	6.74	6.33	6.42	6.45	6.47	6.53	6.38	6.55
Total Suspended Solids	mg/L	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L	10	26	28	31	16	18	20	14	<10	17	13
Turbidity	NTU	0.10	0.44	0.45	0.38	0.50	0.41	0.39	0.67	0.54	0.50	0.53
Leachable Anions & Nutrients												
Anion Sum	meq/L	-	0.25	0.33	0.32	0.17	0.14	0.16	0.12	0.13	0.17	0.13
Cation Sum	meq/L	-	0.27	0.34	0.34	0.19	0.18	0.18	0.15	0.15	0.19	0.15
Cation - Anion Balance	%	-	4.2	2.7	2.8	6.5	11.9	6.7	11.1	7.4	7.5	8.2
Anions and Nutrients												
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	2.0	4.1	5.0	5.0	4.7	4.3	4.3	4.5	4.9	4.7	4.7
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	2.0	4.1	5.0	5.0	4.7	4.3	4.3	4.5	4.9	4.7	4.7
Bromide (Br)	mg/L	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	0.50	3.70	5.27	5.26	0.55	<0.5	0.52	<0.5	<0.5	0.53	<0.5
Fluoride (F)	mg/L	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Sulphate (SO_4)	mg/L	0.50	3.00	3.70	3.71	2.79	2.71	2.72	1.55	1.55	2.80	1.55
Ammonia as N	mg/L	0.0050	<0.0050	<0.0050	0.0060	<0.0050	<0.0050	0.0053	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.050	0.243	0.173	2.30	0.223	0.178	0.199	0.250	0.187	0.212	0.196
Ortho Phosphate (as P)	mg/L	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus	mg/L	0.0020	0.0055	0.0043	0.0037	0.0045	0.0047	0.0043	0.0052	0.0051	0.0048	0.0068
Organic / Inorganic Carbon												
Total Organic Carbon	mg/L	0.50	4.50	3.58	3.57	3.90	3.80	3.75	3.44	3.56	3.89	3.51
Total Metals												
Aluminum (Al)-Total	mg/L	0.0010	0.0124	0.0150	0.0117	0.0154	0.0114	0.0113	0.0097	0.0080	0.0149	0.0124
Antimony (Sb)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	mg/L	0.0002 to 0.0003	<0.00030	<0.00030	0.000318	<0.00030	<0.00030	<0.00030	<0.00020	<0.00020	<0.00030	<0.00020
Barium (Ba)-Total	mg/L	0.000050	0.00462	0.00669	0.00650	0.00248	0.00218	0.00203	0.00256	0.00254	0.00236	0.00250
Beryllium (Be)-Total	mg/L	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)-Total	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Total	mg/L	0.0010	0.0085	0.0095	0.0108	0.0091	0.0095	0.0103	0.0111	0.0099	0.0097	0.0086
Cadmium (Cd)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)-Total	mg/L	0.020	2.37	3.69	3.69	1.49	1.35	1.37	1.21	1.21	1.45	1.20
Chromium (Cr)-Total	mg/L	0.0001 to 0.0005	0.00167	0.00072	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total	mg/L	0.00010	0.00349	0.00286	0.00147	0.00176	0.00166	0.00143	0.00124	0.00089	0.00152	0.00077
Iron (Fe)-Total	mg/L	0.010	0.085	0.033	0.024	0.180	0.043	0.042	0.050	0.050	0.170	0.046
Lead (Pb)-Total	mg/L	0.000050	0.000125	0.000088	<0.000050	0.000090	<0.000050	<0.000050	0.000199	<0.000050	0.000182	<0.000050
Lithium (Li)-Total	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)-Total	mg/L	0.0050	1.34	1.41	1.36	1.08	1.03	1.02	0.807	0.856	1.06	0.841
Manganese (Mn)-Total	mg/L	0.000050	0.00143	0.00237	0.00200	0.00193	0.00159	0.00154	0.00215	0.00212	0.00178	0.00195
Mercury (Hg)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Total	mg/L	0.00010	0.00828	0.00502	0.00161	0.00209	0.00171	0.00171	0.00109	0.00074	0.00161	0.00066

Note: shaded cells exceed CCME water quality guidelines for the protection of aquatic life.

Appendix 2a. Water Quality Data from the Back River Project Study Lakes, August 2010

Sample ID			UMWELT, 1M	LLAMA, 1M	LLAMA, MID, 7M	MAM, 1M	CHAIR, 1M	CHAIR, MID, 5M	REFERENCE B, 1M	REFERENCE B, MID, 2.5 M	DUPLICATE 1 MAM 1M	DUPLICATE 2 Ref Lk B, 2.5M
Date Sampled			20-AUG-10	20-AUG-10	20-AUG-10	21-AUG-10	21-AUG-10	21-AUG-10	22-AUG-10	22-AUG-10	21-AUG-10	22-AUG-10
ALS Sample ID	Units	Realized detection limit	L923641-2	L923641-3	L923641-4	L923641-5	L923641-7	L923641-8	L923641-10	L923641-11	L923641-6	L923641-12
Total Metals (continued)		0.30										
Phosphorus (P)-Total	mg/L	0.050	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Total	mg/L	0.00010	0.500	0.580	0.589	0.364	0.356	0.352	0.315	0.335	0.360	0.326
Selenium (Se)-Total	mg/L	0.050	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)-Total	mg/L	0.000010	0.306	0.258	0.250	0.237	0.254	0.251	0.134	0.132	0.231	0.131
Silver (Ag)-Total	mg/L	0.010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	0.00010	0.771	0.816	0.805	0.636	0.608	0.603	0.500	0.521	0.626	0.511
Strontium (Sr)-Total	mg/L	0.00010	0.0129	0.0281	0.0281	0.00574	0.00548	0.00543	0.00435	0.00448	0.00562	0.00440
Thallium (Tl)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	0.010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	0.000010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L	0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)-Total	mg/L	0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	0.0010	0.0024	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dissolved Metals												
Aluminum (Al)-Dissolved	mg/L	0.0010	0.0036	0.0053	0.0048	0.0050	0.0046	0.0045	0.0018	0.0019	0.0048	0.0017
Antimony (Sb)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.00003 to 0.00005	0.000260	0.000285	0.000296	0.000245	0.000234	0.000241	0.000132	0.000128	0.000264	0.000109
Barium (Ba)-Dissolved	mg/L	0.000050	0.00458	0.00662	0.00658	0.00235	0.00203	0.00202	0.00248	0.00243	0.00234	0.00238
Beryllium (Be)-Dissolved	mg/L	0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)-Dissolved	mg/L	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L	0.001 to 0.005	0.0092	0.0096	0.0086	0.0098	0.0067	0.0077	0.0085	0.0076	0.0077	0.0074
Cadmium (Cd)-Dissolved	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)-Dissolved	mg/L	0.020	2.33	3.61	3.61	1.38	1.31	1.33	1.14	1.15	1.42	1.10
Chromium (Cr)-Dissolved	mg/L	0.0001 to 0.0002	0.00051	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Cobalt (Co)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	0.00010	0.00285	0.00179	0.00125	0.00151	0.00144	0.00131	0.00083	0.00068	0.00136	0.00054
Iron (Fe)-Dissolved	mg/L	0.010	0.011	<0.010	<0.010	0.066	<0.010	<0.010	<0.010	<0.010	0.063	<0.010
Lead (Pb)-Dissolved	mg/L	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000066	<0.000050
Lithium (Li)-Dissolved	mg/L	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)-Dissolved	mg/L	0.0050	1.31	1.38	1.37	1.02	0.984	0.968	0.797	0.789	1.02	0.787
Manganese (Mn)-Dissolved	mg/L	0.000050	0.000979	0.000365	0.000191	0.000867	0.000277	0.000257	0.000144	0.000134	0.000702	0.000153
Mercury (Hg)-Dissolved	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.000050	<0.000050	0.000057	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Dissolved	mg/L	0.00010	0.00768	0.00429	0.00147	0.00188	0.00153	0.00165	0.00085	0.00067	0.00154	0.00074
Phosphorus (P)-Dissolved	mg/L	0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	0.050	0.493	0.578	0.593	0.357	0.349	0.347	0.314	0.318	0.359	0.310
Selenium (Se)-Dissolved	mg/L	0.0001 to 0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon (Si)-Dissolved	mg/L	0.050	0.288	0.239	0.238	0.218	0.229	0.230	0.115	0.110	0.216	0.112
Silver (Ag)-Dissolved	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	0.010	0.739	0.781	0.792	0.609	0.567	0.572	0.475	0.469	0.606	0.471
Strontium (Sr)-Dissolved	mg/L	0.00010	0.0124	0.0274	0.0279	0.00554	0.00531	0.00532	0.00428	0.00424	0.00543	0.00416
Thallium (Tl)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Dissolved	mg/L	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)-Dissolved	mg/L	0.000050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc (Zn)-Dissolved	mg/L	0.0010	0.0021	0.0015	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Note: shaded cells exceed CCME water quality guidelines for the protection of aquatic life.

Appendix 2b. Results from the Principal Components Analysis (PCA) of the Back River Water Quality Data, August 2010

i) Principal Component Scores for the Sample Sites

Lake and Sample Depth	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7
Umwelt, 1 m	-3.58	4.79	0.19	1.47	0.21	0.66	-0.02
Llama, 1 m	-5.03	-0.72	2.35	-0.61	-0.43	-1.31	-0.17
Llama, 7 m	-4.49	-4.31	-1.22	0.45	0.30	0.93	0.21
Mam, 1 m	1.20	1.21	0.50	-2.87	0.13	0.93	-0.03
Chair, 1 m	1.66	1.02	-1.86	-0.19	-0.61	-0.85	0.86
Chair, 5 m	1.34	0.05	-2.98	-0.03	0.25	-0.60	-0.78
Reference Lake B, 1 m	4.42	-0.87	1.68	0.75	2.07	-0.25	0.11
Reference Lake B, 2.5 m	4.49	-1.16	1.35	1.04	-1.93	0.49	-0.18

PC = principal component

ii) Eigenvectors or Loadings for Water Quality Parameters Included in the PCA

	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7
pH	-0.75	-0.40	0.23	0.47	-0.10	0.04	-0.04
Conductivity	-0.98	-0.14	0.12	0.08	0.00	0.04	0.02
Hardness	-0.98	-0.16	0.07	0.01	0.00	0.01	0.03
TDS	-0.89	0.03	-0.25	-0.08	0.35	-0.12	0.06
Turbidity	0.62	0.03	0.71	0.05	0.32	0.07	0.01
TOC	-0.34	0.86	-0.22	0.04	-0.04	0.30	0.02
Alkalinity-bicarbonate	-0.23	-0.78	0.44	-0.29	-0.23	0.08	-0.04
Alkalinity-total	-0.23	-0.78	0.44	-0.29	-0.23	0.08	-0.04
Chloride	-0.97	-0.06	0.12	0.09	0.04	0.11	-0.12
Sulphate	-0.90	0.01	-0.30	-0.31	-0.03	-0.07	0.04
Ammonia	-0.29	-0.55	-0.67	0.10	0.15	0.16	-0.33
TKN	-0.44	-0.62	-0.24	0.17	0.22	0.51	0.17
TP	0.57	0.53	0.43	0.37	-0.23	0.14	0.00
T-Al	-0.61	0.24	0.18	-0.71	-0.14	-0.02	-0.08
T-Ba	-0.89	-0.24	0.34	0.19	0.02	0.07	0.04
T-B	0.20	-0.75	-0.17	0.01	0.59	-0.12	-0.04
T-Ca	-0.96	-0.23	0.14	0.05	0.00	0.01	0.02
T-Cr	-0.62	0.64	0.30	0.32	-0.01	-0.03	-0.10
T-Cu	-0.77	0.57	0.10	-0.05	0.16	-0.19	0.05
T-Fe	0.26	0.67	0.17	-0.51	0.07	0.43	-0.06
T-Pb	-0.04	0.43	0.64	-0.20	0.60	0.09	-0.02
T-Mg	-0.99	0.08	-0.06	-0.09	-0.07	0.02	0.02
T-Mn	-0.02	-0.67	0.71	-0.15	0.03	-0.16	-0.01
T-Ni	-0.78	0.60	0.09	0.02	0.11	-0.14	-0.05
T-K	-0.98	-0.15	0.10	0.09	-0.05	0.05	0.03
T-Si	-0.77	0.38	-0.45	-0.23	-0.02	-0.07	0.05
T-Na	-0.99	0.03	-0.05	-0.07	-0.05	0.04	0.03
T-Sr	-0.96	-0.25	0.13	0.07	-0.01	-0.01	0.03
T-Zn	-0.64	0.62	0.32	0.30	-0.02	-0.06	-0.10

PC = principal component

iii) Percent Variation of the Data Explained by Principal Components (Factors)

Principal Component	Eigenvalue	% Variation Explained	Cumulative % Variation
1	14.8	51.2	51.2
2	6.7	23.0	74.2
3	3.5	12.0	86.1
4	1.8	6.2	92.4
5	1.2	4.3	96.7
6	0.8	2.6	99.3
7	0.2	0.7	100.0

Appendix 2c. Travel, Field, and Equipment Blank Data for Back River Project Water Quality Samples, August 2010

Sample ID			TRAVEL BLANK	FIELD BLANK AT CHAIR	EQUIPMENT BLANK AT UMWELT
Date Sampled			22-AUG-10	21-AUG-10	20-AUG-10
ALS Sample ID	Units	Detection Limit	L923641-13	L923641-9	L923641-1
Physical Tests					
Conductivity	µS/cm	2.0	<2.0	<2.0	2.2
Hardness (as $CaCO_3$)	mg/L	0.50	<0.5	<0.5	<0.5
pH	pH	0.10	5.74	6.08	5.87
Total Suspended Solids	mg/L	3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L	10	<10	<10	<10
Turbidity	NTU	0.10	<0.1	<0.1	<0.1
Leachable Anions & Nutrients					
Anion Sum	meq/L	-	<0.1	<0.1	<0.1
Cation Sum	meq/L	-	<0.1	<0.1	<0.1
Cation - Anion Balance	%	-	0.0	0.0	71.2
Anions and Nutrients					
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	2.0	<2.0	<2.0	<2.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	2.0	<2.0	<2.0	<2.0
Bromide (Br)	mg/L	0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	0.50	<0.5	<0.5	<0.5
Fluoride (F)	mg/L	0.020	<0.020	<0.020	<0.020
Sulphate (SO_4)	mg/L	0.50	<0.5	<0.5	<0.5
Ammonia (as N)	mg/L	0.0050	<0.0050	<0.0050	<0.0050
Nitrate (as N)	mg/L	0.0050	<0.0050	<0.0050	0.0053
Nitrite (as N)	mg/L	0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	0.050	<0.050	<0.050	<0.050
Ortho Phosphate (as P)	mg/L	0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus	mg/L	0.0020	<0.0020	<0.0020	<0.0020
Organic / Inorganic Carbon					
Total Organic Carbon	mg/L	0.50	<0.5	<0.5	0.55
Total Metals					
Aluminum (Al)-Total	mg/L	0.0010	<0.0010	<0.0010	<0.0010
Antimony (Sb)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	mg/L	0.000030	<0.000030	<0.000030	<0.000030
Barium (Ba)-Total	mg/L	0.000050	<0.000050	<0.000050	0.000092
Beryllium (Be)-Total	mg/L	0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)-Total	mg/L	0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Total	mg/L	0.0010	<0.0050	<0.0050	0.0013
Cadmium (Cd)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)-Total	mg/L	0.020	<0.020	<0.020	<0.020
Chromium (Cr)-Total	mg/L	0.00010	<0.00010	<0.00010	0.00043
Cobalt (Co)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Total	mg/L	0.00010	<0.00010	<0.00010	0.00034
Iron (Fe)-Total	mg/L	0.010	<0.010	<0.010	<0.010
Lead (Pb)-Total	mg/L	0.000050	<0.000050	<0.000050	0.000088
Lithium (Li)-Total	mg/L	0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)-Total	mg/L	0.0050	<0.0050	<0.0050	0.0099
Manganese (Mn)-Total	mg/L	0.000050	<0.000050	<0.000050	0.000104
Mercury (Hg)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total	mg/L	0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Total	mg/L	0.00010	<0.00010	<0.00010	0.00253
Phosphorus (P)-Total	mg/L	0.30	<0.30	<0.30	<0.30
Potassium (K)-Total	mg/L	0.050	<0.050	<0.050	<0.050
Selenium (Se)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)-Total	mg/L	0.050	<0.050	<0.050	<0.050
Silver (Ag)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	mg/L	0.010	<0.010	<0.010	<0.010
Strontium (Sr)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010

Note: shaded cell indicates values greater than detection limits.

Appendix 2c. Travel, Field, and Equipment Blank Data for Back River Project Water Quality Samples, August 2010

Sample ID			TRAVEL BLANK	FIELD BLANK AT CHAIR	EQUIPMENT BLANK AT UMWELT
Date Sampled			22-AUG-10	21-AUG-10	20-AUG-10
ALS Sample ID	Units	Detection Limit	L923641-13	L923641-9	L923641-1
Total Metals (continued)					
Thallium (Tl)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Total	mg/L	0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	mg/L	0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	mg/L	0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)-Total	mg/L	0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)-Total	mg/L	0.0010	<0.0010	<0.0010	0.0034
Dissolved Metals					
Aluminum (Al)-Dissolved	mg/L	0.0010	<0.0010	<0.0010	<0.0010
Antimony (Sb)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.000030	<0.000030	<0.000030	<0.000030
Barium (Ba)-Dissolved	mg/L	0.000050	<0.000050	<0.000050	0.000150
Beryllium (Be)-Dissolved	mg/L	0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)-Dissolved	mg/L	0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L	0.0010	<0.0050	<0.0050	0.0095
Cadmium (Cd)-Dissolved	mg/L	0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)-Dissolved	mg/L	0.020	<0.020	<0.020	<0.020
Chromium (Cr)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	0.00046
Cobalt (Co)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	0.00065
Iron (Fe)-Dissolved	mg/L	0.010	<0.010	<0.010	<0.010
Lead (Pb)-Dissolved	mg/L	0.000050	<0.000050	<0.000050	0.000071
Lithium (Li)-Dissolved	mg/L	0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)-Dissolved	mg/L	0.0050	<0.0050	<0.0050	0.0092
Manganese (Mn)-Dissolved	mg/L	0.000050	<0.000050	<0.000050	0.000257
Mercury (Hg)-Dissolved	mg/L	0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	0.00770
Phosphorus (P)-Dissolved	mg/L	0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	0.050	<0.050	<0.050	<0.050
Selenium (Se)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)-Dissolved	mg/L	0.050	<0.050	<0.050	<0.050
Silver (Ag)-Dissolved	mg/L	0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	0.010	<0.010	<0.010	<0.010
Strontium (Sr)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	<0.00010
Thallium (Tl)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)-Dissolved	mg/L	0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	0.010	<0.010	<0.010	<0.010
Uranium (U)-Dissolved	mg/L	0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)-Dissolved	mg/L	0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)-Dissolved	mg/L	0.0010	<0.0010	<0.0010	0.0032

Note: shaded cell indicates values greater than detection limits.

Appendix 3

Sediment Quality Data from the Back River Project Study Lakes, August 2010

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Appendix 3a. Sediment Quality Data from the Back River Project Study Lakes, August 2010

Sample ID					UMWELT, SHALLOW REP1	UMWELT, SHALLOW REP2	UMWELT, SHALLOW REP3	LLAMA, SHALLOW REP1	LLAMA, SHALLOW REP2	LLAMA, SHALLOW REP3	LLAMA, MID REP1	LLAMA, MID REP2	LLAMA, MID REP3	LLAMA, DEEP REP1
Date Sampled					20-AUG-10	20-AUG-10	20-AUG-10	20-AUG-10	20-AUG-10	20-AUG-10	20-AUG-10	20-AUG-10	20-AUG-10	20-AUG-10
ALS Sample ID					L924211-1	L924211-2	L924211-3	L924211-4	L924211-5	L924211-6	L924211-7	L924211-8	L924211-9	L924211-10
Matrix					Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
	Units	Realized Detection Limits	CCME ISQG[1]	CCME PEL[2]										
Physical Tests														
Moisture	%	0.10			48.7	49.2	76.8	63.3	87.1	85.3	90.3	86.5	87.1	69.0
pH	pH	0.10			6.27	6.63	5.55	6.60	6.22	6.31	5.86	6.27	5.72	5.31
Particle Size														
% Gravel (>2 mm)	%	0.10			<0.10	23.4	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
% Sand (2.0 mm - 0.063 mm)	%	0.10			79.1	63.9	59.9	74.1	7.35	13.8	3.28	4.36	4.05	13.4
% Silt (0.063 mm - 4 µm)	%	0.10			20.8	12.6	38.9	24.8	87.4	79.3	85.6	86.9	90.8	85.0
% Clay (<4 µm)	%	0.10			0.14	0.11	1.22	1.10	5.25	6.87	11.2	8.79	5.14	1.59
Leachable Anions & Nutrients														
Total Nitrogen by LECO	%	0.020			0.208	0.171	0.361	0.213	0.702	0.498	0.945	0.704	0.552	0.316
Organic / Inorganic Carbon														
$CaCO_3$ Equivalent	%	0.80			<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	0.87	0.85	<0.80	<0.80
Inorganic Carbon	%	0.10			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Carbon by Combustion	%	0.1			2.3	1.8	4.1	2.5	8.2	5.9	10.2	8.2	6.4	3.6
Total Organic Carbon	%	0.10			2.28	1.79	4.07	2.48	8.19	5.89	10.2	8.18	6.44	3.65
Plant Available Nutrients														
Available Ammonium-N	mg/kg	1 to 3			8.6	4.8	15.8	4.7	32.2	16.7	27.8	24.0	23.6	15.4
Available Nitrate-N	mg/kg	2.5 to 7.5			<2.6	<2.5	<3.0	<3.0	<5.0	<5.0	<7.5	<6.7	<6.7	<4.6
Available Nitrite-N	mg/kg	0.5 to 1.5			<0.52	<0.50	<0.60	<0.60	<1.0	<1.0	<1.5	<1.3	<1.3	<0.92
Available Phosphate-P	mg/kg	2.0			3.4	3.0	<2.0	5.0	<2.0	<2.0	2.1	2.1	<2.0	3.0
Metals														
Aluminum (Al)	mg/kg	50			5580	4590	7630	7300	13700	12200	13500	13900	12300	10200
Antimony (Sb)	mg/kg	0.10			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic (As)	mg/kg	0.050	5.9	17	12.9	11.4	22.5	15.6	33.5	44.6	34.3	53.9	141	15.1
Barium (Ba)	mg/kg	0.50			28.9	23.7	46.2	57.4	115	105	95.1	111	104	58.4
Beryllium (Be)	mg/kg	0.20			<0.20	<0.20	0.28	0.28	0.52	0.45	0.47	0.53	0.50	0.28
Bismuth (Bi)	mg/kg	0.20			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.10	0.6	3.5	0.15	<0.10	0.20	0.20	0.45	0.33	0.42	0.47	0.41	0.19
Calcium (Ca)	mg/kg	50			1240	1080	1740	1860	3280	2790	3550	3490	2910	2450
Chromium (Cr)	mg/kg	0.50	37.3	90	13.8	10.4	21.1	19.9	38.6	35.7	39.6	40.4	36.9	32.8
Cobalt (Co)	mg/kg	0.10			6.15	3.83	9.19	8.00	17.6	15.7	17.4	14.9	20.6	19.5
Copper (Cu)	mg/kg	0.50	35.7	197	27.6	21.9	46.5	47.4	122	99.9	124	150	138	60.8
Iron (Fe)	mg/kg	50			11300	9310	22900	14000	31700	31400	31000	43600	82100	19100
Lead (Pb)	mg/kg	0.50	35	91.3	3.15	2.35	3.84	3.66	6.22	5.66	6.80	7.15	6.43	5.22
Lithium (Li)	mg/kg	1.0			7.5	6.5	10.6	11.6	16.4	17.1	16.9	15.6	13.3	15.1
Magnesium (Mg)	mg/kg	20			2640	2200	3210	3330	5490	5470	5620	5370	4810	5090
Manganese (Mn)	mg/kg	1.0			53.5	45.9	75.0	90.7	238	304	187	183	337	178
Mercury (Hg)	mg/kg	0.0050	0.17	0.486	0.0211	0.0169	0.0454	0.0280	0.0627	0.0563	0.101	0.0978	0.0924	0.0705
Molybdenum (Mo)	mg/kg	0.50			<0.50	<0.50	0.72	0.54	1.25	1.38	1.23	1.63	1.73	0.62
Nickel (Ni)	mg/kg	0.50			23.6	17.8	41.4	40.0	78.8	65.8	71.9	70.8	74.8	42.3
Phosphorus (P)	mg/kg	50			332	247	492	358	715	655	876	844	954	738
Potassium (K)	mg/kg	100			420	360	520	620	1070	1100	1140	1030	800	760
Selenium (Se)	mg/kg	0.20			<0.20	<0.20	0.29	0.20	0.55	0.44	0.70	0.74	0.80	0.38
Silver (Ag)	mg/kg	0.10			<0.10	<0.10	<0.10	<0.10	0.24	1.35	0.37	0.30	0.31	0.18
Sodium (Na)	mg/kg	100			220	<100	130	130	200	170	180	170	140	180
Strontium (Sr)	mg/kg	0.50			7.74	5.49	10.5	12.4	20.9	21.3	29.1	26.8	20.0	14.2
Sulphur (S)-Total	mg/kg	100			820	580	1560	480	1820	1660	2860	1940	2170	1350
Thallium (Tl)	mg/kg	0.050			<0.050	<0.050	0.055	0.055	0.110	0.092	0.133	0.124	0.106	0.088
Tin (Sn)	mg/kg	2.0			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg	1.0			184	171	262	267	390	349	369	355	304	411
Uranium (U)	mg/kg	0.050			0.337	0.292	0.579	0.651	1.38	1.14	1.38	1.51	1.34	0.875
Vanadium (V)	mg/kg	0.20			19.5	17.4	27.6	22.2	40.9	35.3	39.9	41.7	38.0	32.9
Zinc (Zn)	mg/kg	1.0	123	315	32.9	27.5	50.9	47.2	82.4	69.4	81.5	90.4	86.1	46.3

Shaded cells indicated metal concentrations exceed CCME interim sediment quality guideline (ISQG) levels.

1) CCME interim sediment quality guideline

2) CCME probable effects level

Appendix 3a. Sediment Quality Data from the Back River Project Study Lakes, August 2010

Sample ID					LLAMA, DEEP REP2	LLAMA, DEEP REP3	MAM, SHALLOW REP1	MAM, SHALLOW REP2	MAM, SHALLOW REP3	CHAIR, SHALLOW REP1	CHAIR, SHALLOW REP2	CHAIR, SHALLOW REP3	CHAIR, MID REP1	CHAIR, MID REP2
Date Sampled					20-AUG-10	20-AUG-10	21-AUG-10	21-AUG-10	21-AUG-10	21-AUG-10	21-AUG-10	21-AUG-10	21-AUG-10	21-AUG-10
ALS Sample ID					L924211-11	L924211-12	L924211-13	L924211-14	L924211-15	L924211-16	L924211-17	L924211-18	L924211-19	L924211-20
Matrix					Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
	Units	Realized Detection Limits	CCME ISQG[1]	CCME PEL[2]										
Physical Tests														
Moisture	%	0.10			72.3	72.4	77.6	81.9	77.4	85.2	87.7	82.9	75.3	76.2
pH	pH	0.10			5.62	5.49	6.37	6.20	5.73	6.23	6.42	6.59	5.14	5.79
Particle Size														
% Gravel (>2 mm)	%	0.10			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.25
% Sand (2.0 mm - 0.063 mm)	%	0.10			11.1	7.07	3.91	5.16	4.21	3.97	2.84	3.25	9.30	11.8
% Silt (0.063 mm - 4 µm)	%	0.10			86.0	90.0	89.8	89.9	77.5	82.8	83.9	84.4	77.6	72.8
% Clay (<4 µm)	%	0.10			2.89	2.91	6.28	4.97	18.3	13.2	13.3	12.4	13.2	15.1
Leachable Anions & Nutrients														
Total Nitrogen by LECO	%	0.020			0.368	0.385	0.726	0.755	0.641	0.548	0.700	0.628	0.400	0.294
Organic / Inorganic Carbon														
$CaCO_3$ Equivalent	%	0.80			<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	1.07	1.53	<0.80
Inorganic Carbon	%	0.10			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.16	<0.10
Total Carbon by Combustion	%	0.1			4.0	4.1	7.7	7.7	7.2	6.5	8.2	7.4	4.8	3.6
Total Organic Carbon	%	0.10			3.97	4.12	7.73	7.69	7.19	6.47	8.22	7.41	4.59	3.64
Plant Available Nutrients														
Available Ammonium-N	mg/kg	1 to 3			12.0	14.6	49.9	74.9	37.0	14.1	21.8	23.9	11.4	4.7
Available Nitrate-N	mg/kg	2.5 to 7.5			<6.0	<6.0	<6.0	<6.0	<6.0	<7.5	<7.5	<6.7	<4.0	<4.6
Available Nitrite-N	mg/kg	0.5 to 1.5			<1.2	<1.2	<1.2	<1.2	<1.2	<1.5	<1.5	<1.3	<0.80	<0.92
Available Phosphate-P	mg/kg	2.0			11.5	6.6	5.8	4.8	3.5	2.9	<2.0	2.6	11.3	<2.0
Metals														
Aluminum (Al)	mg/kg	50			7830	10900	11100	9950	11400	15100	16200	15000	17400	19500
Antimony (Sb)	mg/kg	0.10			<0.10	0.11	<0.10	<0.10	<0.10	0.16	0.11	0.11	0.11	<0.10
Arsenic (As)	mg/kg	0.050	5.9	17	11.0	27.0	16.1	17.3	37.5	38.3	40.1	35.5	82.9	64.5
Barium (Ba)	mg/kg	0.50			49.7	61.9	73.4	66.2	72.9	79.3	84.0	75.9	75.3	59.2
Beryllium (Be)	mg/kg	0.20			0.22	0.32	0.32	0.28	0.41	0.57	0.64	0.61	0.59	0.74
Bismuth (Bi)	mg/kg	0.20			<0.20	<0.20	<0.20	<0.20	<0.20	0.22	0.23	0.22	0.24	0.29
Cadmium (Cd)	mg/kg	0.10	0.6	3.5	0.12	0.25	0.29	0.23	0.42	0.52	0.48	0.44	1.18	<0.10
Calcium (Ca)	mg/kg	50			2230	2680	2860	2690	2620	2280	2380	2370	2370	1510
Chromium (Cr)	mg/kg	0.50	37.3	90	25.7	37.2	36.6	32.9	37.8	43.0	45.5	42.7	49.6	56.1
Cobalt (Co)	mg/kg	0.10			13.6	22.1	13.9	12.5	16.3	22.9	24.5	22.6	167	43.2
Copper (Cu)	mg/kg	0.50	35.7	197	43.3	77.3	77.6	67.4	92.1	136	143	125	142	138
Iron (Fe)	mg/kg	50			14700	27400	25400	25100	35100	43000	46200	42000	48700	85800
Lead (Pb)	mg/kg	0.50	35	91.3	4.19	6.90	6.20	5.22	6.33	8.46	8.07	7.72	8.38	10.7
Lithium (Li)	mg/kg	1.0			12.5	15.8	16.0	14.7	15.2	15.9	15.8	15.8	16.8	23.4
Magnesium (Mg)	mg/kg	20			4160	5530	5720	5200	5570	5540	5920	5630	6560	6470
Manganese (Mn)	mg/kg	1.0			136	195	155	137	149	257	244	208	257	586
Mercury (Hg)	mg/kg	0.0050	0.17	0.486	0.0511	0.0810	0.0729	0.0625	0.0648	0.0574	0.0601	0.0625	0.0614	0.0679
Molybdenum (Mo)	mg/kg	0.50			<0.50	0.84	0.67	0.62	1.10	2.04	2.22	1.94	4.21	2.04
Nickel (Ni)	mg/kg	0.50			30.7	53.9	62.1	56.7	75.5	89.9	95.5	92.9	242	84.7
Phosphorus (P)	mg/kg	50			783	963	1110	1030	891	705	792	709	1670	1990
Potassium (K)	mg/kg	100			620	940	1010	870	890	1020	1080	1040	1370	1130
Selenium (Se)	mg/kg	0.20			0.27	0.43	0.43	0.37	0.46	0.59	0.62	0.52	1.10	0.68
Silver (Ag)	mg/kg	0.10			0.12	0.21	0.14	0.11	0.13	0.25	0.24	0.22	0.42	0.49
Sodium (Na)	mg/kg	100			110	200	210	150	160	260	150	150	170	100
Strontium (Sr)	mg/kg	0.50			12.3	17.3	14.6	12.2	13.1	12.9	14.0	13.3	15.6	10.1
Sulphur (S)-Total	mg/kg	100			1320	1690	1750	1870	2160	1680	1920	1850	2720	680
Thallium (Tl)	mg/kg	0.050			0.067	0.122	0.108	0.094	0.132	0.131	0.148	0.129	0.599	0.122
Tin (Sn)	mg/kg	2.0			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg	1.0			323	428	360	331	367	320	327	310	513	427
Uranium (U)	mg/kg	0.050			0.692	1.22	1.26	1.09	1.41	2.04	2.19	2.05	2.57	2.81
Vanadium (V)	mg/kg	0.20			27.0	37.4	37.7	34.4	41.2	43.0	45.1	42.6	55.2	53.7
Zinc (Zn)	mg/kg	1.0	123	315	33.7	53.7	63.8	57.0	102	122	156	137	201	93.7

Shaded cells indicated metal concentrations exceed CCME interim sediment quality guideline (ISQG) levels.

1) CCME interim sediment quality guideline

2) CCME probable effects level

Appendix 3a. Sediment Quality Data from the Back River Project Study Lakes, August 2010

Sample ID					CHAIR, MID REP3	REFERENCE LAKE B SHALLOW REP1	REFERENCE LAKE B SHALLOW REP2	REFERENCE LAKE B SHALLOW REP3	REFERENCE LAKE B MID REP1	REFERENCE LAKE B MID REP2	REFERENCE LAKE B MID REP3
Date Sampled					21-AUG-10	22-AUG-10	22-AUG-10	22-AUG-10	22-AUG-10	22-AUG-10	22-AUG-10
ALS Sample ID					L924211-21	L924211-25	L924211-26	L924211-27	L924211-22	L924211-23	L924211-24
Matrix	Units	Realized Detection Limits	CCME ISQG[1]	CCME PEL[2]	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Physical Tests											
Moisture	%	0.10			80.9	68.5	64.0	89.2	77.5	77.2	82.3
pH	pH	0.10			5.83	6.32	6.36	6.09	5.48	5.02	5.42
Particle Size											
% Gravel (>2 mm)	%	0.10			<0.10	<0.10	0.65	<0.10	<0.10	<0.10	<0.10
% Sand (2.0 mm - 0.063 mm)	%	0.10			7.60	69.1	77.3	9.69	62.5	56.4	67.2
% Silt (0.063 mm - 4 µm)	%	0.10			81.4	29.5	21.3	86.4	36.0	41.3	31.4
% Clay (<4 µm)	%	0.10			11.0	1.40	0.78	3.88	1.53	2.31	1.42
Leachable Anions & Nutrients											
Total Nitrogen by LECO	%	0.020			0.346	0.443	0.271	1.03	0.418	0.493	0.398
Organic / Inorganic Carbon											
$CaCO_3$ Equivalent	%	0.80			1.00	<0.80	<0.80	<0.80	0.90	<0.80	<0.80
Inorganic Carbon	%	0.10			<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Total Carbon by Combustion	%	0.1			4.1	5.5	3.4	13.6	5.2	6.4	5.0
Total Organic Carbon	%	0.10			4.15	5.52	3.42	13.6	5.21	6.43	5.04
Plant Available Nutrients											
Available Ammonium-N	mg/kg	1 to 3			5.9	23.9	12.1	34.4	29.0	32.2	22.5
Available Nitrate-N	mg/kg	2.5 to 7.5			<5.5	<3.0	<2.5	<3.8	<3.8	<3.8	<2.7
Available Nitrite-N	mg/kg	0.5 to 1.5			<1.1	<0.60	<0.50	<0.75	<0.75	<0.75	<0.55
Available Phosphate-P	mg/kg	2.0			5.2	<2.0	<2.0	3.7	<2.0	<2.0	<2.0
Metals											
Aluminum (Al)	mg/kg	50			18400	4030	2780	6770	4220	6520	4980
Antimony (Sb)	mg/kg	0.10			<0.10	<0.10	<0.10	0.18	<0.10	<0.10	<0.10
Arsenic (As)	mg/kg	0.050	5.9	17	96.4	5.25	5.71	4.80	14.1	14.8	11.9
Barium (Ba)	mg/kg	0.50			60.4	30.9	20.4	59.0	22.0	34.1	27.0
Beryllium (Be)	mg/kg	0.20			0.68	<0.20	<0.20	0.26	<0.20	0.26	0.23
Bismuth (Bi)	mg/kg	0.20			0.27	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.10	0.6	3.5	0.16	0.11	<0.10	0.25	0.14	0.25	0.20
Calcium (Ca)	mg/kg	50			1400	1320	767	3310	519	1230	822
Chromium (Cr)	mg/kg	0.50	37.3	90	52.6	11.3	7.85	21.3	11.9	20.0	15.3
Cobalt (Co)	mg/kg	0.10			37.6	3.87	2.87	6.01	10.6	17.9	12.9
Copper (Cu)	mg/kg	0.50	35.7	197	170	27.9	13.8	62.9	27.0	43.5	35.8
Iron (Fe)	mg/kg	50			70900	14200	11400	17900	36400	40300	37300
Lead (Pb)	mg/kg	0.50	35	91.3	10.1	3.00	1.84	7.06	2.81	3.67	3.32
Lithium (Li)	mg/kg	1.0			18.3	5.7	5.1	7.5	2.9	5.8	4.2
Magnesium (Mg)	mg/kg	20			6010	1490	1120	2500	1010	1920	1350
Manganese (Mn)	mg/kg	1.0			690	57.1	47.9	74.2	57.5	79.5	62.3
Mercury (Hg)	mg/kg	0.0050	0.17	0.486	0.0576	0.0216	0.0100	0.0508	0.0193	0.0245	0.0238
Molybdenum (Mo)	mg/kg	0.50			2.26	<0.50	<0.50	0.56	<0.50	0.74	<0.50
Nickel (Ni)	mg/kg	0.50			74.3	19.6	13.4	37.6	28.9	48.1	36.2
Phosphorus (P)	mg/kg	50			1590	357	190	664	256	379	345
Potassium (K)	mg/kg	100			1110	390	280	590	270	460	340
Selenium (Se)	mg/kg	0.20			0.85	0.22	<0.20	0.54	0.24	0.47	0.37
Silver (Ag)	mg/kg	0.10			0.30	<0.10	<0.10	0.12	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg	100			110	<100	<100	240	<100	<100	<100
Strontium (Sr)	mg/kg	0.50			9.34	8.18	5.34	17.8	5.35	8.92	7.10
Sulphur (S)-Total	mg/kg	100			1060	810	630	2300	1510	1940	1140
Thallium (Tl)	mg/kg	0.050			0.112	<0.050	<0.050	0.056	<0.050	0.106	0.070
Tin (Sn)	mg/kg	2.0			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg	1.0			407	144	96.0	163	120	201	143
Uranium (U)	mg/kg	0.050			2.43	0.382	0.260	0.717	0.375	0.619	0.521
Vanadium (V)	mg/kg	0.20			53.5	18.6	12.5	26.1	18.6	25.5	20.7
Zinc (Zn)	mg/kg	1.0	123	315	105	22.0	16.3	41.9	32.2	66.9	45.4

Shaded cells indicated metal concentrations exceed CCME interim sediment quality guideline (ISQG) levels.

1) CCME interim sediment quality guideline

2) CCME probable effects level

Appendix 3b. Results from the Principal Components Analysis (PCA) of the Back River Sediment Quality Data, August 2010

i) Principal Component Scores for the Sample Sites

Lake and sample depth	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8
Umwelt shallow	6.39	-2.50	-1.13	0.39	-0.64	0.57	0.42	0.23
Llama shallow	-1.03	-0.12	-1.21	1.14	0.49	0.46	-0.83	-0.13
Llama mid	-4.49	1.99	-0.18	1.12	-0.65	-0.80	0.36	0.19
Llama deep	-0.15	-0.90	-1.97	-0.93	-0.25	-0.87	-0.06	-0.48
Mam shallow	-2.29	2.11	-0.37	-1.21	-0.55	0.65	-0.34	0.39
Chair shallow	-4.09	0.51	0.81	-0.04	0.27	0.95	0.60	-0.49
Chair mid	-5.45	-3.39	1.31	-0.30	0.58	-0.35	-0.04	0.33
Reference Lake B shallow	5.79	2.01	-0.19	-0.21	1.33	-0.34	0.27	0.18
Reference Lake B mid	5.32	0.28	2.93	0.05	-0.57	-0.27	-0.37	-0.22

PC = principal component

ii) Eigenvectors or Loadings for Sediment Quality Parameters Included in the PCA

Parameters	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8
% Sand	0.88	-0.26	0.06	0.22	0.18	-0.04	-0.25	0.05
% Silt	-0.88	0.28	-0.14	-0.23	0.09	-0.17	-0.08	-0.16
% Clay	-0.92	0.23	0.22	-0.11	0.18	0.07	-0.04	0.03
Total Nitrogen	-0.41	0.89	0.14	0.02	0.09	0.06	0.03	0.04
Ammonium-N	0.02	0.90	0.12	-0.19	-0.23	0.16	-0.22	0.04
TOC	-0.34	0.88	0.24	0.05	0.20	0.02	0.02	0.01
Al	-0.97	-0.20	-0.02	0.03	-0.02	0.10	0.02	-0.03
As	-0.88	-0.26	0.11	0.29	-0.23	-0.03	0.02	0.11
Ba	-0.88	0.22	-0.31	0.25	0.03	0.08	-0.08	-0.02
Cd	-0.94	0.04	0.25	0.18	0.00	0.15	-0.03	-0.01
Ca	-0.69	0.38	-0.60	0.07	0.06	-0.01	0.04	0.04
Cr	-0.99	-0.12	-0.03	-0.07	-0.03	0.03	-0.03	-0.05
Co	-0.80	-0.45	0.33	-0.12	-0.03	-0.13	-0.11	-0.06
Cu	-0.98	-0.02	0.05	0.15	0.07	0.03	0.05	-0.01
Fe	-0.77	-0.09	0.60	0.14	-0.12	-0.13	-0.01	0.02
Pb	-0.96	-0.08	0.06	-0.11	0.21	-0.02	0.13	0.01
Li	-0.90	-0.17	-0.38	-0.04	0.02	0.11	0.00	0.05
Mg	-0.91	-0.16	-0.34	-0.07	-0.08	0.13	0.01	0.01
Mn	-0.95	-0.25	0.01	0.04	0.13	-0.08	-0.09	-0.02
Hg	-0.91	0.13	-0.32	-0.04	-0.16	-0.16	0.07	0.01
Ni	-0.94	-0.19	0.25	0.03	0.01	0.12	-0.06	0.02
P	-0.90	-0.18	-0.06	-0.29	0.06	-0.15	-0.02	0.22
K	-0.97	-0.07	-0.18	0.00	0.07	0.09	-0.04	0.01
Se	-0.89	0.06	0.36	0.06	0.12	-0.25	-0.01	0.02
Sr	-0.72	0.36	-0.44	0.34	0.00	-0.21	-0.05	-0.03
S	-0.71	0.56	0.25	-0.04	-0.29	-0.16	0.07	-0.03
Ti	-0.88	-0.27	-0.30	-0.10	-0.16	-0.01	-0.14	-0.03
U	-0.98	-0.11	0.12	-0.07	0.10	0.08	0.03	-0.04
V	-0.98	-0.18	0.04	-0.07	-0.02	0.05	0.01	0.02
Zn	-0.90	-0.15	0.31	0.07	-0.06	0.24	0.06	-0.05

PC = principal component

iii) Percent Variation of the Data Explained by Principal Components

Principal component	Eigenvalue	% Variation Explained	Cumulative % Variation
1	22.0	73.2	73.2
2	3.9	13.1	86.2
3	2.2	7.4	93.6
4	0.6	2.2	95.8
5	0.5	1.6	97.4
6	0.4	1.5	98.9
7	0.2	0.7	99.6
8	0.1	0.4	100.0

Appendix V6-3B

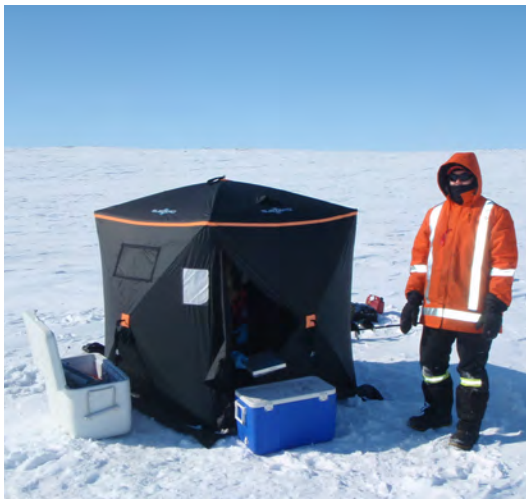
Back River Project: 2011 Freshwater Baseline Report

Rescan™
an ERM company

Sabina Gold & Silver Corp.

BACK RIVER PROJECT
2011 Freshwater Baseline Report








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June 2012

BACK RIVER PROJECT
2011 FRESHWATER BASELINE REPORT

June 2012
Project #833-002-03

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Prepared for:

Sabina Gold & Silver Corp.

Prepared by:

Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

Rescan™
Engineers and Scientists

Executive Summary

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region on Nunavut. The Project consists of several properties, one of which is the Back River property. Environmental baseline studies were conducted by Rescan Environmental Services Ltd. (Rescan) in 2011 on behalf of Sabina in the Goose property area. This report presents the results from the freshwater baseline program that was conducted in 2011.

The 2011 freshwater baseline program involved collecting information for the following: lake water quality (winter and summer), physical limnology (winter and summer), lake sediment quality, lake phytoplankton, lake zooplankton, lake benthos, stream water quality, stream sediment quality, stream periphyton, and stream benthos. The program included collecting samples from lakes and streams in areas that could potentially be influenced by the development of known deposits. A reference lake and stream, located well away from known deposits, were also sampled. A total of 6 lakes and 8 streams were sampled in 2011. Lakes sampled were Llama Lake, Umwelt Lake, Giraffe Lake, Goose Lake (sampled at neck, central and tail), Propellor Lake and Reference B Lake. Streams sampled were Chair Outflow, Llama Outflow, Echo Outflow, Giraffe Outflow, Wolf Outflow, Goose Outflow, Propellor Outflow (upstream and downstream) and Reference B Outflow.

Lake Physical Limnology

Dissolved oxygen concentrations in the lakes ranged from 3.3 mg/L to 16.2 mg/L during winter, with the highest concentrations near the water-ice interface. During summer, shallow lakes were generally well-mixed and deeper lakes weakly stratified, with dissolved oxygen levels ranging from 7.7 mg/L to 10.0 mg/L. Water clarity was high in the lakes sampled as the euphotic zone depths extended throughout the entire water column in all lakes.

Lake Water Quality

Lakes in the study area had slightly acidic to neutral pH, with Goose Lake Tail (pH of 6.46) being slightly below the CCME guideline of 6.5. Lakes in the area had low hardness and conductivity, with Umwelt Lake having considerably higher under-ice levels of hardness and conductivity than other lakes. The lakes contained variable concentrations of metals and nutrients, which were usually greater in winter than in summer. Free cyanide concentrations were below detection limits in most lake samples (93%), and always below the CCME guideline (0.005 mg/L).

Overall, turbidity and total suspended solids were low in the sampled lakes, contributing to the high water clarity in the area. Nutrients were also generally low at all lake sampling sites. Ammonia and nitrate concentrations showed similar patterns, and ranged from below detection to 0.082 mg/L. Nitrite concentrations were below detection at all lake sites. Based on CCME categorizations of total phosphorus, lakes sampled were generally ultra-oligotrophic to oligotrophic, with only Umwelt Lake in winter being outside this range (mesotrophic).

CCME guidelines for aluminum, cadmium and copper were exceeded in at least one replicate from every lake except Llama and Reference lakes. Average concentrations exceeded CCME guidelines at Umwelt (copper), Giraffe (cadmium, copper), Goose Neck (cadmium), Goose Central (cadmium), Goose Tail (aluminum) and Propellor (cadmium) lakes. The soft waters meant lower hardness-dependent CCME guideline concentrations, which were in some cases lower than achievable analytical detection limits (e.g., cadmium at Goose Lake Tail and Propellor Lake).

Stream Water Quality

Streams had relatively high water levels and flow during freshet (June), but lower discharge in August. Echo Outflow was dry during August sampling, and many of the other streams had dry or underground sections. All streams had dissolved oxygen concentrations below CCME guidelines for early life stages (less than 9.5 mg/L) during summer, with Llama Outflow being below CCME guidelines for all life stages (less than 6.5 mg/L). Fall dissolved oxygen concentrations were all above CCME guidelines (9.5 mg/L to 10.9 mg/L).

Streams and rivers in the study area had slightly acidic to neutral pH. Llama Outflow, Goose Outflow and Giraffe Outflow had pH levels below the CCME guideline range (6.5 to 9 pH units) during summer sampling, and Echo Outflow had pH levels below CCME guidelines during the freshet and fall periods. Hardness, conductivity and total dissolved solids were low in most streams, although considerably higher in Llama OF over summer and freshet than at any other stream. Turbidity and total suspended solids were highest at Chair OF and Reference B OF. Free cyanide concentrations were below detection for most streams, and always below the CCME guideline (0.005 mg/L).

Nitrate, nitrite and ammonia concentrations were generally low, often near or below detection limits. Total phosphorus levels were more variable and sites were categorized as ultra-oligotrophic to meso-eutrophic, based on the CCME trigger ranges for total phosphorus.

Over half of the streams had water that exceeded at least one CCME guideline for total aluminum, cadmium, copper and iron concentrations. Mean metal concentrations exceeded CCME guidelines at Chair Outflow (cadmium, copper), Llama Outflow (aluminum, cadmium, and copper), Echo Outflow (aluminum, cadmium, and copper), Giraffe Outflow (copper), and Reference B Outflow (iron).

Lake Sediment Quality

Lake sediments were largely composed of silt, with lesser amounts of clay and sand. Goose Lake Tail and Reference B Lake both had distinctive sediments, being composed of more than two thirds sand. The higher proportion of fine sediments (clay and silt) within a lake was generally associated with an increase in all evaluated parameters.

Lake sediments were naturally elevated in arsenic, cadmium and copper, and concentrations of these metals were often higher than CCME Interim Sediment Quality Guidelines (ISQGs). Mean sediment concentrations exceeded CCME ISQG guidelines at Llama (arsenic, copper), Umwelt (arsenic, copper), Giraffe (arsenic, copper), Goose Neck (arsenic, cadmium and copper), Goose Central (arsenic, copper), and Propellor (copper) lake sampling sites. Llama had particularly high arsenic concentrations, exceeding the CCME Probable Effects Level (PEL) by a factor of 1.37. Two replicate samples from Goose Lake Central exceeded the PEL for arsenic, but the mean concentration for Goose Lake Central was below the PEL.

Stream Sediment Quality

Stream sediments were composed mainly of silt and sand, and tended to have similar or lower metal concentrations than lake sediments. Stream sediments at many sites had naturally elevated levels of arsenic and copper, with some exceeding CCME guidelines. ISQGs were exceeded for mean arsenic and copper concentrations at Chair Outflow (arsenic), Giraffe Outflow (arsenic), Goose Outflow (arsenic, copper) and Reference B Outflow (copper). Individual replicates also exceeded ISQGs at Chair OF (copper), Giraffe Outflow (copper) and Goose Outflow (cadmium). Stream sediment metal concentrations were always below the CCME PELs, except one replicate at Chair Outflow and Goose Outflow for arsenic. Depositional sediments were not present at Llama OF or Propellor Outflow.

Lake Aquatic Life

Lake phytoplankton biomass (as chlorophyll *a*) was low in all lakes, ranging from 0.14 to 0.61 µg chl *a*/L. Densities showed similar patterns to biomass, and ranged from 630 cells/mL to 1,040 cells/mL, with chrysophytes, diatoms, green algae and cyanobacteria being the most prevalent taxa. Phytoplankton richness and diversity was high and very similar across lakes, ranging from 20 to 25 genera/sample and from 0.82 to 0.88 (Simpson's index), respectively.

Mean zooplankton densities ranged from 6,400 organisms/m^3 to 23,000 organisms/m^3 for most lake sites. Llama Lake, the deepest lake, had zooplankton densities more than twice as high as other sites (40,200 organisms/m^3). The zooplankton assemblages typically consisted of rotifers and calanoid and cyclopoid copepods. Calanoid copepods were the dominant group in all lakes, except Reference B, where rotifers dominated. Zooplankton genera richness (4.0 to 10.7 genera/sample) and diversity varied between lakes (0.22 to 0.73).

Lake benthos densities varied between lakes, ranging from 1,140 to 6,650 organisms/m^2. Lake benthic communities were generally dominated by dipterans. The most abundant genera tended to be chironomids (non-biting midges) and at some lake sites, bivalves (pea clams). Lakes had similar richness and diversity, with a mean of 5.7 families/sample, and a mean diversity of 0.84 (Simpson's index).

Stream Aquatic Life

Periphyton biomass ranged from approximately 0.96 to 2.51 µg chl *a*/cm^2, while density ranged from 1.1×10^6 cells/cm^2 to 7.1×10^6 cells/cm^2 among stream sites. Diatoms and cyanobacteria were the dominant periphyton taxa in all streams surveyed, with cyanobacteria being more prevalent in Chair OF, Giraffe OF and Reference B OF. Genera richness ranged from 18 to 35 genera/sample, and diversity from 0.72 to 0.84 (Simpson's index). Llama OF had the lowest richness and diversity of all stream sites.

Overall, stream benthos density ranged from 970 to 2,070 organisms/m^2, except in Llama OF (4,370 organisms/m^2) and Propellor OF (3,230 organisms/m^2) where higher densities were present. Stream benthos assemblages were dominated by dipterans, with oligochaetes and ostracods present in smaller numbers. Mean benthic community richness ranged from 6.4 to 14.6 families/sample, with a mean of 9.9 families/sample. Diversity was lower in stream benthic communities than in lake benthic communities, with a mean diversity of 0.50 (Simpson's index).

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BACK RIVER PROJECT
2011 FRESHWATER BASELINE REPORT

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

°C	Degrees Celsius
Allochthonous	External inputs of carbon and nutrients into aquatic systems, for example plant debris or soils from riparian systems
ALS	ALS Environmental Services
Autotrophic	Organisms which manufacture their food, usually via photosynthesis.
$CaCO_3$	Calcium carbonate
Chl *a*	Chlorophyll *a*
CCME	Canadian Council of Ministers of the Environment
D/S	Downstream
DDI	Double de-ionized water
DGPS	Differential Global Positioning System
Heterotrophic	Organisms unable to synthesize their own food, e.g., animals and fungi
ISQG	Interim Sediment Quality Guideline
m	Metres
m^3	Cubic metres
mm	Millimetres
OF	Outflow
PEL	Probable Effects Level
QA/QC	Quality Assurance and Quality Control
RDL	Realized Detection Limit
Rescan	Rescan Environmental Services Ltd.
Sabina	Sabina Gold & Silver Corp.
sp.	Refers to a single species in a genus
spp.	Refers to multiple species within a genus
TKN	Total Kjeldahl Nitrogen
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
TOC	Total Organic Carbon
TP	Total Phosphorus
WAD	Weak Acid Dissociable

1. Introduction

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1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region on Nunavut. The Project consists of several properties, one of which is the Goose property (Figure 1-1). An exploration camp is located beside Goose Lake (Goose Camp), and Sabina conducted a drilling program from this camp during 2011.

Several exploration targets exist in the Goose property area, including the Llama, Umwelt, Echo and Goose deposits. For 2011, select baseline studies were conducted in the areas that could be influenced by the future development of these deposits. Rescan Environmental Services (Rescan) was contracted by Sabina to conduct the following baseline studies in 2011:

- Dustfall and Air Quality;
- Surface Hydrology;
- ML/ARD;
- Lake and Pond Bathymetry;
- Freshwater Water Quality, Sediment Quality and Aquatic Biology;
- Freshwater Fish and Fish Habitat;
- Wildlife; and
- Archaeology.

In addition, Sabina continued the on-site meteorology and hydrogeology monitoring programs. Data from these programs will also be included in 2011 baseline reports to be prepared by Rescan.

This report presents the results from the freshwater baseline program (water quality, sediment quality and aquatic biology) that was carried out in 2011. Results from the lake and pond bathymetric surveys are also included. The freshwater baseline program included sampling lakes and streams within the watersheds that could be influenced by the development of known deposits, as well as in a reference watershed located well away from known deposits.

For lakes, the following environmental components were sampled:

- bathymetry;
- physical limnology;
- water quality;
- sediment quality;
- phytoplankton assemblages;
- zooplankton assemblages; and
- benthic macroinvertebrate communities.



Sabina GOLD & SILVER CORP.

Back River Project Location

Figure 1-1

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For streams, the following components were sampled:

- water quality;
- sediment quality;
- periphyton assemblages; and
- benthic macroinvertebrate communities.

Chapter 2 of this report presents the overall sampling design and the methods used for all sample collection. Chapter 3 of this report provides the results. All raw data are provided as appendices to this report.

2. Methods

2. Methods

2.1 SAMPLING DESIGN

In 2011, baseline data were collected from lakes and streams in watersheds containing known deposits as well as a reference lake and stream well away from any known deposits.

The following components were sampled as part of the 2011 freshwater baseline program:

Lakes:

- bathymetry;
- physical limnology;
- water quality;
- sediment quality;
- phytoplankton assemblages;
- zooplankton assemblages; and
- benthic macroinvertebrate communities.

Streams:

- water quality;
- sediment quality;
- periphyton assemblages; and
- benthic macroinvertebrate communities.

The sampling locations and the dates for each component in lakes and streams are shown in Tables 2.1-1 and 2.1-2, and sampling details can be seen in Table 2.1-3.

Within each lake, sampling locations were selected either where historical data existed, or in the deepest section in the lake, or in a spatially significant location (i.e., a central location where water from multiple inflows mix; Table 2.1-4). Winter sampling occurred near the middle of the lake, or in the middle of any obvious basins as estimated by the topography if no bathymetric information or prior sampling history was available. In such cases, at least three holes were drilled and samples were collected from the deepest point. Summer sampling locations were moved when new bathymetric information found more suitable sites.

Sampling locations in streams were selected to be on the outflows of the major watersheds in the area. The exception to this was Propellor D/S (downstream), which was selected the furtherest downstream sampling site immediately before a major confluence with another drainage area within the Regional Western River Watershed. During freshet, water quality samples were taken slightly upstream or downstream as required to avoid large blocks of unmelted ice influencing water quality samples.

Bathymetric surveys were conducted on Goose Lake and the two ponds north east of Umwelt Lake during summer 2012.

Table 2.1-1. Water, Sediment, and Aquatic Biology Sampling Dates and Locations in Lakes, Back River Project, 2011

Watershed	Lake Site Name	Abbreviated Name	Water Quality and Limnology		Sediment Quality	Phytoplankton	Zooplankton	Benthos
			Winter	Summer				
Llama Watershed	Llama Lake	Llama	12-Apr	06-Aug	06-Aug	06-Aug	09-Aug	09-Aug
	Umwelt Lake	Umwelt	13-Apr	05-Aug	05-Aug	05-Aug	05-Aug	10-Aug
Giraffe Watershed	Giraffe Lake	Giraffe	16-Apr	10-Aug	11-Aug	10-Aug	10-Aug	11-Aug
Goose Watershed	Goose Lake Neck	Goose Neck	17-Apr	07-Aug	07-Aug	07-Aug	14-Aug	7-Aug-11 and 14-Aug-11
	Goose Lake Central	Goose Central	14-Apr	07-Aug	07-Aug	07-Aug	07-Aug	07-Aug
	Goose Lake Tail	Goose Tail	*nc*	17-Aug	17-Aug	*nc*	*nc*	*nc*
Propellor Watershed	Propellor Lake	Propellor	16-Apr	11-Aug	11-Aug	*nc*	*nc*	*nc*
Reference B Watershed	Reference B Lake	Reference B	12-Apr	08-Aug	08-Aug	08-Aug	08-Aug	08-Aug

nc = data not collected at these sites by sampling design.

Table 2.1-2. Water, Sediment, and Aquatic Biology Sampling Dates and Locations in Streams, Back River Project, 2011

Watershed	Stream Site Name	Stream Site Name	Water Quality and Limnology			Sediment Quality	Periphyton	Benthos
			Freshet	Summer	Fall			
Chair Watershed	Chair Watershed Outflow	Chair OF	18-Jun	13-Aug	08-Sep	13-Aug	13-Aug	13-Aug
Llama Watershed	Llama Watershed Outflow	Llama OF	18-Jun	17-Aug	08-Sep	*nc*	17-Aug	17-Aug
Echo Watershed	Echo Watershed Outflow	Echo OF	18-Jun	*nc*	08-Sep	*nc*	*nc*	*nc*
Giraffe Watershed	Giraffe Watershed Outflow	Giraffe OF	18-Jun	12-Aug	08-Sep	12-Aug	12-Aug	12-Aug
Wolf Watershed	Wolf Watershed Outflow	Wolf OF	18-Jun	13-Aug	09-Sep	13-Aug	13-Aug	13-Aug
Goose Watershed	Goose Watershed Outflow	Goose OF	18-Jun	16-Aug	08-Sep	16-Aug	16-Aug	16-Aug
Propellor Watershed	Propellor Watershed Outflow	Propellor OF	18-Jun	15-Aug	09-Sep	*nc*	15- & 16-Aug	16-Aug
	Propellor Downstream	Propellor D/S	18-Jun	15-Aug	09-Sep	15-Aug	15-Aug	15-Aug
Reference B Watershed	Reference B Outflow	Ref. B OF	18-Jun	14-Aug	09-Sep	14-Aug	14-Aug	17-Aug

nc = data could not be collected at these sites due to either low water levels, lack of fine sediments, or unsuitable sediment at the site.

Note: Echo Watershed Outflow was completely dry during August sampling.

Table 2.1-3. Sampling Details for Physical Limnology, Water Quality, Sediment Quality, and Aquatic Biology, Back River Project, 2011

Monitoring Parameter	Sampling Frequency	Sampling Replication	Sampling Equipment	Sampling Dates/Timing
Lakes				
Winter Physical Limnology				
Dissolved oxygen/temperature profile	1 x	n=1	YSI DO Probe	April (winter)
Summer Physical Limnology				
Dissolved oxygen/temperature profile; Secchi depth	1 x	n=1	YSI DO Probe	August (summer)
Winter Lake Water Quality				
Physical, nutrients, total & dissolved metals	1 x	n=1 at 1 m below the ice and at 1.5 m to 2 m above the water-sediment interface in lakes deeper than approximately 5 m + 20% replication	Modified 5 L Skinny Niskin Bottle; preservatives	April (winter)
Summer Lake Water Quality				
Physical, nutrients, cyanides, total & dissolved metals	1 x	n=1 at 1 m depth and at mid depth in lakes deeper than approximately 5 m + 20% replication	5 L Go-Flo Bottle; preservatives	August (summer)
Lake Sediment Quality				
Physical, nutrients, cyanide, metals	1 x	n=3, each sample is a composite of two grabs. Sampled at deep and shallow depths in lakes deeper than approximately 5 m	Ekman Grab	August (summer)
Phytoplankton				
Biomass (as chlorophyll *a*)	1 x	n=3 at 1 m below surface	5 L Go-Flo Bottle; filtration with 45µm filters	August (summer)
Abundance and taxonomy	1 x	n=3 at 1 m below surface	5 L Go-Flo Bottle; Lugols solution to preserve	August (summer)
Zooplankton				
Abundance and taxonomy	1 x	n=3 horizontal tows of ~10 m at 0.5 m depth or vertical hauls from 1.5 m above bottom in lakes deeper than approximately 5 m	120 µm mesh with a 30 cm mouth diameter; with General Oceanics Flow Meter attached to calculate volume filtered	August (summer)
Lake Benthos				
Density and taxonomy	1 x	n=5, each sample is a composite samples of three grabs. Sampled at deep and shallow depths in lakes deeper than approximately 5 m	Ekman grab and 500 µm seive bucket; formalin to preserve	August (summer)
Streams				
Stream Water Quality				
Dissolved oxygen and temperature	1 x	n=1	YSI DO Probe	August (summer), September (fall)
Physical, nutrients, cyanide, total & dissolved metals	3x	n=2	grab samples; preservatives	June (freshet), August (summer), September (fall)
Stream Sediment Quality				
Physical, nutrients, cyanide, metals	1 x	n=3	Ekman sampler where possible, alternatively bowl and spoon	August (summer)
Periphyton				
Biomass (as chlorophyll *a*)	1 x	n=3	instantaneous samples; peiphyton collected from 4.5 cm diameter circle templates; periphyton from six circles from two different rocks were pooled and then split in half for biomass and density/taxonomy samples; Lugols solution to preserve	August (summer)
Density and taxonomy	1 x	n=3		August (summer)
Stream Benthos				
Density and taxonomy	1 x	n=5; each a composite of three	500µm Hess sampler; formalin to preserve	August (summer)

Table 2.1-4. Rationale for Water, Sediment, and Aquatic Biology Sampling Location Selection in Lakes, Back River Project, 2011

Site Name	Sampling Locations*	Reason for Site Selection
Llama Lake	Shallow and Deep	Near deposits and future potential Project activities
		Historical sampling locations (2010 water quality, sediment quality and physical limnology data).
	Deep	Deepest point on lake.
Umwelt Lake	Shallow	Near deposits and future potential Project activities.
		Historical sampling location (2010 water quality, sediment quality and physical limnology data).
		Deepest point on lake.
Giraffe Lake	Shallow and Deep	Near future potential Project activities.
	Winter and Summer Shallow	Aimed for deepest point in central part of lake in winter. Used same site in summer for consistency.
	Summer Deep	Added deep sampling site in summer after discovering deeper basin in south eastern end of lake.
Goose Lake Neck	Shallow	Downstream of deposits and future potential Project activities.
		Aimed for deepest area in neck area of the lake.
Goose Lake Central	Shallow and Deep	Downstream of deposits and future potential Project activities.
	Winter Deep	Central part of lake.
	Summer Shallow	Moved sampling site 350 m southeast in summer to a more central location to ensure flow out of Goose Lake was captured.
		Historical sampling location (2007 water quality, sediment quality and physical limnology data).
Goose Lake Tail	Shallow	Downstream of deposits and near future potential Project activities.
		Close to the only drainage of Goose Lake.
Propellor Lake	Deep	Lake which receives flow from watersheds near deposits and future potential Project activities.
		Central part of southern end of lake (near the Goose Lake Outflow), away from the influence of the central island.
Reference B Lake	Shallow	Reference site away from any future potential Project activities.
		Historical sampling location (2010 water quality, sediment quality and physical limnology data).
		Deepest point on lake

**Note: In deep lakes, benthos and sediment quality samples were collected from both a shallow and deep location in summer.*
When not specified winter and summer locations were identical.

Figure 2.1-1 presents an overview of the 2011 sampling locations along with the major drainage basins in the area. Arrows show the direction of water flow. For the Ellice River watershed, Llama OF, Echo OF, and Giraffe OF drain the eastern watersheds and their lakes (Llama, Echo and Giraffe) into Goose Lake. Wolf OF drains the southern Wolf Watershed into Goose Lake. Water flows out of Goose Lake via the Goose OF into Propellor Lake, which then drains out of Propellor Stream. Figures 2.1-2 through to 2.1-5 show sampling locations on lakes with known bathymetry.

PROJECT #0833-002-03 GIS # BAC-01-005 July 16 2012

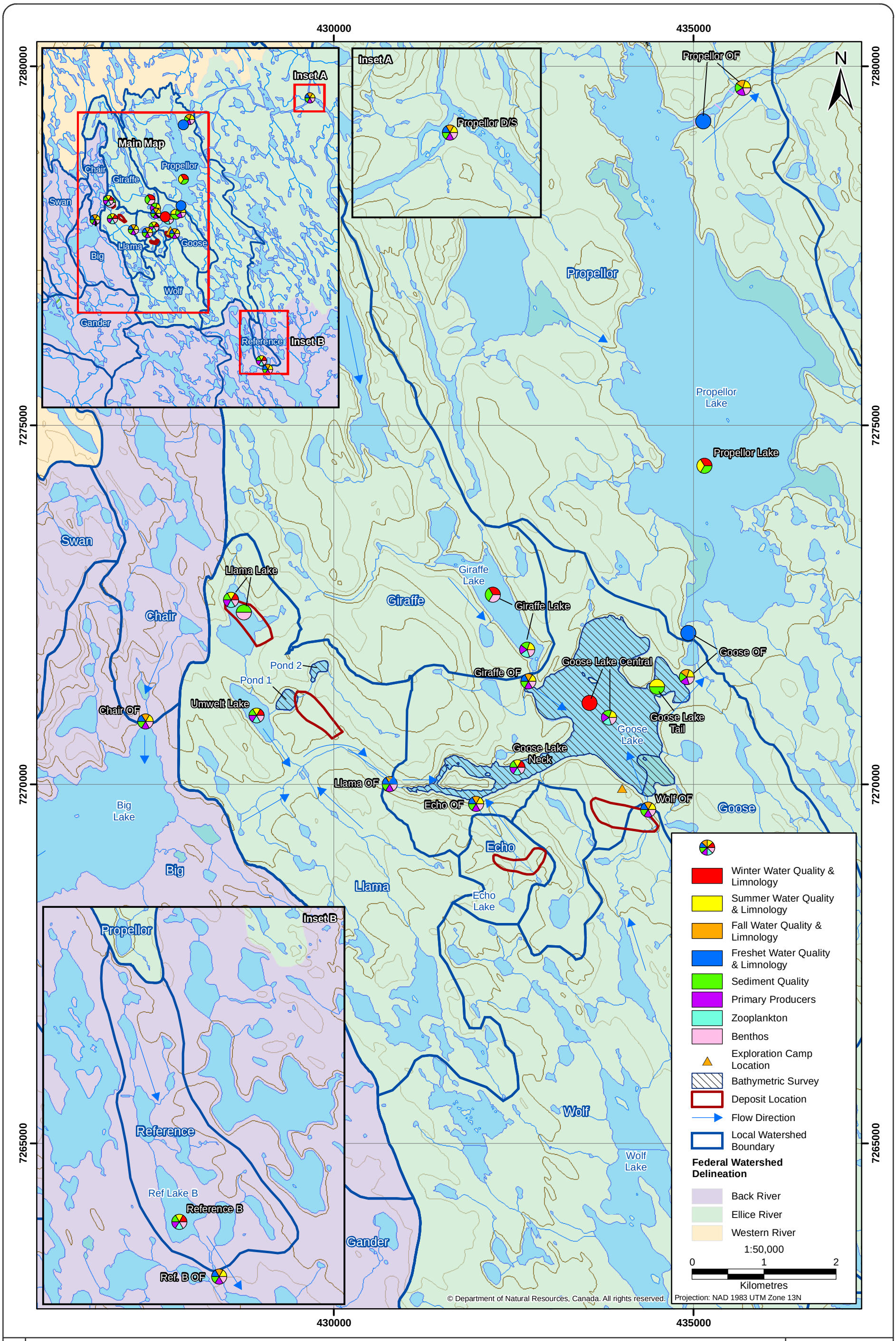


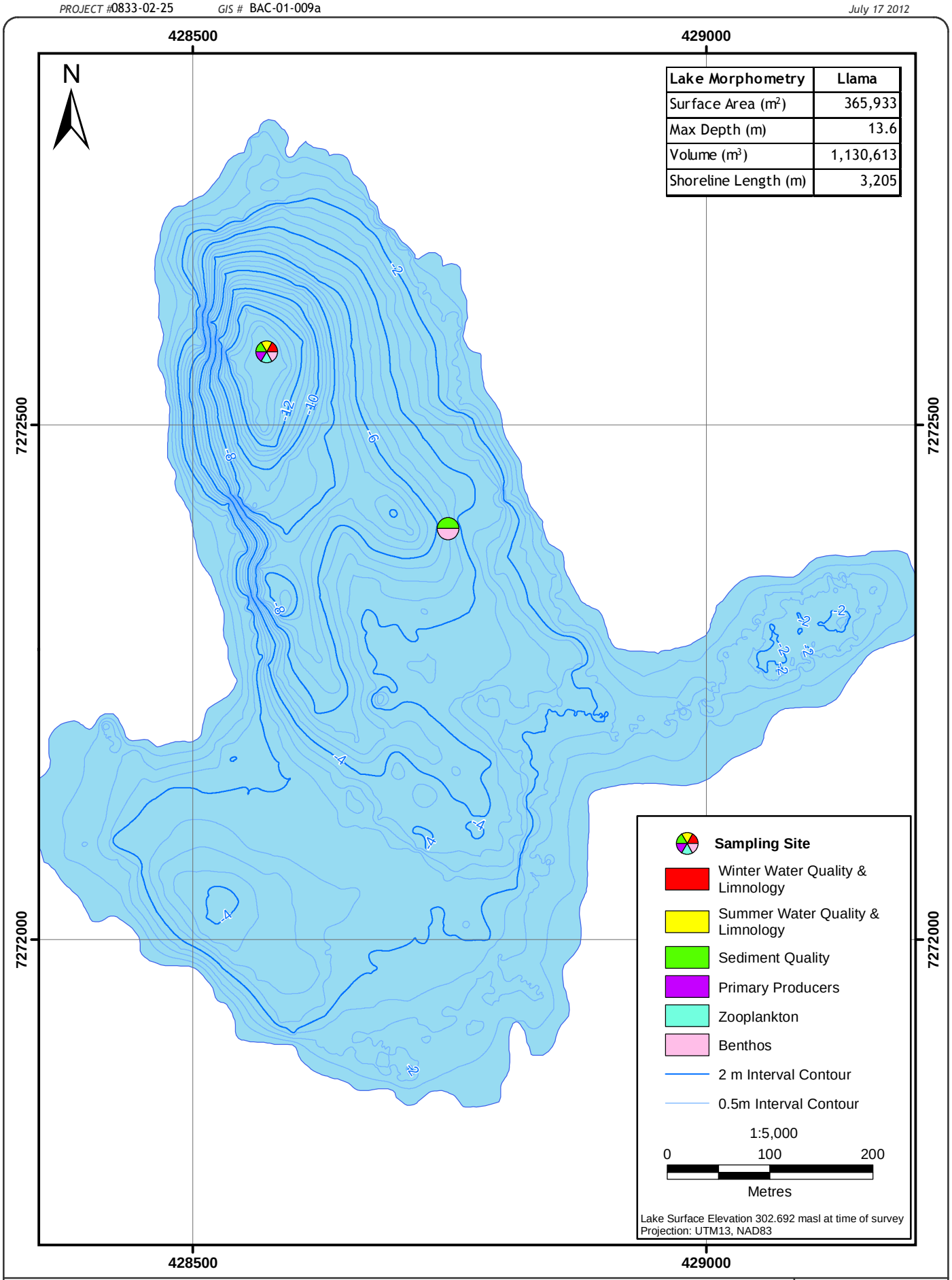
Figure 2.1-1

Sabina GOLD & SILVER CORP.

Water Quality, Sediment Quality, Aquatic Biology and Bathymetric Survey Sampling Locations in Lakes and Streams, Back River Project, 2011

Figure 2.1-1

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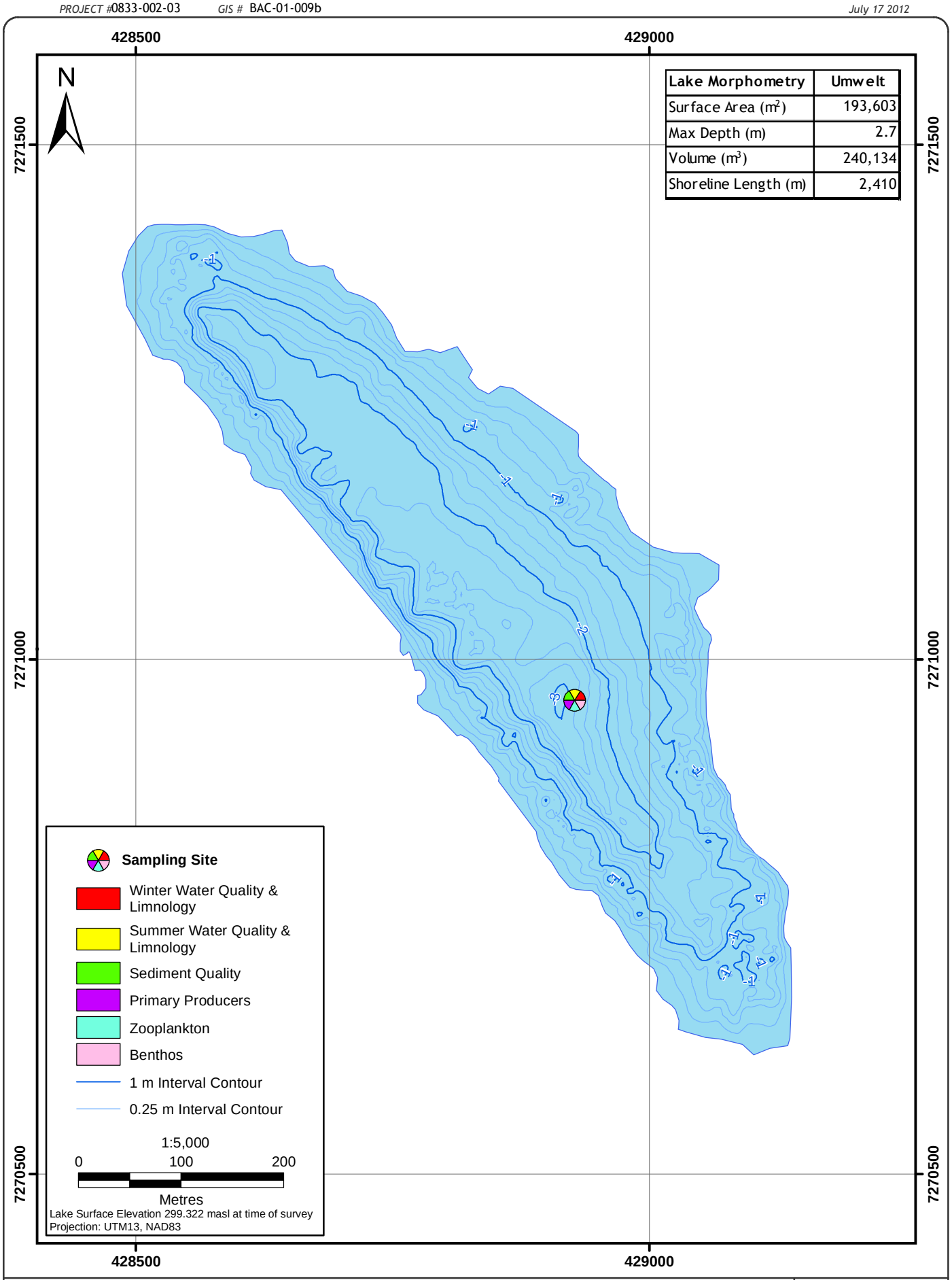


Sabina GOLD & SILVER CORP.

Bathymetry and Sampling Locations in Llama Lake, Back River Project, 2011

Figure 2.1-2

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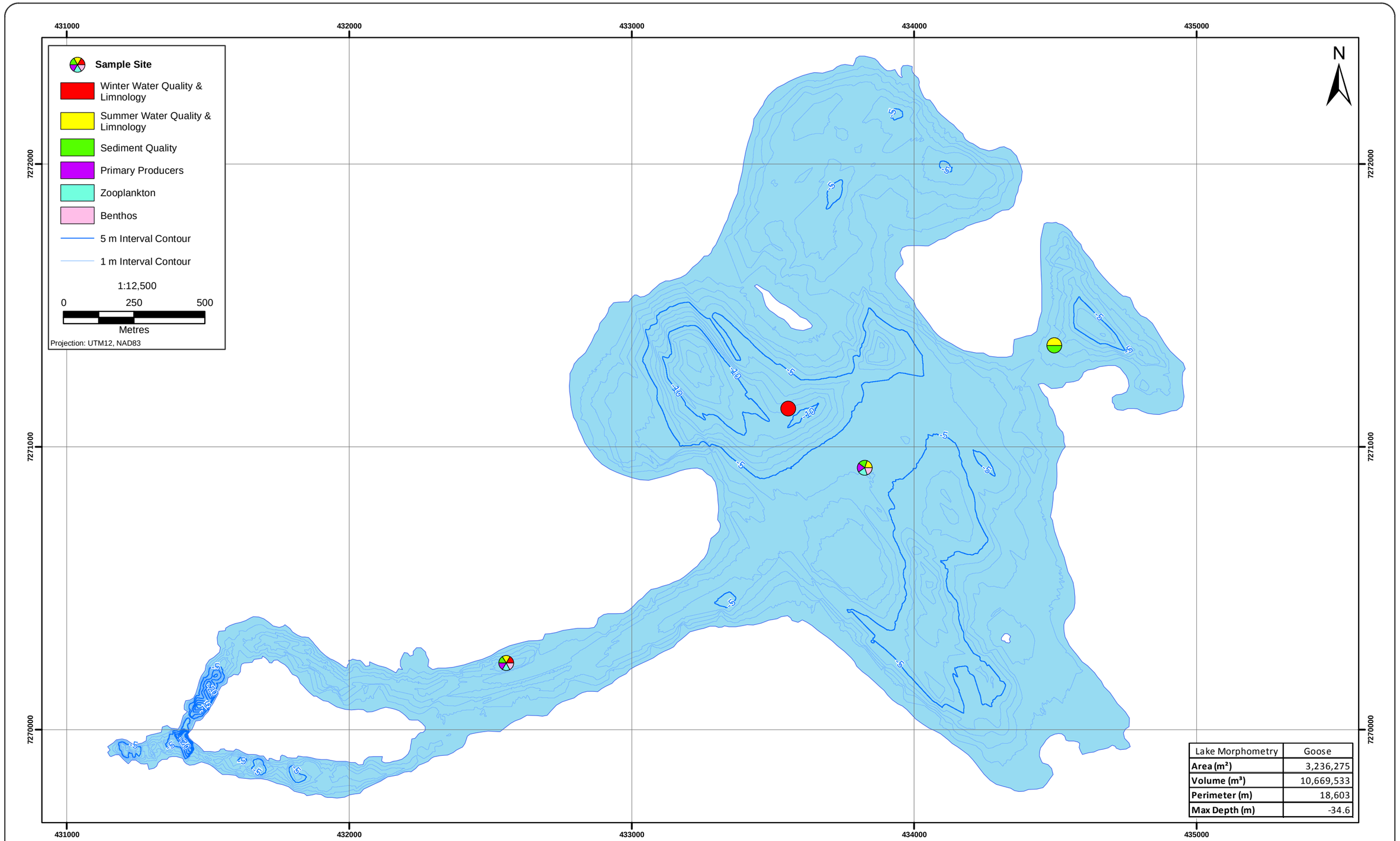


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Bathymetry and Sampling Locations in Umwelt Lake, Back River Project, 2011

Figure 2.1-3

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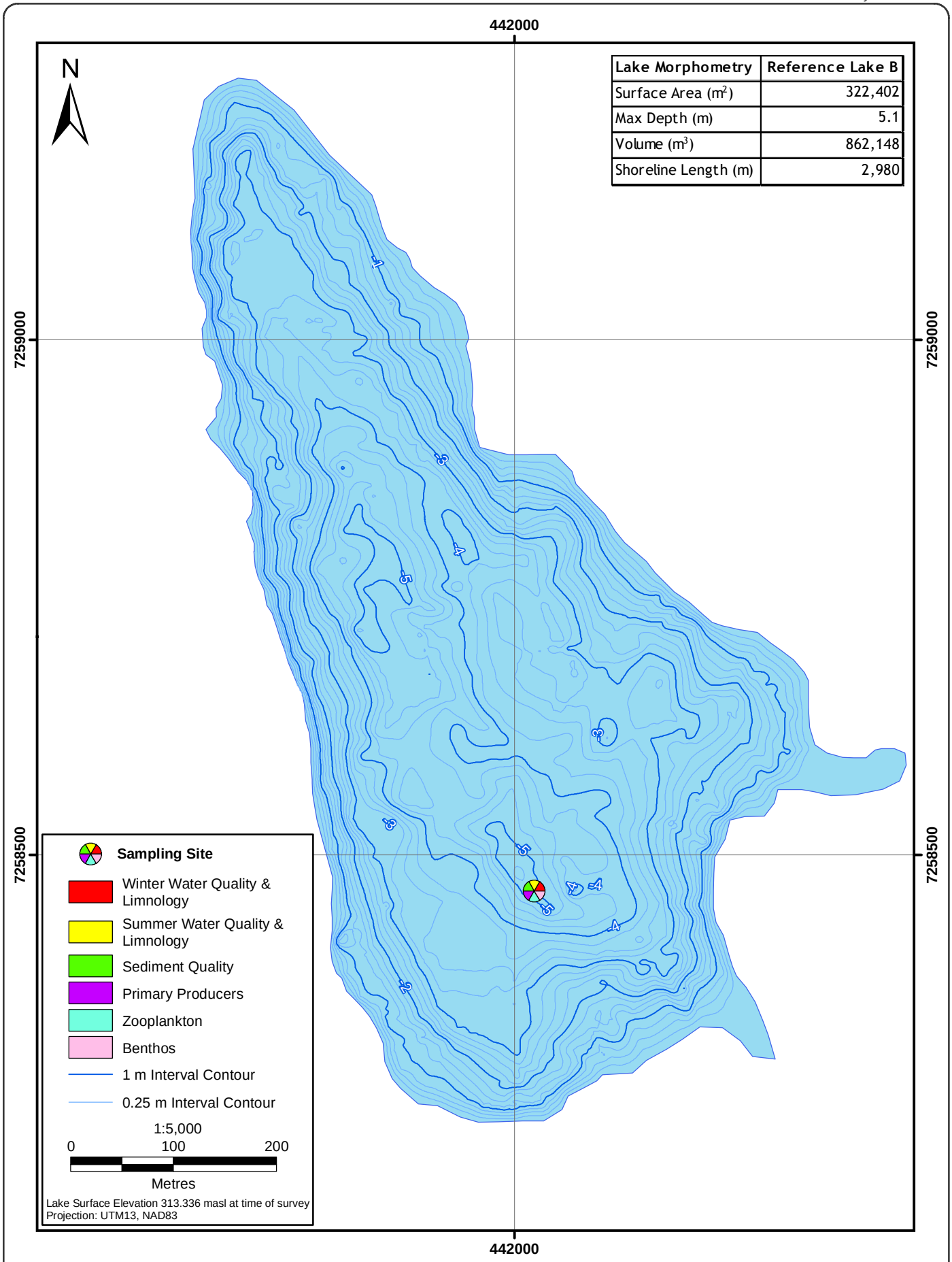
Lake Morphometry	Goose
Area (m^2)	3,236,275
Volume (m^3)	10,669,533
Perimeter (m)	18,603
Max Depth (m)	-34.6

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Figure 2.1-4

Bathymetry and Sampling Locations in Goose Lake, Back River Project, 2011



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Bathymetry and Sampling Locations in Reference B Lake, Back River Project, 2011

Figure 2.1-5

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2.2 PHYSICAL LIMNOLOGY

During 2011, dissolved oxygen and temperature profiles were collected in April and August in six lakes. Secchi depth measurements were also recorded in August.

2.2.1 Winter Lake Physical Limnology

Lake sampling sites were accessed by helicopter during April. Before collecting the physical profiles (and later water samples), an ice auger was used to drill a 25-cm hole through the ice (Plate 2.2-1). Water column profiling and water quality sampling depths were calculated based on bottom depth.

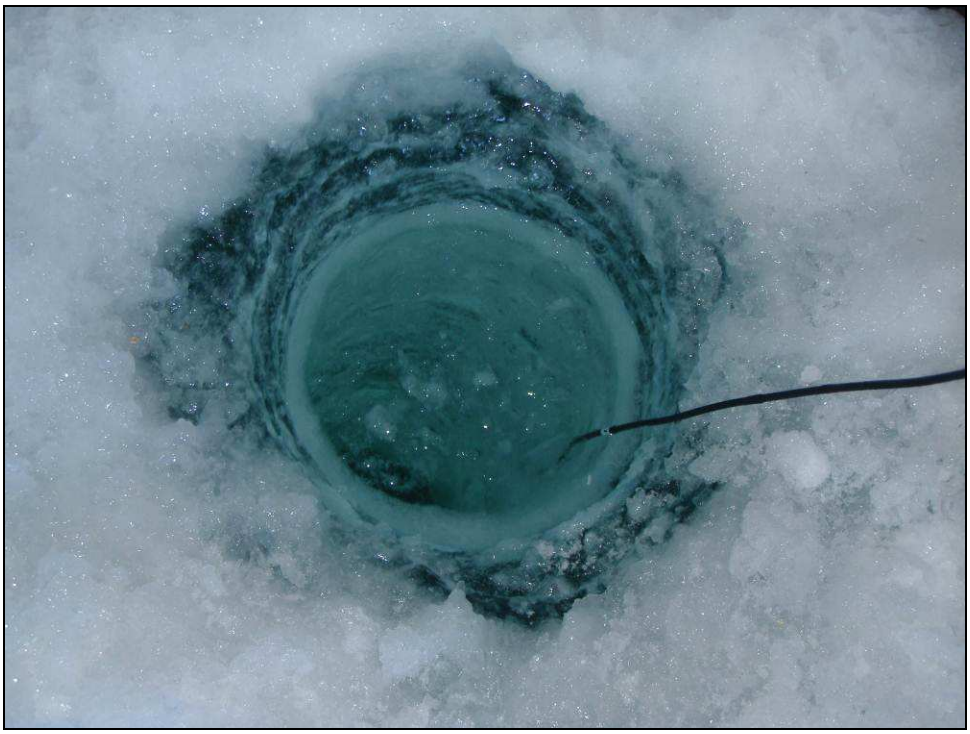


Plate 2.2-1. Measuring dissolved oxygen and temperature through an augered hole in the ice.

Temperature and dissolved oxygen profiles were recorded at 0.5 m intervals down the water column using a YSI Pro-ODO optical dissolved oxygen meter. The profiles ended at approximately 0.5 m above the sediment surface to reduce suspension of bottom sediments.

2.2.2 Summer Lake Physical Limnology

Summer temperature and dissolved oxygen profiles were measured from an aluminum boat at the same locations that winter samples were collected, unless new information prompted relocation to a more suitable location (e.g., Giraffe Lake and Goose Lake Central).

Light attenuation was estimated in each lake using a 20-cm, black and white Secchi disk. Measurements were collected at each site by lowering the disk on a metred line through the water column on the shaded side of the boat until it disappeared from sight. The depth of disappearance was identified as the Secchi depth, which was then used to calculate the depth of the euphotic zone. Euphotic zone depth (EZD) is defined in this report as the depth at which 1% of surface radiation occurs, and generally represents the zone in a waterbody where integrated photosynthesis equals the integrated respiration

(i.e., compensation depth). Above this depth net primary production is possible given sufficient nutrients. The EZD was calculated as follows:

$$k' = 1.7/D_s ;$$

where k' = light extinction coefficient, D_s is the Secchi depth, and 1.7 is a constant derived from experimental data (Parsons, Maita, and Lalli 1984).

$$EZD = 4.6/k'$$

2.3 LAKE WATER QUALITY

The 2011 lake water quality sampling focused on characterizing the natural variation in water quality with water column depth, season (winter vs. summer), and geographical location. A total of eight sites in six lakes within several different watersheds were sampled, including one reference lake located approximately 15 km away from camp and known deposits.

Parameters of interest, including parameters with Canadian Council for Ministers of the Environment (CCME) water quality guidelines for the protection of aquatic life, were graphed for all study lakes and streams unless values were consistently below detection limits (CCME 2011b). Values below analytical detection limits were replaced with half the realized sample detection limit (RDL) for graphing and analysis.

2.3.1 Winter Lake Water Quality

Winter water quality samples were collected from the ice hole augered for the physical limnology measurements. Where lake sites were sufficiently deep, shallow (1 m below the ice) and deep (1.5 m to 2 m from the bottom) samples were collected. One sample was collected at each depth with 20% replication for QA/QC.

A modifed 2.5 L 'skinny' Niskin bottle was used for winter sampling as GO-FLO sampling bottles (generally preferred for sampling waters with low metal concentrations) are prone to freezing in cold waters.

The Niskin bottles were acid-cleaned at ALS Environmental Services (ALS), Burnaby, BC, and contained acid-cleaned clear silicone tubing in the interior of the bottle to avoid metal contamination. A dual rope system was used for bottle closure.

The water collected in the Niskin was used to rinse and fill the appropriate sample bottles. All water samples were analyzed for general physical parameters, nutrients, major anions, total organic carbon (TOC), and total and dissolved metals at the lowest feasible detection limits by ALS (Table 2.3-1). Preservatives were added in the field to the nutrient (sulphuric acid), TOC (hydrochloric acid), and total metals (ultra-pure nitric acid) sample containers.

All water samples were kept cold, but above freezing, and sent to ALS in Yellowknife, NT on the first available flight from camp. Samples were then sent to ALS's Burnaby laboratory where the lowest metal detection limits are available. Due to logistical constraints, hold times for some parameters and some samples were exceeded. Dissolved metals samples were filtered by ALS in their Burnaby laboratory to avoid contamination issues related to field filtration.

Detection limits were the lowest achievable by the lab. Detection limits were occasionally higher than the theoretical minimum presented in Table 2.3-1. This occurred when dilution of a sample was required to compensate for other interfering parameters (e.g., turbidity). Realized detection limit ranges are indicated on all relevant figures in this report.

Table 2.3-1. Water Quality Parameters and Method Detection Limits, Back River Project, 2011

Parameter	Detection Limit	Parameter	Detection Limit
Physical Tests		***Metals (Total and Dissolved continued)***	
Conductivity	2 µS/cm	Barium (Ba)	0.00005
Hardness (as $CaCO_3$)	0.5	Beryllium (Be)	0.0002
pH	0.1 pH	Bismuth (Bi)	0.0005
Alkalinity, Bicarbonate (as $CaCO_3$)	2	Boron (B)	0.001
Alkalinity, Carbonate (as $CaCO_3$)	2	Cadmium (Cd)	0.00001
Alkalinity, Hydroxide (as $CaCO_3$)	2	Calcium (Ca)	0.02
Alkalinity, Total (as $CaCO_3$)	2	Chromium (Cr)	0.0001
Total Suspended Solids	3	Cobalt (Co)	0.0001
Total Dissolved Solids	10	Copper (Cu)	0.0005
Turbidity	0.1 NTU	Iron (Fe)	0.01
Nutrients		Lead (Pb)	0.00005
Ammonia (as N)	0.005	Lithium (Li)	0.005
Nitrate (as N)	0.005	Magnesium (Mg)	0.005
Nitrite (as N)	0.001	Manganese (Mn)	0.00005
Total Kjeldahl Nitrogen	0.05	Mercury (Hg)	0.00001
Ortho Phosphate (as P)	0.001	Molybdenum (Mo)	0.00005
Total Phosphorus	0.002	Nickel (Ni)	0.0001
Major Anions		Phosphorus (P)	0.3
Bromide (Br)	0.05	Potassium (K)	0.05
Chloride (Cl)	0.5	Selenium (Se)	0.0001
Fluoride (F)	0.02	Silicon (Si)	0.05
Sulphate (SO_4)	0.5	Silver (Ag)	0.00001
Organic Carbon		Sodium (Na)	0.01
Total Organic Carbon	0.5	Strontium (Sr)	0.0001
Cyanides*		Thallium (Tl)	0.0001
Free Cyanide	0.005	Tin (Sn)	0.0001
Total Cyanide	0.001	Titanium (Ti)	0.01
Metals (Total and Dissolved)		Uranium (U)	0.00001
Aluminum (Al)	0.003	Vanadium (V)	0.00005
Antimony (Sb)	0.0001	Zinc (Zn)	0.003
Arsenic (As)	0.00003		

Detection limits are mg/L unless otherwise indicated.

** Collected in August from lakes, and in June, August and September for streams.*

2.3.2 Summer Lake Water Quality

Summer lake sampling locations were the same as those sampled in the winter. Exceptions were Giraffe Lake, where a deeper basin was found in the southern part of the lake in summer, and Goose Lake, where the central sampling station was moved 350 m in summer to align with a historical station and to better capture the water flow out of Goose Lake.

Where lake sites were deep enough (greater than 5 m), two depths were sampled: shallow-depth (1 m below the surface) and mid-depth. One sample was collected at each depth with 20% replication for QA/QC.

A 5 L Teflon-lined GO-FLO bottle was used for water collection. The GO-FLO was lowered on a metred line to a depth 0.5 m lower than the desired sampling depth, before being raised to the sampling depth and closed using a weighted messenger. The water collected was used to triple-rinse and fill the laboratory-provided sample containers.

In August, free and total cyanides were measured in addition to the parameters measured in winter. Cyanide samples were field preserved with sodium hydroxide. Preservatives were added to the other samples as outlined in the winter water quality section.

Summer water quality samples were handled, transported, and analyzed as described in the winter water quality section.

2.3.3 Quality Assurance/Quality Control (QA/QC)

A quality assurance and quality control program (QA/QC) was incorporated into the design of the freshwater baseline program to account for within site variability and any contamination that originated from sampling equipment, field sampling, or sample transportation. This included the use of replicates, blanks, and chain of custody forms.

Replicate samples accounted for approximately 20% of lake water samples collected during each sampling period.

Equipment blanks, field blanks, and travel blanks comprised approximately 5% of the total number of lake water quality samples collected. Equipment blanks were designed to detect contamination from the sampling equipment, including the sampling bottle (GO-FLO or Niskin). Field blanks measured any contamination from sample exposure to air, while travel blanks were designed to detect any contamination from travel and storage during sampling.

Equipment blanks were collected in the field by first rinsing an acid-washed GO-FLO with double de-ionized water (DDI water; provided by ALS) then filling the GO-FLO bottle with DDI water, allowing the water to sit for one minute (as would occur with a real sample), and then drawing sub-samples from the bottle. Equipment blanks were preserved and handled the same as real samples.

Field blanks were processed in the field by opening the bottles provided by ALS (containing DDI water) and exposing the sample to air for one minute. The bottles were preserved and handled the same as the regular samples.

Travel blanks were provided by ALS and were never opened, but were otherwise handled in the same way as the regular samples.

All samples, including blanks, were recorded on a chain of custody form and sent to ALS Burnaby via ALS Yellowknife. Blanks were tested for general parameters, nutrients, anions, cyanides and metals.

2.4 STREAM WATER QUALITY

The 2011 stream water quality sampling focused on characterizing the potential natural variation by season (during freshet, the low flow summer period, and the higher flow fall period) and geographical location. Nine sites within eight streams were sampled, including one reference stream approximately 15 km from camp and known deposits.

Surface temperature and dissolved oxygen concentrations were measured during August and September at nine stream sites using a YSI meter.

Duplicate stream water samples were collected from each site using clean techniques. Where reduced flow was present, samples were collected from banks or rocks to prevent contamination from sediments. Where flow was high, the scientist stood facing upstream being careful not to disturb sediments, and plunged the sample bottle 30 cm into the water. For every sample the bottle and cap were triple-rinsed with stream water before filling the bottle.

All water samples were analyzed for general physical parameters, nutrients, anions, TOC, cyanide, and total and dissolved metals, at the lowest feasible detection limits by ALS (Table 2.3.1). Preservatives were added in the field as described in the lake water quality section above.

All water samples were transported and analyzed as described for lake water quality samples.

2.4.1 Quality Assurance/Quality Control (QA/QC)

As with lake water quality, a quality assurance and quality control program (QA/QC) was included in the study design. The program included the use of replicates, blanks, and chain of custody forms.

Replicate samples were collected at all sites to allow identification of natural variability, which tends to be higher in streams compared to lakes due to heterogeneously suspended matter (such as organic debris, small insects, etc.).

Field blanks and travel blanks comprised about 5% of the total number of water quality samples, and were collected in addition to any collected for lake QA/QC purposes. Field blanks and travel blanks were collected as described in the lake water quality section above.

2.5 LAKE SEDIMENT QUALITY

The 2011 sediment quality sampling focused on characterizing the natural variation in lake sediments with depth and by lake. Samples were collected in August at eight sites from six different lakes, and included one reference lake located approximately 15 km away from the camp and known deposits.

Triplicate sediment quality samples were collected from one depth for lakes shallower than 5 m. For deeper lakes, triplicate sediment quality samples were collected from shallow and deep (greater than 5 m) depth strata.

An Ekman grab sampler (surface area: 0.0225 m^2) was used to collect two grabs per replicate, which were composited to ensure enough sediment was obtained for all of the required analyses.

Sediment was carefully transferred onto a white plastic tray, photographed, and described for colour, texture, and other characteristics (measured parameters are listed in Table 2.5-1) (Plate 2.5-1). The top 2–3 cm of sediment was collected and analyzed for grain size, moisture, nutrients, cyanide and solid-phase metals. Of the two grabs making up a replicate, half of the top layer from each was used for sediment chemistry and half for grain size to ensure that the grain size data corresponded to the chemistry data. The sample was then homogenized before being sent to ALS.

Table 2.5-1. Sediment Quality Parameters and Detection Limits, Back River Project, 2011

Parameter	Units	Detection Limit	Parameter	Units	Detection Limit
Physical Tests			***Metals (continued)***		
% Moisture	%	0.25	Cadmium (Cd)	mg/kg	0.1
pH	pH	0.1	Calcium (Ca)	mg/kg	50
Particle Size			Chromium (Cr)	mg/kg	0.5
% Gravel (>2 mm)	%	0.1	Cobalt (Co)	mg/kg	0.1
% Sand (2.0 mm - 0.063 mm)	%	0.1	Copper (Cu)	mg/kg	0.5
% Silt (0.063 mm – 4 µm)	%	0.1	Iron (Fe)	mg/kg	50
% Clay (<4 µm)	%	0.1	Lead (Pb)	mg/kg	0.5
Organic Carbon			Lithium (Li)	mg/kg	1
Total Organic Carbon	%	0.1	Magnesium (Mg)	mg/kg	20
Leachable Nutrients			Manganese (Mn)	mg/kg	1
Total Nitrogen	%	0.02	Mercury (Hg)	mg/kg	0.005
Plant Available Nutrients			Molybdenum (Mo)	mg/kg	0.5
Available Ammonium (as N)	mg/kg	1	Nickel (Ni)	mg/kg	0.5
Available Nitrate (as N)	mg/kg	2	Phosphorus (P)	mg/kg	50
Nitrite (as N)	mg/kg	0.4	Potassium (K)	mg/kg	100
Available Phosphate (as P)	mg/kg	2	Selenium (Se)	mg/kg	0.2
Cyanides			Silver (Ag)	mg/kg	0.1
Total Cyanide	mg/kg	3	Sodium (Na)	mg/kg	100
Weak-acid dissociable Cyanide	mg/kg	3	Strontium (Sr)	mg/kg	0.5
Metals			Sulphur (S)	mg/kg	100
Aluminum (Al)	mg/kg	50	Thallium (Tl)	mg/kg	0.05
Antimony (Sb)	mg/kg	0.1	Tin (Sn)	mg/kg	2
Arsenic (As)	mg/kg	0.05	Titanium (Ti)	mg/kg	1
Barium (Ba)	mg/kg	0.05	Uranium (U)	mg/kg	0.05
Beryllium (Be)	mg/kg	0.5	Vanadium (V)	mg/kg	0.2
Bismuth (Bi)	mg/kg	0.2	Zinc (Zn)	mg/kg	1

Table 2.5-1 presents the sediment quality parameters that were analyzed and their detection limits. Note that realized detection limits may differ from these theoretical values. The realized detection limit ranges are indicated on all relevant figures.

All sediment quality samples were recorded on a chain of custody form and sent to ALS in Yellowknife. Samples were then sent to ALS's Burnaby laboratory for analysis, as lower detection limits could be obtained there.

All parameters for which CCME sediment quality guidelines for the protection of aquatic life exist, as well as other parameters of interest, were graphed. Values below analytical detection limits were replaced with half the realized detection limit for graphing and analysis.

All sediment samples collected were compared to the following CCME guidelines for the protection of aquatic life: the interim sediment quality guidelines (ISQGs) and the probable effects levels (PELs; CCME 2011a). The more conservative ISQGs are levels below which adverse biological effects are rarely observed, whereas the higher PELs correspond to concentrations above which negative effects frequently occur.



Plate 2.5-1. A sediment quality sample collected at Umwelt Lake, August 2011.

2.6 STREAM SEDIMENT QUALITY

Nine stream sites were sampled for sediment quality in August 2011, including a reference stream (Table 2.1-2). Three replicate samples were collected per stream site.

Sediments were collected with an Ekman grab where possible, or a spoon in streams with only small patches of sediment. Depositional zones (where finer sediments accumulate) were preferentially sampled. All sediment quality samples were transported and analyzed as described in the lake sediment section above.

2.7 PRIMARY PRODUCERS

2.7.1 Phytoplankton

Phytoplankton are free-floating autotrophic algae that play an important role in many aquatic systems as primary producers and prey for higher trophic levels. Phytoplankton have short generation times and can respond rapidly to environmental change. These characteristics make them useful indicators of water quality and ecosystem health.

Phytoplankton biomass, densities and taxonomy samples were collected from seven sites in six lakes during August 2011. Triplicate samples were collected from 1 m below the surface using a 5 L Go-Flo bottle. Samples were collected 5 to 20 m apart, and each sample was split for phytoplankton biomass (as chlorophyll *a*), and density/taxonomy.

Phytoplankton biomass samples were filtered onto 0.45 µm pore size filters back in camp and kept dark and frozen until analysis by ALS in Burnaby. Density/taxonomic samples were preserved with Lugol's iodine solution and were sent to Bio-limno Research and Consulting Inc, Halifax, Nova Scotia for enumeration and identification.

2.7.2 Periphyton

Periphyton are algae that grow on the surfaces of rocks or larger plants and are an important food item for many benthic invertebrates, which are in turn the main food source for fish in streams and rivers. Because of their short life cycles, periphyton are among the first organisms to respond to environmental stressors or nutrients, and can exhibit taxon-specific changes, making them good indicators of current environmental conditions.

Three stream periphyton samples were collected at each stream site in August. A circular template with a foam base was used to seal a known area of rock from the rest of the rock. Periphyton in this area were collected using tweezers, a modified toothbrush, a syringe and distilled water. For each replicate, two rocks were selected with flat upper surfaces suitable for periphyton sampling. The periphyton were sampled from three circles on each of the two rocks for each replicate (i.e., a total of six circles) (Plate 2.7-1).



Plate 2.7-1. Collection of periphyton for one replicate at Wolf Outflow, August 2011.

Periphyton samples were diluted to 500 mL back in camp, homogenized, and then split into two 250 mL samples for biomass (as chlorophyll *a*), and density/taxonomy. In order to avoid clogging of the filter, periphyton biomass samples were diluted to 1 L and homogenized before a subsample was filtered, as described above for lake phytoplankton. Periphyton density/taxonomy samples were preserved and analyzed as outlined above for lake phytoplankton.

2.7.3 Data Management and Analysis

The number of organisms per sample was converted to density, either cells/L for phytoplankton and cells/cm^2 for periphyton, by dividing each sample by the volume/area sampled.

Density, genus richness, and diversity were calculated from the taxonomic analysis. Richness is the simplest measure of biodiversity and is simply a count of the number of taxa (in this case genera) in a given area or volume. Diversity indices are used as a measure to define overall ecosystem health, defining how equal the community is numerically, taking into account both richness and density.

For the calculation of richness and diversity, taxa were grouped by genera. Organisms were occasionally not identifiable to the genus level, and were identified only to higher taxonomic levels (e.g., family or order). In cases where an unidentified group made up more than 15% of total individuals collected, unidentified groups were treated as a single genus for the diversity and richness calculations. In cases where the unidentified group made up less than 15% of the total individuals collected, unidentifiable individuals were excluded from the calculations if the higher taxonomic group contained identified genera, or treated as a single genus if the higher taxonomic group contained no other identified genera. The proportion of individuals excluded from the diversity analysis is reported with the diversity results.

Simpson's Diversity Index was used as the measure of diversity, and takes into account dominance, the number of species present, and relative abundance of each species (evenness).

This was calculated by:

$$\textit{Simpson's Diversity Index (D)} = 1 - \sum_{i=1}^{G} p_i^2$$

where G is the number of genera present, and p_i is the relative density of each genus calculated as n_i/N, where n_i is the number of individuals in genus i, and N is the total number of all individuals.

Note that this formula for the Simpson's diversity index produces values that range from 0 (lowest diversity) to 1 (maximum diversity).

2.8 AQUATIC INVERTEBRATES

2.8.1 Zooplankton

Zooplankton, the heterotrophic component of aquatic plankton, are an important link in the aquatic food web, acting as consumers of phytoplankton and prey to many fish species. Zooplankton samples were collected from seven sites in six lakes during August 2011, including one reference lake (Table 2.1-1).

Three samples were collected using a 30 cm diameter, 118 µm mesh size zooplankton net fitted with an internally mounted flowmeter (General Oceanics, model 2030R; Plate 2.8-1). At locations deeper than 5 m, vertical hauls were used. At these sites, the net was lowered to within 1.5 m to 2 m of the lake bottom and brought to the surface at a speed of 0.5 m/s. Horizontal tows were conducted at the shallower sites by pulling the zooplankton net through the surface water (0.5 m depth) for approximately 10 seconds at a rate of 0.5 m/s. The volumes sieved in horizontal tows were similar to that sieved in the vertical tows. The samples were preserved with 5% buffered formalin and sent to Applied Technical Services in Victoria, BC, for enumeration and identification.

The internally mounted flowmeter was used to allow the calculation of the volume of water passing through the net during all hauls. The volume sampled for zooplankton was calculated, as outlined in the General Oceanics instruction manual (General Oceanics Inc.), and shown by the following equation:

$$\textit{Volume in } m^3 = (\textit{number of flowmeter counts} \times 26{,}873/999{,}999) \times (\textit{diameter of net opening}^2/4) \times \pi$$

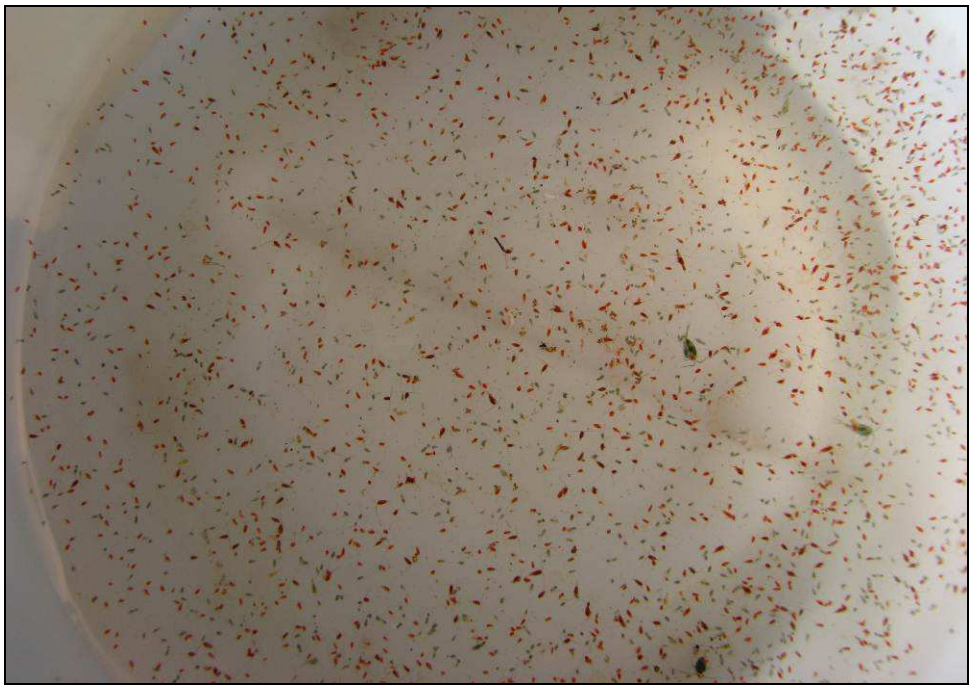


Plate 2.8-1. Zooplankton collected at Goose Lake Neck, August 2011.

Zooplankton densities were calculated by dividing the number of individuals per sample by the volume of water filtered (in cubic metres). Genus richness and diversity were calculated as outlined in the primary production section. Different life stages of the same genus, for example nauplii and copepodites, were pooled together.

2.8.2 Benthic Macroinvertebrates

Benthic macroinvertebrates (benthos) are organisms greater than 0.5 mm in size that inhabit lake and stream bottoms. Benthos are important indicators of environmental change as these organisms are in close contact with the sediments and feed on algae, bacteria, and detritus. Benthos also tend to be less mobile than fish, making them good indicators of local conditions. Benthic organisms are also important food sources for fish, particularly in streams.

2.8.2.1 Lake Benthos

Lake benthos samples were collected from six lake sites in August 2011, including one reference lake located approximately 15 km away from the camp and known deposits. Benthos samples were collected from the same depth zones and locations as the sediment samples: shallow (less than 5 m) and deep (over 5 m).

Five replicate samples, each a composite of three Ekman grab samples, were collected at each sampling location. Samples were gently sieved in the field using a 500 μm sieve bucket and were preserved in 10% buffered formalin. Samples were sent to Dr. Jack Zloty in Summerland, BC, for enumeration and identification.

2.8.2.2 Stream Benthos

Benthos samples were collected from nine stream sites in eight streams during August 2011, including one reference stream. Streams sampled for benthos were the same as those sampled for other parameters such as water quality, sediment quality, and periphyton.

A 500 μm mesh size Hess sampler, with a sampling surface area of 0.096 m^2, was used to collect stream benthos samples. Five replicate samples, each a composite of three Hess samples were collected from each stream station. Most streams had limited flow during August. Consequently, replicate samples were collected where depth and substrate allowed. Notes were taken on depth and flow in the area. When required, flow was created by the sampler to ensure all benthic invertebrates were swept into the Hess sampler's cod end.

Samples were preserved in 10% buffered formalin and sent to Dr. Jack Zloty in Summerland, BC, for enumeration and identification.

2.8.2.3 Data Management and Analysis

Benthos samples were converted to density by dividing the number of organisms in a sample by the surface area sampled.

Richness and diversity samples were calculated to the family taxonomic level, which is the recommended level for freshwater systems (Environment Canada 2011). Individuals were occasionally not able to be identified to the family level. Where an unidentified group made up greater than 15% of total individuals collected, it was treated as a single family for richness and diversity analyses. Where the higher taxonomic contained no identified families, as in the case of Ostracoda and Hydracarina, the unidentifiable individuals were treated as a single family for the richness and diversity analyses. Where the unidentified group was less than 15% and in cases where the higher taxonomic group contained identified families, the unidentifiable individuals were excluded from the richness and diversity analyses.

2.8.3 Quality Assurance/Quality Control (QA/QC)

Chain of custody forms were used for all aquatic biology samples as part of the QA/QC program. All samples had replication, as triplicate samples were taken for phytoplankton, periphyton, and zooplankton, and five replicates of three composite samples were collected for lake and stream benthos.

To ensure consistent and accurate sorting of benthos samples, the re-sorting of benthic sample residues was conducted on a randomly selected 10% of the benthos samples. The criterion for an acceptable sorting was that more than 90% of the total number of organisms found in both the initial and QA/QC sort were recovered during the initial sort, as required by Environment Canada for invertebrate community surveys (Environment Canada 2002). This was calculated by the following equation:

$$\% \text{ Sorting Efficiency} = [1 - (\#\text{ in QA/QC re-sort} / (\#\text{ sorted originally} + \#\text{ QA/QC resort}))] \times 100$$

Any sample not meeting the 90% removal criterion was re-sorted a third time. The 90% minimum sorting efficiency was attained for all benthos samples in this study.

2.9 BATHYMETRY

Bathymetric surveys of Goose Lake and two ponds east of Umwelt Lake were undertaken in July 2011. The surveys consisted of two parts:

1. The collection of continuous depth records along perpendicular and perimeter transects along the lake and pond surfaces using Differential Global Positioning System (DGPS) ; and
2. Establishing proper on-land benchmarks via DGPS surveys of the lake shorelines.

A Trimble PF power DGPS was used for positioning during the depth survey, and a depth sounder and a Trimble TSC1 datalogger were used to collect and store the data in electronic files. The DGPS and sounder were mounted on the boat for surveys along the lake surfaces.

Depth surveys were carried out by navigating a course of regular spaced transects across the width of each lake. Several transects along the long-axis of the lake and in prominent bay areas were also navigated to improve the accuracy of the bathymetric measurements. The transect spacing was determined from a number of factors, including the lake area and the level of bathymetric detail required. Manual survey methods were used along pond shorelines and in areas too shallow for reliable depth readings.

3. Results and Discussion

3. Results and Discussion

3.1 LAKE PHYSICAL LIMNOLOGY

3.1.1 Winter Lake Physical Limnology

Ice thickness and dissolved oxygen concentrations were measured in April 2011. Ice thickness on the lakes in April ranged from 1.3 m to 1.85 m. Maximum lake depths ranged from 1.1 m to 12.2 m (not including ice), so some lakes had very little open water under ice in winter.

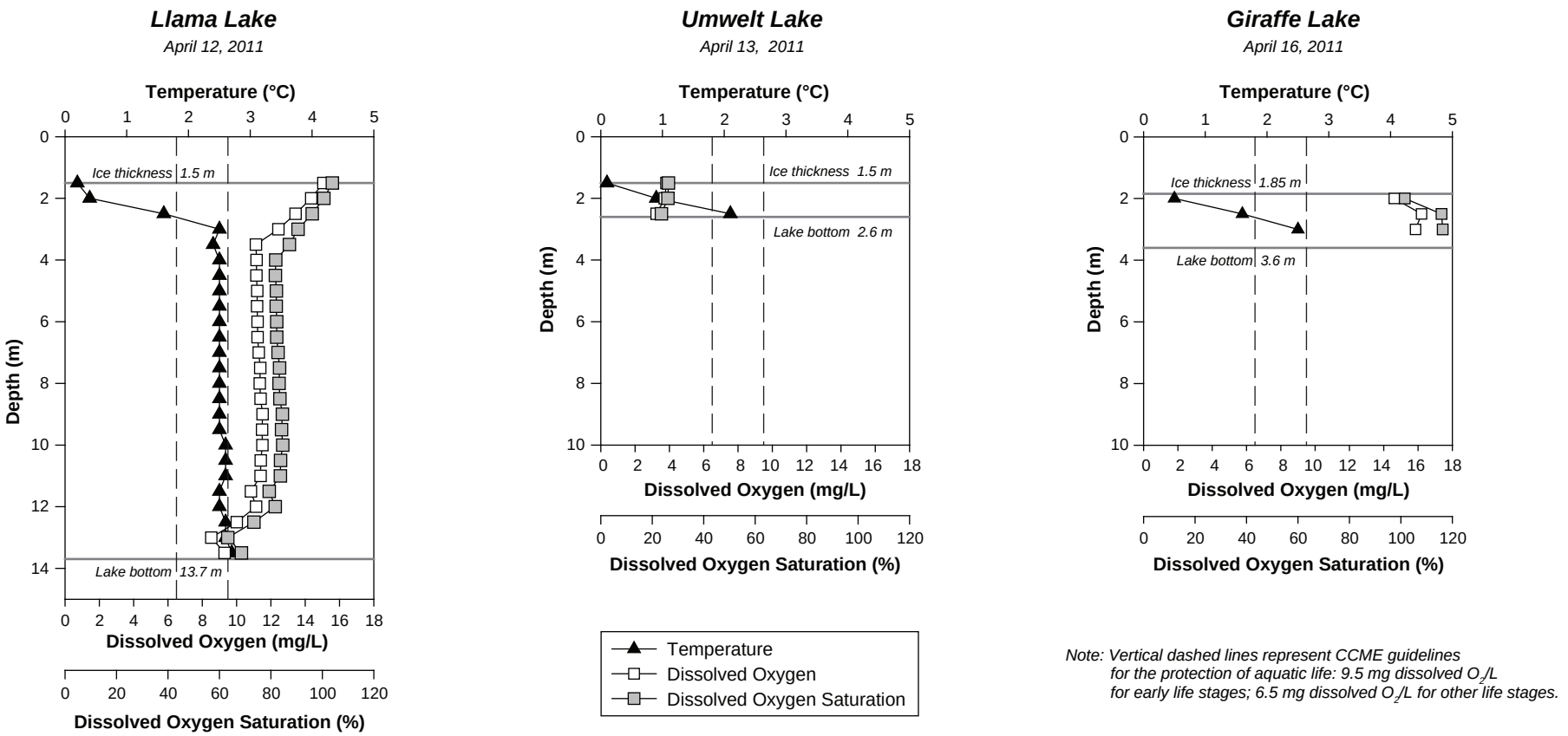
Winter dissolved oxygen and temperature profiles showed an increase in temperature and a decrease in dissolved oxygen with depth (Figures 3.1-1a and 3.1-1b; Appendix 3.1-1). Four lake sites contained more than 3 m of water below the ice: Llama, Goose Central, Propellor, and Reference B. Of these lakes, Llama Lake and Goose Lake Central were stratified, with uniform temperatures and dissolved oxygen concentrations below 4 m, while Propellor Lake and Reference B showed gradual vertical gradients of temperature and dissolved oxygen.

Temperatures near the ice-water interface were close to 0°C, and warmed to approximately 2.5°C in the top 2 m. Temperatures in the two deepest lake sites, Llama Lake (13.7 m) and Goose Lake Central (9.2 m), were stratified and were largely isothermal (2.5°C) below 3 m. There was a gradual warming with depth in the deeper waters of the two moderately deep lakes, Propellor (7.9 m) and Reference B (5.1 m). Temperatures in all deeper lakes tended to warm slightly at the water-sediment interface.

Dissolved oxygen concentrations tended to be highest near the water-ice interface: between 13.4 and 15.7 mg/L in all lakes. This suggests primary productivity was high during this time' since any algae would be actively photosynthesizing during this period. The surface waters tended to be near 100% oxygen saturation, except at the shallow Umwelt Lake, which had much lower dissolved oxygen levels than the other lakes. Umwelt Lake had between 3.3 mg/L and 3.8 mg/L of dissolved oxygen in the 1.1 m of open water under ice, which translated into the low oxygen saturation levels of 23.6 to 26.3%.

Dissolved oxygen stabilized below the surface 4 m in the deepest lakes at approximately 11.3 mg/L or 82% saturation in Llama Lake, and 8 mg/L or 60% saturation in Goose Lake Central. In the moderately deep lakes, Propellor and Reference B, dissolved oxygen concentrations declined gradually throughout the water column to minimum concentrations at the water-sediment interface. Dissolved oxygen was lowest near the water-sediment interface for all deeper lakes, ranging from 1.4 mg/L or 10.4% saturation at Reference B to 8.5 mg/L or 63.3% saturation at Llama Lake.

Established CCME guideline oxygen concentrations for the protection of (cold-water) aquatic life are 9.5 mg/L for early life stages and 6.5 mg/L for other life stages (CCME 2011b). During winter, most lakes had dissolved oxygen concentrations above these guidelines in the upper portions of the water column. Bottom oxygen concentrations were below guideline levels in the deeper lakes (Llama, Goose Lake Central, Propellor, and Reference B). In the shallow Umwelt Lake, oxygen levels were below 6.5 mg/L throughout the water column. Low levels of dissolved oxygen near the water-sediment interface are common in Arctic lakes over winter, and are a result of oxygen depletion from decomposition and respiration in the water-sediment interface and a lack of mixing or aeration due to ice cover (CCME 2011b).



Note: Vertical dashed lines represent CCME guidelines for the protection of aquatic life: 9.5 mg dissolved O_2/L for early life stages; 6.5 mg dissolved O_2/L for other life stages.

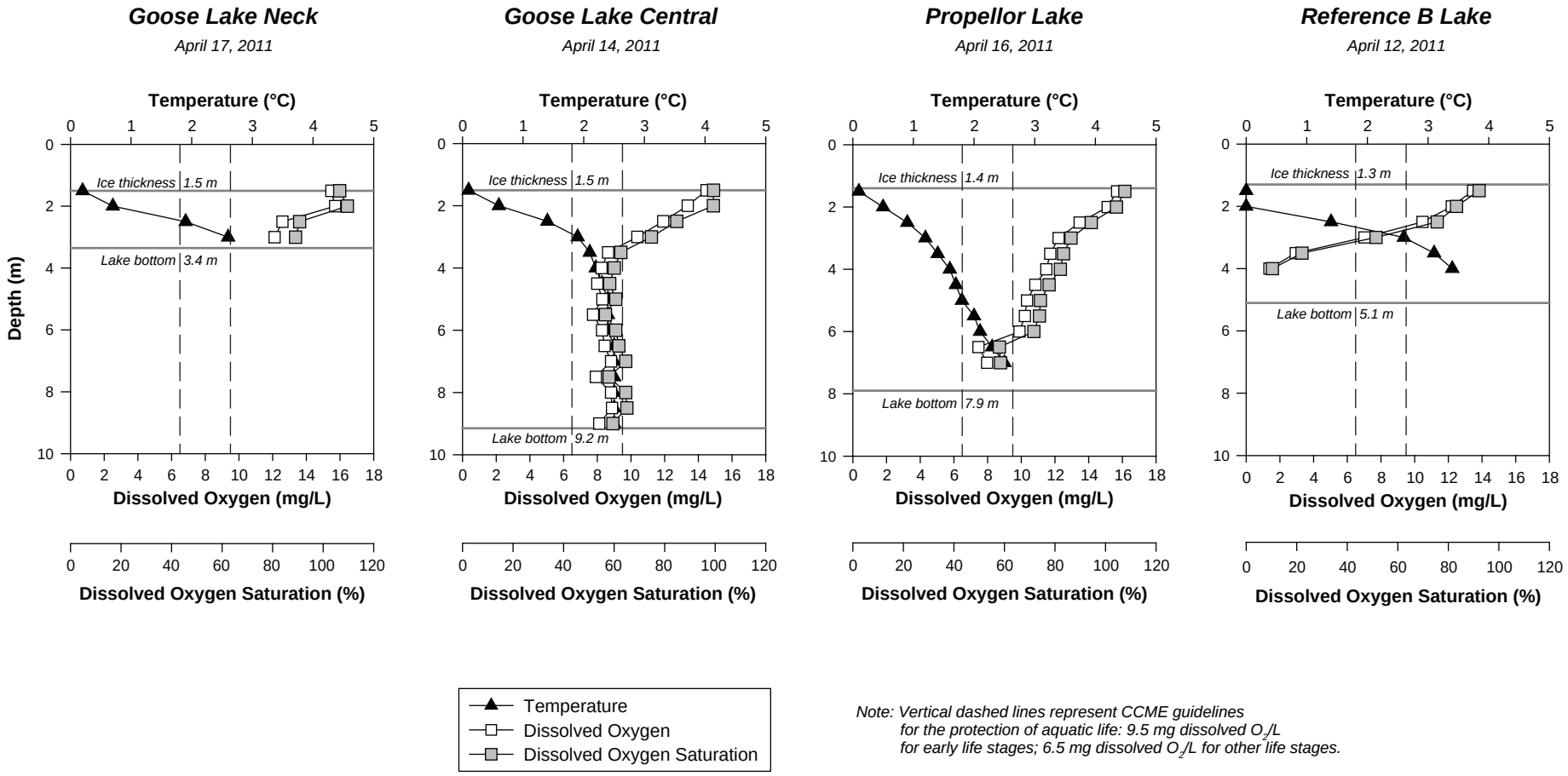
Figure 3.1-1a

Sabina GOLD & SILVER CORP.

Winter Under-ice Dissolved Oxygen and Temperature Profiles in Lakes, Back River Project, April 2011

Figure 3.1-1a

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Note: Vertical dashed lines represent CCME guidelines for the protection of aquatic life: 9.5 mg dissolved O_2/L for early life stages; 6.5 mg dissolved O_2/L for other life stages.

Figure 3.1-1b

Sabina GOLD & SILVER CORP.

Winter Under-ice Dissolved Oxygen and Temperature Profiles in Lakes, Back River Project, April 2011

Figure 3.1-1b

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3.1.2 Summer Lake Physical Limnology

Limnological characteristics were measured during the open-water season in August 2011, and included dissolved oxygen and temperature profiles (Figures 3.1-2a and 3.1-2b) and Secchi depths. Unlike in the ice-covered season (April), profiles showed lakes to be well mixed in the summer, with temperatures that ranged from 12.6°C to 16.8°C. The deepest lake, Llama Lake, was weakly stratified with a poorly developed thermocline between 3 and 7 m.

Summer dissolved oxygen concentrations generally remained stable throughout the water column of all lakes, mirroring patterns observed in water temperature. Some oxygen depletion was present near the lake bottom of Goose Lake Tail and Propellor Lake, indicating oxygen consumption due to decomposition.

Overall, lakes had lower dissolved oxygen concentrations in August than in April, with concentrations ranging from 7.70 mg/L to 9.96 mg/L. Lakes were generally between 80% and 90% oxygen saturation throughout the water column, although Goose Lake Tail had surface saturations of over 90%.

Dissolved oxygen concentrations were below CCME guidelines for the protection of aquatic life for early life stages (9.5 mg/L) at all lake sites, at all depths, except the shallow depths at Goose Lake Tail (CCME 2011b). Dissolved oxygen concentrations measured in August were consistently above the CCME guidelines for early life stages (6.5 mg/L).

Secchi depth, a measure of water clarity, was deeper than the bottom in shallow lakes and Propellor Lake (Table 3.1-1). The Secchi depth ranged from 4 m to 9.2 m at the deeper lakes, Llama, Giraffe and Reference B. The euphotic depth extended throughout the water column in all lakes (Table 3.1-1). Consequently, both benthic and pelagic primary production can occur throughout the sampled lakes.

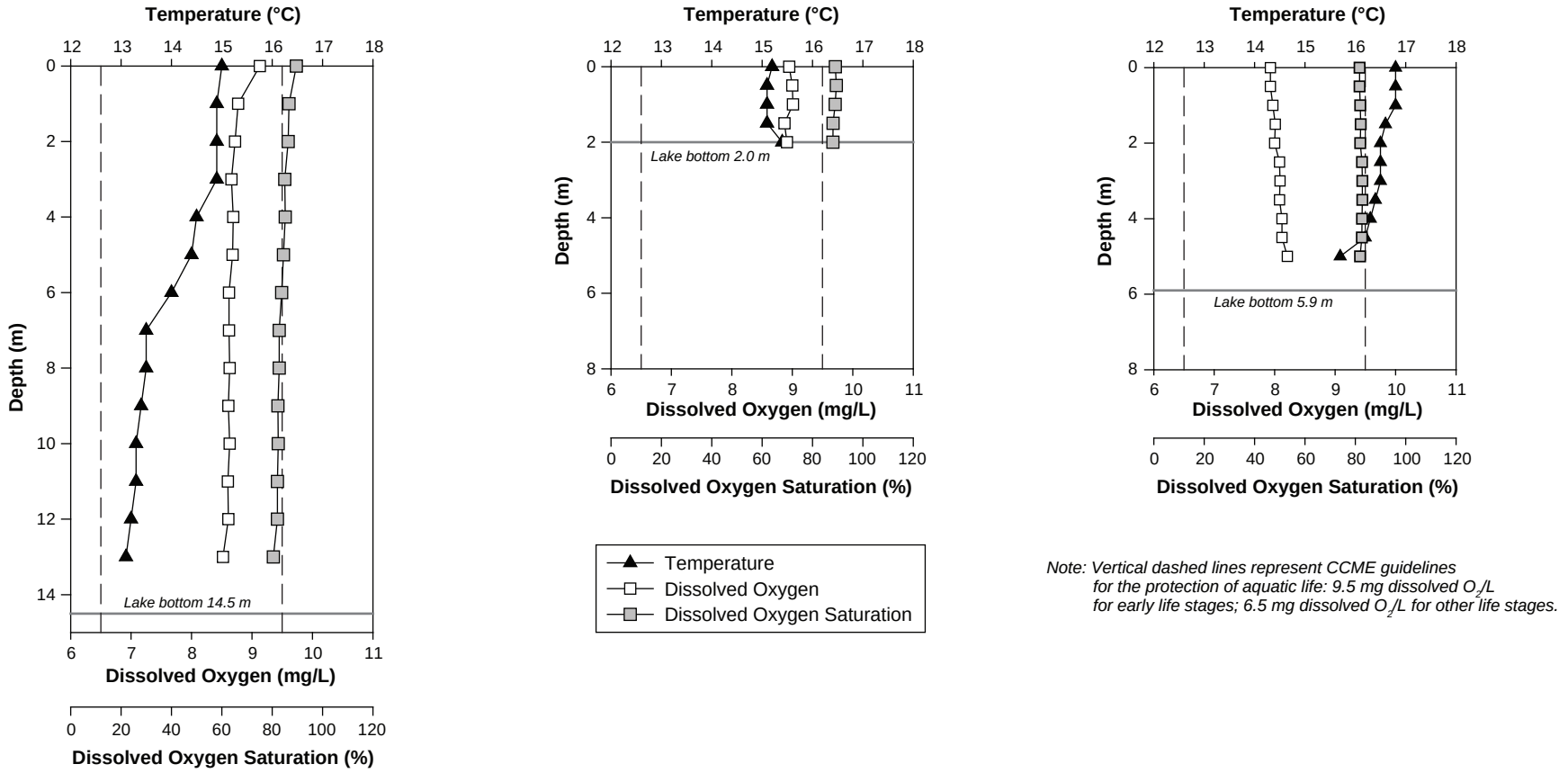
Table 3.1-1. Secchi and Euphotic Zone Depths for the Back River Lakes, August 2011

Lake	Lake Depth (m)	Secchi Depth D_s (m)	Euphotic Zone Depth EZD (m)
Llama	14.5	9.2	bottom (24.9 m)
Umwelt	2.0	bottom	
Giraffe	5.9	4	bottom (10.8 m)
Goose Neck	3.5	bottom	
Goose Central	5.2	bottom	
Goose Tail	2.5	bottom	
Propellor	7.8	bottom	
Reference B	5.3	4.5	bottom (12.2 m)

Note: Euphotic Zone Depth is the depth at which light penetration is 1% of the surface irradiance.

3.1.3 Stream Temperature and Dissolved Oxygen

Surface temperature and dissolved oxygen were measured at all streams in August and September 2011 (Table 3.1-2). Streams had higher water levels and flow in June, and lower levels and flow in August. Echo OF was completely dry in August, and sections of most streams were either dry or flowed underground or through boulder fields. By September, water levels and flow were higher, and no dry or underground sections were observed. Plate 3.1-1 shows photos of stream sites during summer sampling.



Note: Vertical dashed lines represent CCME guidelines for the protection of aquatic life: 9.5 mg dissolved O_2/L for early life stages; 6.5 mg dissolved O_2/L for other life stages.

Figure 3.1-2a

Sabina GOLD & SILVER CORP.

Summer Dissolved Oxygen and Temperature Profiles in Lakes, Back River Project, August 2011

Figure 3.1-2a

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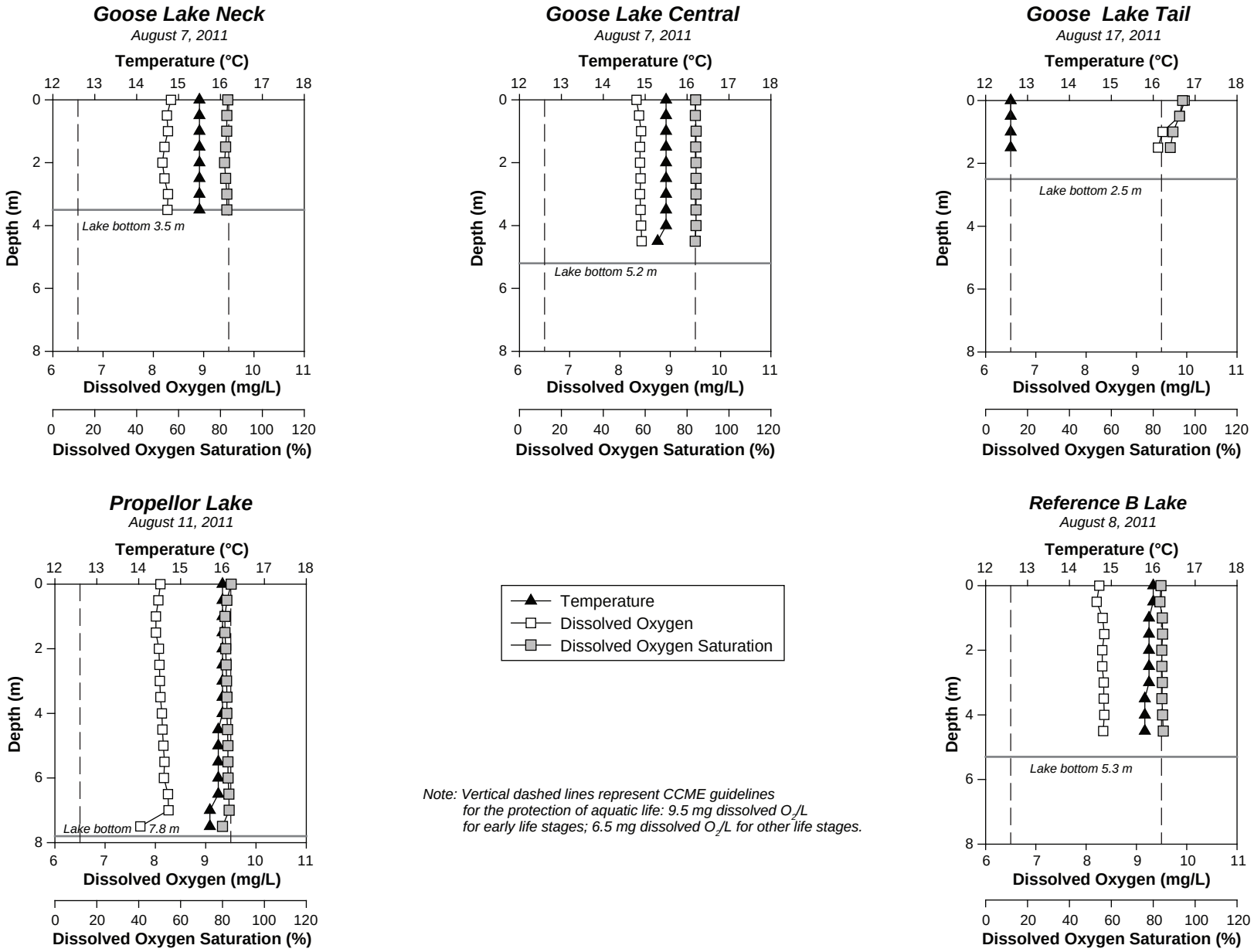


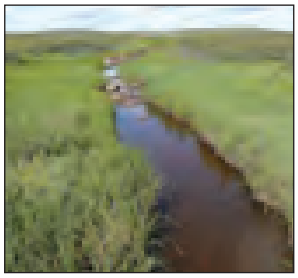
Figure 3.1-2b

Sabina GOLD & SILVER CORP.

Summer Dissolved Oxygen and Temperature Profiles in Lakes, Back River Project, August 2011

Figure 3.1-2b

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Chair Outflow

Small stream through floodplain.



Goose Outflow

Short medium sized stream linking to close by lakes, cobbles.



Llama Outflow

Medium stream through large boulder field.



Propellor Outflow

Large stream draining largest lake in the area. Runs through boulder field.



Echo Outflow

Very small stream through flood plain, dry during summer sampling.



Propellor Downstream

Large stream down-stream from the source lake, cobbles and boulders.



Giraffe Outflow

Short medium sized stream linking to close by lakes, cobbles.



Reference B Outflow

Small stream through floodplain.



Wolf Outflow

Small stream running through flood plain.

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Streams during August Sampling, Back River Project, 2011

Plate 3.1-1

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Table 3.1-2. Temperature and Dissolved Oxygen in Streams, Back River Project, 2011

Stream	August			September		
	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
Chair OF	17.7	8.35	87.7	8.3	10.72	91.0
Llama OF	9.4	3.73	31.5	7.4	9.60	79.7
Echo OF	*nc*	*nc*	*nc*	8.3	9.61	82.1
Giraffe OF	12.9	9.11	85.1	8.1	10.15	84.9
Wolf OF	10.6	9.30	84.1	5.3	10.90	85.9
Goose OF	12.7	9.37	87.3	8.7	10.00	85.2
Propellor OF	14.2	7.88	76.6	8.1	9.51	80.9
Propellor D/S	13.4	8.82	84.5	7.6	10.10	84.0
Ref. B OF	17.6	6.81	71.3	5.1	10.38	81.5

Note: nc = not collected; Echo OF was dry in August.

3.2 LAKE WATER QUALITY

Lake water quality samples were collected in April (ice-covered) and August (open-water) 2011. Lake water quality data collected in 2011 are presented graphically in Figures 3.2-1a to 3.2-6. Raw water quality data for lakes are presented in Appendices 3.2-1 and 3.2-2 (QA/QC data).

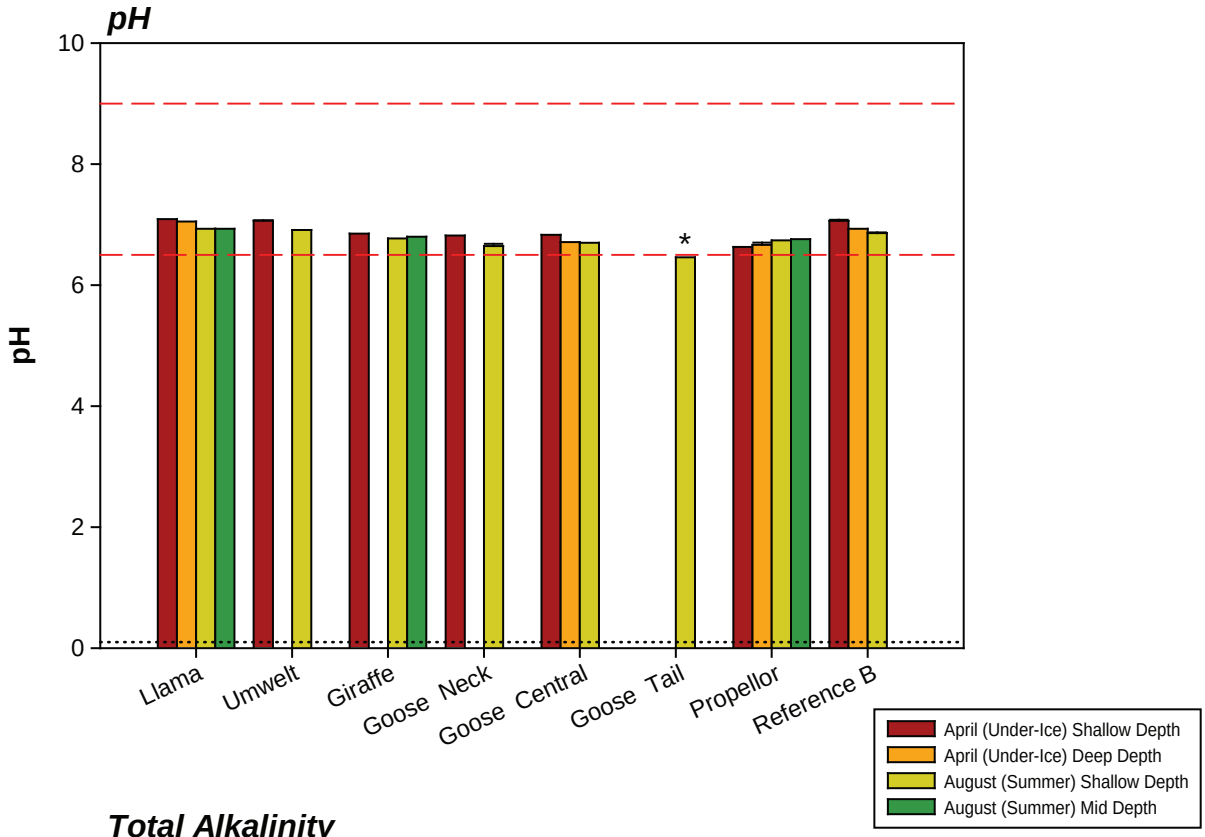
3.2.1 Physical Parameters

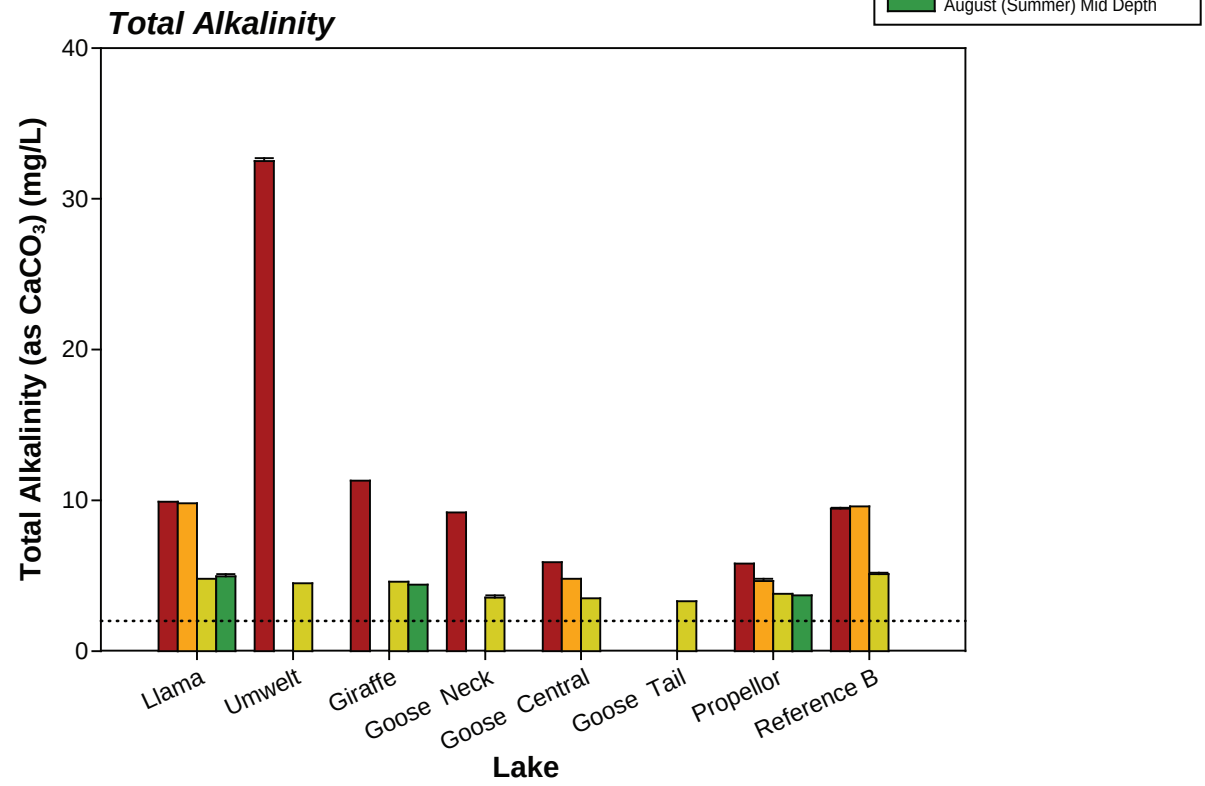
The lakes had slightly acidic to neutral pH values ranging from 6.46 at Goose Lake Tail to 7.08 at Reference B Lake (shallow depth) (Figure 3.2-1a). Only Goose Lake Tail during August was outside the CCME pH guideline of 6.5 to 9.0 (CCME 2011b) with a pH of 6.46. The Project lakes were poorly buffered (total alkalinity below 40 mg $CaCO_3$/L), with total alkalinity ranging from 3.3 mg/L $CaCO_3$ at Goose Lake Tail (summer) to 11.3 mg/L $CaCO_3$ at Giraffe Lake (winter), with increased alkalinity in Umwelt Lake in the winter (averaging 32.5 mg/L $CaCO_3$) (Figure 3.2-1a).

Hardness, conductivity and total dissolved solids followed similar patterns to alkalinity, with Umwelt Lake having elevated levels of each parameter during winter sampling, over twice as high as other lake samples (Figure 3.2-1b). This reflected the increased calcium and magnesium concentrations at Umwelt Lake, and may have resulted from the extrusion of salts from the lake ice into a small volume of water. The sampled lakes generally had soft water (hardness less than 60 mg CaCO3/L) and low conductivity. Llama and Umwelt lakes had the highest total dissolved solids (TDS) concentrations generally ranging from 49 mg/L to 55 mg/L, with the exception of Umwelt Lake over winter which had 128 mg/L. Mean TDS concentrations at other lakes ranged from 11 mg/L to 55 mg/L and tended to be highest in winter.

3.2.2 Major Anions

Sulphate concentrations in lakes were highest over winter (Figure 3.2-2). The highest concentrations occurred at Umwelt (13.5 mg/L) and Giraffe lakes (14.9 mg/L), while all other lakes had concentrations below 8 mg/L. Propellor Lake and Reference B Lake had the lowest concentrations of sulphate between 1.8 mg/L and 3.4 mg/L.





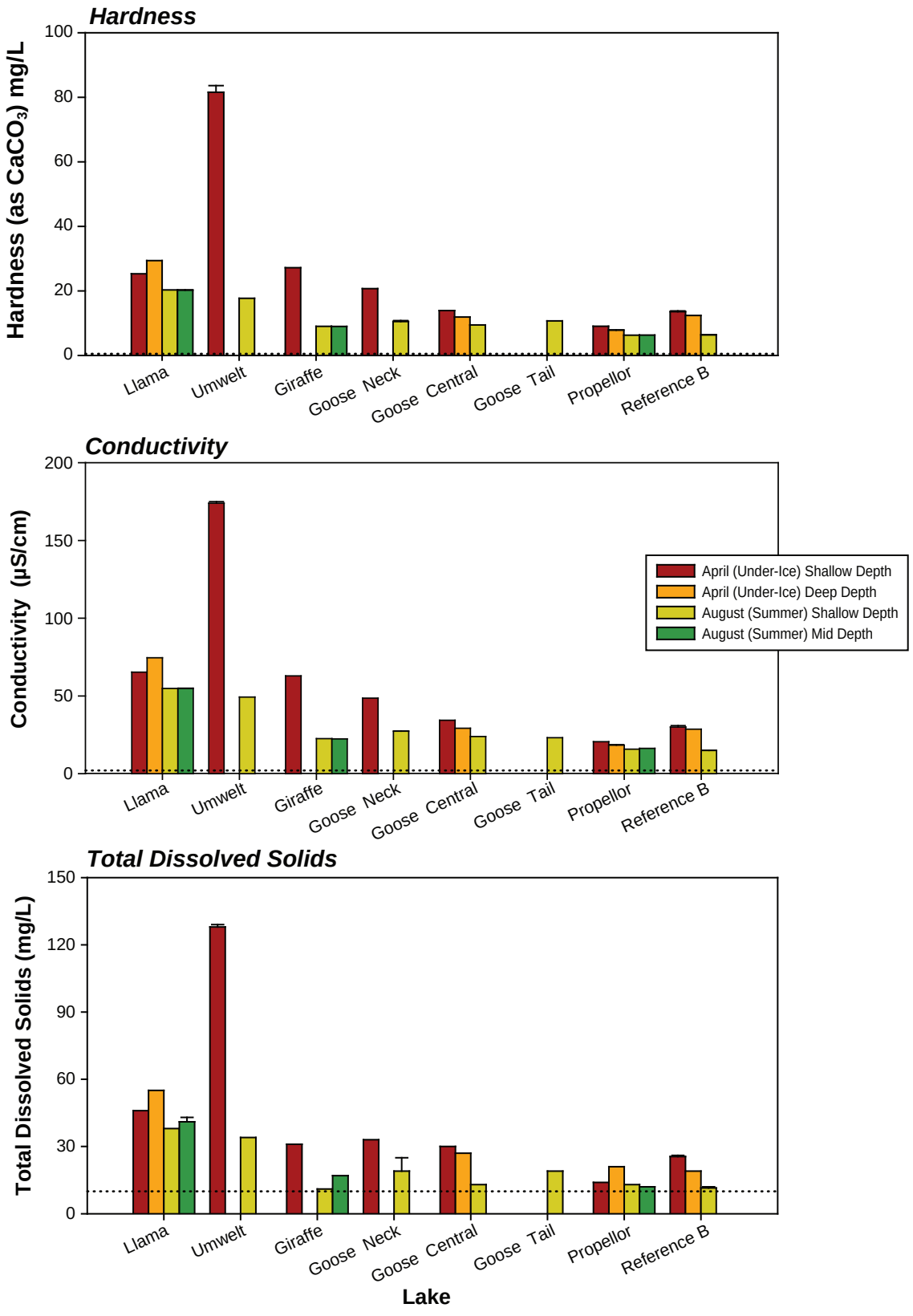
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (pH 0.1; alkalinity 2 mg/L).
Dashed lines represent CCME guideline for pH 6.5–9.

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pH and Alkalinity in Lakes, Back River Project, 2011

Figure 3.2-1a

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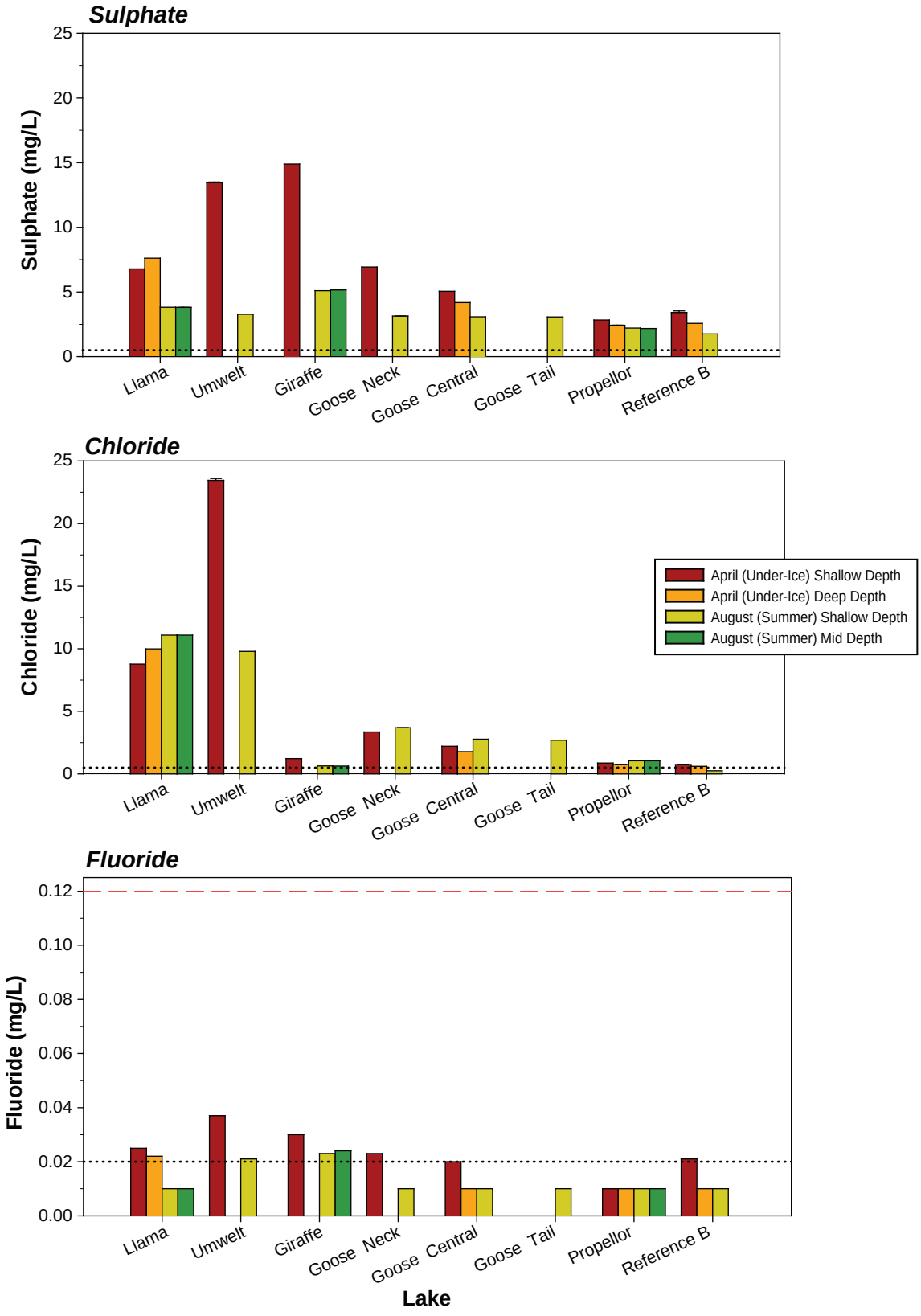
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (hardness 0.5 mg/L; conductivity 2.0 mS/cm; total disolved solids 10 mg/L).

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Hardness, Conductivity and Total Dissolved Solid Concentrations in Lakes, Back River Project, 2011

Figure 3.2-1b

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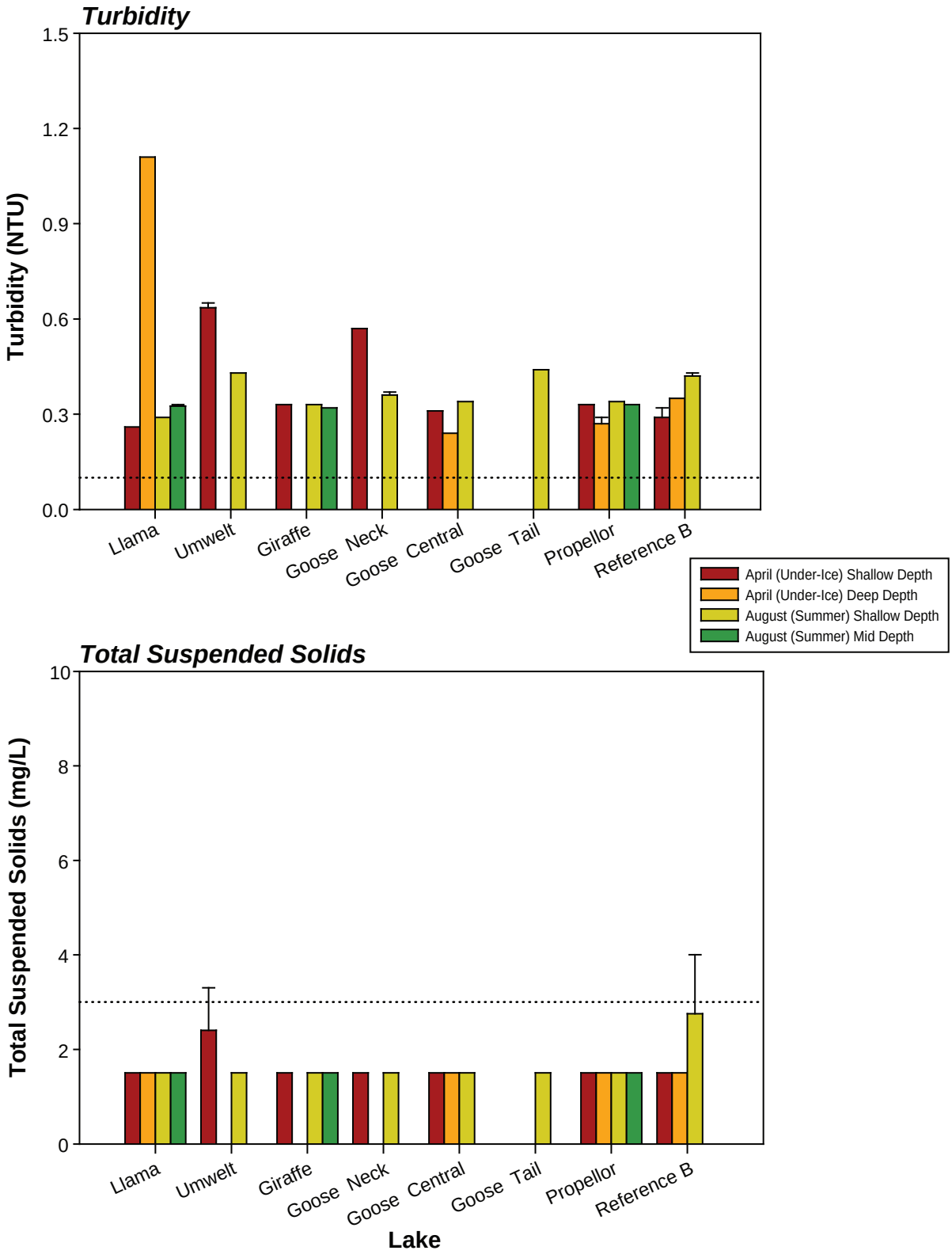
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (sulphate 0.5 mg/L; chloride 0.5 mg/L; fluoride 0.02 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME guideline for fluoride (0.12 mg/L).
The CCME guideline for chloride is 640 mg/L (not shown).

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Sulphate, Chloride and Fluoride Concentrations in Lakes, Back River Project, 2011

Figure 3.2-2

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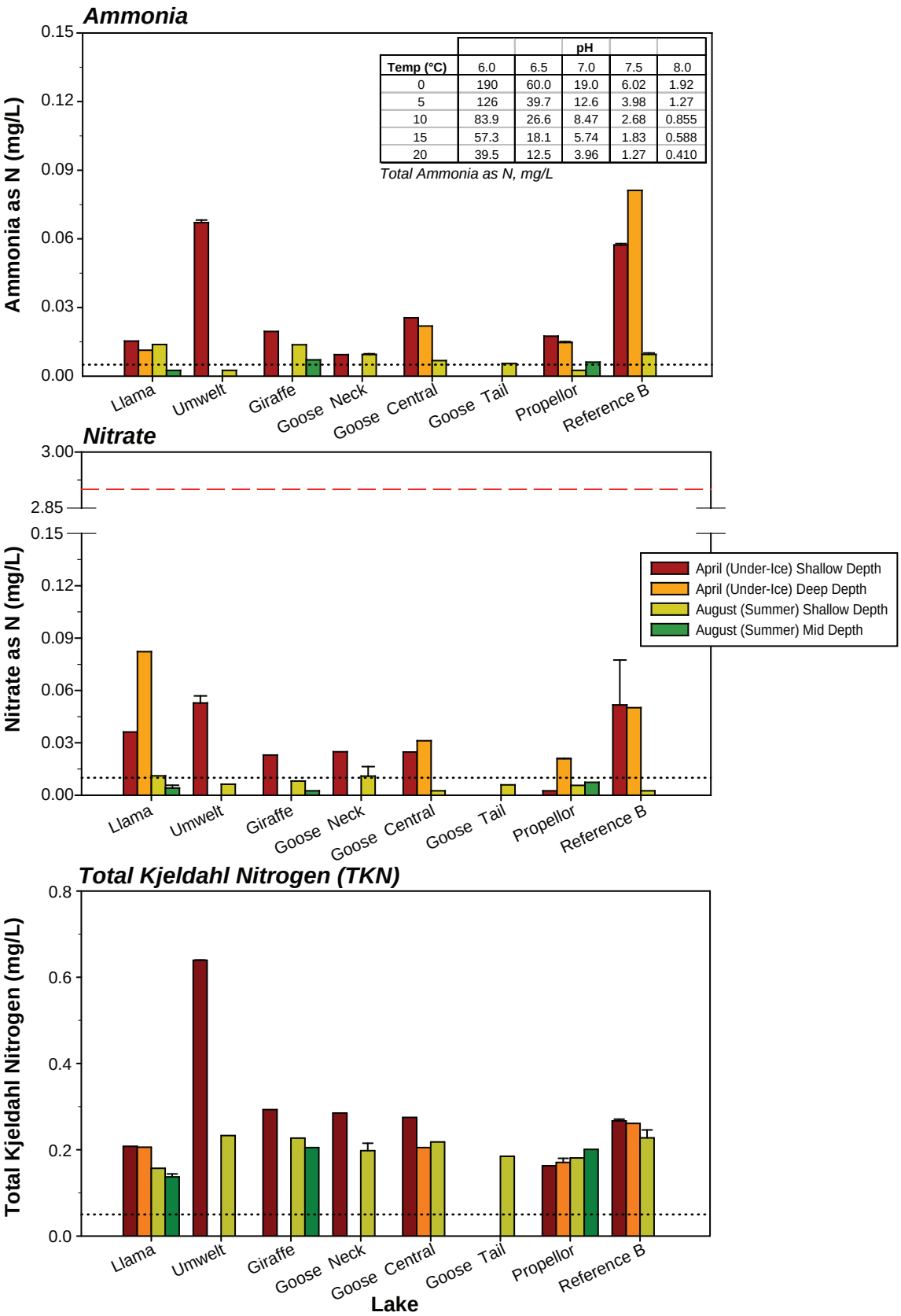
Note: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (turbidity 0.1 NTU; total suspended solids 3 mg/L).
Values below the detection limit are plotted at half the detection limit.
CCME guidelines for turbidity and total suspended solids are dependent upon background levels.

Sabina GOLD & SILVER CORP.

Turbidity and Total Suspended Solid Concentrations in Lakes, Back River Project, 2011

Figure 3.2-3

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Temp (°C)	pH 6.0	6.5	7.0	7.5	8.0
0	190	60.0	19.0	6.02	1.92
5	126	39.7	12.6	3.98	1.27
10	83.9	26.6	8.47	2.68	0.855
15	57.3	18.1	5.74	1.83	0.588
20	39.5	12.5	3.96	1.27	0.410

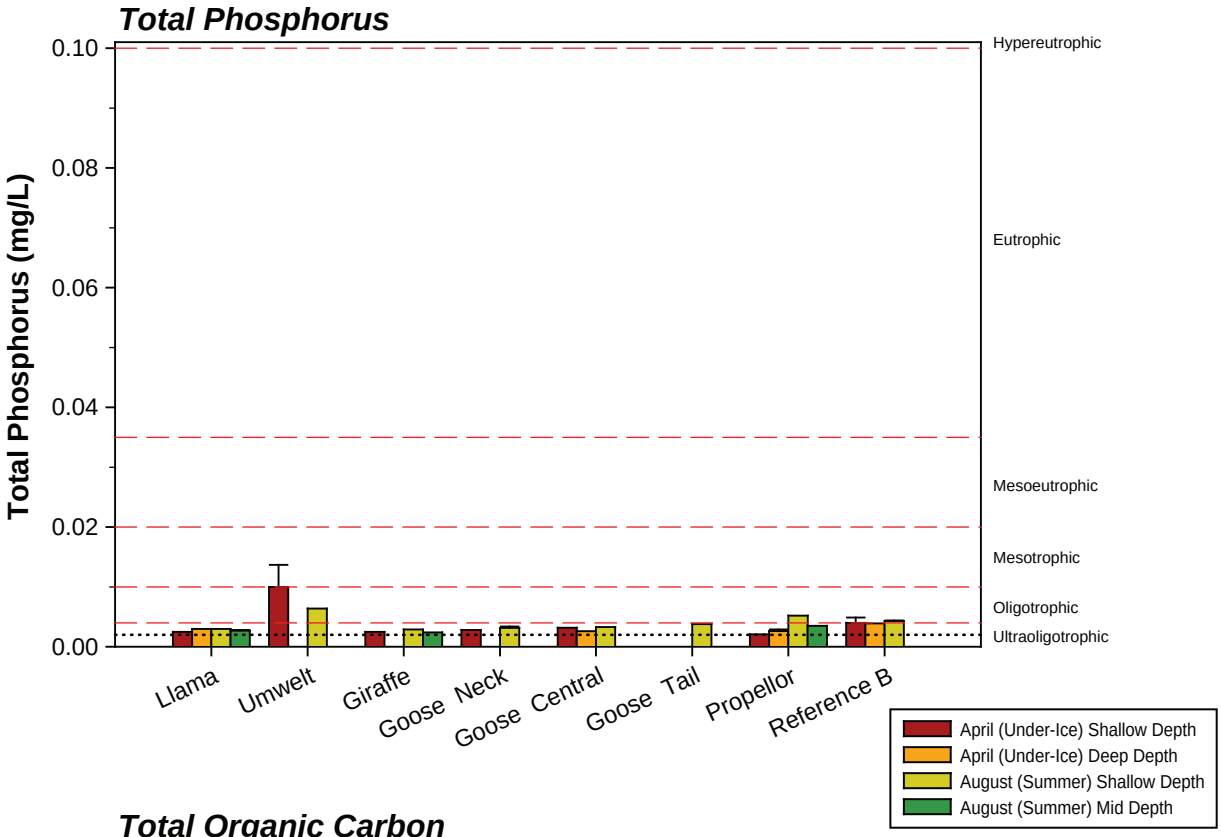
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (ammonia 0.005 mg/L; nitrate 0.05 mg/L; TKN 0.05 mg/L).
Values below the detection limit are plotted at half the detection limit.
Inset table shows temperature- and pH-dependent CCME guideline for ammonia.
Dashed lines represent CCME guidelines for nitrate (2.9 mg/L).
Nitrite concentrations were always below detection limits (0.001 mg/L) so were not plotted.

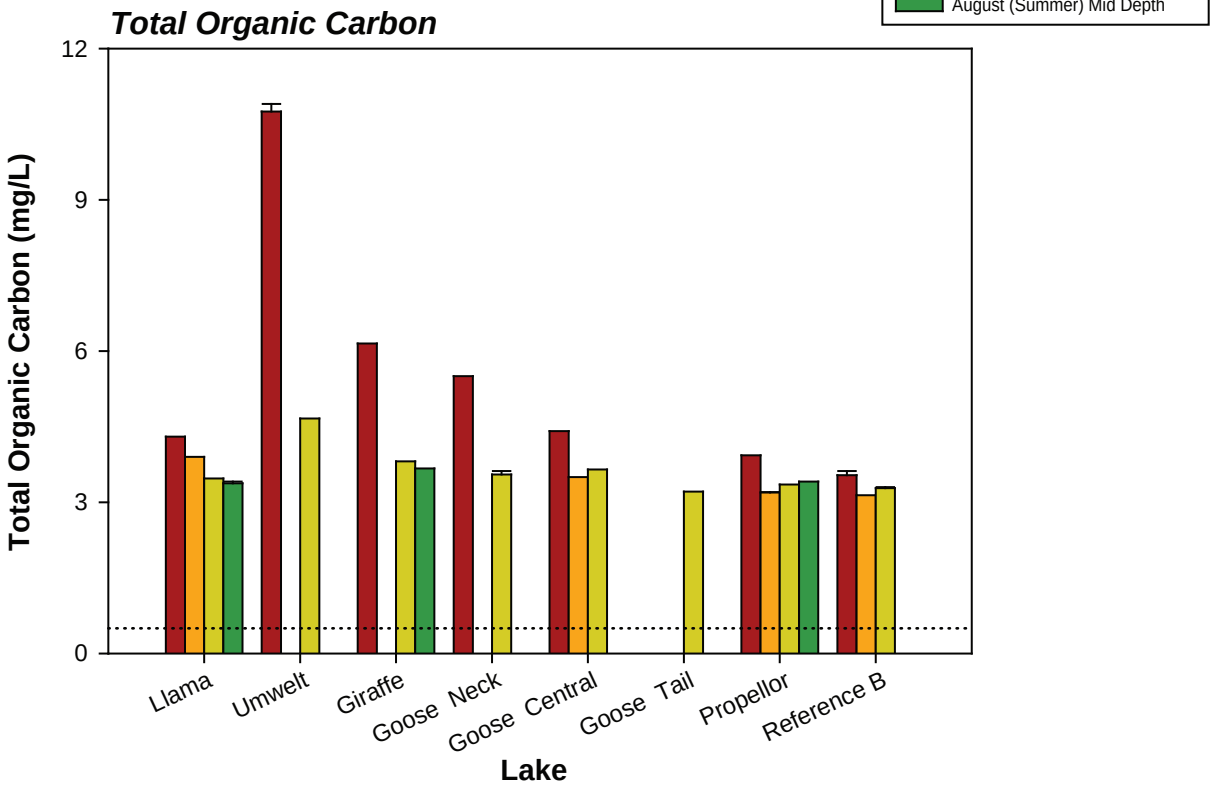
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Ammonia, Nitrate and Total Kjeldahl Nitrogen Concentrations in Lakes, Back River Project, 2011

Figure 3.2-4a

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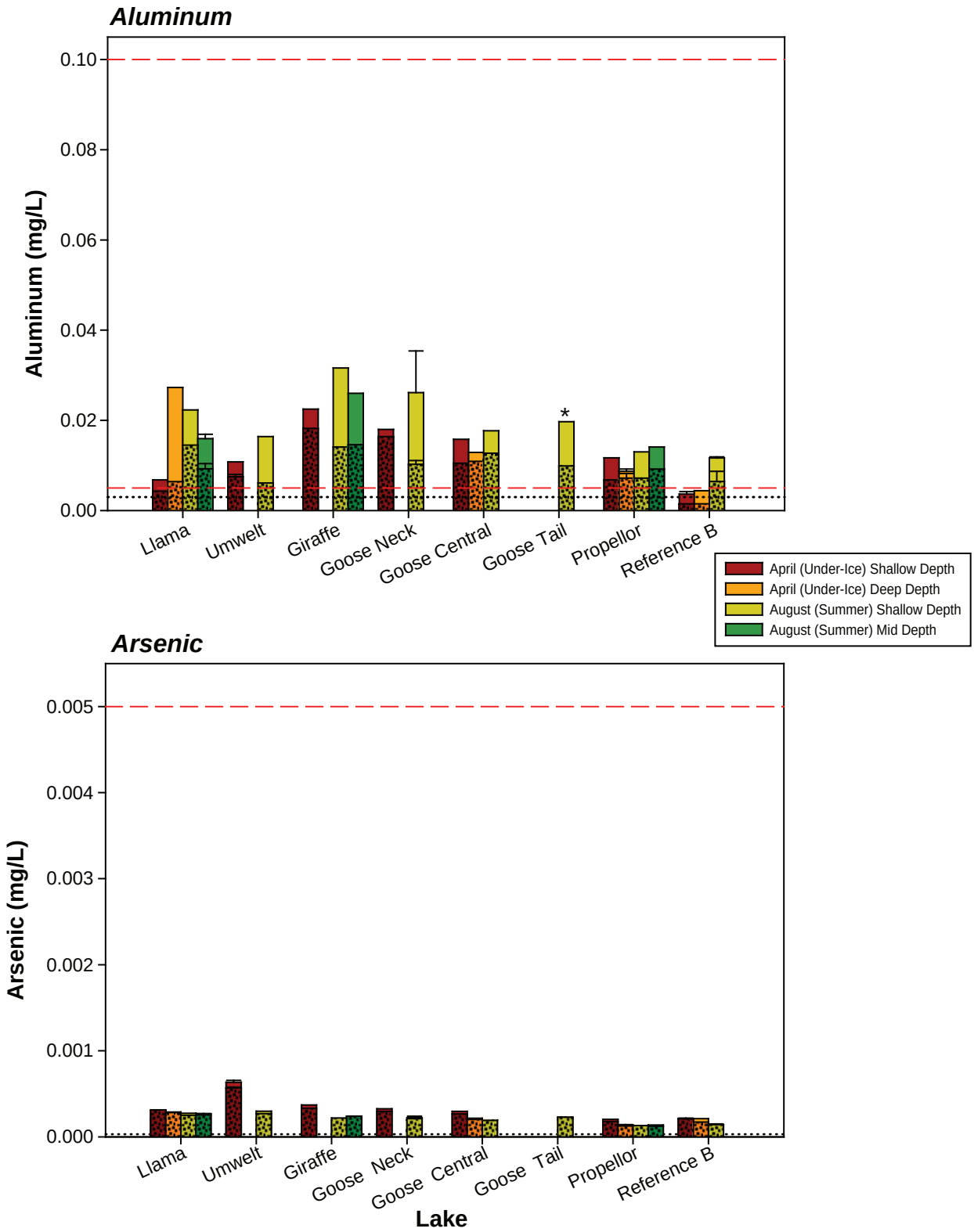
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (total phosphorus 0.002 mg/L; TOC 0.5 mg/L).
Dashed lines represents CCME trigger ranges (<0.004 mg/L = ultraoligotrophic; 0.004–0.010 mg/L = oligotrophic; 0.01–0.02 mg/L = mesotrophic; 0.02–0.035 mg/L = mesoeutrophic; 0.035–0.1 mg/L = eutrophic; >0.1 mg/L = hypereutrophic).

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Total Phosphorus and Total Organic Carbon Concentrations in Lakes, Back River Project, 2011

Figure 3.2-4b

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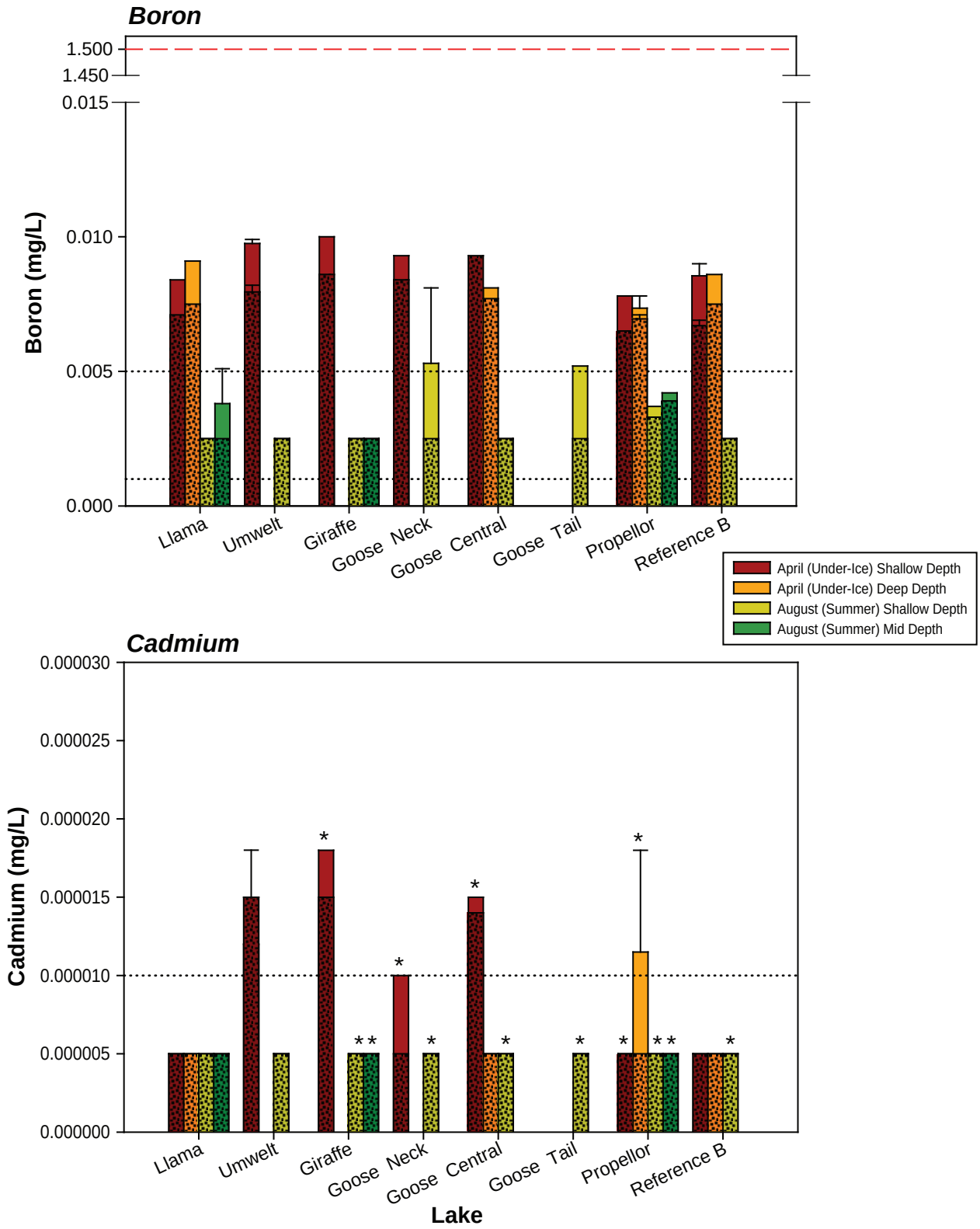
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limits (aluminum 0.003 mg/L; arsenic 0.00003 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
CCME guidelines for aluminum are pH-dependent (0.005 mg/L at pH less than 6.5; 0.1 mg/L at pH greater than or equal to 6.5).
pH was above 6.5 at all sites except Goose Lake Tail (6.46).
CCME guidelines for arsenic are 0.005 mg/L.
** Indicates mean total metal values that are higher than CCME guidelines.*

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Aluminum and Arsenic Concentrations in Lakes, Back River Project, 2011

Figure 3.2-5a

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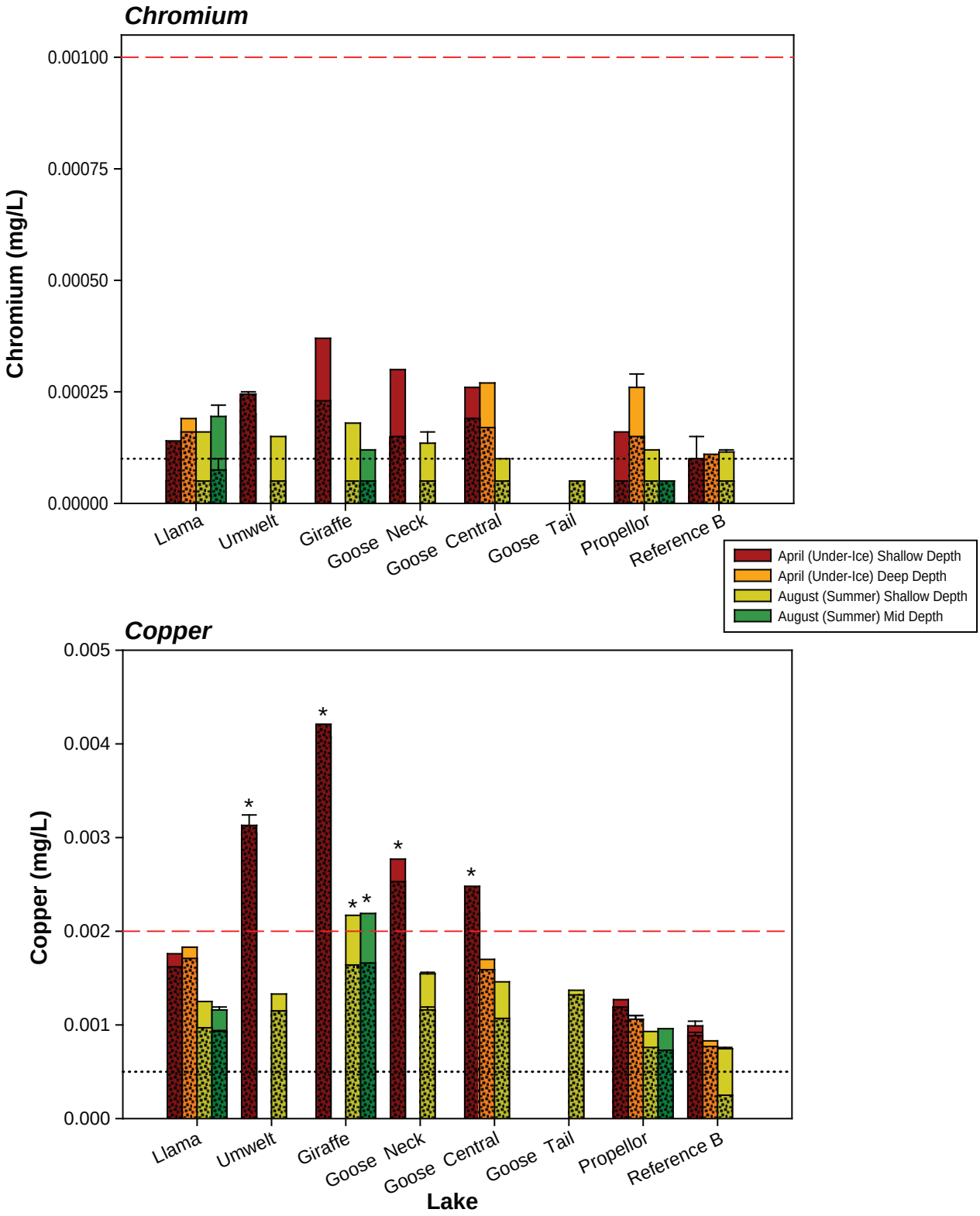
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limits (boron 0.001 or 0.005 mg/L; cadmium 0.00001 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines (boron 1.5 mg/L long term and 29 mg/L short term [not shown]).
The interim CCME guideline for cadmium (in mg/L) is calculated using the equation $10^{(0.86[\log(\text{hardness})]-3.2)}/1000$.
The CCME guideline for hexavalent chromium (0.001 mg/L) and interim guideline for trivalent chromium (0.0089 mg/L) [not shown].
** Indicates mean total metal values that are higher than CCME guidelines (hardness corrected in the case of cadmium).*

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Boron and Cadmium Concentrations in Lakes, Back River Project, 2011

Figure 3.2-5b

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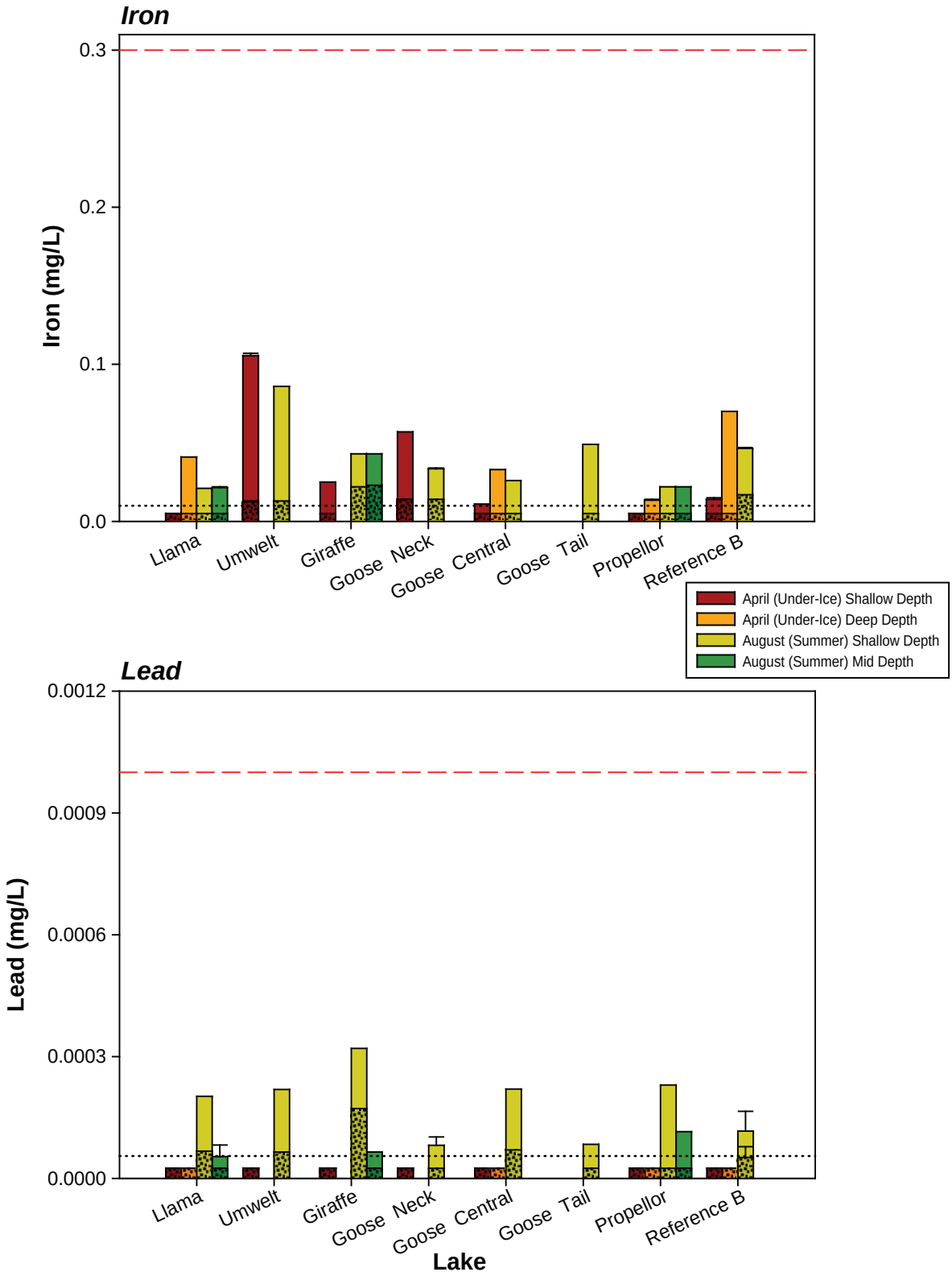
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (copper 0.0005 mg/L; chromium 0.0001 mg/L).
Values below the detection limit are plotted at half the detection limit.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dashed lines represent CCME guidelines.
The CCME guideline for hexavalent chromium (0.001 mg/L) and interim guideline for trivalent chromium (0.0089 mg/L) [not shown].
The CCME guideline for copper (in mg/L) is calculated using the equation: $e^{(0.8545[\ln(\text{hardness})]-1.465)} * 0.0002$.
Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.
** Indicates mean total metal values that are higher than CCME guidelines (hardness corrected in the case of cadmium).*

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Chromium and Copper Concentrations in Lakes, Back River Project, 2011

Figure 3.2-5c

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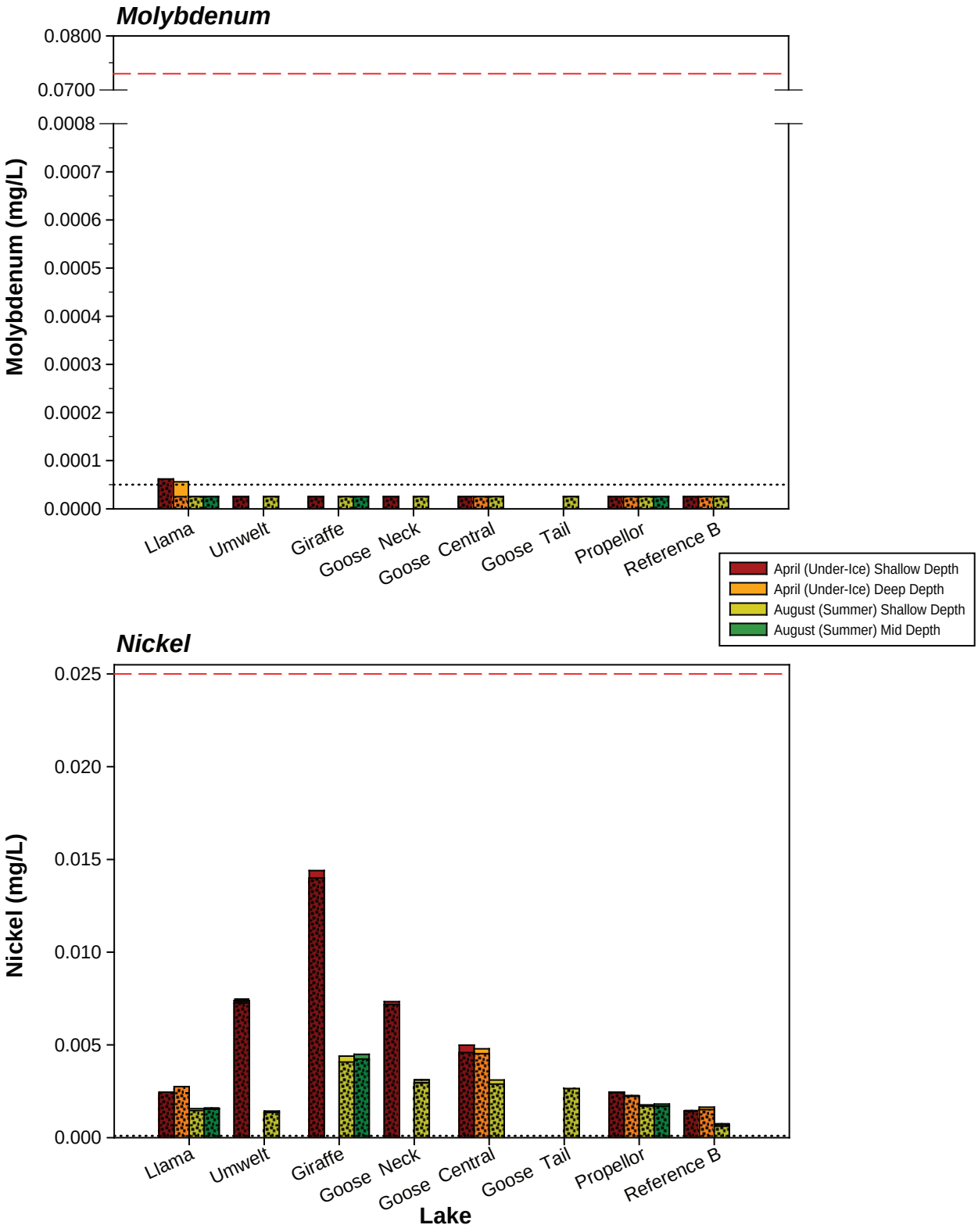
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (iron 0.01 mg/L; lead 0.00005 mg/L).
Values below the detection limit are plotted at half the detection limit.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dashed lines represent CCME guidelines.
The CCME guideline for iron is 0.3 mg/L.
The CCME guideline for lead (in mg/L) is calculated using the equatione $e^{(1.273[\ln(\text{hardness})]-4.705)}/1000$, and is a minumum of 0.001 mg/L regardless of hardness.

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Iron and Lead Concentrations in Lakes, Back River Project, 2011

Figure 3.2-5d

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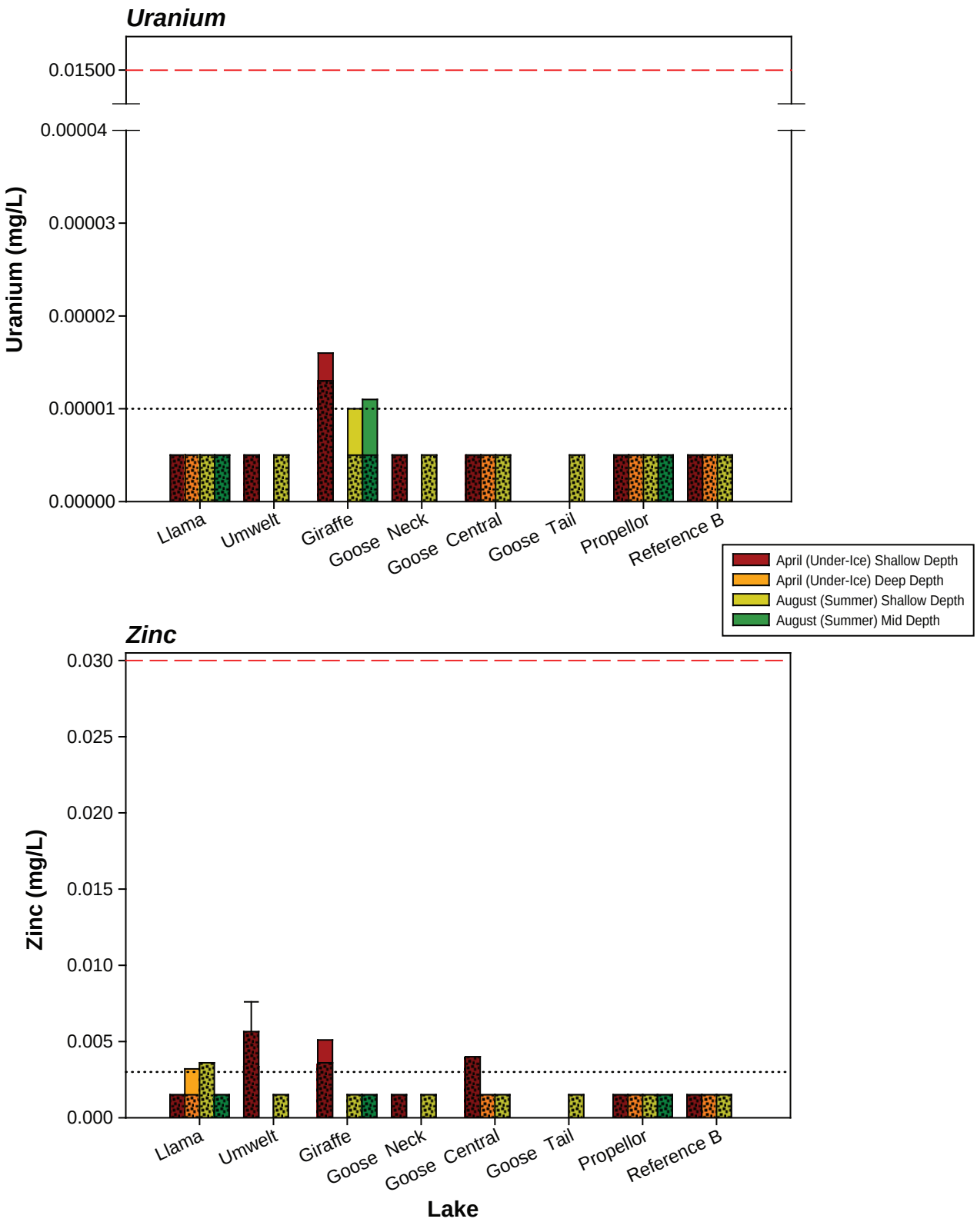
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (molybdenum 0.00005 mg/L; nickel 0.0001 mg/L).
Values below the detection limit are plotted at half the detection limit.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Red dashed lines represent CCME guidelines.
The interim CCME guideline for molybdenum is 0.073 mg/L.
The CCME guideline for nickel (in mg/L) can be calculated using the equation $e^{(1.273[\ln(\text{hardness})]-4.705)}/1000$.
Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

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Molybdenum and Nickel Concentrations in Lakes, Back River Project, 2011

Figure 3.2-5e

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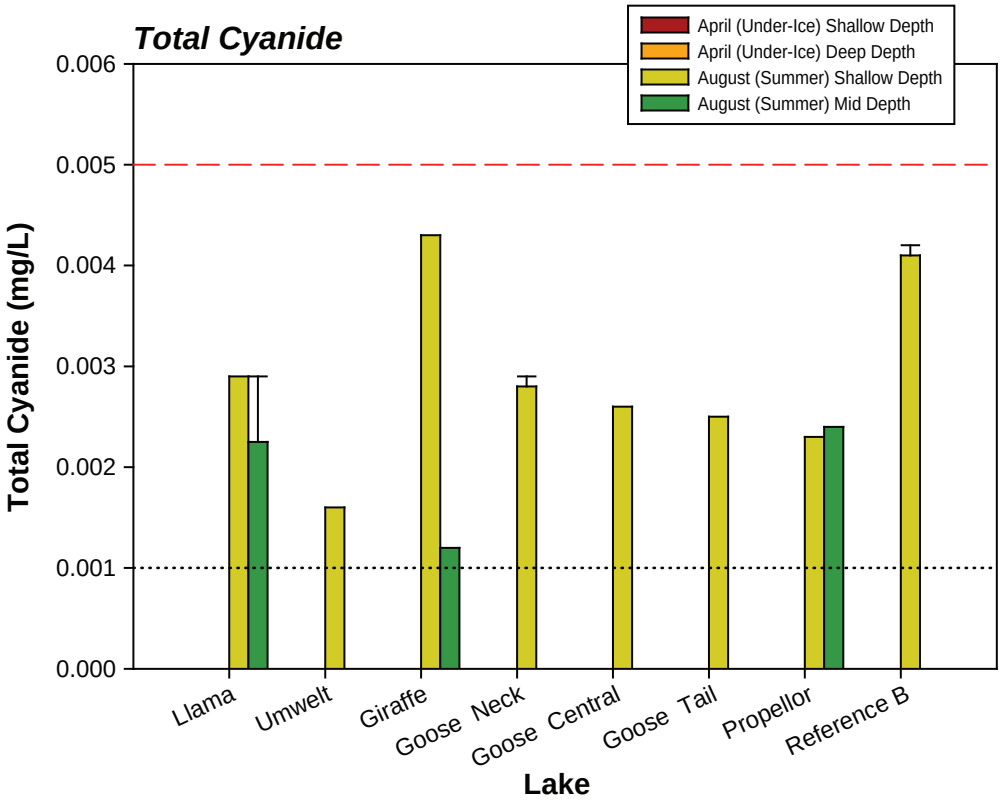
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (uranium 0.00001 mg/L; zinc 0.003 mg/L).
Values below the detection limit are plotted at half the detection limit.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dashed lines represent CCME guidelines (uranium long term 0.015 mg/L and short term 0.033 mg/L; zinc 0.03 mg/L).

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Uranium and Zinc Concentrations in Lakes, Back River Project, 2011

Figure 3.2-5f

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Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (total cyanide 0.001 mg/L).
Dashed line represents CCME guideline for cyanide as free CN (0.005 mg/L).
Free CN was not plotted as 93 % of samples were below detection limits, and all were below the CCME guideline.

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Total Cyanide Concentrations in Lakes, Back River Project, 2011

Figure 3.2-6

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Highest chloride concentrations occurred at Umwelt Lake over winter, with a mean of 23.5 mg/L, whilst all other lake sampling sessions had concentrations less than 12 mg/L (Figure 3.2-2). Lake fluoride concentrations were generally higher in the winter, and often below detection limits in summer (Figure 3.2-2). The highest fluoride concentrations were in Umwelt Lake over winter at 0.037 mg/L, well below the CCME interim guideline of 0.12 mg/L (CCME 2011b).

Higher sulphate and chloride concentrations in Umwelt and Llama have previously been inferred as a result of deep groundwater influence (Rescan 2010).

3.2.3 Suspended Material

Turbidity levels were low in all lakes, generally below 0.64 NTU. The exception was Llama Lake where turbidity was 1.1 NTU near the bottom over winter. The lakes sampled had low levels of total suspended solids (TSS), with concentrations generally below detection limits (Figure 3.2-3). The low turbidity and TSS allowed greater light penetration in the water column, creating the high water clarity observed with the Secchi depths.

3.2.4 Nutrients

Nutrient concentrations across the eight lakes were frequently below detection and the lakes can be considered nutrient-poor (Figure 3.2-4a). Nutrient concentrations varied seasonally, with nutrients highest over winter due to reduced biological uptake and increased remineralization.

Overall, ammonia and nitrate concentrations showed similar patterns across lakes, while nitrite concentrations were consistently below detection limits. The highest ammonia concentrations were at Reference B Lake and Umwelt Lake over winter, ranging from 0.057 mg/L to 0.081 mg/L. All other lakes and seasons had concentrations less than 0.026 mg/L. Nitrate concentrations were highest in winter at Llama, Umwelt and Reference B lakes (0.036 mg/L to 0.082 mg/L), and lowest in summer in all lakes (below 0.011 mg/L).

Ortho-phosphate concentrations were below detection for all lakes and total phosphorus concentrations were generally low (Figure 3.2-4b). The lakes sampled can be classified as ultra-oligotrophic (<0.004 mg/L) to oligotrophic (0.004 to 0.01 mg/L) based on the CCME trigger ranges for phosphorus in freshwater systems (CCME 2011b).

Much of the nutrients in the lakes were in forms not as readily available to plant life. The vast majority of both nitrogen and phosphorus were tied up in the organic fraction, with total total Kjeldahl nitrogen (TKN) generally a magnitude greater than nitrate and ammonia concentrations, and phosphate was only detectable in the total phase.

Total organic carbon (TOC) concentrations in lakes were highest in shallow winter waters (Figure 3.2-4b). Lake TOC concentrations ranged between 3.2 mg/L and 6.2 mg/L, except in Umwelt Lake where levels reached 10.8 mg/L in April.

3.2.5 Metals

Lakes generally had low metal concentrations, with higher concentrations occurring in the winter for most lakes. Metals concentrations can be higher during the winter due to natural processes, including solute exclusion during ice formation, changes in redox chemistry, increased remineralization, and decreased biological uptake.

Overall, the lakes tended to have similar metal concentrations, although some patterns appeared as Giraffe Lake often had the highest concentrations and Reference B often had the lowest. Graphs for all metals with CCME guidelines are presented in Figures 3.2-5a to 3.2-5f.

Total aluminum concentrations in lakes ranged from 0.0037 mg/L to 0.032 mg/L and was lowest in Reference B Lake (Figure 3.2-5a). Total arsenic concentrations ranged from 0.00013 mg/L to 0.00037 mg/L and were highest in winter, particularly in Umwelt Lake (0.00063 mg/L) (Figure 3.2-5a).

Lake total boron and cadmium concentrations were higher in winter than in summer, with most samples over the detection limits in winter and below in summer (boron 0.001 mg/L or 0.005 mg/L; cadmium 0.00001 mg/L) (Figure 3.2-5b).

Generally, total chromium and copper concentrations in lakes were highest over winter at Umwelt, Giraffe, Goose Neck and Goose Central, and lowest at Reference B (Figure 3.2-5c). This pattern was most pronounced in copper.

Lakes had similar total iron concentrations, with highest concentrations at Umwelt Lake (Figure 3.2-5d). Iron was one of the only metals where Reference B Lake had relatively high concentrations compared to the other lake sites.

Total lead concentrations were highest in summer, opposite to the trends seen in other metals (Figure 3.2-5d). During winter, most lakes had lead concentrations below detection limits (0.00005 mg/L). Total lead concentrations were similar across lakes in summer, with Giraffe Lake having the highest concentrations (0.00032 mg/L in summer).

Total nickel concentrations followed a similar pattern to chromium and copper, with highest concentrations tending to occur in winter in the western lakes (Llama, Umwelt, Giraffe and Goose) (Figure 3.2-5e).

The majority of lakes had total molybdenum, uranium and zinc concentrations below detection limits (Figures 3.2-5e and 3.2-5f). Exceptions were Llama (molybdenum, zinc), Umwelt (zinc), Giraffe (uranium and zinc), and Goose Lake Central (zinc).

Total mercury, selenium, silver and thallium concentrations were consistently below analytical detection limits in all study lakes and were not graphed.

3.2.6 Cyanides

Total cyanide concentrations in lakes ranged from 0.0012 mg/L to 0.0043 mg/L over summer (Figure 3.2-6), with the lowest and highest concentrations occurring in Giraffe Lake (mid depth and shallow depth). The vast majority (93%) of lakes had free cyanide concentrations below detection limits and all were below the CCME guideline for free cyanide (0.005 mg/L; CCME 2011b).

3.2.7 Comparison with CCME Guidelines

Table 3.2-1 gives the percentage of lake water quality samples that were above their respective parameter CCME guideline level, and Table 3.2-2 provides the factor by which the mean concentrations were higher than CCME guidelines.

All lakes had water quality within the CCME guidelines for pH, (6.5 to 9), except Goose Tail (pH: 6.46). All lakes had water quality below CCME guidelines for nitrate, nitrite, ammonia, fluoride, chloride and free cyanide. All lakes except Llama and Reference B exceeded CCME guidelines for at least one of the following metals: total aluminum, total cadmium and total copper.

Table 3.2-1. Lake Water Quality, Percent of Samples in which Concentrations are Higher than CCME Guidelines, Back River Project, 2011

Lake	Total Number of Samples Collected	CCME Guideline Value[a]:	pH	Ammonia (as N)	Fluoride (F)	Chloride (Cl)	Nitrate (as N)	Nitrite (as N)	Total Phosphorus	Free Cyanide
			6.5-9.0	temperature - and pH-dependent	0.12[b] mg/L	640 mg/L	2.935[b] mg/L	0.06 mg/L	Trophic Status[c]	0.005 mg/L
Llama	5		0	0	0	0	0	0	Ultraoligotrophic	0
Umwelt	3		0	0	0	0	0	0	Oligotrophic - Mesotrophic	0
Giraffe	3		0	0	0	0	0	0	Ultraoligotrophic	0
Goose Neck	3		0	0	0	0	0	0	Ultraoligotrophic	0
Goose Central	3		0	0	0	0	0	0	Ultraoligotrophic	0
Goose Tail	1		100	0	0	0	0	0	Ultraoligotrophic	0
Propellor	5		0	0	0	0	0	0	Ultraoligotrophic - Oligotrophic	0
Reference B	5		0	0	0	0	0	0	Ultraoligotrophic - Oligotrophic	0
Total	**28**									

Lake	Total Number of Samples Collected	CCME Guideline Value[a]:	Aluminum (Al) - Total	Arsenic (As) -Total	Boron (B) - Total	Cadmium (Cd) - Total	Chromium (Cr) - Total	Copper (Cu) - Total	Iron (Fe) - Total	Lead (Pb) - Total
			0.005-0.1[d] mg/L	0.005 mg/L	Short term 29 mg/L; Long term 1.5 mg/L	hardness-based equation[be]	Cr (VI) 0.001[bf] mg/L	hardness dependent ≥0.002[g] mg/L	0.3 mg/L	hardness dependent ≥0.001[h] mg/L
Llama	5		0	0	0	0	0	0	0	0
Umwelt	3		0	0	0	0	0	66.6	0	0
Giraffe	3		0	0	0	100	0	100	0	0
Goose Neck	3		0	0	0	100	0	33.3	0	0
Goose Central	3		0	0	0	66.6	0	33.3	0	0
Goose Tail	1		100	0	0	0	0	0	0	0
Propellor	5		0	0	0	20	0	0	0	0
Reference B	5		0	0	0	0	0	0	0	0
Total	**28**									

Lake	Total Number of Samples Collected	CCME Guideline Value[a]:	Mercury (Hg) - Total	Molybdenum (Mo) - Total	Nickel (Ni) - Total	Selenium (Se) - Total	Silver (Ag) - Total	Thallium (Tl) - Total	Uranium (U) - Total	Zinc (Zn) - Total
			0.000026[i] mg/L	0.073[b] mg/L	hardness dependent ≥0.025[j] mg/L	0.001 mg/L	0.0001 mg/L	0.0008 mg/L	Short term 0.033 mg/L; Long term 0.015 mg/L	0.03 mg/L
Llama	5		0	0	0	0	0	0	0	0
Umwelt	3		0	0	0	0	0	0	0	0
Giraffe	3		0	0	0	0	0	0	0	0
Goose Neck	3		0	0	0	0	0	0	0	0
Goose Central	3		0	0	0	0	0	0	0	0
Goose Tail	1		0	0	0	0	0	0	0	0
Propellor	5		0	0	0	0	0	0	0	0
Reference B	5		0	0	0	0	0	0	0	0
Total	**28**									

All values represent percentages of 2011 samples that are both higher than the CCME guidelines and above detection limits.

a) Canadian water quality guidelines for the protection of aquatic life (CCME 2011)

b) Intermin guideline

c) <0.004 mg/L = ultraoligotrophic; 0.004 - 0.010 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; >0.1 mg/L = hypereutrophic

d) 0.005 mg/L at pH <6.5; 0.1 mg/L at pH ≥6.5

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000

f) Guideline concentration for hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L)

*g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness*

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness

i) Guideline concentration for inorganic mercury

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness

Table 3.2-2. Lake Water Quality, Factor by which Average Concentrations are Higher than CCME Guidelines, Back River Project, 2011

Lake	Total Number of Samples Collected	CCME Guideline Value[a]:	pH*	Ammonia (as N)	Fluoride (F)	Chloride (Cl)	Nitrate (as N)	Nitrite (as N)	Total Phosphorus	Free Cyanide
			6.5-9.0	temperature- and pH-dependent	0.120[b] mg/L	640 mg/L	2.935[b] mg/L	0.06 mg/L	Trophic Status[c]	0.005 as free CN
Llama	5		-	-	-	-	-	-	Ultraoligotrophic	-
Umwelt	3		-	-	-	-	-	-	Oligotrophic - Mesotrophic	-
Giraffe	3		-	-	-	-	-	-	Ultraoligotrophic	-
Goose Neck	3		-	-	-	-	-	-	Ultraoligotrophic	-
Goose Central	3		-	-	-	-	-	-	Ultraoligotrophic	-
Goose Tail	1		exceed	-	-	-	-	-	Ultraoligotrophic	-
Propellor	5		-	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-
Reference B	5		-	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-
Total	**28**									

Lake	Total Number of Samples Collected	CCME Guideline Value[a]:	Aluminum (Al) - Total	Arsenic (As) -Total	Boron (B) - Total	Cadmium (Cd) - Total	Chromium (Cr) - Total	Copper (Cu) - Total	Iron (Fe) - Total	Lead (Pb) - Total
			0.005-0.1[d] mg/L	0.005 mg/L	Short term 29 mg/L; Long term 1.5 mg/L	hardness based equation[be]	Cr (VI) 0.001[bf] mg/L	hardness dependent ≥0.002[g] mg/L	0.3 mg/L	hardness dependent ≥0.001[h] mg/L
Llama	5		-	-	-	-	-	-	-	-
Umwelt	3		-	-	-	-	-	1.24	-	-
Giraffe	3		-	-	-	1.43	-	1.41	-	-
Goose Neck	3		-	-	-	1.10	-	-	-	-
Goose Central	3		-	-	-	1.59	-	-	-	-
Goose Tail	1		3.94	-	-	-	-	-	-	-
Propellor	5		-	-	-	2.14	-	-	-	-
Reference B	5		-	-	-	-	-	-	-	-
Total	**28**									

Lake	Total Number of Samples Collected	CCME Guideline Value[a]:	Mercury (Hg) - Total	Molybdenum (Mo) - Total	Nickel (Ni) - Total	Selenium (Se) - Total	Silver (Ag) - Total	Thallium (Tl) - Total	Uranium (U) - Total	Zinc (Zn) - Total
			0.000026[i] mg/L	0.073[b] mg/L	hardness dependent ≥0.025[j] mg/L	0.001 mg/L	0.0001 mg/L	0.0008 mg/L	Short term 0.033 mg/L; Long term 0.015 mg/L	0.03 mg/L
Llama	5		-	-	-	-	-	-	-	-
Umwelt	3		-	-	-	-	-	-	-	-
Giraffe	3		-	-	-	-	-	-	-	-
Goose Neck	3		-	-	-	-	-	-	-	-
Goose Central	3		-	-	-	-	-	-	-	-
Goose Tail	1		-	-	-	-	-	-	-	-
Propellor	5		-	-	-	-	-	-	-	-
Reference B	5		-	-	-	-	-	-	-	-
Total	**28**									

Values represent the factor by which average 2011 concentrations are higher than CCME guidelines.

Half the detection limit was substituted for values that were below the detection limit for the calculation of parameter averages.

Factors were not calculated in cases where all replicates were below detection limits.

The average 2011 concentration of a particular parameter may be below the CCME guideline concentration even if a percentage of samples is higher than this guideline concentration.

For hardness-dependent guidelines, the average hardness over all sampling periods was used to determine the site-specific CCME guideline.

a) Canadian water quality guidelines for the protection of aquatic life (CCME 2011)

b) Intermin guideline

c) <0.004 mg/L = ultraoligotrophic; 0.004 - 0.010 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; >0.1 mg/L = hypereutrophic

d) 0.005 mg/L at pH <6.5; 0.1 mg/L at pH ≥6.5

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000

f) Guideline concentration for hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L)

*g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness*

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness

i) Guideline concentration for inorganic mercury

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness

**Note factor by which average concentrations exceeded pH guidelines was not calculated as pH guidelines are a range. Exceendences are shown for reference only.*

Llama and Umwelt Lake had higher hardness levels than other lakes, which resulted in higher site specific CCME guideline concentrations for parameters that are hardness dependent (total cadmium, copper, lead, and nickel). Despite this, Umwelt Lake had total copper concentrations on average 1.24 times the hardness-dependent CCME guideline levels. All other lakes had much lower hardness levels (i.e., were softer), meaning the hardness-dependent CCME guidelines were lower—sometimes below detection limits.

Giraffe Lake exceeded the hardness-dependent CCME guidelines for total cadmium and copper, on average by a factor of 1.43 and 1.41, respectively. Goose Lake Neck, Goose Lake Central, and Propellor Lake exceeded hardness-dependent CCME total cadmium guidelines on average by a factor of 1.10, 1.59, and 2.14.

3.2.8 Lake Water Quality Assurance/Quality Control

In total, two equipment blanks, two field blanks, and two travel blanks (accounting for 21% of lake samples collected) were processed as part of the 2011 lake water quality program.

The winter equipment and field blanks showed detectable levels of nitrogen (Appendix 3.2-2). Nitrate concentrations were 0.0165 mg/L in the winter equipment blank and TKN concentrations were 0.161 mg/L in the winter field blank. Both of these concentrations were amongst the lowest concentrations observed in lake samples so no modifications were made to the data.

The summer equipment and field blanks showed detectable levels of nitrate, some metals and cyanide. The summer equipment blank had nitrate concentrations of 0.012 mg/L, total aluminum concentrations of 0.0125 mg/L and dissolved aluminum concentrations of 0.0062 mg/L, and total lead concentrations of 0.000194 mg/L. The summer field blank had total cyanide concentrations of 0.002 mg/L, although free cyanide was below detection limits. These residual levels would likely have been removed during field sampling as the GO-FLOs remained in the water for one minute to equilibrate with the surrounding water before being triggered. Given that the QA/QC concentrations were near or below the lower concentrations observed in lake samples, this suggests the water quality data is reliable.

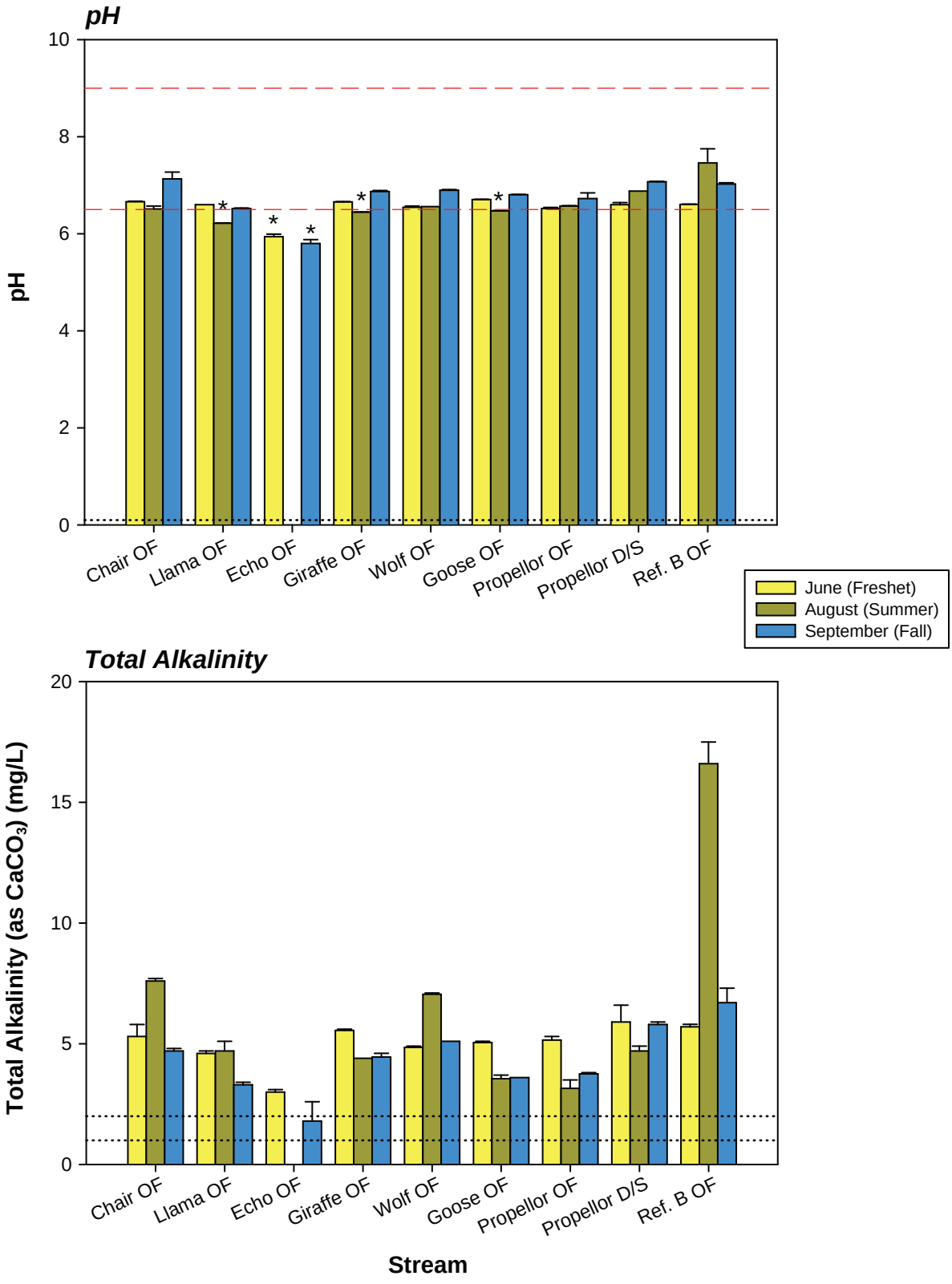
3.3 STREAM WATER QUALITY

Stream water quality samples were collected in June (freshet), August (summer), and September (fall) (Figures 3.3-1a to 3.3-6; Appendix 3.3-1 and 3.3-2).

3.3.1 Physical Parameters

The surveyed streams were slightly acidic to neutral, with the lowest pH levels at Echo OF (mean: 5.87) and highest at Ref. B OF (mean: 7.03; Figure 3.3-1a). Streams were poorly buffered, with low alkalinity levels. Total alkalinities were less than 8 mg/L at all streams, except at Reference B OF during summer which had 16.6 mg/L (Figure 3.3-1a).

All streams had low levels of hardness (Figure 3.3-1b) and would be classified as soft, except for Llama OF which would be classified as hard (121 mg/L – 180 mg/L) and moderately hard (61 mg/L – 120 mg/L) over summer and fall (Briggs et al. 1977). Patterns in conductivity and TDS followed those of hardness, with low conductivity (less than 85 µs/cm) and TDS (less than 100 mg/L) in all streams, except Llama OF where conductivity was elevated in summer (conductivity 325 µs/cm; TDS 403 mg/L) and fall (264 µs/cm; TDS 300 mg/L) (Figure 3.3-1b).



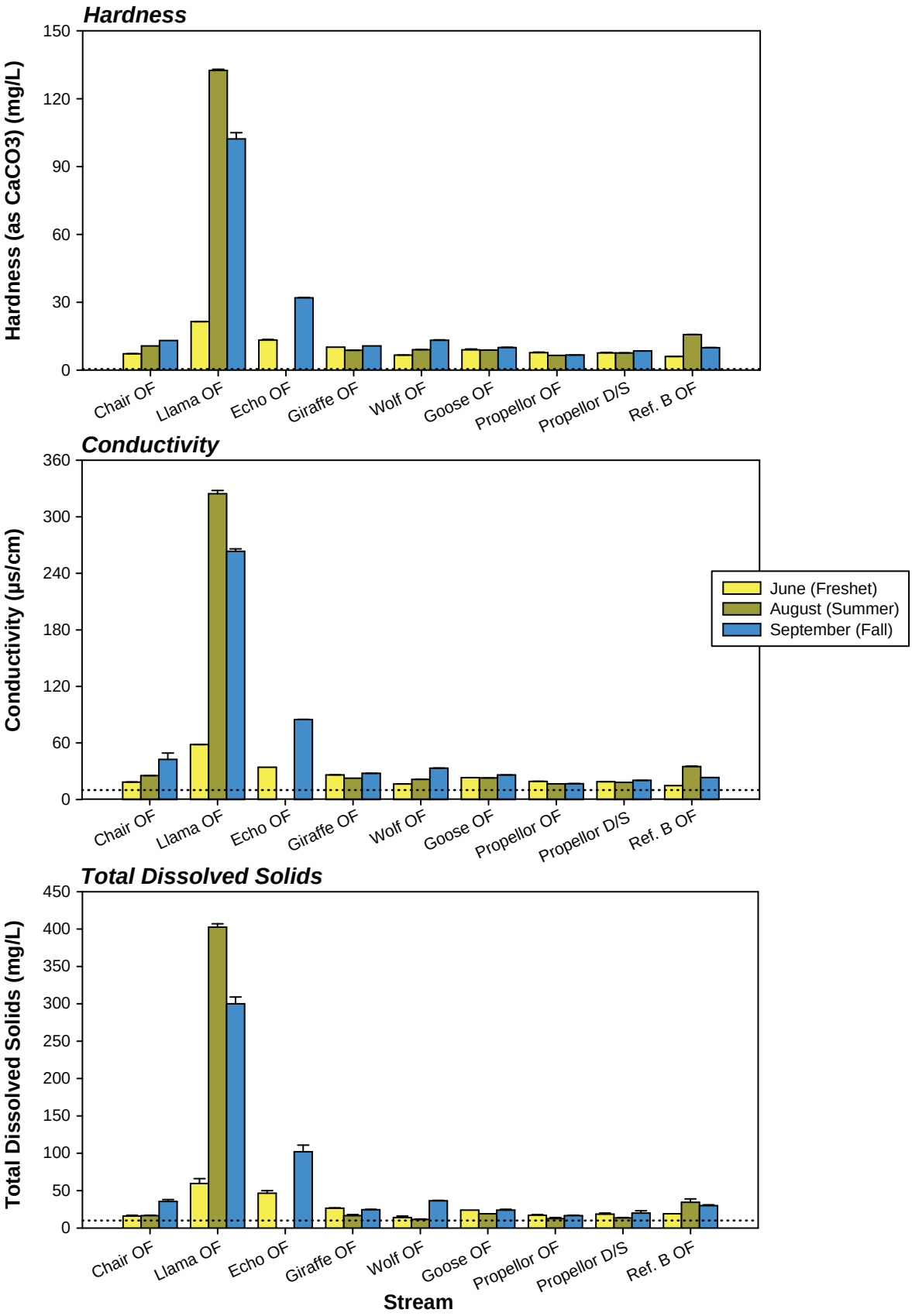
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (pH 0.1; total alkalinity 1 mg/L or 2 mg/L).
Dashed lines represent CCME guideline for pH 6.5–9.
** Indicates mean values that are outside of CCME guidelines.*

Sabina GOLD & SILVER CORP.

pH and Alkalinity in Streams, Back River Project, 2011

Figure 3.3-1a

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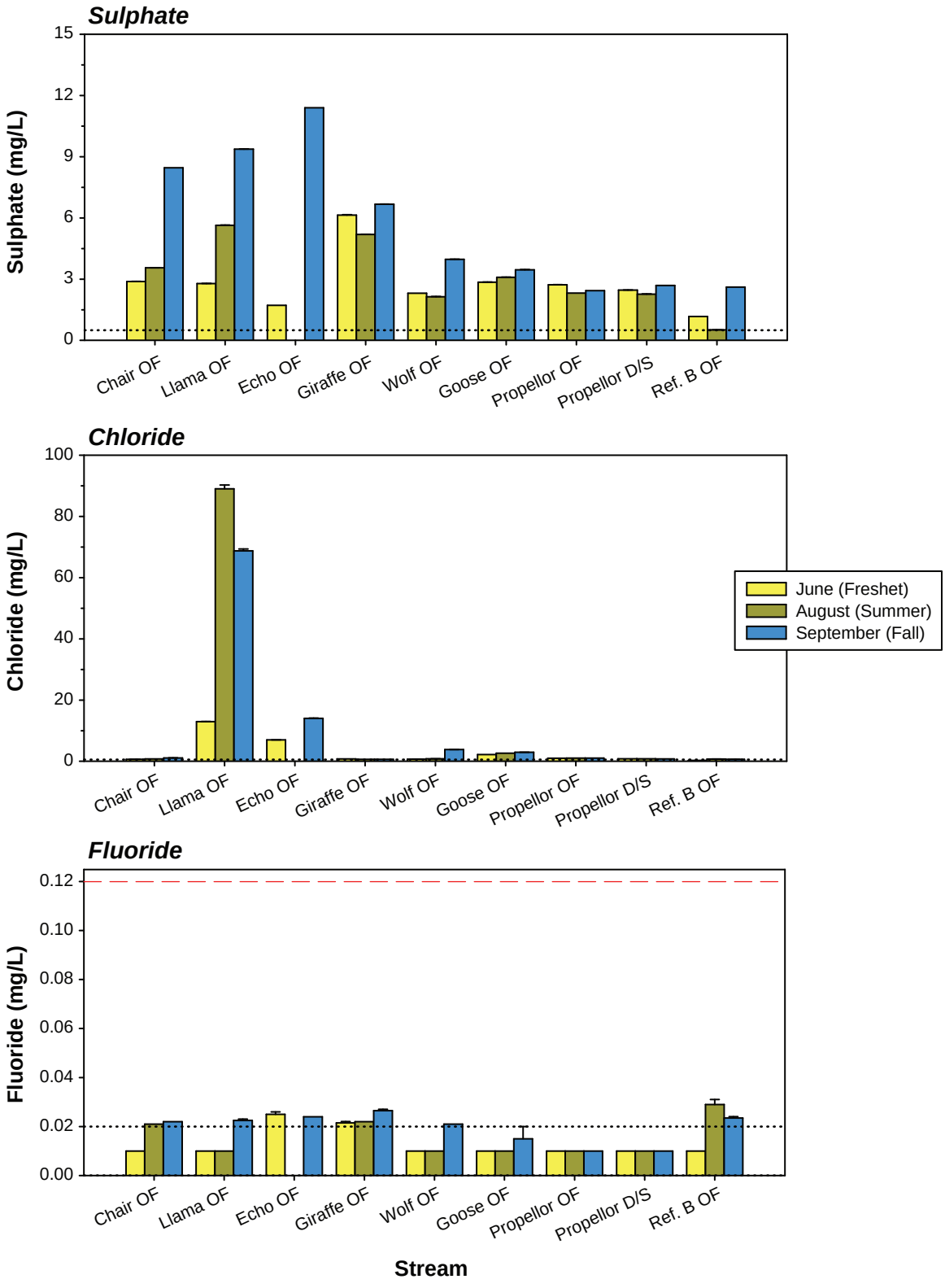
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (hardness 0.5 mg/L; conductivity 2 mg/L; total dissolved solids 10 mg/L).
Dashed lines represent CCME guideline for pH 6.5–9. There is no CCME guideline for hardness.
** Indicates average values that are outside of CCME guidelines.*

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Hardness, Conductivity and Total Dissolved Solids in Streams, Back River Project, 2011

Figure 3.3-1b

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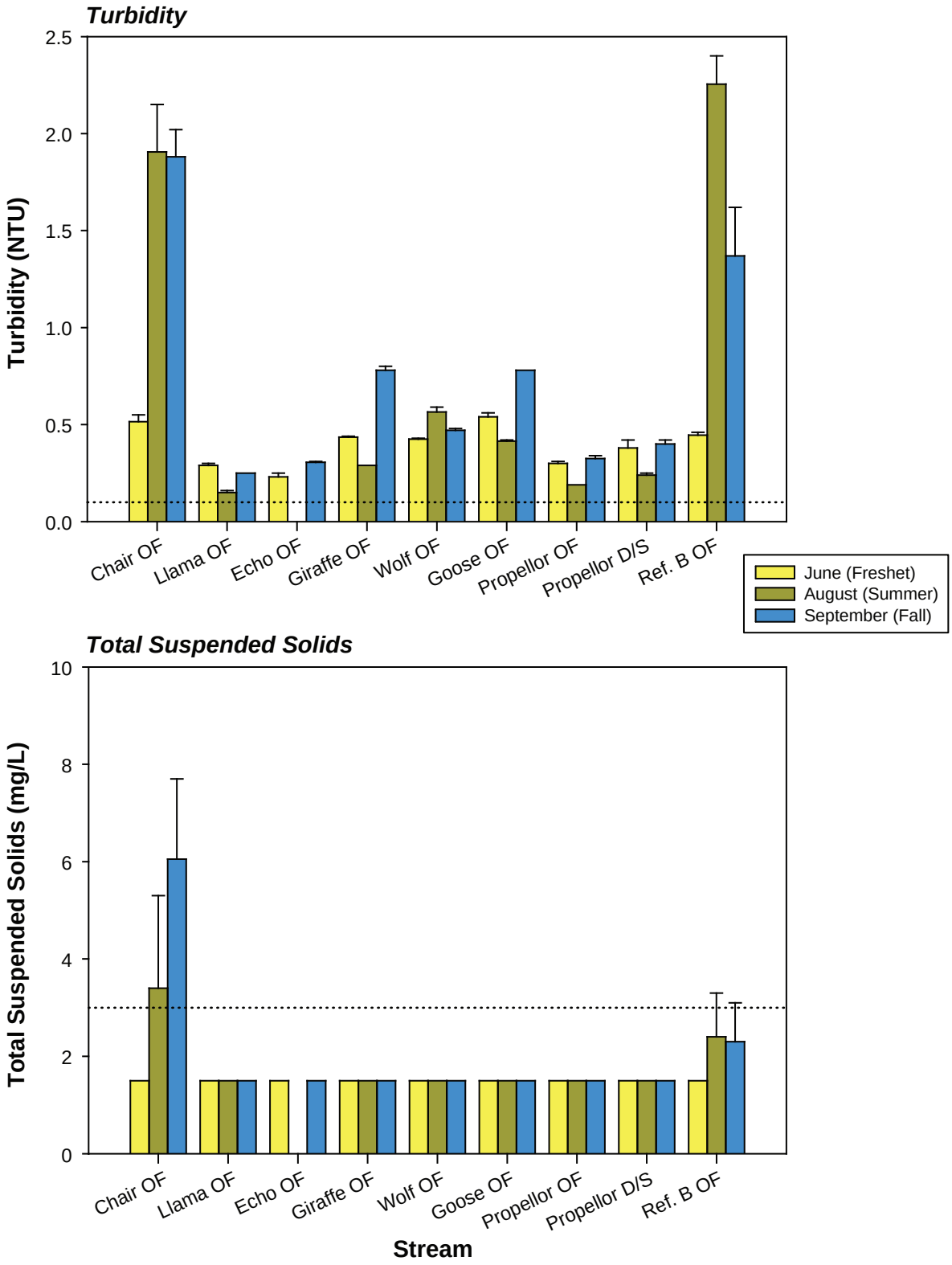
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (sulphate 0.5 mg/L; chloride 0.5 mg/L; fluoride 0.02 mg/L).
The dashed line represents the CCME guideline for fluoride (0.12 mg/L).

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Sulphate, Chloride and Fluoride Concentrations in Streams, Back River Project, 2011

Figure 3.3-2

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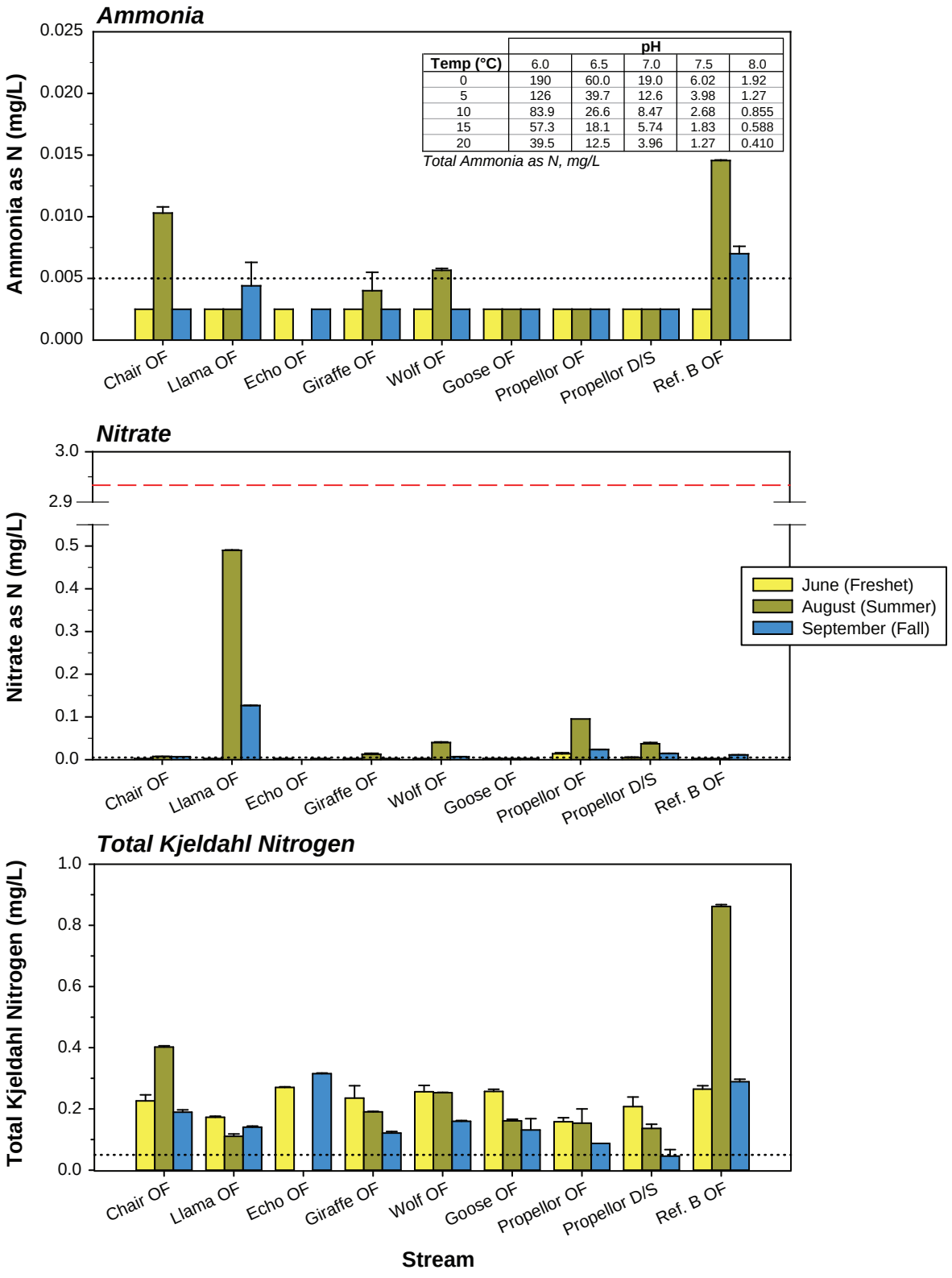
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (turbidity 0.1 NTU; total suspended solids 3 mg/L).
Values below the detection limit are plotted at half the detection limit.
CCME guidelines for turbidity and total suspended solids are dependent on background levels.

Sabina GOLD & SILVER CORP.

Turbidity and Total Suspended Solids in Streams, Back River Project, 2011

Figure 3.3-3

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Temp (°C)	pH 6.0	6.5	7.0	7.5	8.0
0	190	60.0	19.0	6.02	1.92
5	126	39.7	12.6	3.98	1.27
10	83.9	26.6	8.47	2.68	0.855
15	57.3	18.1	5.74	1.83	0.588
20	39.5	12.5	3.96	1.27	0.410

Total Ammonia as N, mg/L

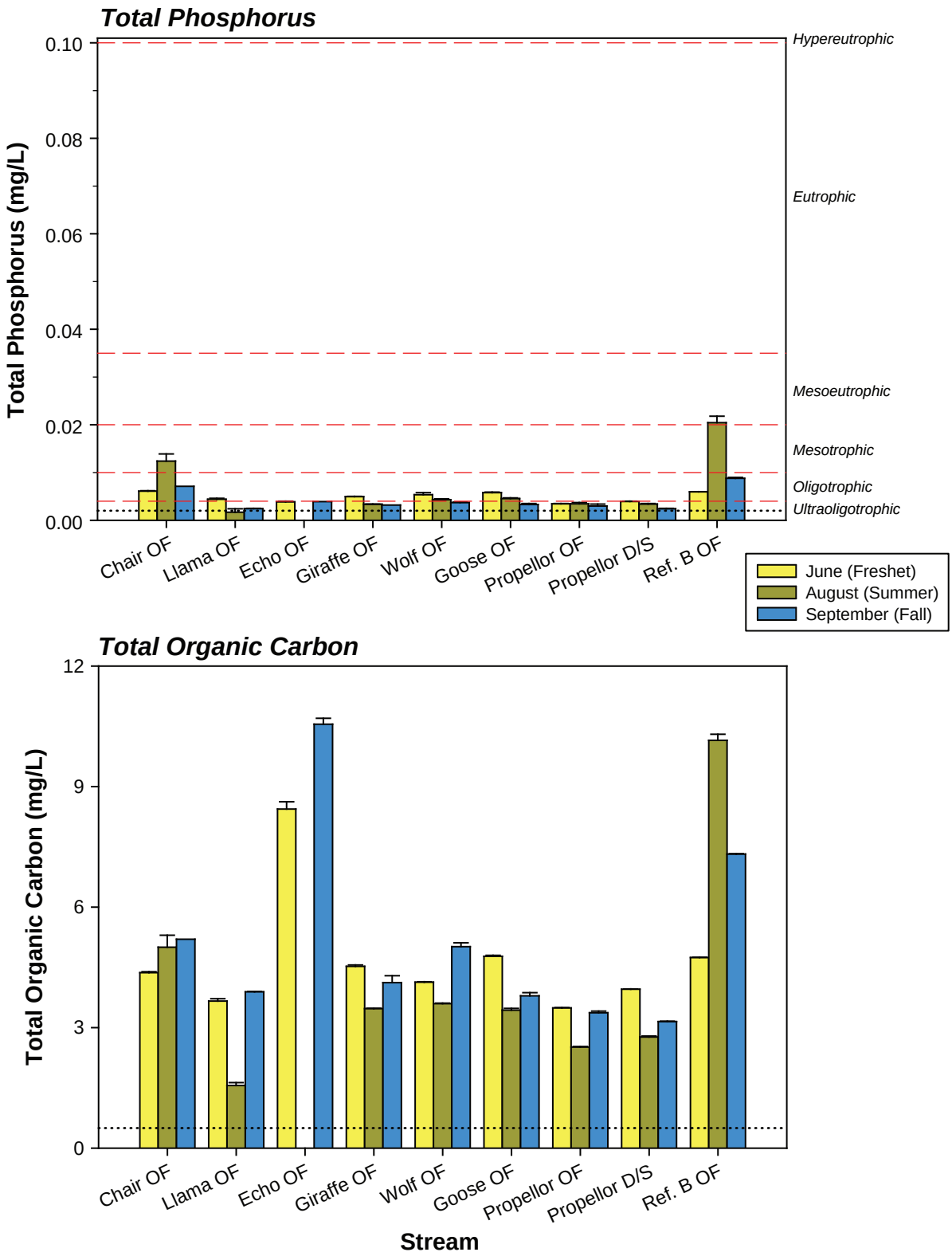
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (ammonia 0.005 mg/L; nitrate 0.005 mg/L; TKN 0.05 mg/L).
Values below the detection limit are plotted at half the detection limit.
Inset table shows temperature- and pH-dependent CCME guidelines for ammonia.
Dashed lines represent CCME guidelines (nitrate 2.935 mg/L; nitrite 0.06 mg/L).

Sabina GOLD & SILVER CORP.

Ammonia, Nitrate and Total Kjeldahl Nitrogen Concentrations in Streams, Back River Project, 2011

Figure 3.3-4a

Rescan™ Engineers & Scientists



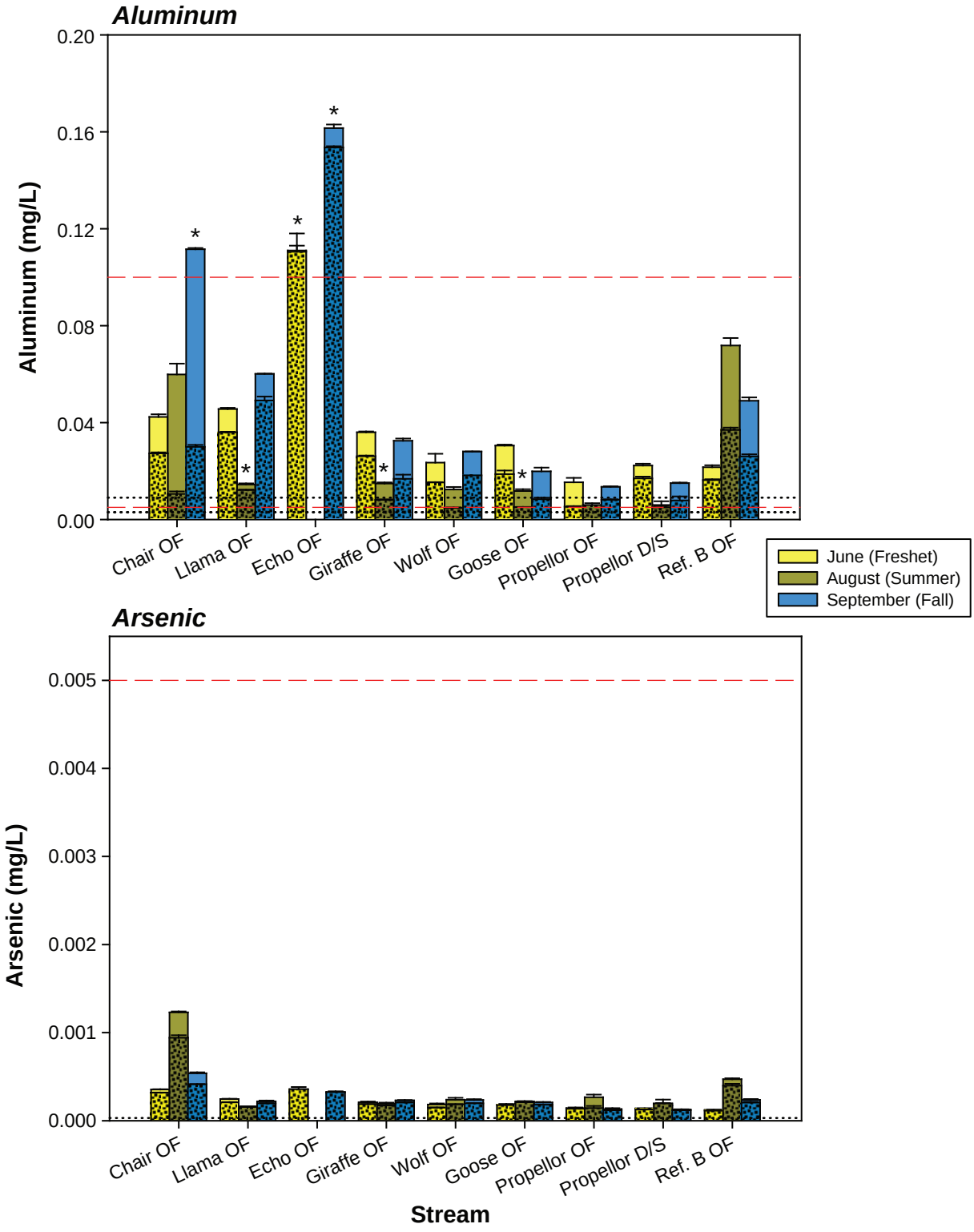
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (total phosphorus 0.002 mg/L; total organic carbon 0.5 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represents CCME trigger ranges for total phosphorus (<0.004 mg/L = ultraoligotrophic; 0.004–0.010 mg/L = oligotrophic; 0.01–0.02 mg/L = mesotrophic; 0.02–0.035 mg/L = mesoeutrophic; 0.035–0.1 mg/L = eutrophic; >0.1 mg/L = hypereutrophic).
There is no CCME guideline for total organic carbon.

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Total Phosphorus and Total Organic Carbon Concentrations in Streams, Back River Project, 2011

Figure 3.3-4b

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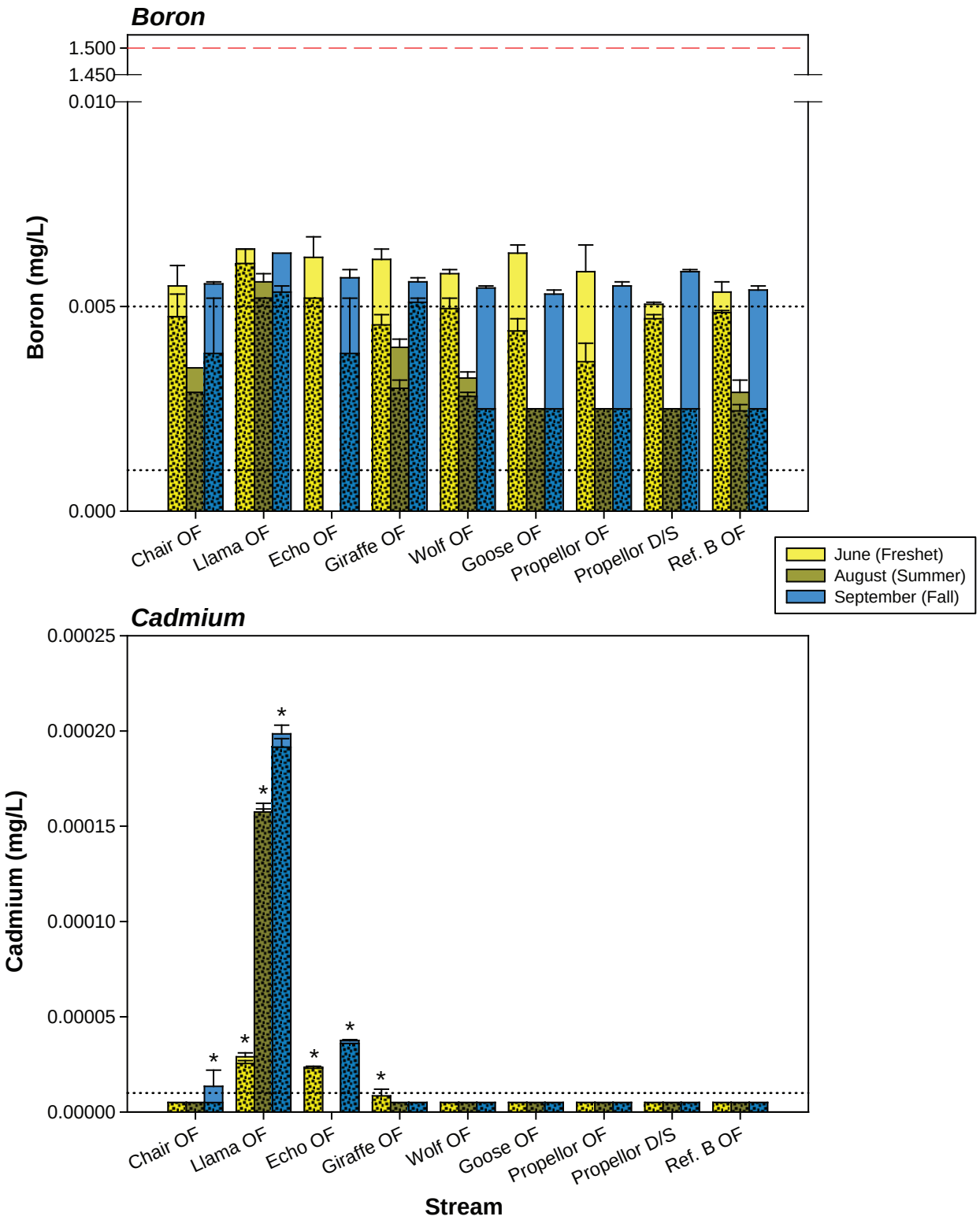
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limits (aluminum 0.003 mg/L or 0.009 mg/L; arsenic 0.00003 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines. The CCME interim guideline for arsenic is 0.005 mg/L.
CCME guidelines for aluminum are pH-dependendent (0.005 mg/L at pH less than 6.5; 0.1 mg/L at pH greater than or equal to 6.5).
pH was above 6.5 at all sites except Llama OF, Giraffe OF and Goose OF in summer, and Echo OF in freshet and fall.
** Indicates mean total metal values that are higher than CCME guidelines.*

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Aluminum and Arsenic Concentrations in Streams, Back River Project, 2011

Figure 3.3-5a

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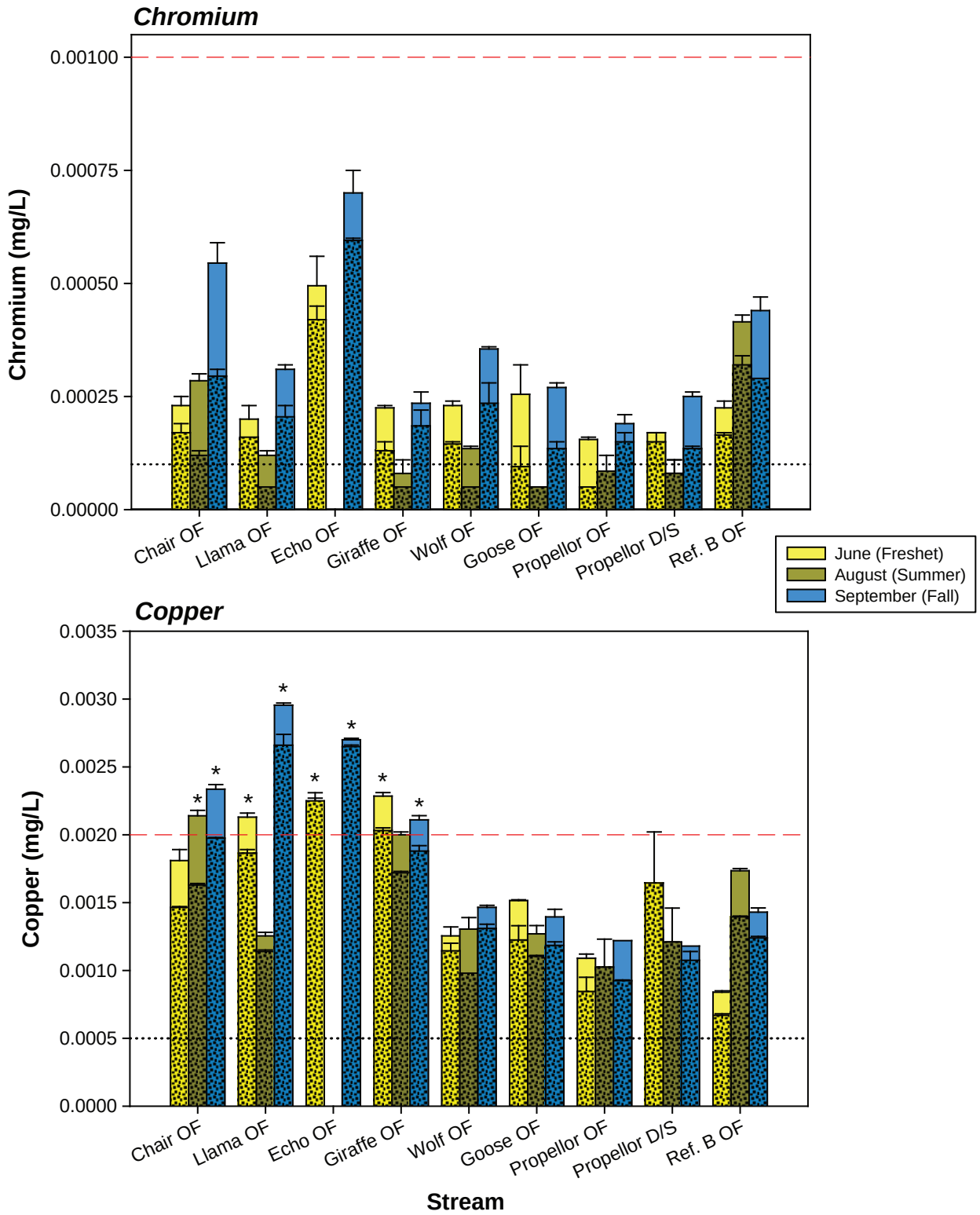
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limits (boron 0.001 or 0.005 mg/L; cadmium 0.00001 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
The CCME guideline for cadmium (in mg/L) can be calculated using the equation: $10^{[0.86[\log(\text{hardness})]-3.2]}/1000$.
The CCME guidelines for boron are 1.5 mg/L long term and 29 mg/L short term [not shown]).
** Indicates mean total metal values that are higher than CCME guidelines.*

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Boron and Cadmium Concentrations in Streams, Back River Project, 2011

Figure 3.3-5b

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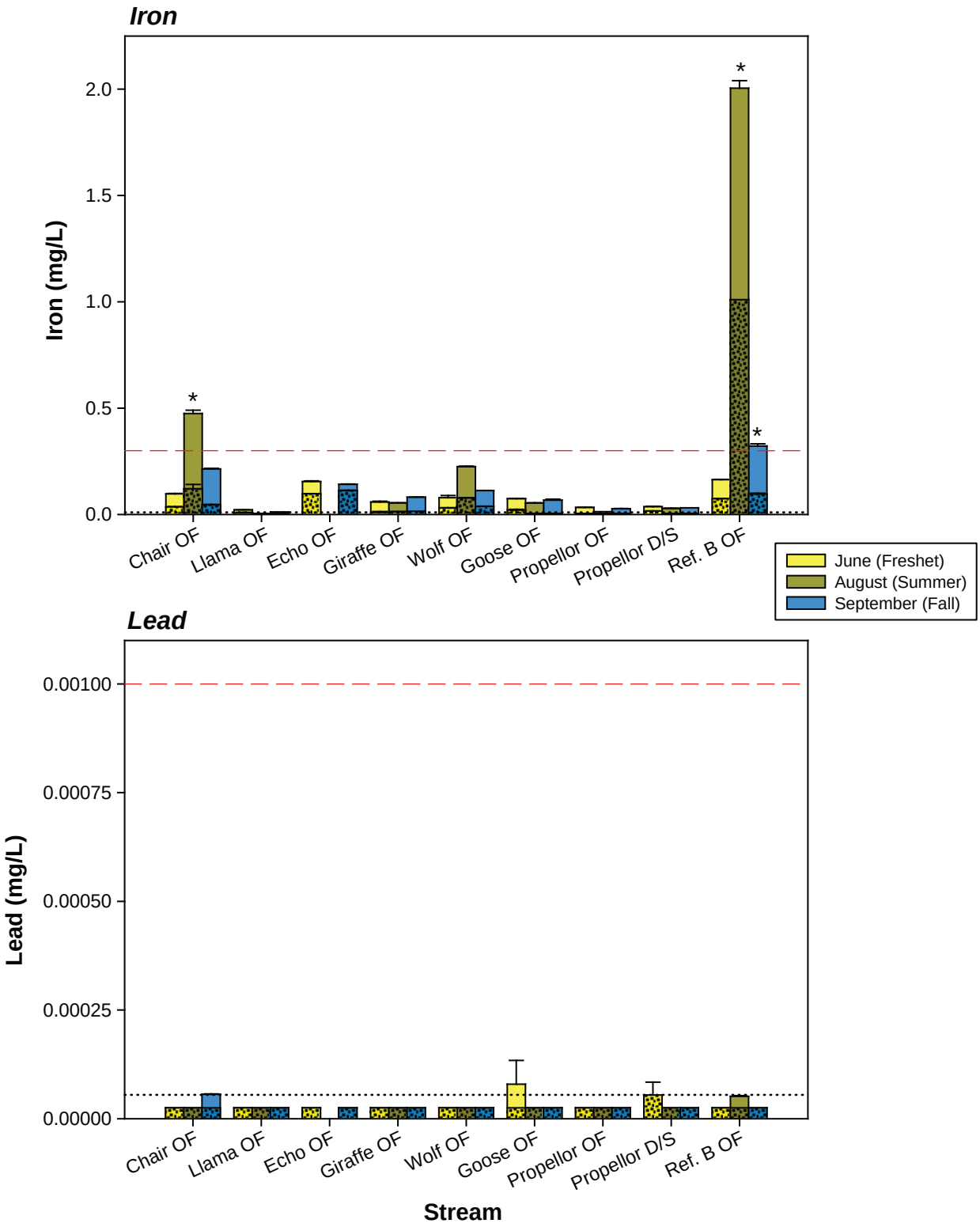
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (chromium 0.0001 mg/L; copper 0.0005 mg/L).
Values below the detection limit are plotted at half the detection limit.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dashed lines represent CCME guidelines.
The CCME guideline for copper (in mg/L) can be calculated using the equation: $C^{\{0.8545[\ln(\text{hardness})]-1.465\}} * 0.0002$.
Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.
The CCME guideline for hexavalent chromium (0.001 mg/L) and interim guideline for trivalent chromium (0.0089 mg/L) [not shown].
** Indicates mean total metal values that are higher than CCME guidelines.*

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Chromium and Copper Concentrations in Streams, Back River Project, 2011

Figure 3.3-5c

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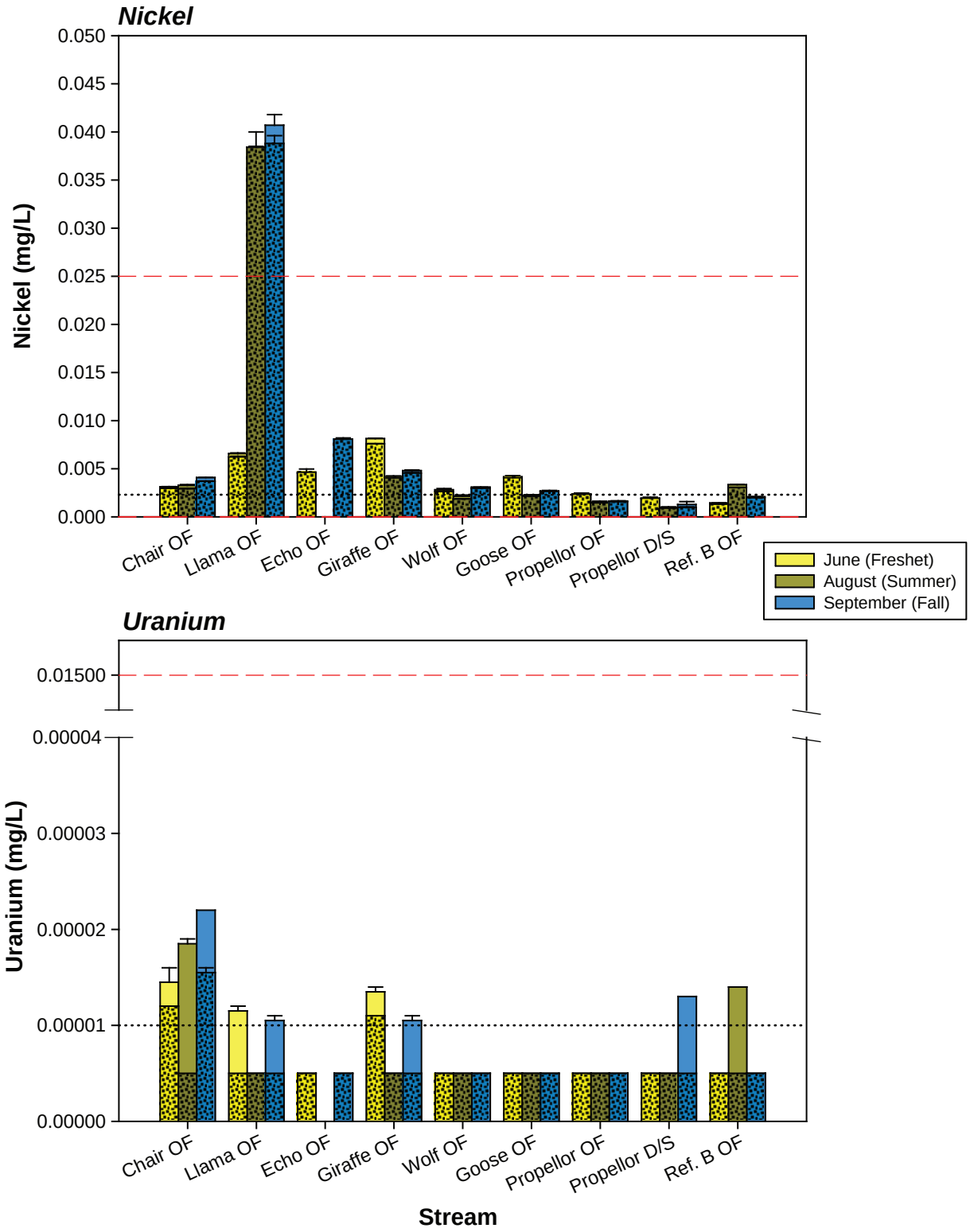
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (iron 0.01 mg/L; lead 0.00005 mg/L).
Values below the detection limit are plotted at half the detection limit.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dashed lines represent CCME guidelines.
The CCME guideline for iron is 0.3 mg/L.
The CCME guideline for lead (in mg/L) can be calculated using the equation: $e^{\{1.273[\ln(\text{hardness})]-4.705\}}/1000$.
Lead guideline is a minumum of 0.001 mg/L regardless of hardness.
** Indicates mean total metal values that are higher than CCME guideline.*

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Iron and Lead Concentrations in Streams, Back River Project, 2011

Figure 3.3-5d

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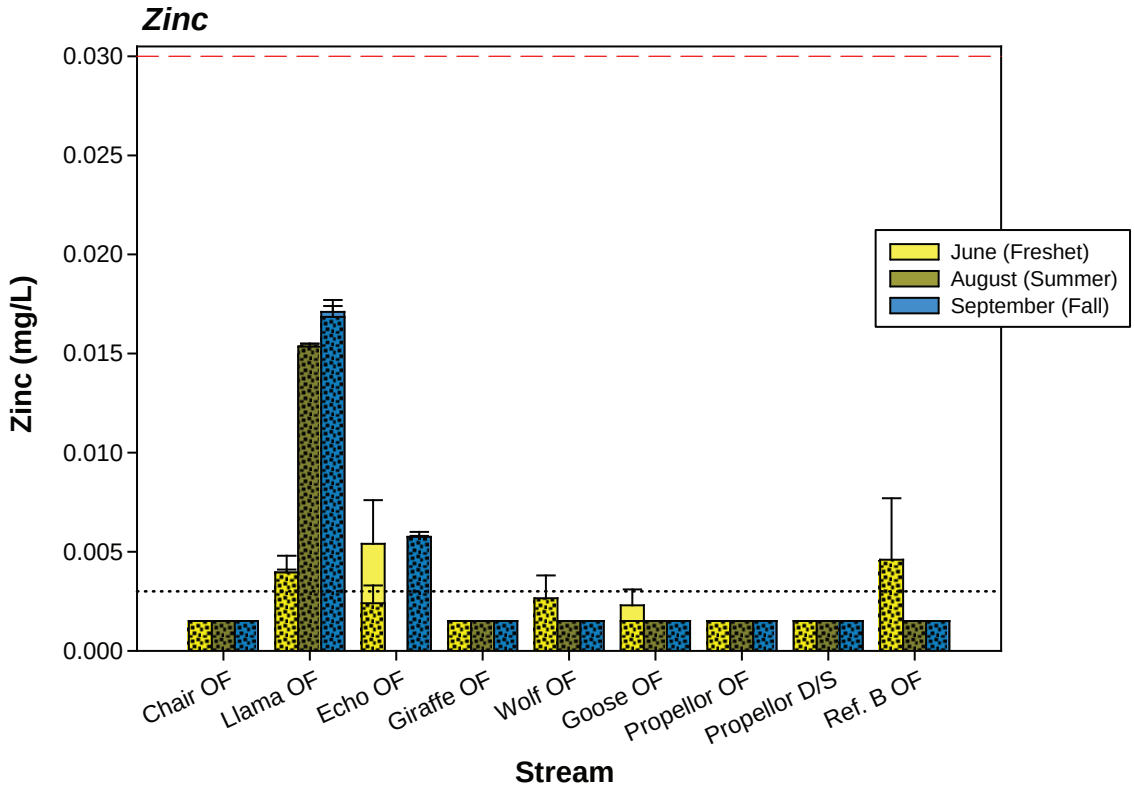
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (nickel 0.0001 mg/L; uranium 0.00001 mg/L).
Values below the detection limit are plotted at half the detection limit.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dashed lines represent CCME guidelines.
The CCME guideline for nickel (in mg/L) can be calculated using the equation $e^{\{0.76[\ln(\text{hardness})]+1.06\}}/1000$.
Nickel guideline is a minumum of 0.025 mg/L regardless of hardness.
The CCME guidelines for uranium are 0.015 mg/L long term and 0.033 mg/L short term(not shown).

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Nickel and Uranium Concentrations in Streams, Back River Project, 2011

Figure 3.3-5e

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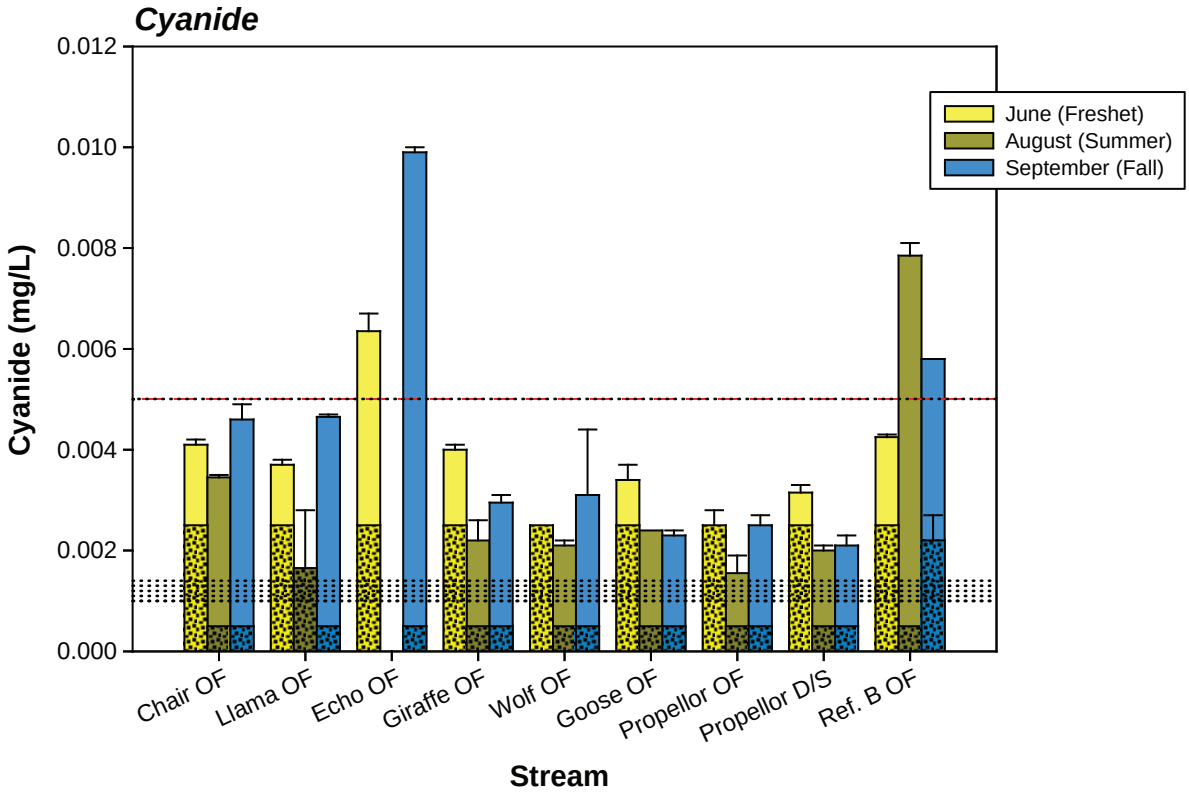
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (zinc 0.003 mg/L).
Values below the detection limit are plotted at half the detection limit.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dashed lines represent CCME guidelines (zinc 0.03 mg/L).

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Zinc Concentrations in Streams, Back River Project, 2011

Figure 3.3-5f

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Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total cyanide and superimposed dotted columns represent free cyanide.
Dotted lines represent analytical detection limits (total cyanide 0.001 mg/L to 0.0014 mg/L; free cyanide 0.001 mg/L or 0.005 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed line represents CCME guideline for free cyanide (0.005 mg/L).
** Indicates average values that are higher than the CCME guideline.*

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Cyanide Concentrations in Streams, Back River Project, 2011

Figure 3.3-6

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3.3.2 Major Anions

Sulphate concentrations varied seasonally, tending to be highest in fall (Figure 3.3-2). Sulphate concentrations also varied geographically, with the greatest concentrations in the western streams (Chair OF, Llama OF, Echo OF and Giraffe OF).

Patterns in chloride concentrations followed those of conductivity, with low concentrations (< 14 mg/L) at all streams except Llama OF during summer (89 mg/L) and fall (69 mg/L) (Figure 3.3-2). Fluoride concentrations were also low in streams, often below detection limits (0.02 mg/L) (Figure 3.3-2). Giraffe OF and Echo OF were the only sites with concentrations above detection limits in all seasons, while both Propellor OF and Propellor D/S were always below detection limits.

3.3.3 Suspended Material

In general, project streams had clear water. Turbidity levels were low at most streams, ranging from 0.15 to 0.78 NTU (Figure 3.3-3). The exceptions were Chair OF and Ref. B OF, which had higher turbidity levels than other streams during summer and fall and ranged from 1.37 to 2.55 NTU. TSS followed a similar pattern to turbidity, with all streams being under detection limits (3 mg/L) except in Chair OF and Ref. B OF (Figure 3.3-3).

3.3.4 Nutrients

Like the surveyed lakes, streams in the study area tended to have low concentrations of inorganic nitrogen (ammonia, nitrate, and nitrite) (Figure 3.3-4a). Most stream sites had ammonia concentrations below detection limits (0.005 mg/L) in all seasons. Chair OF (summer), Wolf OF (summer), and Ref. B OF (summer and fall) were the only stream sites to be above detection limits in both replicates. Nitrate levels were low in streams in all seasons, generally below 0.13 mg/L. The exception to this was Llama OF in summer, which had nitrate concentrations more than three times higher than other sites (0.49 mg/L). Nitrite levels were below detection limits (0.001 mg/L) at all stream sites in all seasons.

All streams sampled had total phosphorus concentrations below 0.02 mg/L (Figure 3.3-4b), which would be considered either ultraoligotrophic (0.004 to 0.01 mg/L) or oligotrophic (0.01 to 0.02 mg/L) based on the CCME trigger ranges for total phosphorus (CCME 2011b). The exceptions to this were Ref. B OF and Chair OF, which during the low flow summer period had total phosphorus peaks high enough to be considered meso-eutrophic and mesotrophic, respectively.

TOC was similar across all streams, between 1.6 and 5.2 mg/L (Figure 3.3-4b). Exceptions to this were Echo OF in freshet and fall and Ref. B OF in summer and fall, which were between 7.32 and 10.6 mg/L. These two streams had the lowest water levels.

3.3.5 Metals

Overall, metal concentrations tended to be slightly higher in the western streams (Chair OF, Llama OF, Echo OF, and Giraffe OF) than the eastern streams draining out of Goose Lake (Goose OF, Propellor OF, Propellor D/S) (Figures 3.3-5a to 3.3-5f). The western streams run through the Llama, Umwelt and Echo ore deposit areas, and are likely influenced by local geochemistry. This influence appears to be diluted by Goose Lake, leaving downstream eastern stream sites with lower metal concentrations.

The highest total aluminum concentrations were found in Echo OF, with a mean of 0.14 mg/L, which was more than twice as high as most other streams (Figure 3.3-5a). Chair OF, Llama OF, and Ref. B OF had the next highest aluminum concentrations, whilst the two Propellor Stream sites had the lowest (averaging 0.011 and 0.014 mg/L, respectively).

Overall, streams had low total arsenic concentrations (Figure 3.3-5a). Mean concentrations were highest during the summer low flow period at Chair OF (0.0012 mg/L) and Ref. B OF (0.0015 mg/L). Boron concentrations were similar across sites, and tended to be highest during the freshet and lowest in summer (Figure 3.3-5b).

Total cadmium concentrations varied geographically (Figure 3.3-5b). Eastern streams and the reference stream (Wolf OF, Goose OF, Propellor OF, Propellor D/S and Ref. B OF) had cadmium concentrations consistently below detection limits (0.00001 mg/L). Llama OF had particularly high cadmium concentrations during summer (0.00016 mg/L) and fall (0.0002 mg/L), at an order of magnitude greater than the analytical detection limit (0.00001 mg/L) and that observed at other stream sites (less than 0.000038 mg/L).

Total chromium concentrations ranged from below detection limits (0.0001 mg/L) to 0.0007 mg/L, and tended to be highest in fall and in Chair OF, Echo OF, and Ref. B OF (Figure 3.3-5c).

Western streams (Chair, Llama, Echo and Giraffe) had naturally high levels of total copper (Figure 3.3-5c), with most seasons above the minimum CCME guideline level (0.002 mg/L; CCME 2011b)). Eastern streams, including Wolf OF, Goose OF, Propellor OF, Propellor D/S, and Ref. B OF, had lower concentrations of total copper ranging from 0.0008 mg/L to 0.0017 mg/L.

Patterns in total iron concentrations were similar to arsenic, with summer samples from Chair OF and Ref. B OF having the highest concentrations (Figure 3.3-5d). Total iron concentrations at Ref. B OF over summer averaged 2.01 mg/L, more than four times higher than summer concentrations at Chair OF and over eight times higher than any other stream site in any season. Chair OF and Ref B OF had the lowest summer water levels and flows out of all streams sampled.

Total nickel concentrations were low at most sites (Figure 3.3-5e), except in Llama OF, showing similar patterns to cadmium. Summer and fall nickel concentrations at Llama OF were over four times higher than at any other site in any other season, and at 0.0383 mg/L and 0.0407 mg/L, exceeded the CCME guideline of 0.025 mg/L (CCME 2011b).

Total uranium concentrations were low in the streams sampled (Figure 3.3-5e), frequently below the analytical detection limit (0.00001 mg/L). Concentrations were above detection limits in Chair OF in all seasons, Llama OF and Giraffe OF in freshet and fall, Propellor D/S in freshet, and Ref. B OF in summer.

Total zinc concentrations followed a similar pattern to nickel, with summer and fall concentrations at Llama OF being particularly high (0.015 mg/L and 0.017 mg/L compared to less than 0.006 mg/L at all other sites) (Figure 3.3-5f).

Total lead and molybdenum concentrations were below detection limits in all streams in all seasons, with a few exceptions. All streams in all seasons had total mercury, selenium, silver and thallium concentrations below detection limits.

3.3.6 Cyanides

Total cyanide concentrations followed a similar pattern to TOC. Concentrations tended to be below 0.005 mg/L, except in Echo OF (June 0.006 mg/L; September 0.01 mg/L) and Ref. B OF (June 0.008 mg/L; September 0.006 mg/L). Free cyanide concentrations were below detection limits for almost all samples (0.001 mg/L or 0.005 mg/L).

3.3.7 Comparison with CCME Guidelines

The percentage of stream water quality samples where parameter concentrations were above CCME guidelines is presented in Table 3.3-1. Table 3.3-2 shows the factor that mean concentrations, pooled across depth and season for each site, were higher than CCME guidelines.

Over half of the streams had mean concentrations that exceeded CCME guidelines for at least one of the following parameters: pH, total aluminum, cadmium, copper and iron (Table 3.3-2). Cyanide and nutrient concentrations were within CCME guidelines at all streams in all seasons. Generally, there were larger and more numerous exceedances in the western streams that drain into Goose Lake (Llama OF, Echo OF, Giraffe OF) than the eastern streams down flow from Goose Lake (Goose OF, Propellor OF, Propellor D/S). Ref. B OF had similar exceedances to the eastern streams, except its iron exceedance.

Llama OF, Goose OF and Giraffe OF had pH levels below the CCME guideline range (6.5 to 9 pH units) during summer sampling, and Echo OF had pH levels below CCME guidelines during all sampling (freshet and fall). Mean pH levels at Llama OF (pH: 6.4) and Echo OF (pH: 5.9) were outside of the CCME guideline range of 6.5 to 9 pH units.

CCME guidelines for total aluminum are pH dependent, with a lower total aluminum guideline for waters with a pH of less than 6.5. Only the two streams with mean pH values below 6.5, Llama OF and Echo OF, had average aluminum concentrations that exceeded the guideline concentration (by a factor of 8.01 and 27.3). Seasonal exceedances for total aluminum were also found in Chair OF (fall), Giraffe OF (summer) and Goose OF (summer).

Chair OF, Llama OF, and Echo OF exceeded the CCME guideline for total cadmium, which is hardness dependent. These three streams had total cadmium concentrations between 1.7 and 4.4 times higher than their site specific guidelines.

The western streams, Chair OF, Llama OF, Echo OF and Giraffe OF, had mean total copper concentrations between 1.02 and 1.23 times higher than the CCME guidelines.

Ref. B OF had mean total iron concentrations 2.8 times higher than the CCME guidelines for iron. Iron concentrations were particularly high at Ref. B OF during summer (6.7 times the CCME guideline). Chair OF exceeded CCME guidelines during summer, but annually averaged data was below CCME guidelines.

3.3.8 Stream Water Quality Assurance/Quality Control

Six field and travel blanks were collected during stream sampling, representing 12% of stream samples collected (Appendix 3.3-2). Detectable levels of key parameters were found in some of the blanks.

Summer field and travel blanks showed detectable TOC (0.75 mg/L and 0.73 mg/L). This was below the minimum concentrations found in summer samples (1.56 mg/L). The consistency between field and travel blanks suggests this is either due to the lab supplied water, or the handling and transporting of samples.

The fall field blank showed sodium present (0.171 mg/L), below the levels found in samples. The fall travel blank showed ammonia (as N) at a level higher than found in any of the samples (0.0197 mg/L), and TOC at a level below all samples.

The presence of detectable parameters in travel blanks, which were never opened in the field, suggests they come from the lab water lab-supplied bottles, or are an artefact of handling and transporting of samples.

Table 3.3-1. Stream Water Quality, Percent of Samples in which Concentrations are Higher than CCME Guidelines, Back River Project, 2011

Stream	Total Number of Samples Collected	CCME Guideline Value[a]:	pH	Ammonia (as N)	Fluoride (F)	Chloride (Cl)	Nitrate (as N)	Nitrite (as N)	Total Phosphorus	Free Cyanide	Aluminum (Al)
			6.5 - 9.0	temperature- and pH-dependent	0.12[b] mg/L	640 mg/L	2.935[b] mg/L	0.06 mg/L	Trophic Status[c]	0.005 as free CN	0.005-0.1[d] mg/L
Chair OF	6		16.7	-	-	-	-	-	Oligotrophic - Mesotrophic	-	50
Llama OF	6		33.3	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	33.3
Echo OF	4		100	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	100
Giraffe OF	6		33.3	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	33.3
Wolf OF	6		-	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	-
Goose OF	6		33.3	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	33.3
Propellor OF	6		-	-	-	-	-	-	Ultraoligotrophic	-	-
Propellor D/S	6		-	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	-
Ref. B OF	6		-	-	-	-	-	-	Oligotrophic - Mesoeutrophic	-	-
Total	**52**										

Stream	Total Number of Samples Collected	CCME Guideline Value[a]:	Arsenic (As)	Boron (B)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Mercury (Hg)	Molybdenum (Mo)
			0.005 mg/L	Short term 29 mg/L; Long term 1.5 mg/L	hardness based equation[be]	Cr (VI) 0.001[bf] mg/L	hardness dependent ≥0.002[g] mg/L	0.3 mg/L	hardness dependent ≥0.001[h] mg/L	0.000026[i] mg/L	0.073[b] mg/L
Chair OF	6		-	-	16.7	-	66.6	33.3	-	-	-
Llama OF	6		-	-	100	-	66.6	-	-	-	-
Echo OF	4		-	-	100	-	100	-	-	-	-
Giraffe OF	6		-	-	-	-	83.3	-	-	-	-
Wolf OF	6		-	-	-	-	-	-	-	-	-
Goose OF	6		-	-	-	-	-	-	-	-	-
Propellor OF	6		-	-	-	-	-	-	-	-	-
Propellor D/S	6		-	-	-	-	-	-	-	-	-
Ref. B OF	6		-	-	-	-	-	66.6	-	-	-
Total	**52**										

Stream	Total Number of Samples Collected	CCME Guideline Value[a]:	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Uranium (U)	Zinc (Zn)
			≥0.025[j] mg/L	0.001 mg/L	0.0001 mg/L	0.0008 mg/L	Short term 0.033 mg/L; Long term 0.015 mg/L	0.03 mg/L
Chair OF	6		-	-	-	-	-	-
Llama OF	6		-	-	-	-	-	-
Echo OF	4		-	-	-	-	-	-
Giraffe OF	6		-	-	-	-	-	-
Wolf OF	6		-	-	-	-	-	-
Goose OF	6		-	-	-	-	-	-
Propellor OF	6		-	-	-	-	-	-
Propellor D/S	6		-	-	-	-	-	-
Ref. B OF	6		-	-	-	-	-	-
Total	**52**							

All values represent percentages of 2011 samples that are both higher than the CCME guidelines and above detection limits.

a) Canadian water quality guidelines for the protection of aquatic life (CCME 2011)

b) Intermin guideline

c) <0.004 mg/L = ultraoligotrophic; 0.004 - 0.010 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; >0.1 mg/L = hypereutrophic

d) 0.005 mg/L at pH <6.5; 0.1 mg/L at pH ≥6.5

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}} / 1000$

f) Guideline concentration for hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L)

g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}} * 0.0002$. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}} / 1000$. Lead guideline is a minumum of 0.001 mg/L regardless of hardness

i) Guideline concentration for inorganic mercury

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}} / 1000$. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness

Table 3.3-2. Stream Water Quality, Factor by which Average Concentrations are Higher than CCME Guidelines, Back River Project, 2011

Stream	Total Number of Samples Collected	CCME Guideline Value[a]:	pH*	Ammonia (as N)	Fluoride (F)	Chloride (Cl)	Nitrate (as N)	Nitrite (as N)	Total Phosphorus	Free Cyanide	Aluminum (Al) - Total
			6.5-9.0	temperature- and pH-dependent	0.120[b] mg/L	640 mg/L	2.935[b] mg/L	0.06 mg/L	Trophic Status[c]	0.005 as free CN	0.005-0.1[d] mg/L
Chair OF	6		-	-	-	-	-	-	Oligotrophic - Mesotrophic	-	-
Llama OF	6		exceed	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	8.01
Echo OF	4		exceed	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	27.25
Giraffe OF	6		-	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	-
Wolf OF	6		-	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	-
Goose OF	6		-	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	-
Propellor OF	6		-	-	-	-	-	-	Ultraoligotrophic	-	-
Propellor D/S	6		-	-	-	-	-	-	Ultraoligotrophic - Oligotrophic	-	-
Ref. B OF	6		-	-	-	-	-	-	Oligotrophic - Mesoeutrophic	-	-
Total	**52**										

Stream	Total Number of Samples Collected	CCME Guideline Value[a]:	Arsenic (As) -Total	Boron (B) - Total	Cadmium (Cd) - Total	Chromium (Cr) - Total	Copper (Cu) - Total	Iron (Fe) - Total	Lead (Pb) - Total	Mercury (Hg) - Total	Molybdenum (Mo) - Total
			0.005 mg/L	Short term 29 mg/L; Long term 1.5 mg/L	hardness based equation[be]	Cr (VI) 0.001[bf] mg/L	hardness dependent ≥0.002[g] mg/L	0.3 mg/L	hardness dependent ≥0.001[h] mg/L	0.000026[i] mg/L	0.073[b] mg/L
Chair OF	6		-	-	1.66	-	1.05	-	-	-	-
Llama OF	6		-	-	4.42	-	1.02	-	-	-	-
Echo OF	4		-	-	3.30	-	1.23	-	-	-	-
Giraffe OF	6		-	-	-	-	1.07	-	-	-	-
Wolf OF	6		-	-	-	-	-	-	-	-	-
Goose OF	6		-	-	-	-	-	-	-	-	-
Propellor OF	6		-	-	-	-	-	-	-	-	-
Propellor D/S	6		-	-	-	-	-	-	-	-	-
Ref. B OF	6		-	-	-	-	-	2.77	-	-	-
Total	**52**										

Stream	Total Number of Samples Collected	CCME Guideline Value[a]:	Nickel (Ni) - Total	Selenium (Se) - Total	Silver (Ag) - Total	Thallium (Tl) - Total	Uranium (U) - Total	Zinc (Zn) - Total
			hardness dependent ≥0.025[j] mg/L	0.001 mg/L	0.0001 mg/L	0.0008 mg/L	Short term 0.033 mg/L; Long term 0.015 mg/L	0.03 mg/L
Chair OF	6		-	-	-	-	-	-
Llama OF	6		-	-	-	-	-	-
Echo OF	4		-	-	-	-	-	-
Giraffe OF	6		-	-	-	-	-	-
Wolf OF	6		-	-	-	-	-	-
Goose OF	6		-	-	-	-	-	-
Propellor OF	6		-	-	-	-	-	-
Propellor D/S	6		-	-	-	-	-	-
Ref. B OF	6		-	-	-	-	-	-
Total	**52**							

All values represent percentages of 2011 samples that are both higher than the CCME guidelines and above detection limits.

a) Canadian water quality guidelines for the protection of aquatic life (CCME 2011)

b) Intermin guideline

c) <0.004 mg/L = ultraoligotrophic; 0.004 - 0.010 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; >0.1 mg/L = hypereutrophic

d) 0.005 mg/L at pH <6.5; 0.1 mg/L at pH ≥6.5

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000

f) Guideline concentration for hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L)

g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}} * 0.0002$. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness

i) Guideline concentration for inorganic mercury

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness

**Note factor by which average concentrations exceeded pH guidelines was not calculated as pH guidelines are a range. Exceendences are shown for reference only.*

The majority of parameters in the blanks were below detection limits. Analytical results from the stream samples were unmodified for parameters which were detected in the blanks.

3.4 LAKE SEDIMENT QUALITY

Lake sediment quality samples were collected in the summer of 2011. Lake sediment quality data are presented graphically in Figures 3.4-1 to 3.4-2b. Appendices 3.4-1 and 3.4-2 provide sediment descriptions and raw analytical data.

3.4.1 Particle Size

Lake sediments were largely composed of silt, with lesser amounts of clay and sand (Figure 3.4-1). Two exceptions to this were Goose Lake Tail and Reference B Lake which were mainly composed of sand (67% and 74%).

3.4.2 Nutrients

Overall, nutrient concentrations tended to be higher in sediments from the western lake sites (Llama, Umwelt, Giraffe, Goose Neck and Goose Central) compared to sediments from the eastern Goose Tail, Propellor, and Reference B lake sampling sites (Figure 3.4-2a).

Available ammonium and total nitrogen showed similar patterns, with the highest concentrations at Goose Lake Neck and lowest concentrations at Goose Lake Tail. Propellor Lake and Reference B Lake also tended to have low available ammonium and total nitrogen concentrations. Nitrate and nitrite concentrations were below detection limits for all sediment replicates at all lakes.

Available phosphate (as P) was less than 24 mg/kg for all lakes, except Propellor Lake which had more than 2.5 times as much as all other sites (61.3 mg/kg) (Figure 3.4-2b). Deeper sediments tended to have higher concentrations of available phosphate compared to shallow sediments within the deeper lakes (Llama and Giraffe).

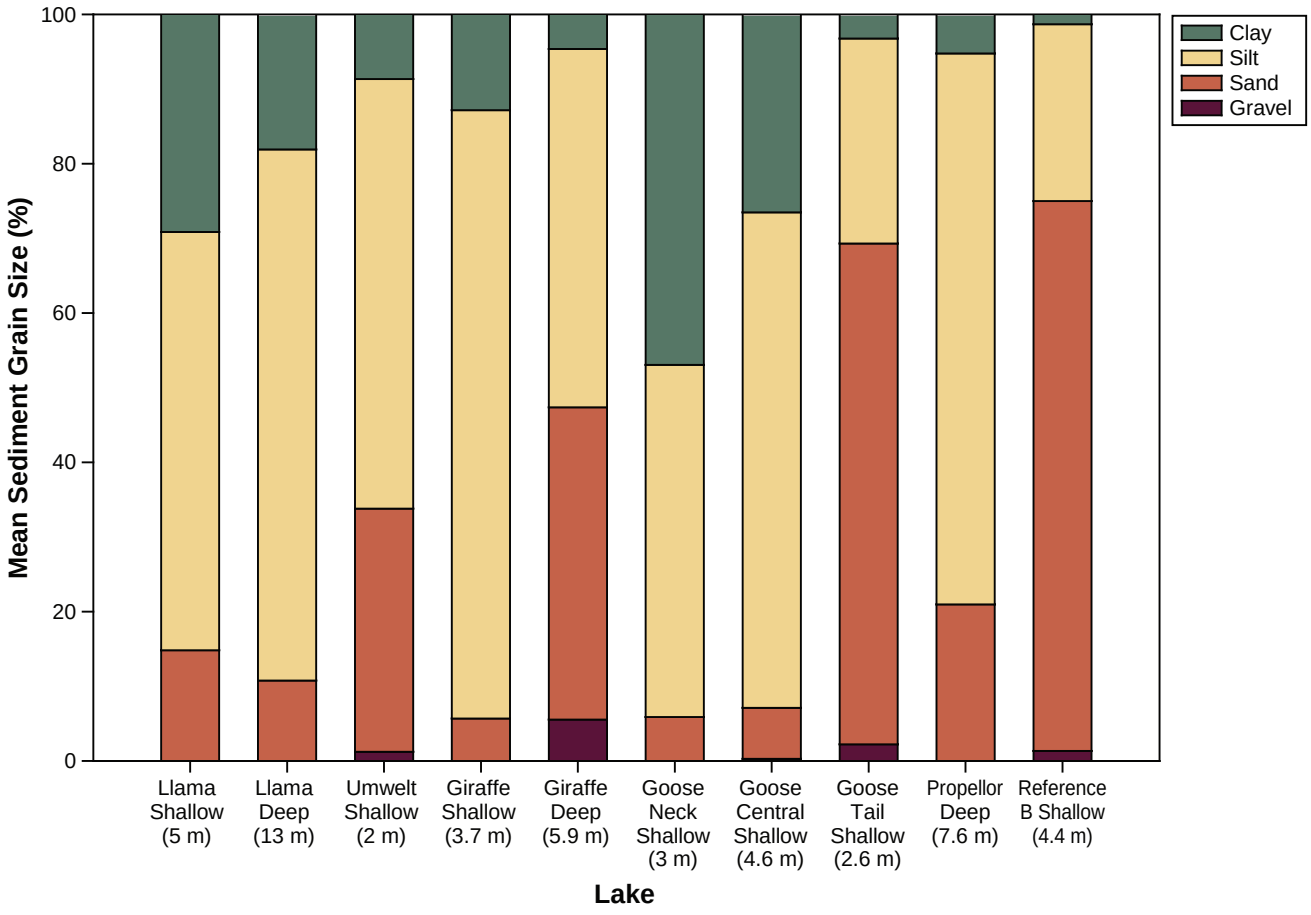
Lake sediments contained between 1.5% and 14.3% TOC, with greater proportions of TOC in the shallow western lake sampling sites (Llama Lake, Umwelt Lake, Giraffe Lake, Goose Lake Neck, Goose Lake Central) (Figure 3.4-2b). TOC levels were roughly 2 to 3 times higher in the shallow sites of Llama and Giraffe lakes compared to their deep sampling sites.

3.4.3 Metals

Overall, the highest metal concentrations tended to occur in shallow samples and in western lake sampling sites (Llama, Umwelt, Giraffe, Goose Neck and Goose Central). The lowest concentrations tended to occur in Goose Lake Tail and Reference B Lake, which had the lowest proportions of silt in their sediments.

Mean arsenic concentrations varied between lakes, with particularly high concentrations at Llama Lake in both the shallow (29 mg/kg) and deep sediments (17 mg/kg) (Figure 3.4-3a). High arsenic levels at Llama Lake were also observed in 2010 (Rescan 2011), and are likely a result of geological influence from the ore deposit directly below the lake. Other lakes in the general area of the ore deposits also tended to have naturally elevated levels of arsenic in their sediments, as Llama, Umwelt, Giraffe, Goose Neck and Goose Central all had mean concentrations above the CCME ISQG level of 5.9 mg/kg.

Lake sediments showed similar patterns for cadmium, copper, mercury and zinc, with the highest concentrations at Goose Lake Neck and Giraffe Lake, and lowest concentrations at Goose Lake Tail and Reference B Lake (Figures 3.4-3a to 3.4-3d). Cadmium levels were high in sediments at Goose Lake Neck (Figure 3.4-3a), and copper levels were high in all sediments except Goose Lake Tail and Reference B Lake (Figure 3.4-3b). Mercury levels were generally low, and zinc levels were always below CCME guidelines (Figures 3.4-3c and 3.4-3d).



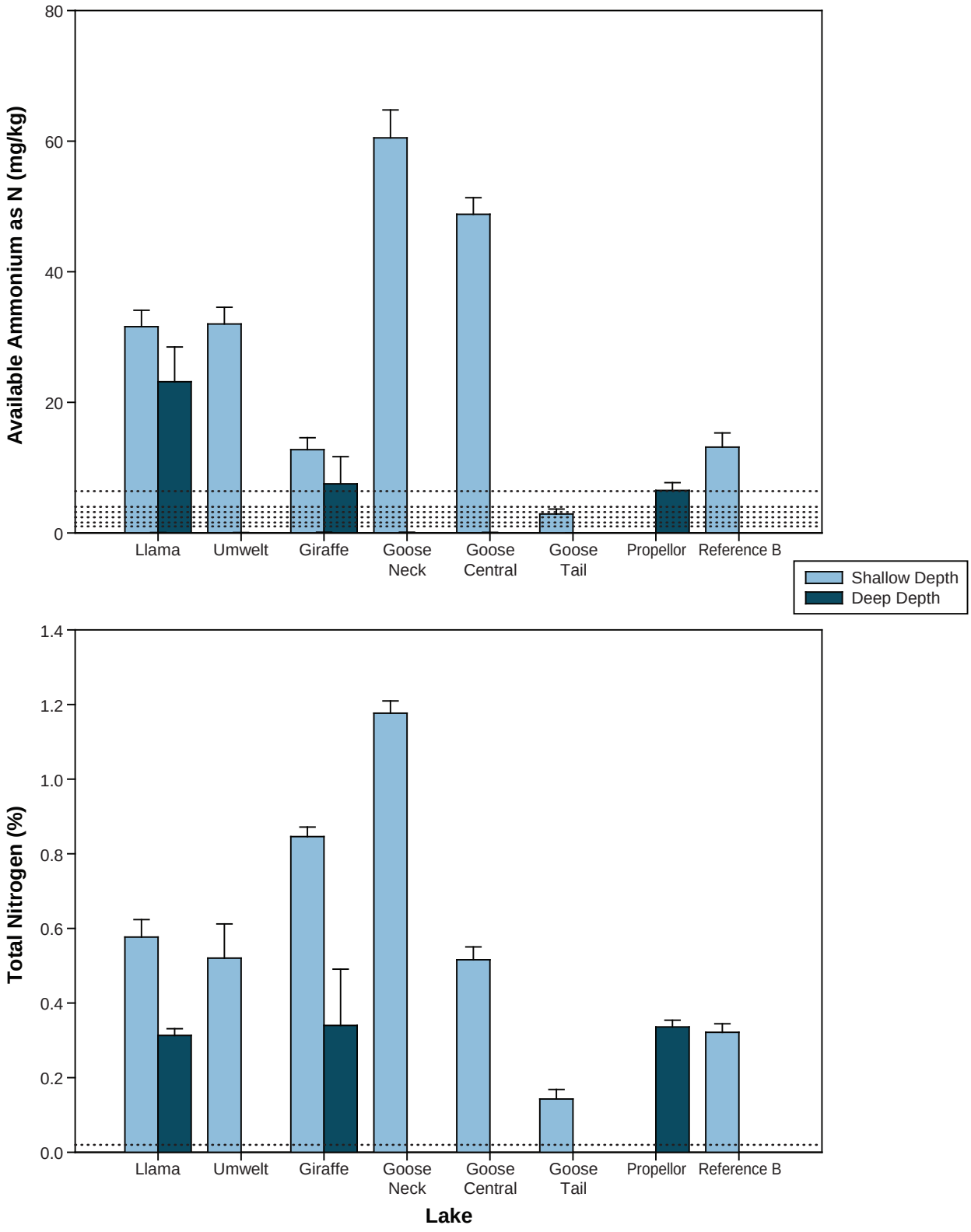
Note: Stacked bars are means of triplicate samples.

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Sediment Grain Size Composition in Lakes, Back River Project, 2011

Figure 3.4-1

Rescan™ Engineers & Scientists



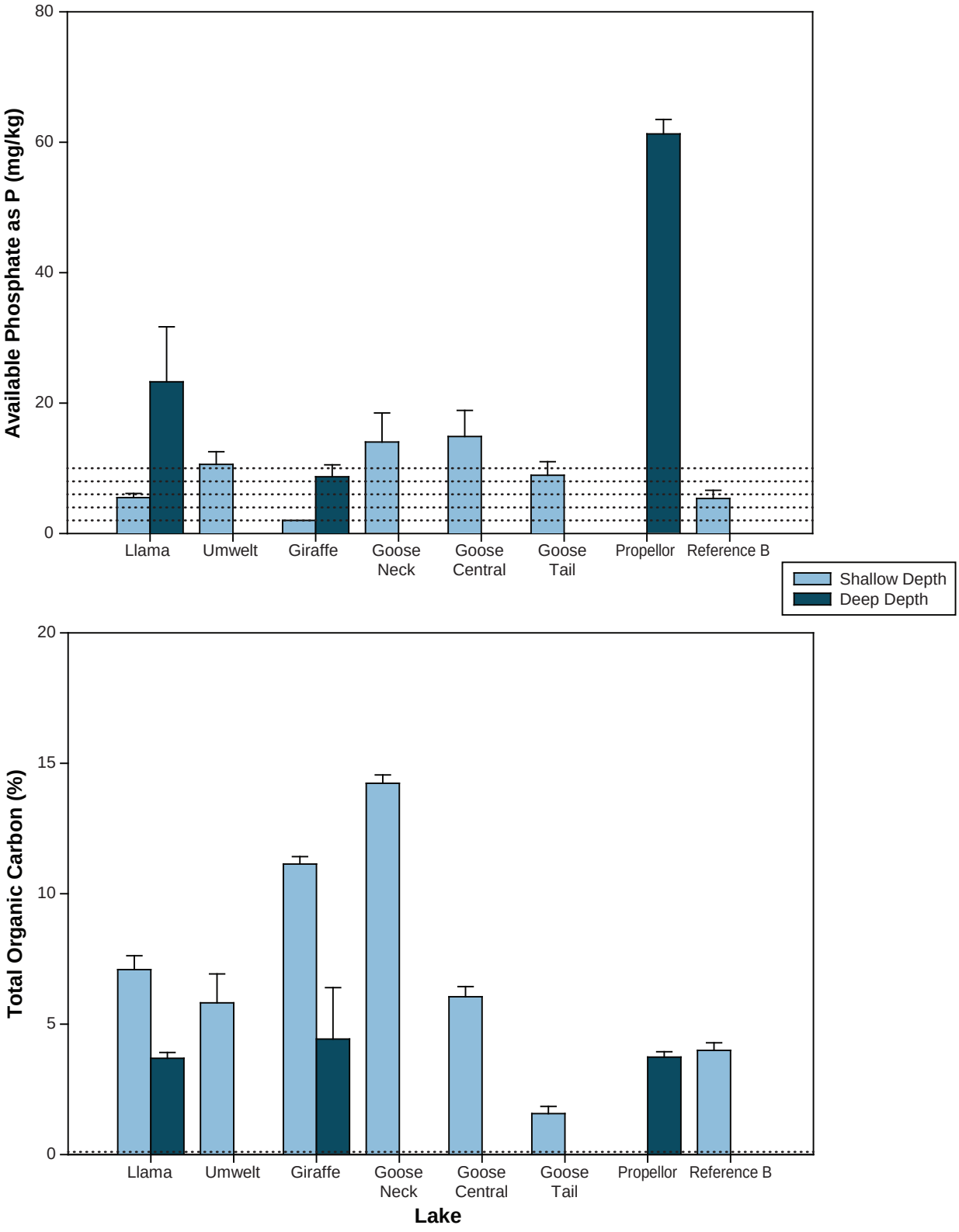
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (available ammonia 1 - 6.4 mgkg; total nitrogen 0.02%).
Values below the detection limit are plotted at half the detection limit.

Figure 3.4-2a

Available Ammonium and Total Nitrogen Concentrations in Lake Sediments, Back River Project, 2011

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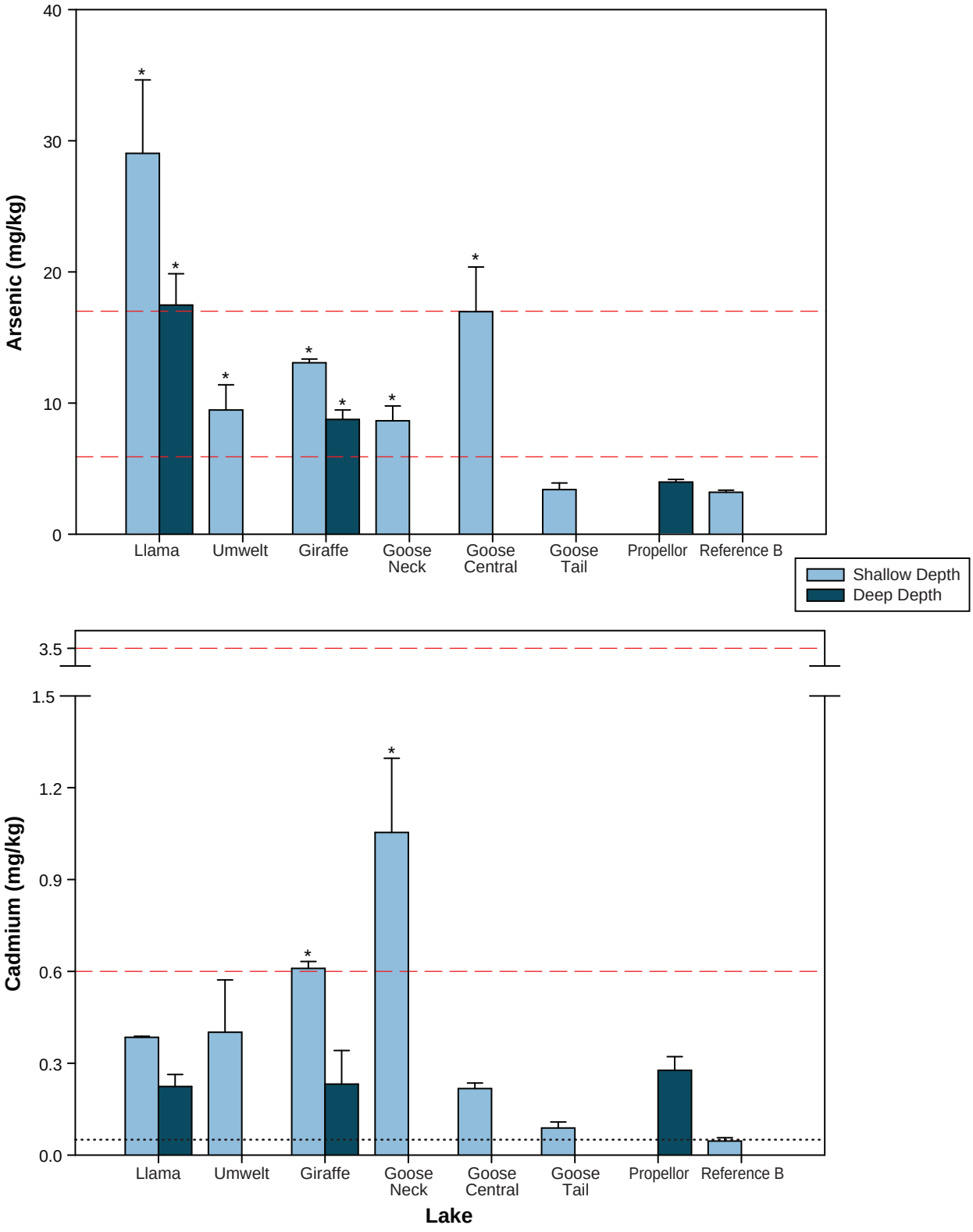
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (available phosphate 2.0 - 10.0 mg/kg; total organic carbon 0.1%).
Values below the detection limit are plotted at half the detection limit.

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Available Phosphate and Total Organic Carbon Concentrations in Lake Sediments, Back River Project, 2011

Figure 3.4-2b

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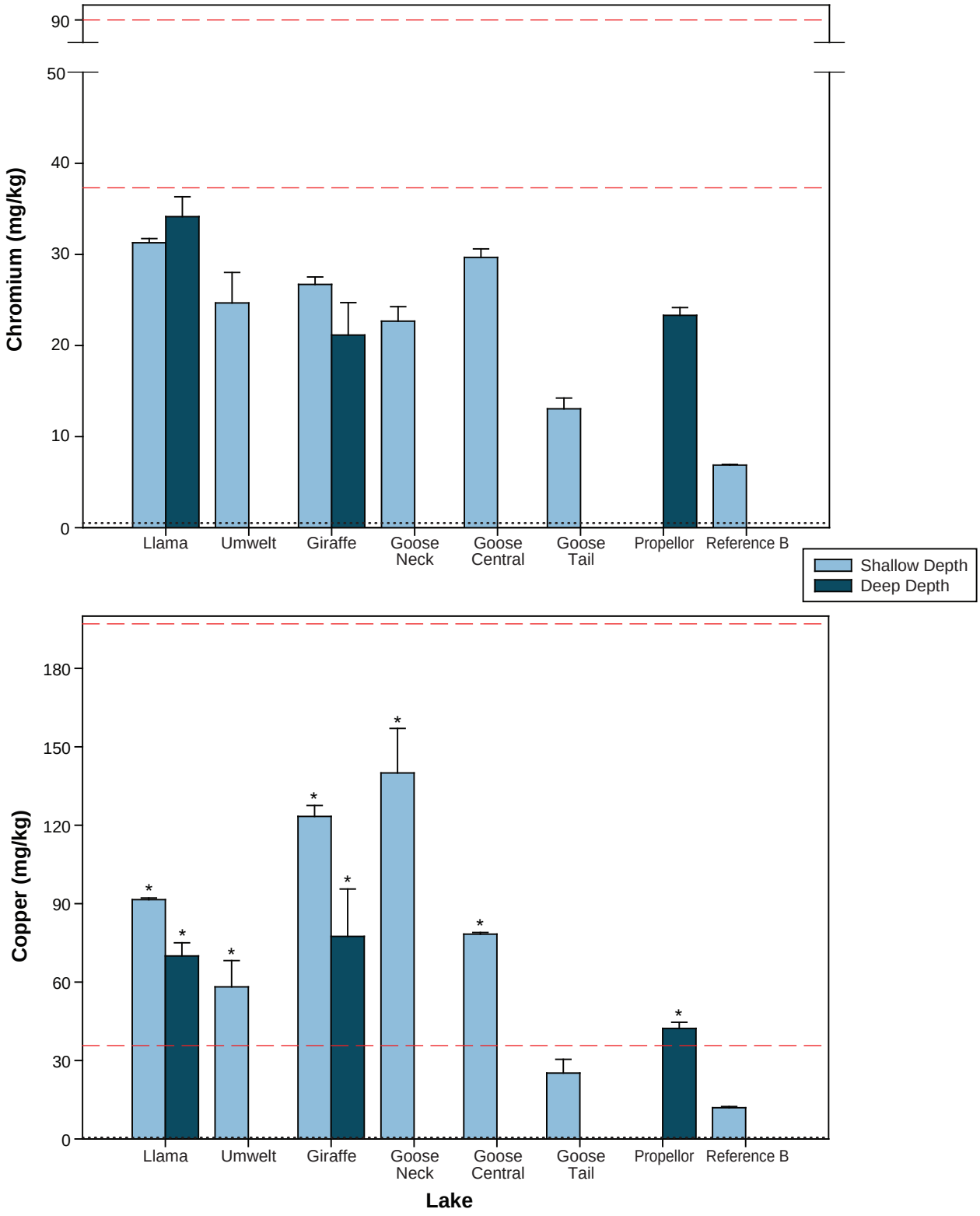
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (arsenic 0.05 mg/kg; cadmium 0.05 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
For arsenic, the interim sediment quality guideline is 5.9 mg/kg and the probable effects level is 17 mg/kg.
For cadmium, the interim sediment quality guideline is 0.6 mg/kg and the probable effects level is 3.5 mg/kg.
** Indicates mean total metal values that are higher than CCME guidelines.*

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Arsenic and Cadmium Concentrations in Lake Sediments, Back River Project, 2011

Figure 3.4-3a

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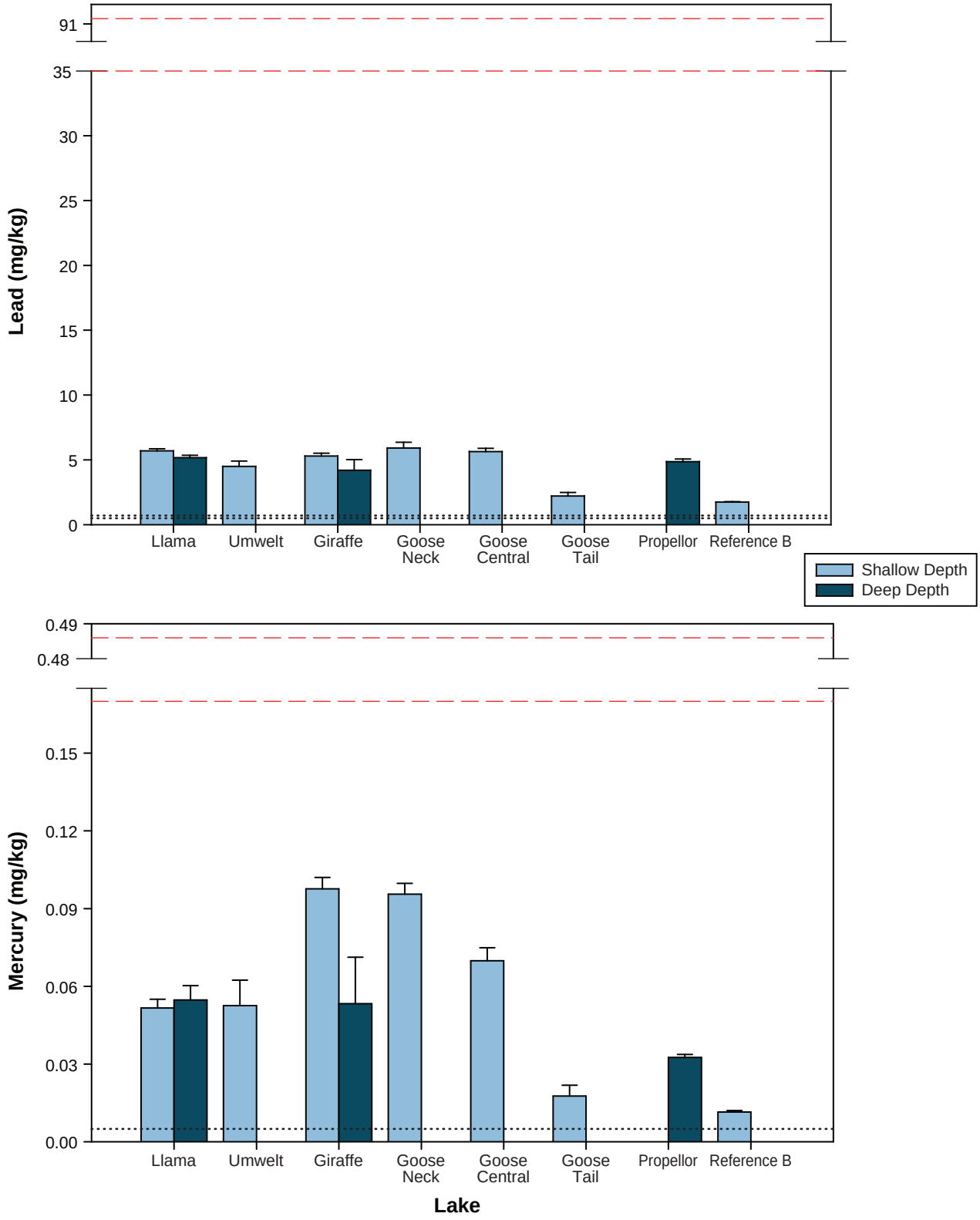
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (cadmium 0.05 mg/kg; chromium 0.5 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
For chromium, the interim sediment quality guideline is 37.3 mg/kg and the probable effects level is 90 mg/kg.
For copper, the interim sediment quality guideline is 35.7 mg/kg and the probable effects level is 197 mg/kg.
** Indicates mean total metal values that are higher than CCME guidelines.*

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Chromium and Copper Concentrations in Lake Sediments, Back River Project, 2011

Figure 3.4-3b

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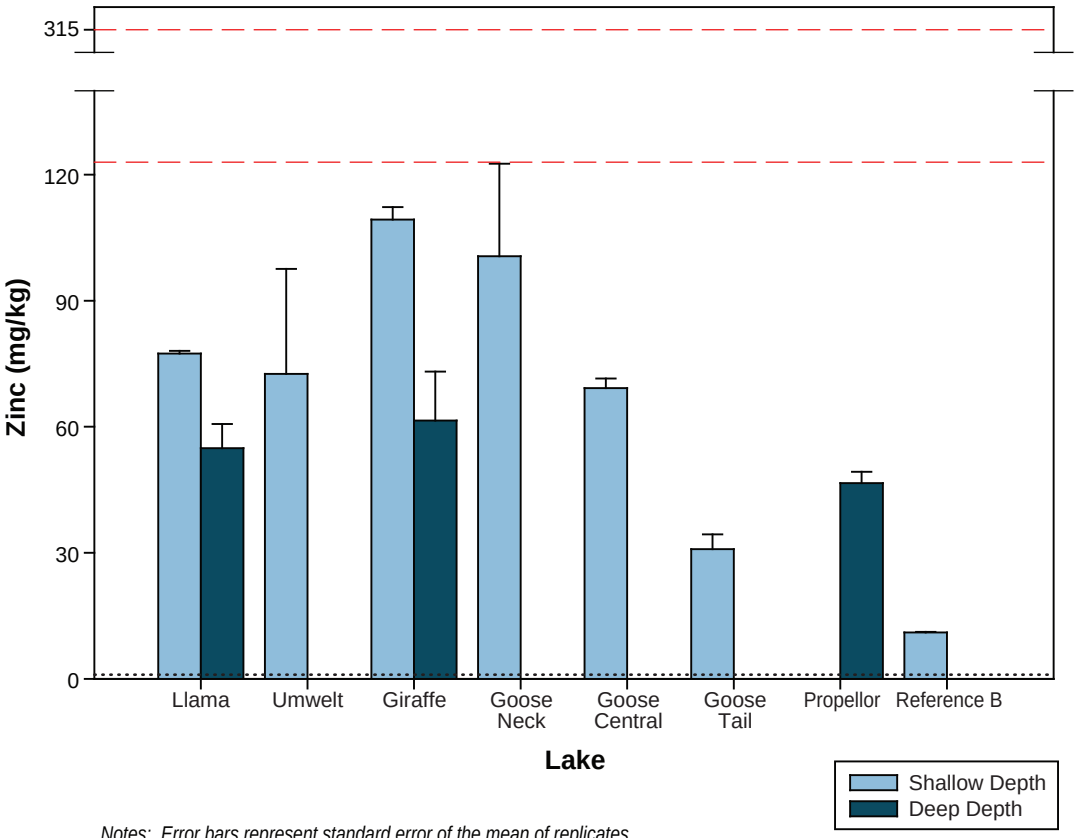
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (mercury 0.005 mg/kg; lead 0.5 or 0.7 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME guidelines.
For lead, the interim sediment quality guideline is 35 mg/kg and the probable effects level is 91.3 mg/kg.
For mercury, the interim sediment quality guideline is 0.17 mg/kg and the probable effects level is 0.486 mg/kg.

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Lead and Mercury Concentrations in Lake Sediments, Back River Project, 2011

Figure 3.4-3c

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Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (zinc 1.0 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
For zinc, the interim sediment quality guideline is 123 mg/kg and the probable effects level is 315 mg/kg.

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Zinc Concentrations in Lake Sediments, Back River Project, 2011

Figure 3.4-3d

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Lake sediments also showed similar patterns for chromium and lead concentrations, as Llama Lake, Umwelt Lake, Giraffe Lake, Goose Lake Neck, Goose Lake Central and Propellor Lake had similar concentrations, with the lowest concentrations at Goose Lake Tail and Reference B Lake.

3.4.4 Cyanides

Cyanide levels were very low in all lake sediment samples as the total and weak acid dissociable (WAD) concentrations were below their analytical detection limit of 3 mg/kg, except one shallow replicate at Giraffe Lake that had 3.1 mg/kg.

3.4.5 Comparison with CCME Guidelines

Table 3.4-1 summarizes the percentage of sediment sample in which metal concentrations were higher than CCME guidelines, and Table 3.4-2 presents the factor by which sediment metal concentrations were higher than CCME guidelines.

Overall, the surveyed lakes sediments had concentrations of arsenic, cadmium and copper that were often higher than CCME ISQGs. Most lakes exceeded at ISQGs for at least one parameter, with the two exceptions being Goose Lake Tail and Reference B Lake.

The western lake sampling sites, Llama, Umwelt, Giraffe and Goose Neck and Goose Central, had mean arsenic and copper concentrations between 1.4 and 4.0 times the ISQGs. Goose Lake Neck also had mean cadmium concentrations 1.8 times higher than the ISQG. Although their means were below guideline levels, a few lakes had individual replicates above ISQGs: Llama (chromium), Umwelt (cadmium), Giraffe (cadmium) and Goose Neck (cadmium). Propellor Lake was the only other lake to exceed any ISQG, with a mean copper concentration 1.2 times the ISQG.

All lake sediments were below CCME PELs, except the arsenic levels in the Llama Lake sediments that were on average 1.37 times higher than the arsenic PEL (17 mg/kg). Llama Lake sediments also exceeded the arsenic PEL in 2010 (Rescan 2011). Llama Lake appears to have naturally elevated levels of arsenic; probably due to its location directly above a gold deposit (arsenic and gold are often found in conjunction). Two of the three Goose Central replicates exceeded the arsenic PEL (17 mg/kg), although the mean was still below the PEL (16.97 mg/kg).

3.5 STREAM SEDIMENT QUALITY

Stream sediment samples were collected in August 2011. Due to the absence of fine depositional sediments, no data could be collected at Llama OF or Propellor OF. Also, no sediments could be collected at Echo OF because it was dry during the August sampling period. Figure 3.5-1 to 3.5-3d present 2011 stream sediment quality results. All raw sediment quality data are presented in Appendix 3.5-1.

3.5.1 Particle Size

Stream sediments were a mixture of gravel, sand, silt and clay, with a combination of sand/silt dominant across all sites (Figure 3.5-1). The exception to this was Giraffe OF, which was over half gravel.

3.5.2 Nutrients

Mean available ammonium ranged between 12.4 mg/kg and 21.6 mg/kg in most stream sediments, except in Ref. B OF sediments where higher concentrations were present (36.9 mg/kg) (Figure 3.5-2a). Total nitrogen tended to be higher in sediments at Goose OF, Propellor D/S and Ref. B OF (averaging between 0.85% and 1.0%) than at Chair OF, Giraffe OF and Wolf OF (averaging between 0.13% and 0.42%).

Table 3.4-1. Lake Sediment Quality, Percent of Samples in which Concentrations are Higher than CCME Guidelines, Back River Project, 2011

Lake	Total Number of Samples Collected	CCME Guideline value[a] (mg/kg):	Percent of samples that exceed the ISQG[b] guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
			5.9	0.6	37.3	35.7	35	0.17	123
Llama	6		100	-	16.6	100	-	-	-
Umwelt	3		66.6	33.3	-	100	-	-	-
Giraffe	6		100	33.3	-	100	-	-	-
Goose Neck	3		100	100	-	100	-	-	33.3
Goose Central	3		100	-	-	100	-	-	-
Goose Tail	3		-	-	-	-	-	-	-
Propellor	3		-	-	-	100	-	-	-
Reference B	3		-	-	-	-	-	-	-
Total Sites	**30**		**5**	**3**	**1**	**6**	**0**	**0**	**1**

Lake	Total Number of Samples Collected	CCME Guideline value[a] (mg/kg):	Percent of samples that exceed the PEL[c] guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
			17	3.5	90	197	91.3	0.486	315
Llama	6		66.6	-	-	-	-	-	-
Umwelt	3		-	-	-	-	-	-	-
Giraffe	6		-	-	-	-	-	-	-
Goose Neck	3		-	-	-	-	-	-	-
Goose Central	3		66.6	-	-	-	-	-	-
Goose Tail	3		-	-	-	-	-	-	-
Propellor	3		-	-	-	-	-	-	-
Reference B	3		-	-	-	-	-	-	-
Total Sites	**30**		**2**	**0**	**0**	**0**	**0**	**0**	**0**

All values represent the percent of samples which are higher than CCME guidelines.

Even though a percentage of samples may be higher than a guideline amount, the calculated lake average may not be higher than a guideline amount.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME 2011)

b) ISQG = Interim sediment quality guideline

c) PEL = Probable Effects Level

Table 3.4-2. Lake Sediment Quality, Factor by which Average Concentrations are Higher than CCME Guidelines, Back River Project, 2011

Lake	Total Number of Samples Collected	CCME Guideline value[a] (mg/kg):	Factor by which samples are higher than ISQG[b] guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
			5.9	0.6	37.3	35.7	35	0.17	123
Llama	6		3.94	-	-	2.26	-	-	-
Umwelt	3		1.61	-	-	1.63	-	-	-
Giraffe	6		1.85	-	-	2.81	-	-	-
Goose Neck	3		1.46	1.76	-	3.92	-	-	-
Goose Central	3		2.88	-	-	2.19	-	-	-
Goose Tail	3		-	-	-	-	-	-	-
Propellor	3		-	-	-	1.18	-	-	-
Reference B	3		-	-	-	-	-	-	-
Total	**30**								

Lake	Total Number of Samples Collected	CCME Guideline value[a] (mg/kg):	Factor by which samples are higher than PEL[c] guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
			17	3.5	90	197	91.3	0.486	315
Llama	6		1.37	-	-	-	-	-	-
Umwelt	3		-	-	-	-	-	-	-
Giraffe	6		-	-	-	-	-	-	-
Goose Neck	3		-	-	-	-	-	-	-
Goose Central	3		-	-	-	-	-	-	-
Goose Tail	3		-	-	-	-	-	-	-
Propellor	3		-	-	-	-	-	-	-
Reference B	3		-	-	-	-	-	-	-
Total	**30**								

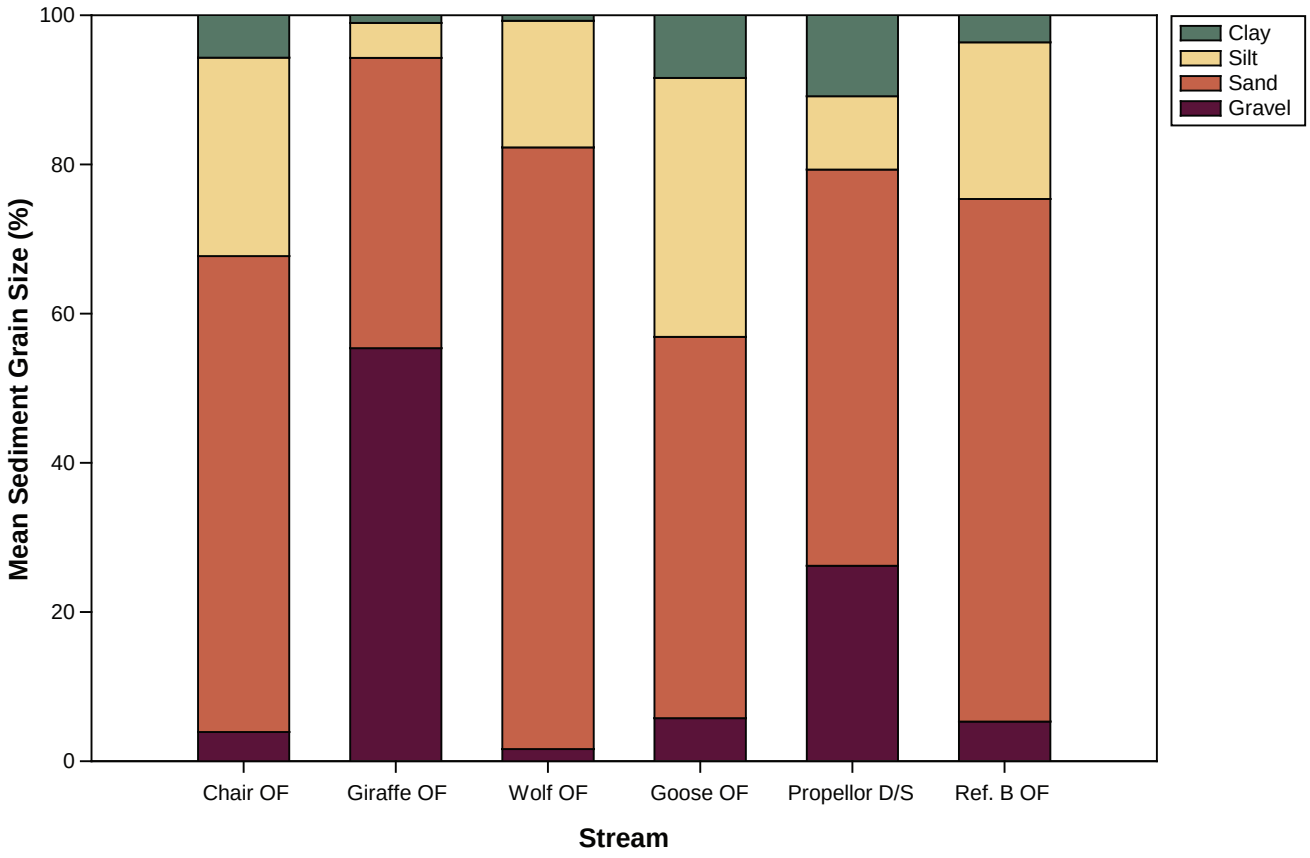
All values represent the percent of samples which are higher than CCME guidelines.

Even though a percentage of samples may be higher than a guideline amount, the calculated lake average may not be higher than a guideline amount.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME 2011)

b) ISQG = Interim sediment quality guideline

c) PEL = Probable Effects Level



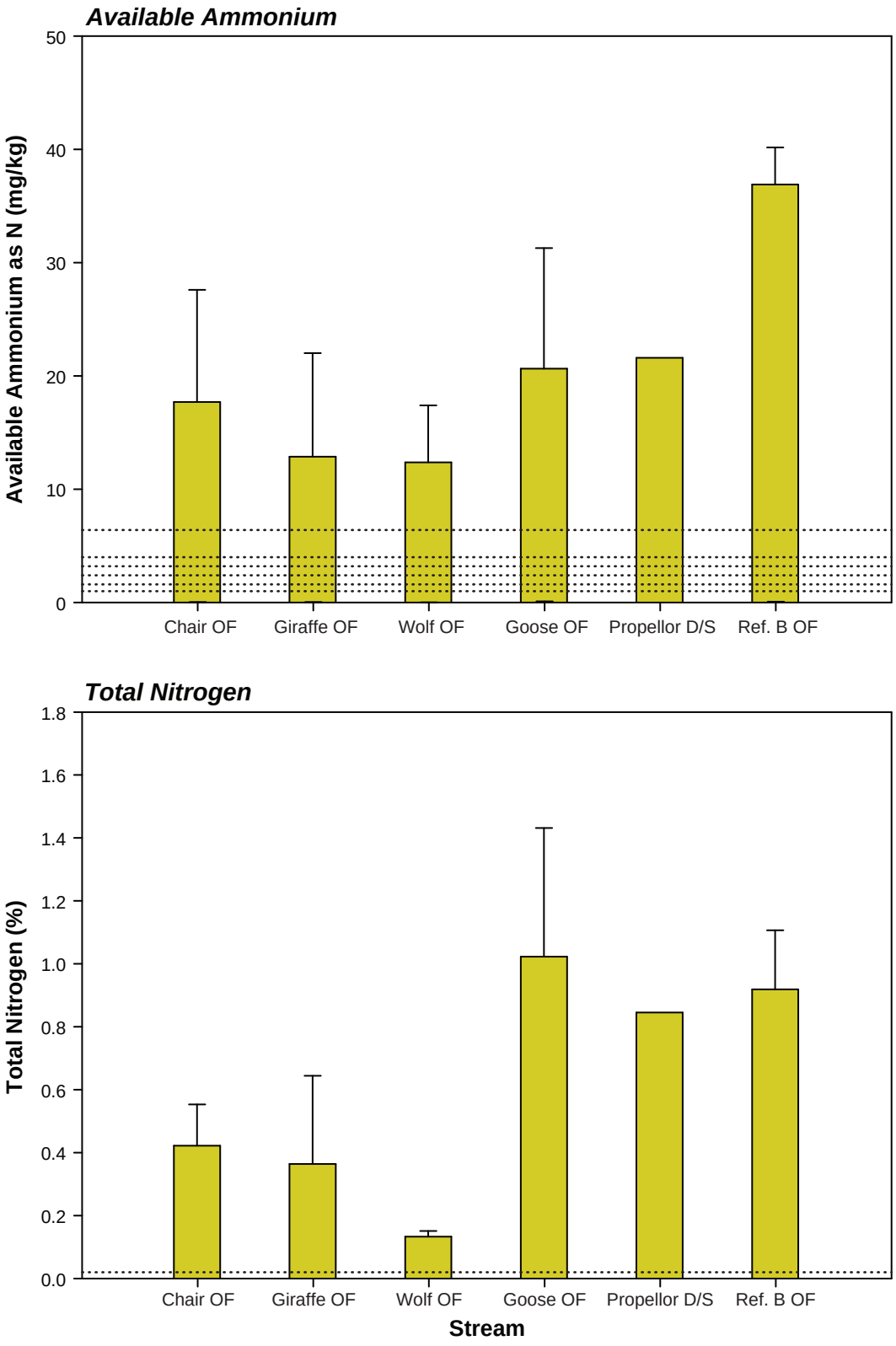
Note: Stacked bars are means of triplicate samples.

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Sediment Grain Size Composition in Streams, Back River Project, 2011

Figure 3.5-1

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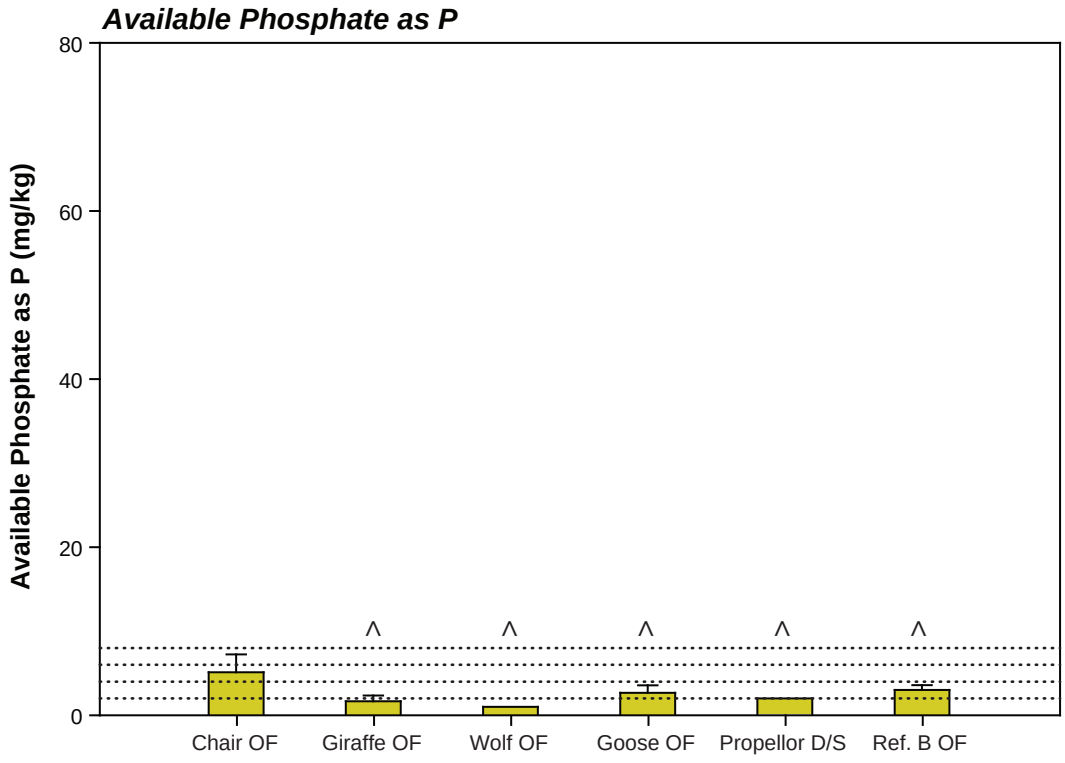
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (available ammonia 1 - 6.4 mg/kg; total nitrogen 0.02%).
Values below the detection limit are plotted at half the detection limit.

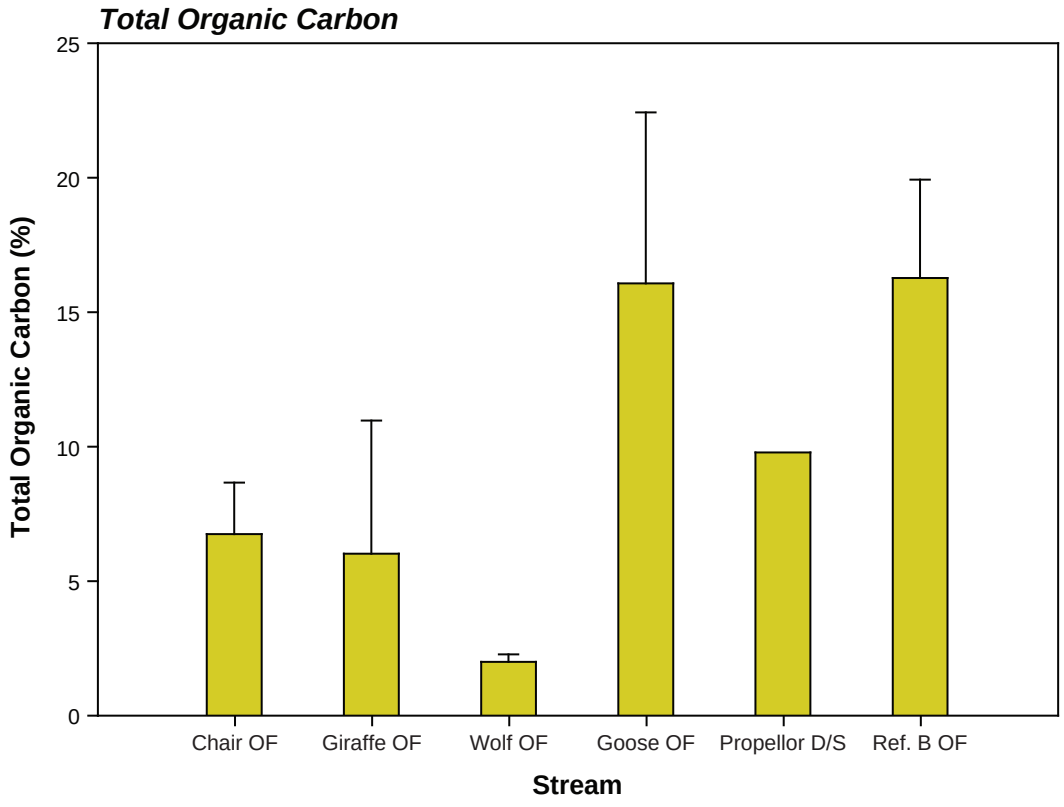
Sabina GOLD & SILVER CORP.

Available Ammonium and Total Nitrogen Concentrations in Stream Sediments, Back River Project, 2011

Figure 3.5-2a

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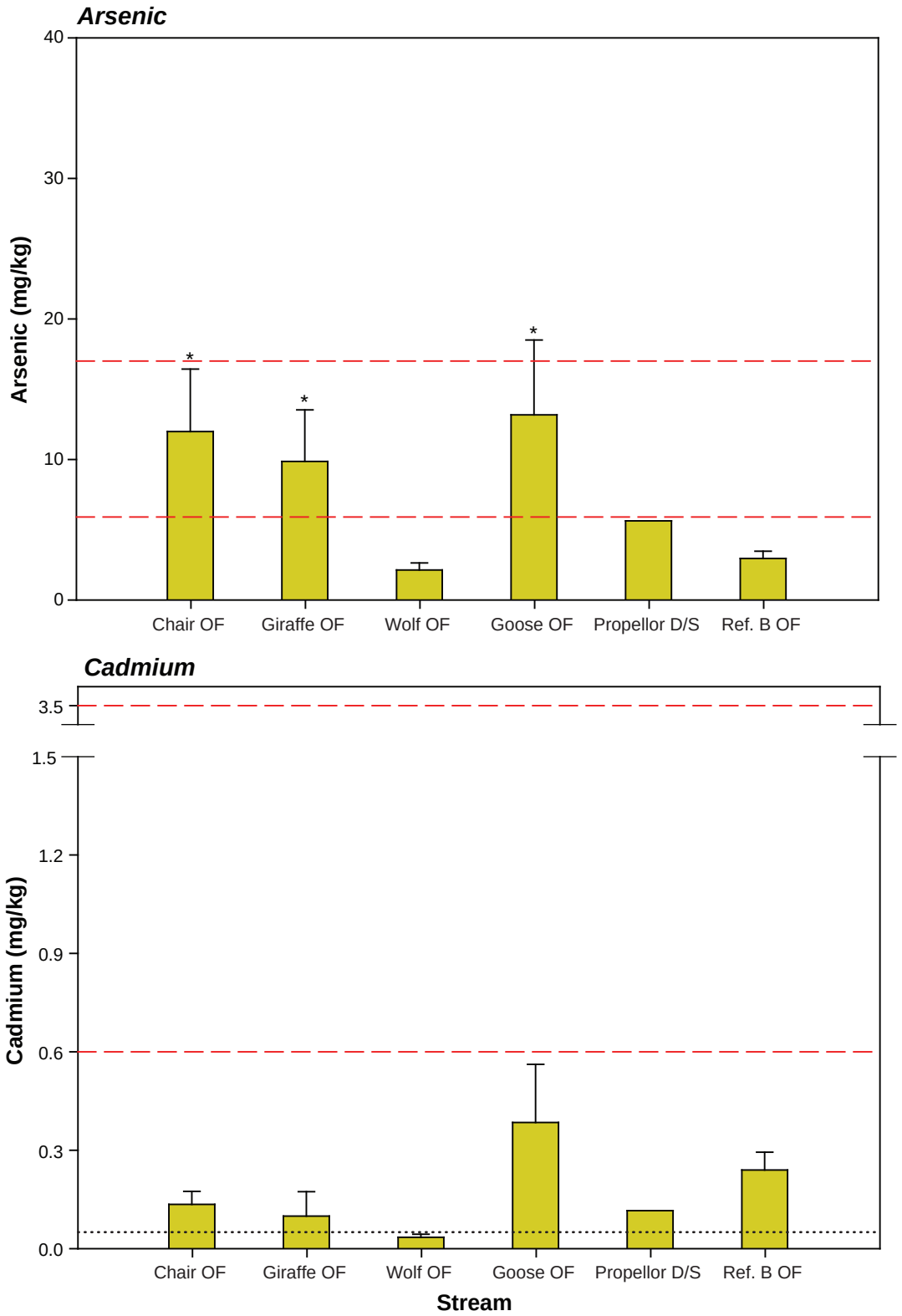
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (available phosphate 2.0 - 8.0 mg/kg; total organic carbon 0.1%).
Values below the detection limit are plotted at half the detection limit.
^ Indicates all replicates were below detection limits.

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Available Phosphate and Total Organic Carbon Concentrations in Stream Sediments, Back River Project, 2011

Figure 3.5-2b

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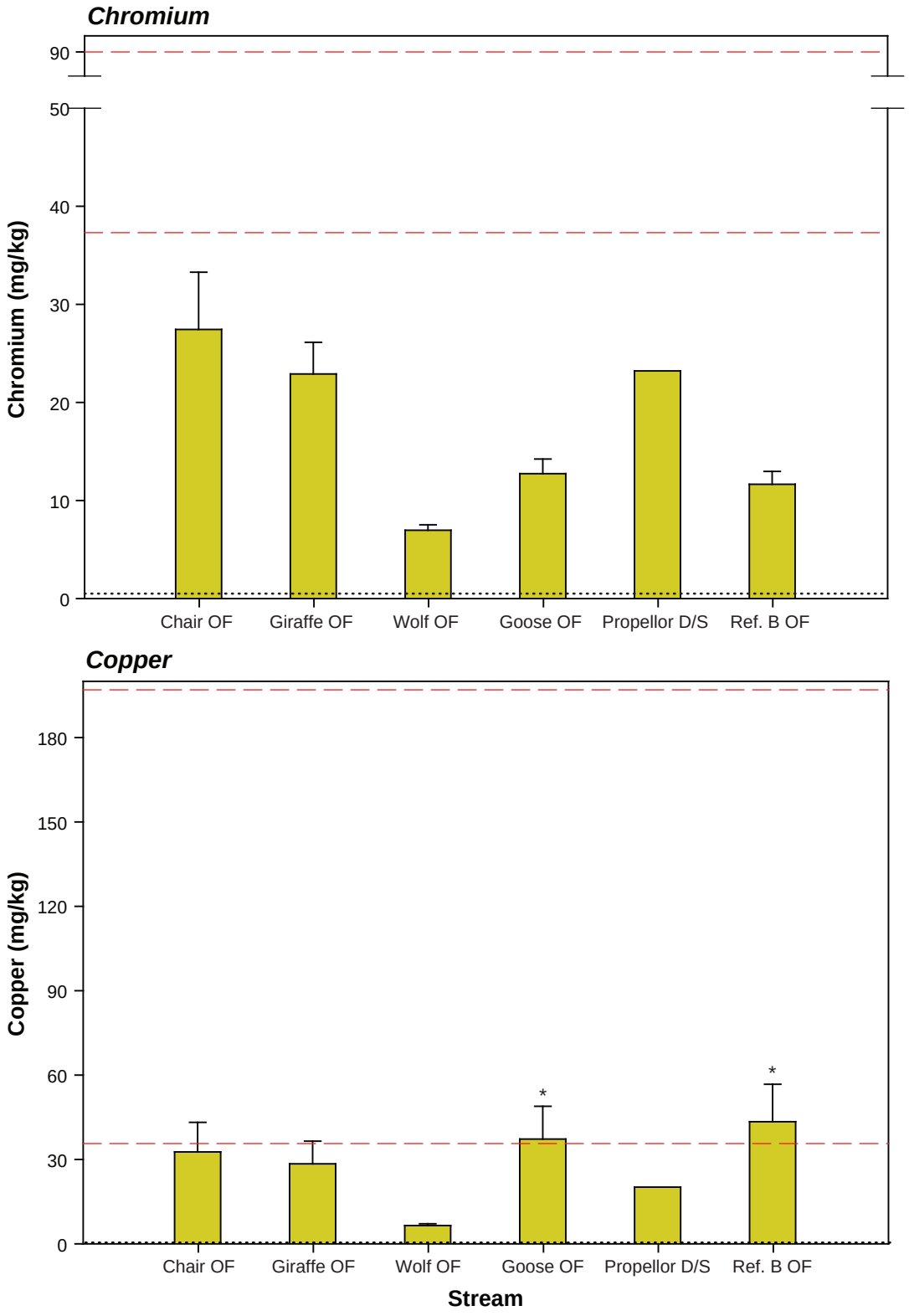
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (arsenic 0.05 mg/kg; cadminum 0.05 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
For arsenic, the interim sediment quality guideline is 5.9 mg/kg and the probable effects level is 17 mg/kg.
For cadmium, the interim sediment quality guideline is 0.6 mg/kg and the probable effects level is 3.5 mg/kg.
** Indicates mean total metal values that are higher than CCME guidelines.*

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Arsenic and Cadmium Concentrations in Stream Sediments, Back River Project, 2011

Figure 3.5-3a

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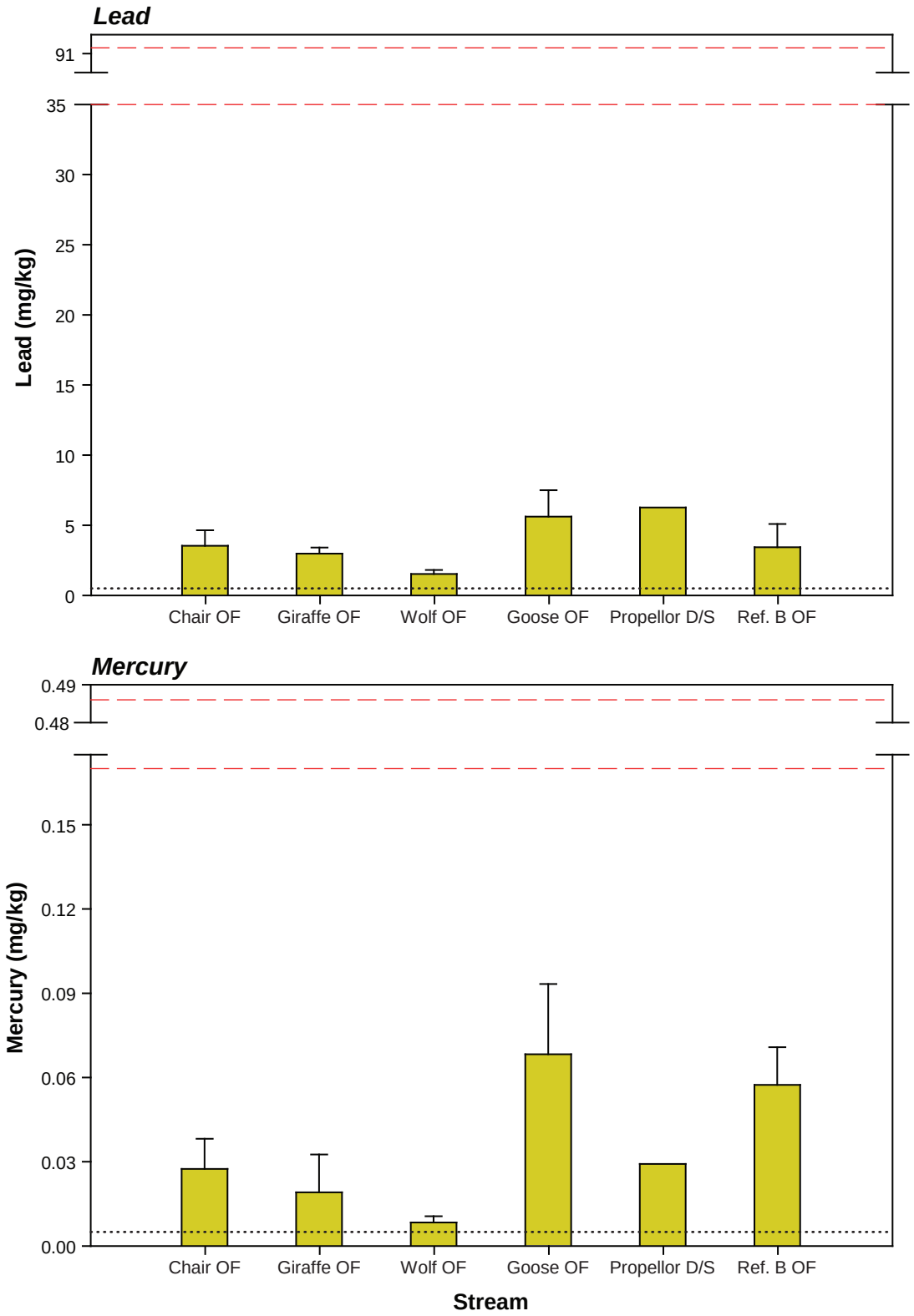
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (chromium 0.5 mg/kg; copper 0.5 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
For chromium, the interim sediment quality guideline is 37.3 mg/kg and the probable effects level is 90 mg/kg.
For copper the interim sediment quality guideline is 35.7 mg/kg and the probable effects level 197 mg/kg.
** Indicates mean total metal values that are higher than CCME guidelines.*

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Chromium and Copper Concentrations in Stream Sediments, Back River Project, 2011

Figure 3.5-3b

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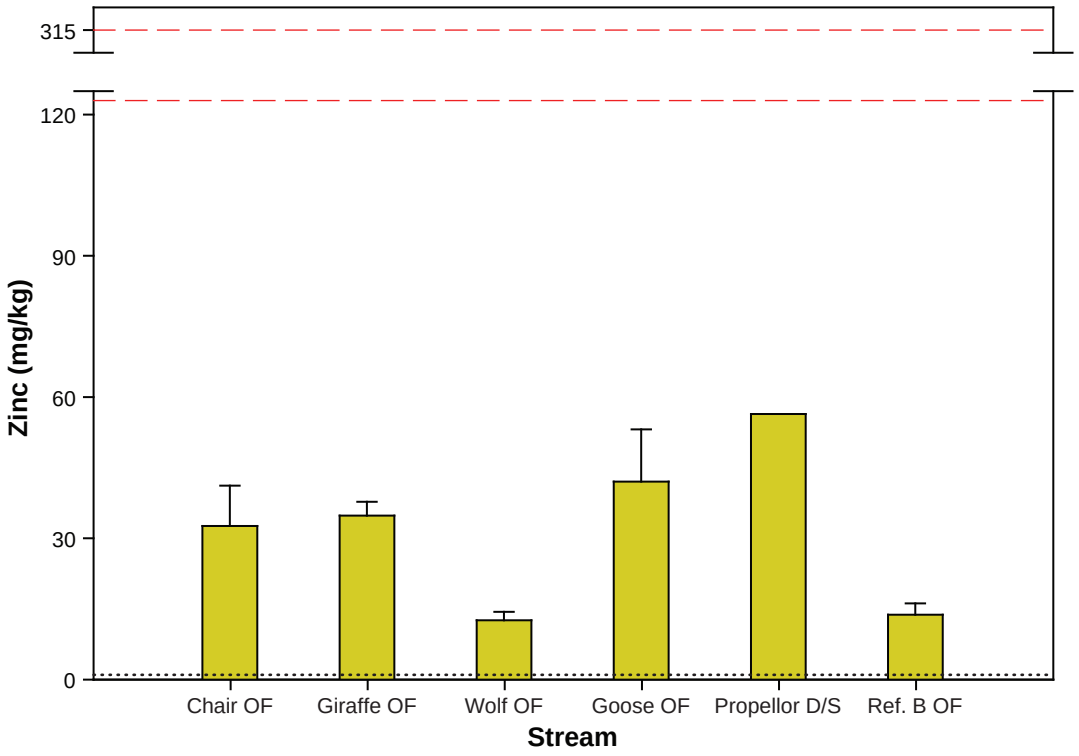
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (lead 0.5 mg/kg; mercury 0.005 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent the CCME guidelines.
For lead the interim sediment quality guideline is 35 mg/kg and the probable effects level is 91.3 mg/kg.
For mercury the interim sediment quality guideline is 0.17 mg/kg and the probable effects level is 0.486 mg/kg.

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Lead and Mercury Concentrations in Stream Sediments, Back River Project, 2011

Figure 3.5-3c

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Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (zinc 1.0 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
For zinc, the interim sediment quality guideline is 123 mg/kg and the probable effects level is 315 mg/kg.

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Zinc Concentrations in Stream Sediments, Back River Project, 2011

Figure 3.5-3d

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Available phosphate levels were below detection limits in all stream sediments (2.0 mg/kg to 8.0 mg/kg), except in two Chair OF replicates (6.1 mg/kg and 8.2 mg/kg) (Figure 3.5-2b).

Total organic carbon (TOC) content was highest in Goose OF and Ref. B OF sediments, averaging 16% (Figure 3.5-2b). Chair OF, Giraffe OF and Propellor D/S sediments had intermediate TOC content, averaging between 6.0% and 9.8%, while Wolf OF had the lowest content at 2.0%.

3.5.3 Metals

Metal concentrations in stream sediments were similar or lower than in lake sediments (Figures 3.5-3a to 3.5-3b). Metal concentrations varied considerably between stream sediments, and were consistently lowest in the sediments at Wolf OF. Concentrations of arsenic and copper were naturally elevated in the sediments of some streams.

Arsenic concentrations were highest in sediments at Chair OF, Giraffe OF and Goose OF, averaging between 9.9 mg/kg and 13.2 mg/kg (Figure 3.5-3a). This was higher than the ISQG levels of 5.9 mg/kg. The other streams sampled had less than 5.6 mg/kg in their sediments. Copper concentrations were high in the stream sediments, averaging between 20.2 mg/kg and 43.4 mg/kg (Figure 3.5-3c). The exception to this was Wolf OF sediments, which had an average of 6.6 mg/kg copper.

Similar spatial patterns were seen in the concentrations of some metals in the stream sediments. The highest concentrations of cadmium, copper and mercury were found in the Goose OF and Ref. B OF sediments, and the lowest concentrations in Wolf OF. For chromium and zinc, the highest concentrations were at Chair OF, Giraffe OF, Goose OF and Propellor D/S, and lowest concentrations at Wolf OF and Ref. B OF.

3.5.4 Cyanides

Both total and WAD cyanides were below their respective analytical detection limit in all replicates at all streams (3.0 mg/kg).

3.5.5 Comparison with CCME Guidelines

The percentage of sediment samples in which metal concentrations were higher than CCME guidelines is summarized in Table 3.5-1. Table 3.5-2 presents the factor by which mean sediment concentrations were higher than CCME guidelines.

At most stream sites, sediments from at least one replicate exceeded the CCME ISQG for arsenic, chromium, and copper. Goose Lake had the most parameters that at least one replicate exceeded an ISQG (arsenic, cadmium, and copper), followed by Chair OF (arsenic and copper), and Giraffe OF (arsenic and copper). Chair OF and Giraffe OF had mean arsenic concentrations 2.0 and 1.7 times higher than the ISQG, and while they had replicates that exceeded copper ISQGs, their mean concentrations did not. Mean arsenic and copper concentrations at Goose OF exceeded ISQGs (by factors of 2.23 and 1.04), and one replicate exceeded cadmium ISQGs. Ref. B OF exceeded the ISQG for copper by a factor of 1.22.

No stream sites had average concentrations above the CCME PELs, although both Chair OF and Giraffe OF had replicates that were higher than the PEL for arsenic (17 mg/kg).

Table 3.5-1. Stream Sediment Quality, Percent of Samples in which Concentrations are Higher than CCME Guidelines, Back River Project, 2011

Stream	Total Number of Samples Collected	CCME Guideline value[a] (mg/kg):	Percent of samples that exceed the ISQG[b] guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
			5.9	0.6	37.3	35.7	35	0.17	123
Chair OF	3		66.7	-	-	66.7	-	-	-
Giraffe OF	3		66.7	-	-	33.3	-	-	-
Wolf OF	3		-	-	-	-	-	-	-
Goose OF	3		66.7	33.3	-	66.7	-	-	-
Propellor D/S	1		-	-	-	-	-	-	-
Ref. B OF	3		-	-	-	66.7	-	-	-
Total	**16**								

Stream	Total Number of Samples Collected	CCME Guideline value[a] (mg/kg):	Percent of samples that exceed the PEL[c] guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
			17	3.5	90	197	91.3	0.486	315
Chair OF	3		33.3	-	-	-	-	-	-
Giraffe OF	3		-	-	-	-	-	-	-
Wolf OF	3		-	-	-	-	-	-	-
Goose OF	3		33.3	-	-	-	-	-	-
Propellor D/S	1		-	-	-	-	-	-	-
Ref. B OF	3		-	-	-	-	-	-	-
Total Sites	**16**								

All values represent the percent of samples which are higher than CCME guidelines.

Note: sediment sampleswere not collected from Echo OF, Llama OF and Propellor OF. Only one sample was collected from Propellor D/S.

Even though a percentage of samples may be higher than a guideline amount, the calculated stream mean may not be higher than a guideline amount.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME 2011)

b) ISQG = Interim sediment quality guideline

c) PEL = Probable Effects Level

Table 3.5-2. Stream Sediment Quality, Factor by which Average Concentrations are Higher than CCME Guidelines, Back River Project, 2011

Stream	Total Number of Samples Collected	CCME Guideline value[a] (mg/kg):	Factor by which samples are higher than ISQG[b] guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
			5.9	0.6	37.3	35.7	35	0.17	123
Chair OF	3		2.03	-	-	-	-	-	-
Giraffe OF	3		1.67	-	-	-	-	-	-
Wolf OF	3		-	-	-	-	-	-	-
Goose OF	3		2.23	-	-	1.04	-	-	-
Propellor D/S	1		-	-	-	-	-	-	-
Ref. B OF	3		-	-	-	1.22	-	-	-
Total	**16**								

Stream	Total Number of Samples Collected	CCME Guideline value[a] (mg/kg):	Factor by which samples are higher than PEL[c] guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
			17	3.5	90	197	91.3	0.486	315
Chair OF	3		-	-	-	-	-	-	-
Giraffe OF	3		-	-	-	-	-	-	-
Wolf OF	3		-	-	-	-	-	-	-
Goose OF	3		-	-	-	-	-	-	-
Propellor D/S	1		-	-	-	-	-	-	-
Ref. B OF	3		-	-	-	-	-	-	-
Total	**16**								

All values represent the percent of samples which are higher than CCME guidelines.

Note: sediment samples were not collected from Echo OF, Llama OF and Propellor OF. Only one sample was collected from Propellor D/S.

Even though a percentage of samples may be higher than a guideline amount, the calculated stream mean may not be higher than a guideline amount.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME 2011)

b) ISQG = Interim sediment quality guideline

c) PEL = Probable Effects Level

3.6 PRIMARY PRODUCERS

3.6.1 Phytoplankton

Lake phytoplankton samples were collected in August 2011. Figures 3.6-1 and 3.6-2 present 2011 phytoplankton results, and all raw phytoplankton data are presented in Appendix 3.6-1 to 3.6-3.

3.6.1.1 Biomass, Density and Community Composition

Summer phytoplankton biomass (as chlorophyll *a*) was very low in all lakes, consistently below 1 µg chl *a*/L, and can be considered ultra-oligotrophic (Vollenweider and Kerekes 1982; Figure 3.6-1). Chlorophyll *a* levels were highest at Umwelt Lake, Goose Lake Central, and Reference B Lake, averaging 0.6 µg chl *a*/L, and was lowest at Giraffe Lake, averaging just 0.14 µg chl *a*/L.

Summer phytoplankton biomass calculated as biovolume followed a similar trend to biomass based on chlorophyll *a*. Differences may reflect varying levels of intracellular chlorophyll *a* in different phytoplankton cells, or the presence of mixotrophic or heterotrophic algae.

There was no clear spatial pattern in phytoplankton densities. Phytoplankton densities averaged 1,036 cells/mL, and ranged from 630 cells/mL at Goose Lake Neck to 1,300 cells/mL at Umwelt and Reference B lakes.

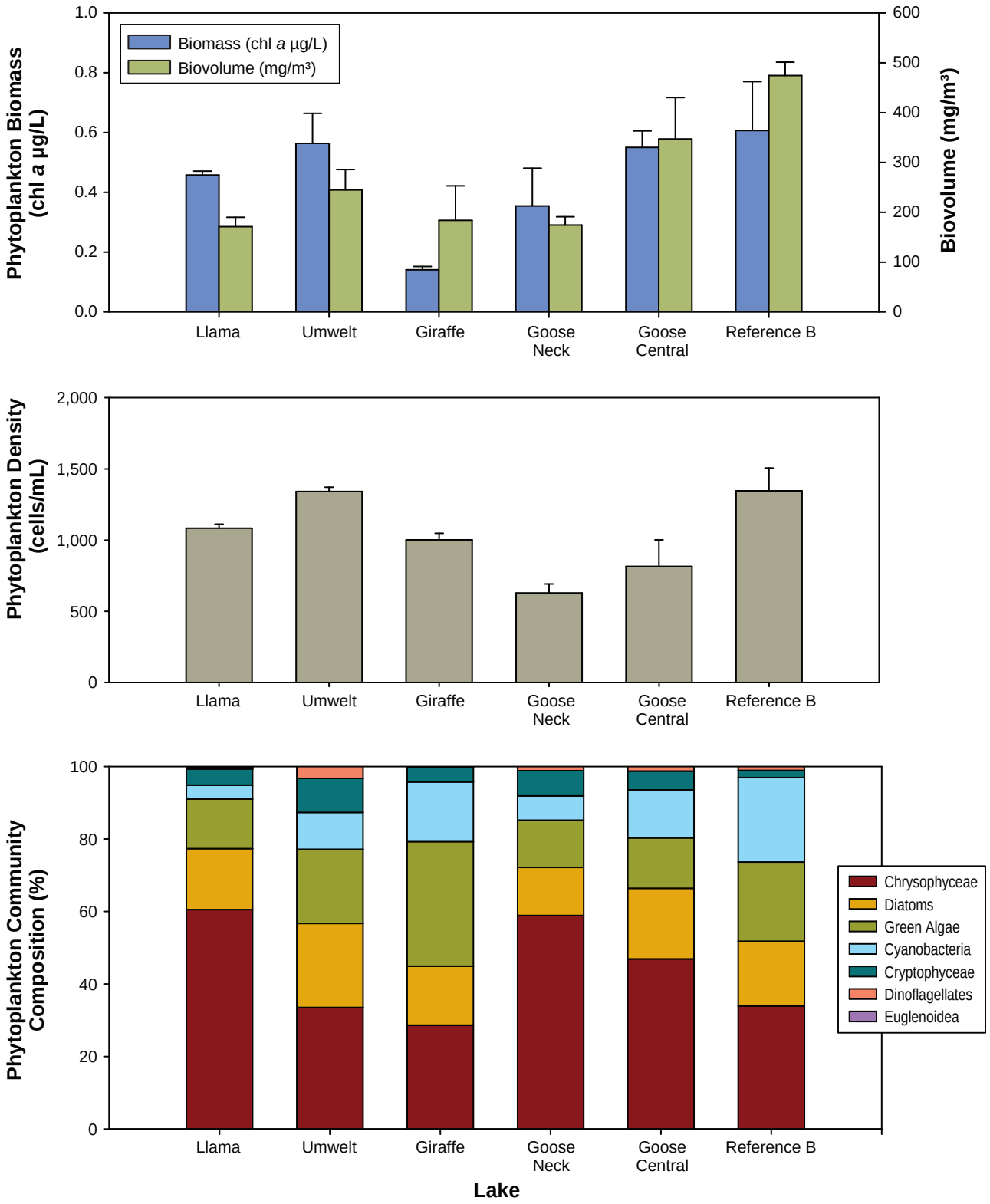
Lakes in the study area contained a diverse assemblage of phytoplankton taxa (Figure 3.6-1). The major phytoplankton group observed was chrysophytes (including diatoms shown separately in Figure 3.6-1 from other chrysophytes), representing between 45% and 77% of phytoplankton communities. The composition of the rest of the phytoplankton community, mainly green algae, cyanobacteria and cryptophytes, varied between lakes. Umwelt Lake also had dinoflagellates that comprised 3% of the community, whilst at all other lakes dinoflagellates made up 1% or lower of the total community.

Phytoplankton unidentified to the genus level made up a significant portion of the communities at all lakes, on average 39% to 68% of the total individuals collected. Two groups of unidentified naked chrysophytes, and one group of unidentified centric diatoms were considered as a single genus for the purpose of diversity and richness analyses as each group averaged greater than 15% of the total individuals collected. Unidentified individuals excluded from diversity and richness analysis made up less than 0.02%.

Of the genera that were identified, the three most abundant made up between 12% and 38% percent of the total community (Table 3.6-1). The three most abundant genera tended to be green algae or cyanobacteria, with the green alga *Elakatothrix* and the cyanobacteria *Aphanocapsa* present for all lakes. The exception to this was Reference B Lake, where the chrysophyte, *Dinobryon*, was the third most abundant genera and the dominant genera did not include *Elakatothrix* or *Aphanocapsa*. The green algal genus *Monoraphidium* was the most abundant genus at Giraffe Lake, composing nearly 20% of the total individuals collected.

3.6.1.2 Richness and Diversity

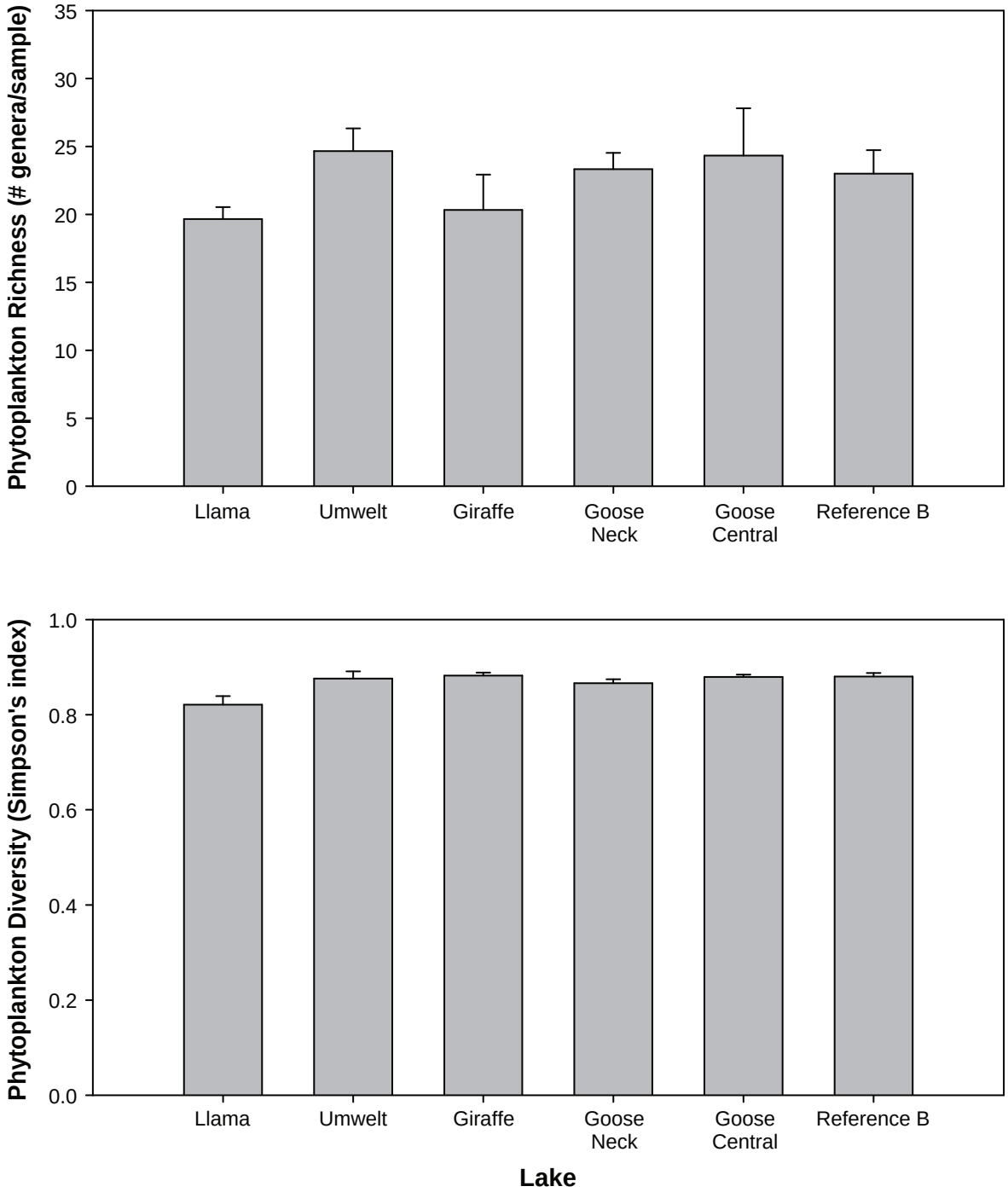
Genera richness averaged 23 genera per sample in the study lakes during August 2011 (Figure 3.6-2). Richness was similar at all lakes, ranging from 20 genera/sample at Llama and Giraffe lakes to 25 genera/sample at Umwelt Lake.



Note: Error bars represent standard error of the mean.
Community composition values represent the mean of replicates.

Figure 3.6-1

Phytoplankton Biomass, Density and Community Composition in Lakes, Back River Project, August 2011



Note: Error bars represent standard error of the mean.
Diversity was analyzed at the genus level.

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Phytoplankton Richness and Diversity in Lakes, Back River Project, 2011

Figure 3.6-2

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Table 3.6-1. Most Abundant Phytoplankton Genera in Lakes, Back River Project, August 2011

Lake	Most Abundant Phytoplankton Genera		
	Major Taxonomic Group	Genus Species	% Relative Abundance
Llama	Green Algae - Chlorophyceae	*Oocystis* spp.	4.7
	Green Algae - Chlorophyceae	*Elakatothrix genevensis*	4.3
	Cyanobacteria	*Aphanocapsa* spp.	3.4
Umwelt	Green Algae - Chlorophyceae	*Elakatothrix genevensis*	9.2
	Cyanobacteria	*Aphanocapsa* spp.	8.2
	Cryptophyceae	*Cryptomonas* spp.	6.9
Giraffe	Green Algae - Chlorophyceae	*Monoraphidium* spp.	19.8
	Cyanobacteria	*Aphanocapsa* spp.	9.5
	Green Algae - Chlorophyceae	*Elakatothrix* spp.	8.3
Goose Neck	Cyanobacteria	*Aphanocapsa* spp.	4.6
	Cryptophyceae	*Rhodomonas minuta*	4.4
	Green Algae - Chlorophyceae	*Elakatothrix genevensis*	4.1
Goose Central	Cyanobacteria	*Aphanocapsa* spp.	6.3
	Green Algae – Chlorophyceae	*Elakatothrix genvensis*	4.6
	Cyanobacteria	*Limnothrix* sp.	3.3
Reference B	Cyanobacteria	*Limnothrix* sp.	17.9
	Green Algae – Chlorophyceae	*Ankistrodesmus* spp.	11.4
	Chrysophyceae	*Dinobryon* spp.	4.2

Note: Species names are only included where all individuals in the genus were identified as from a single species. Individuals not identified to the genus level were not included in this table.

Simpson's diversity index is a combined measure of genera richness and the evenness with which abundances are distributed among these genera. Diversity was high and similar across lakes, averaging between 0.82 and 0.88 (Simpson's index; Figure 3.6-2).

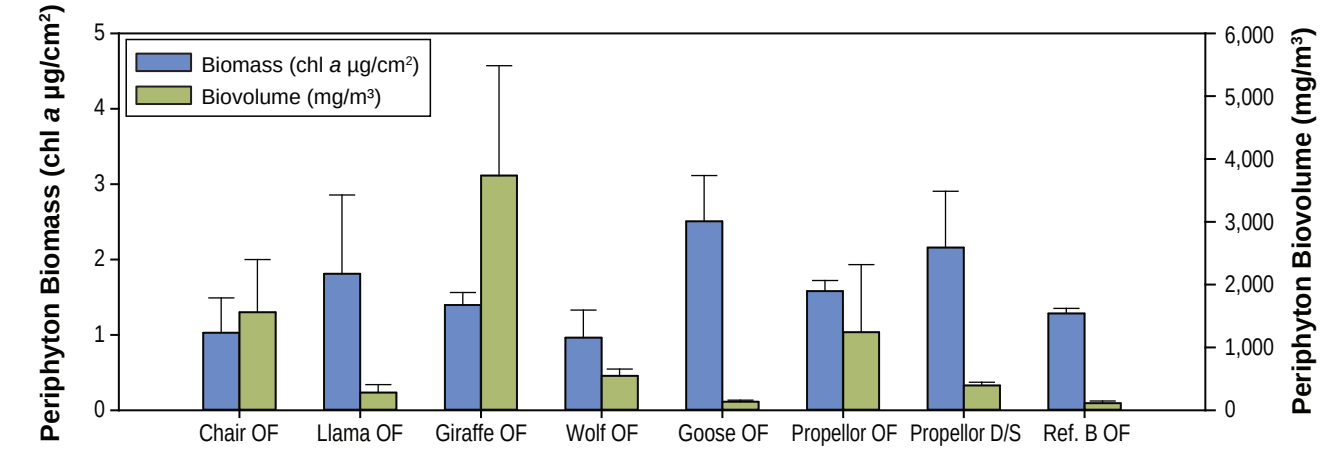
3.6.2 Periphyton

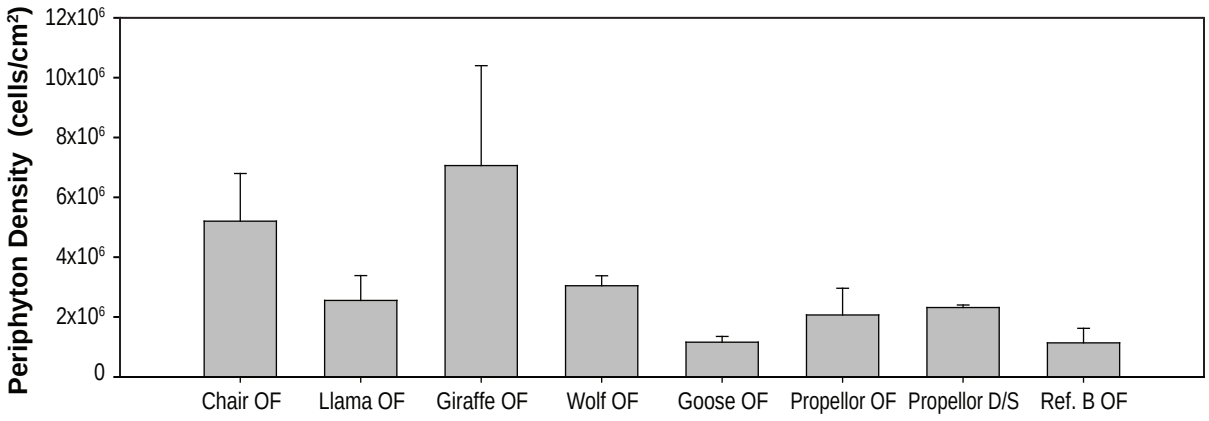
Stream periphyton samples were collected in August 2011. No periphyton samples could be collected at Echo OF as it was dry during summer sampling. Figures 3.6-3 and 3.6-4 present 2011 periphyton results, and all raw periphyton data are presented in Appendix 3.6-4 to 3.6-6.

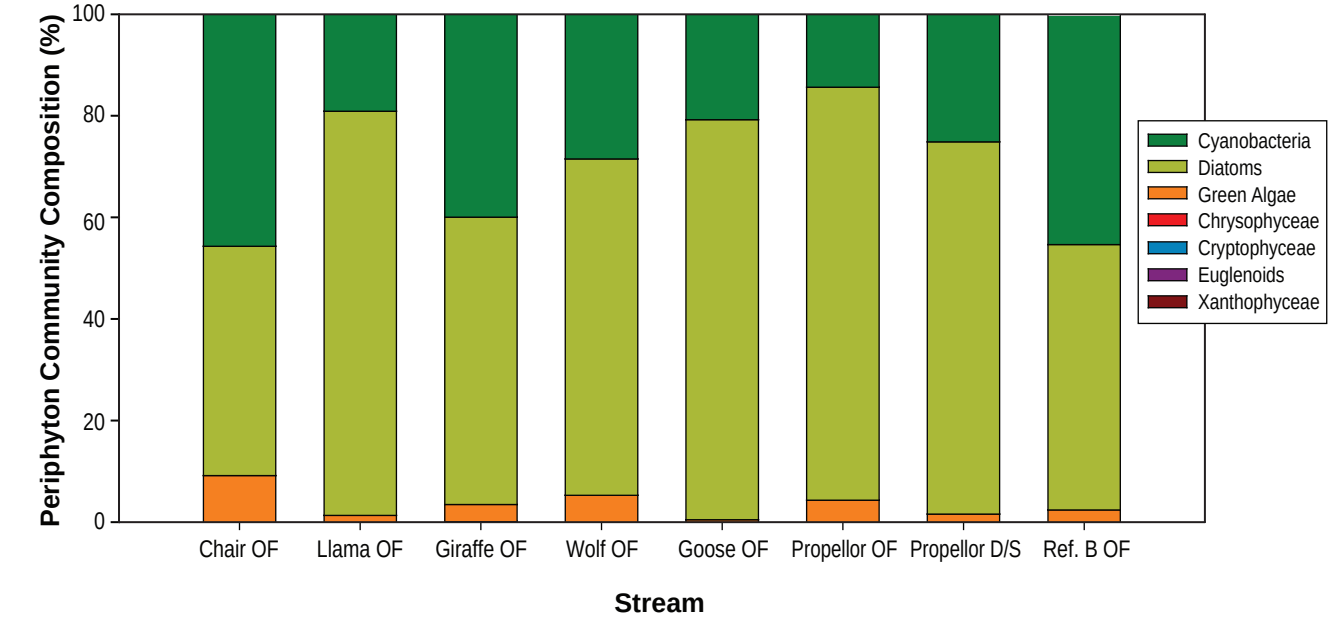
3.6.2.1 Biomass, Density and Community Composition

Mean periphyton biomass (as chlorophyll *a*) ranged from 0.96 µg chl *a*/cm^2 at Wolf OF to 2.51 µg chl *a*/cm^2 at Goose OF (Figure 3.6-3), and averaged 1.59 µg chl *a*/cm^2 over all streams. Biomass as chlorophyll *a* tended to be highest in the larger streams, which had higher discharge during the summer sampling (e.g., Goose OF and both Propellor sites). Biomass as calculated by biovolume was variable across sites, with Giraffe OF having higher total biovolume levels than the other streams.

Periphyton density ranged from a mean of 1.1×10^6 to 7.1×10^6 cells/cm^2 and differed slightly from patterns seen in biomass (Figure 3.6-3). Differences between density and biomass patterns are likely a reflection of size variation between taxa. Densities at Giraffe OF (7.1×10^6 cells/cm^2) and Chair OF (5.2×10^6 cells/cm^2) were higher than at other sites, which were less than 3.0×10^6 cells/cm^2.







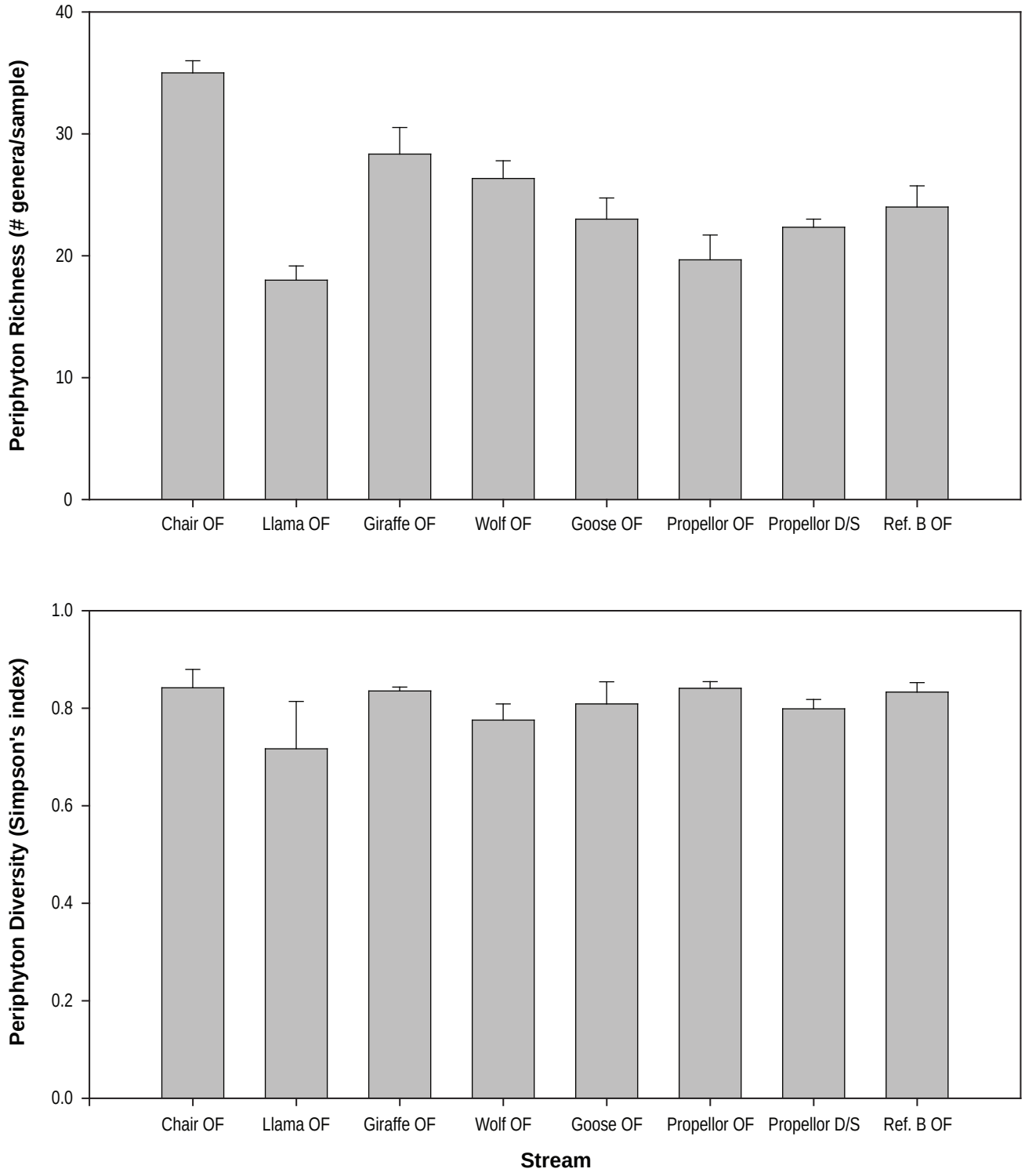
Note: Error bars represent standard error of the mean
Community composition values represent the mean of replicates

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Periphyton Biomass, Density and Community Composition in Streams, Back River Project, August 2011

Figure 3.6-3

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Note: Error bars represent standard error of the mean
Diversity was analyzed at the genus level.

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Periphyton Richness and Diversity in Streams, Back River Project, August 2011

Figure 3.6-4

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Stream periphyton were dominated by diatoms (by density), which made up between 45% and 81% of the community (see Figure 3.7-2). Common species were *Achnanthidium minutissimum, Tabellaria flocculosa, Nitzschia* spp. *and Anomoeoneis* spp. (Table 3.6-2). The second most common periphyton group was cyanobacteria, including *Phormidium formosum, Snowella lacustris, Limnothrix* sp., *Leibleinia* sp., *and Aphanocapsa delicatissima.* Cyanobacteria averaged between 14% and 47% of the stream community, and made up 40% or more of the communities at the small stream sites with low summer flow (e.g., Chair OF, Giraffe OF and Ref. B OF). Green algae were the third other significant component, averaging 9% or less of stream communities depending on the stream. Although other taxa were present (e.g., chyrsophytes, cryptophytes, euglenoids, and xanthophytes), these averaged under 1% at all stream sites.

Table 3.6-2. Most Abundant Periphyton Genera in Streams, Back River Project, August 2011

Stream	Most Abundant Periphyton Genera		
	Major Taxonomic Group	Genus species	% Relative Abundance
Chair OF	Diatom	*Achnanthidium minutissimum*	20.1
	Cyanobacteria	*Phormidium formosum*	20.1
	Cyanobacteria	*Snowella lacustris*	10.9
Llama OF	Diatom	*Achnanthidium minutissimum*	41.3
	Diatom	*Tabellaria flocculosa*	17.4
	Cyanobacteria	*Limnothrix* sp.	11.1
Giraffe OF	Diatom	*Nitzschia* spp.	20.8
	Cyanobacteria	*Limnothrix* sp.	18.2
	Cyanobacteria	*Leibleinia* sp.	16.5
Wolf OF	Diatom	*Achnanthidium minutissimum*	35.9
	Cyanobacteria	*Limnothrix* sp.	17.5
	Cyanobacteria	*Leibleinia* sp.	8.3
Goose OF	Diatom	*Achnanthidium* spp.	37.5
	Diatom	*Tabellaria flocculosa*	13.0
	Cyanobacteria	*Limnothrix* sp.	8.1
Propellor OF	Diatom	*Achnanthidium* spp.	20.4
	Diatom	*Anomoeoneis* spp.	19.4
	Diatom	*Tabellaria flocculosa*	19.3
Propellor D/S	Diatom	*Achnanthidium minutissimum*	31.9
	Diatom	*Nitzschia* spp.	11.7
	Diatom	*Anomoeoneis* spp.	10.8
Ref. B OF	Diatom	*Achnanthidium minutissimum*	23.9
	Cyanobacteria	*Aphanocapsa delicatissima*	18.4
	Cyanobacteria	*Leibleinia* sp.	8.3

Note: Species names are only included where all individuals in the genus were identified as from a single species. Individuals not identified to the genus level were not included in this table.

3.6.2.2 Richness and Diversity

Periphyton genera richness ranged from a mean of 18 genera/sample at Llama OF to 35 genera/sample at Chair OF (see Figure 3.7-3). Periphyton diversity was high at all stream sites, averaging 0.81.

3.7 AQUATIC INVERTEBRATES

3.7.1 Zooplankton

Lake zooplankton samples were collected in August 2011. Figures 3.7-1 and 3.7-2 present 2011 zooplankton results, and all raw data are presented in Appendix 3.7-1 and 3.7-3.

3.7.1.1 Density and Community Composition

Zooplankton densities averaged between 6,360 organisms/m^3 and 22,900 organisms/m^3 at most lakes (Figure 3.7-1). The exception was Llama Lake, the deepest lake, where mean densities were almost twice those found in other lakes (40,200 organisms/m^3).

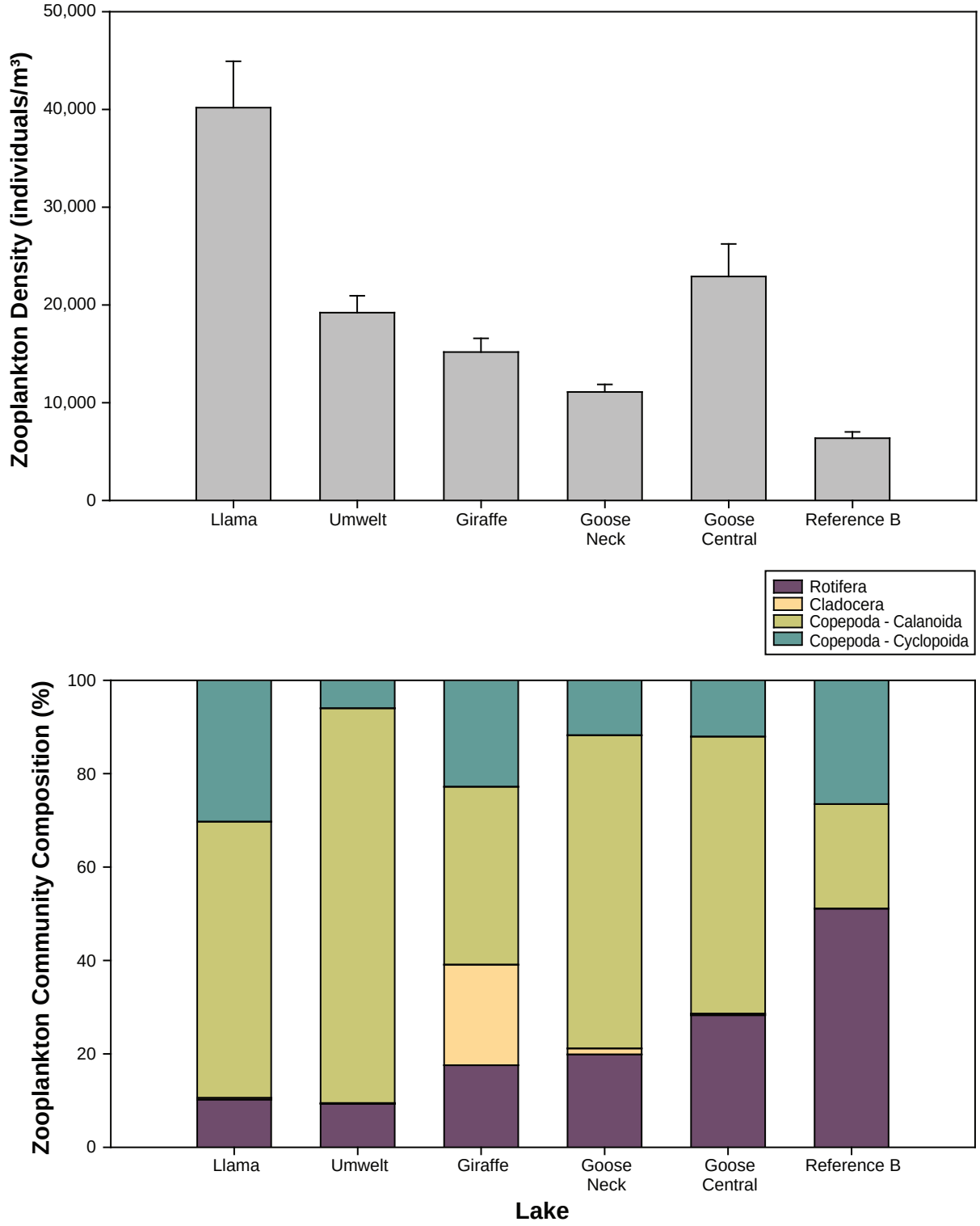
In general, lake zooplankton communities were dominated by rotifers, and calanoid and cyclopoid copepods, with smaller proportions of cladocerans also present (Figure 3.7-1). Llama, Umwelt, Goose Neck and Goose Central had similar zooplankton community composition, with calanoid copepods making up more than half of their community (59% to 85%) and the remainder of the community split between rotifers and cyclopoid copepods. Giraffe Lake (38%) and Reference B Lake (22%) both had smaller proportions of calanoid copepods, but differed in the composition of the rest of community. Giraffe Lake was the only site with a significant proportion of cladocerans (22%), whilst Reference B Lake was dominated by rotifers (51%).

Lakes were dominated by a few highly abundant genera, with the three most abundant genera comprising over 70% of communities (Table 3.7-1). Common zooplankton genera encountered in the area included *Leptodiaptomus*, a calanoid copepod, *Cyclop,* a cyclopoid copepod, and *Kellicottia longispina,* a rotifer. The cladoceran *Holopedium gibberum* was common at Giraffe Lake (making up 16.2% of the community).

Table 3.7-1. Most Abundant Zooplankton Genera in Lakes, Back River Project, August 2011

Lake	Most Abundant Zooplankton Genera		
	Major Taxonomic Group	Genus species	% Relative Abundance
Llama	Copepoda – Calanoida	*Leptodiaptomus* spp.	58.2
	Copepoda – Cyclopoida	*Cyclops* spp.	15.3
	Rotifera	*Kellicottia longispina*	9.4
Umwelt	Copepoda – Calanoida	*Leptodiaptomus* spp.	83.8
	Rotifera	*Kellicottia longispina*	8.9
	Copepoda - Cyclopoida	*Cyclops* spp.	1.6
Giraffe	Copepoda – Calanoida	*Leptodiaptomus* spp.	37.2
	Rotifera	*Kellicottia longispina*	17.3
	Cladocera	*Holopedium gibberum*	16.2
Goose Neck	Copepoda – Calanoida	*Leptodiaptomus* spp.	66.0
	Rotifera	*Kellicottia longispina*	19.3
	Copepoda - Cyclopoida	*Cyclops* spp.	9.7
Goose Central	Copepoda – Calanoida	*Leptodiaptomus* spp.	58.5
	Rotifera	*Kellicottia longispina*	28.1
	Copepoda - Cyclopoida	*Cyclops* spp.	9.5
Reference B	Rotifera	*Kellicottia longispina*	51.1
	Copepoda – Calanoida	*Leptodiaptomus* spp.	22.3
	Copepoda - Cyclopoida	*Cyclops* spp.	13.8

Note: Species names are only included where all individuals in the genus were identified as from a single species. Individuals not identified to the genus level were not included in this table.



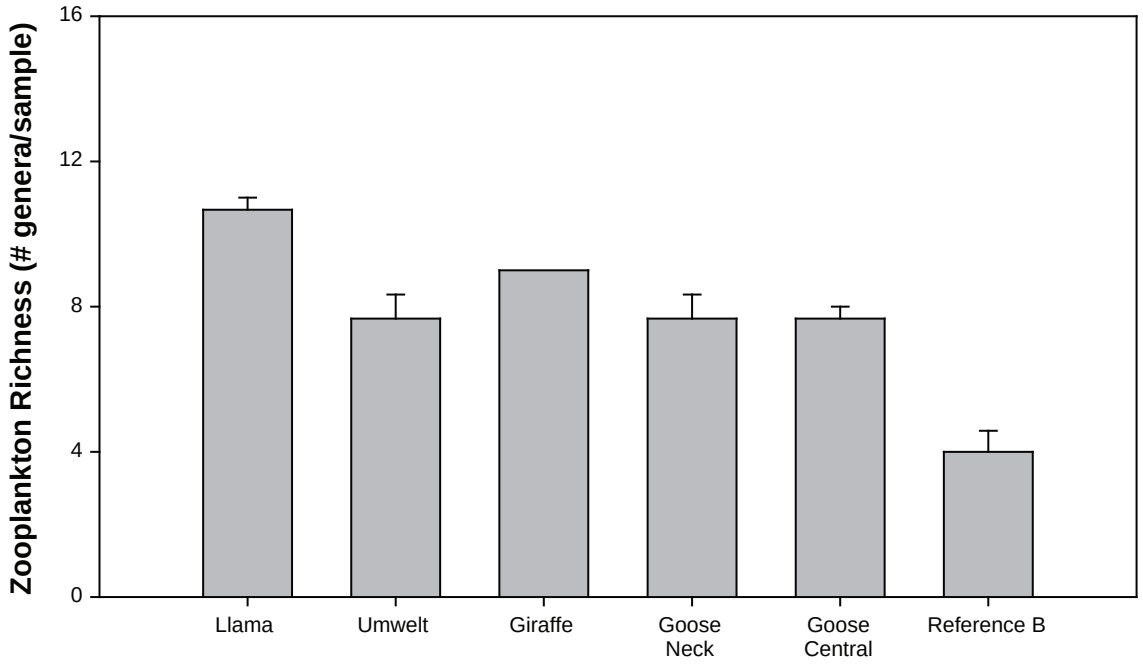
Note: Error bars represent the standard error of the mean of the total density.
Community composition values represent the mean of replicates.
Zooplankton were collected with vertical tows at Llama and Giraffe lakes (the deeper lakes), and horizontal tows at the shallow lakes.

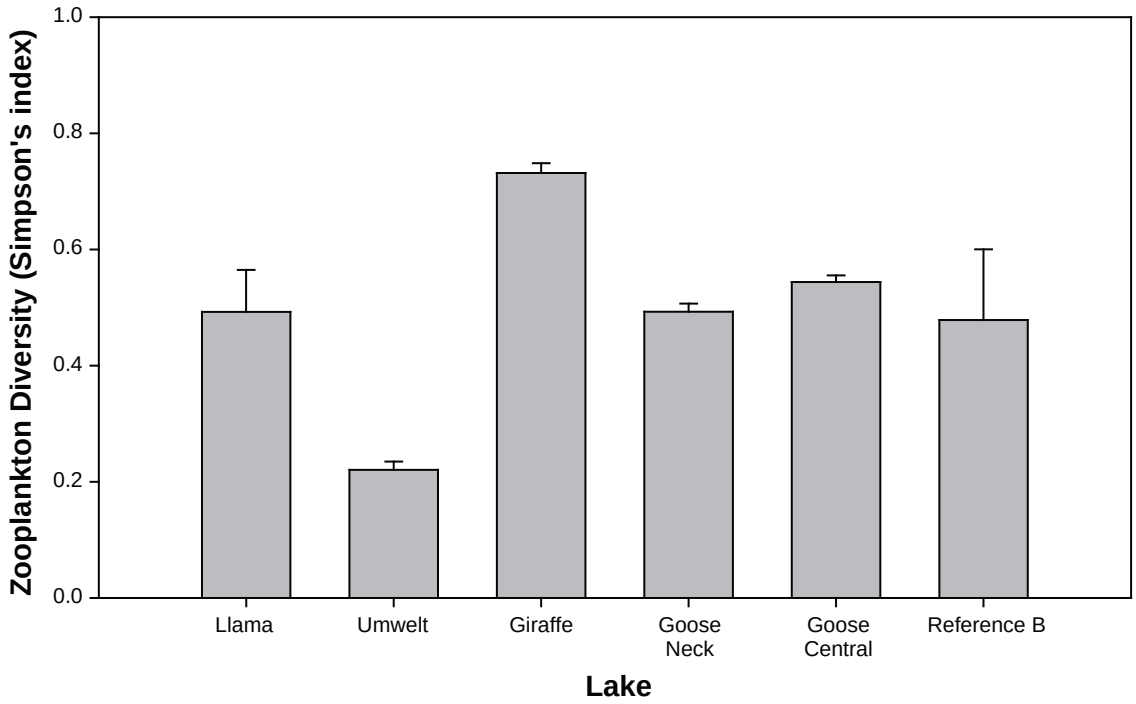
Sabina GOLD & SILVER CORP.

Zooplankton Density and Taxonomic Composition in Lakes, Back River Project, August 2011

Figure 3.7-1

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Note: Error bars represent standard error of the mean.
Diversity was analyzed at the genus level.

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Zooplankton Richness and Diversity in Lakes, Back River Project, 2011

Figure 3.7-2

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3.7.1.2 Richness and Diversity

Mean zooplankton genera richness varied between lakes, with a low of 4.0 genera at Reference B Lake to a high of 10.7 at Llama Lake (see Figure 3.7-2). The mean genera richness of the other sites ranged from 7.7 to 9.0.

Zooplankton diversity also varied between lakes, with highest diversity at Giraffe Lake (0.73) and lowest at Umwelt Lake (0.22). Other lakes had similar diversity, with Simpson's index values between 0.48 and 0.54. The differences in diversity mirrors the evenness in the lakes; Giraffe Lake had a more even spread of taxa, while at Umwelt Lake more than 80% of individuals were from a single genus (*Leptodiaptomus*).

Unidentified cyclopoid and calanoid copepod nauplii, composing 8% of total individuals, were excluded from the richness and diversity analyses.

3.7.2 Lake Benthic Macroinvertebrates

Lake benthos samples were collected in August 2011. Figures 3.7-3 and 3.7-4 present 2011 benthos results, and all raw data are presented in Appendix 3.7-3 and 3.7-4. Sorting efficiencies for both lake and stream benthic invertebrates are presented in Appendix 3.7-7.

3.7.2.1 Density and Community Composition

Mean benthos densities varied between lakes, ranging from 1,140 organisms/m^2 in Llama Lake (deep depth) to 6,650 organisms/m^2 in the shallow Umwelt Lake (see Figure 3.7-3). Benthos densities at Umwelt, Goose Central and Reference B lake sampling sites were higher than in Llama, Giraffe or Goose Neck lake sampling sites.

Benthic communities were similar across the different lake sampling sites. Lake benthic communities were dominated by dipterans (true flies), which made up between 66% and 82% of individuals found (see Figure 3.7-3). The rest of the community was mainly bivalves (small to tiny clams from the family Sphaeriidae), smaller numbers of oligochaetes (a subclass of worms), and ostracods (seed shrimp).

The most abundant three genera at each site made up between 35% and 72% of all individuals. These genera were mainly chironomid dipterans (non-biting midges), with the bivalve *Psidium* (pill or pea clams) also present at Llama Lake and Reference B Lake (Table 3.7-2).

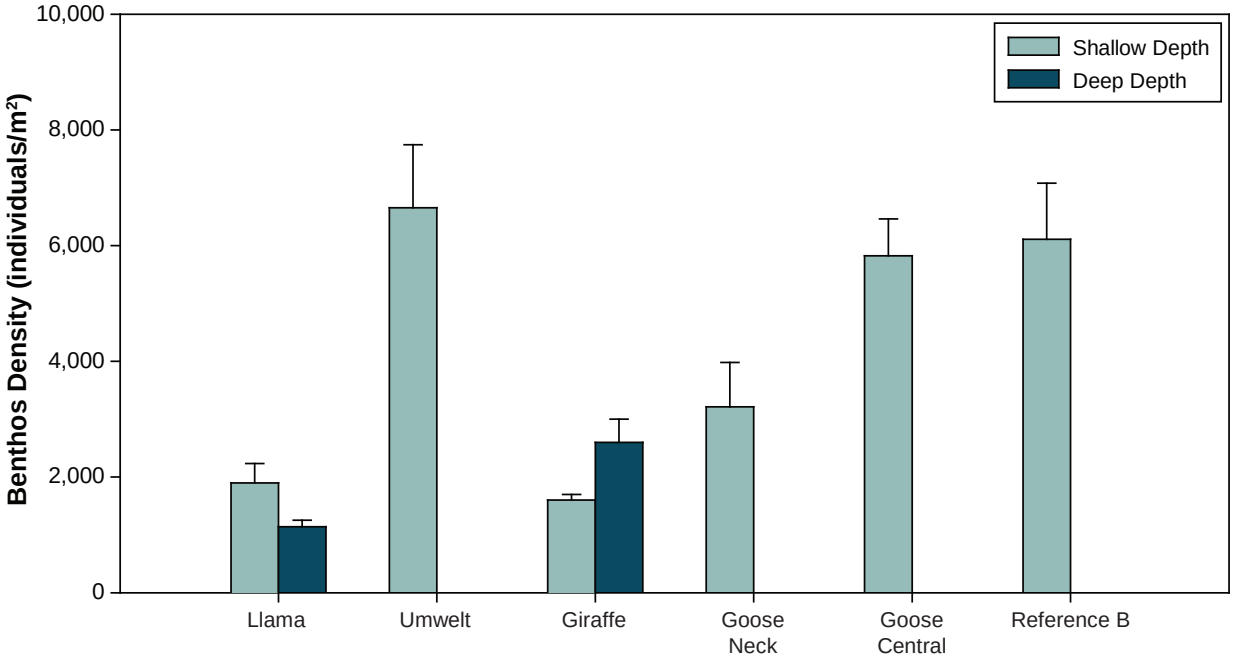
3.7.2.2 Richness and Diversity

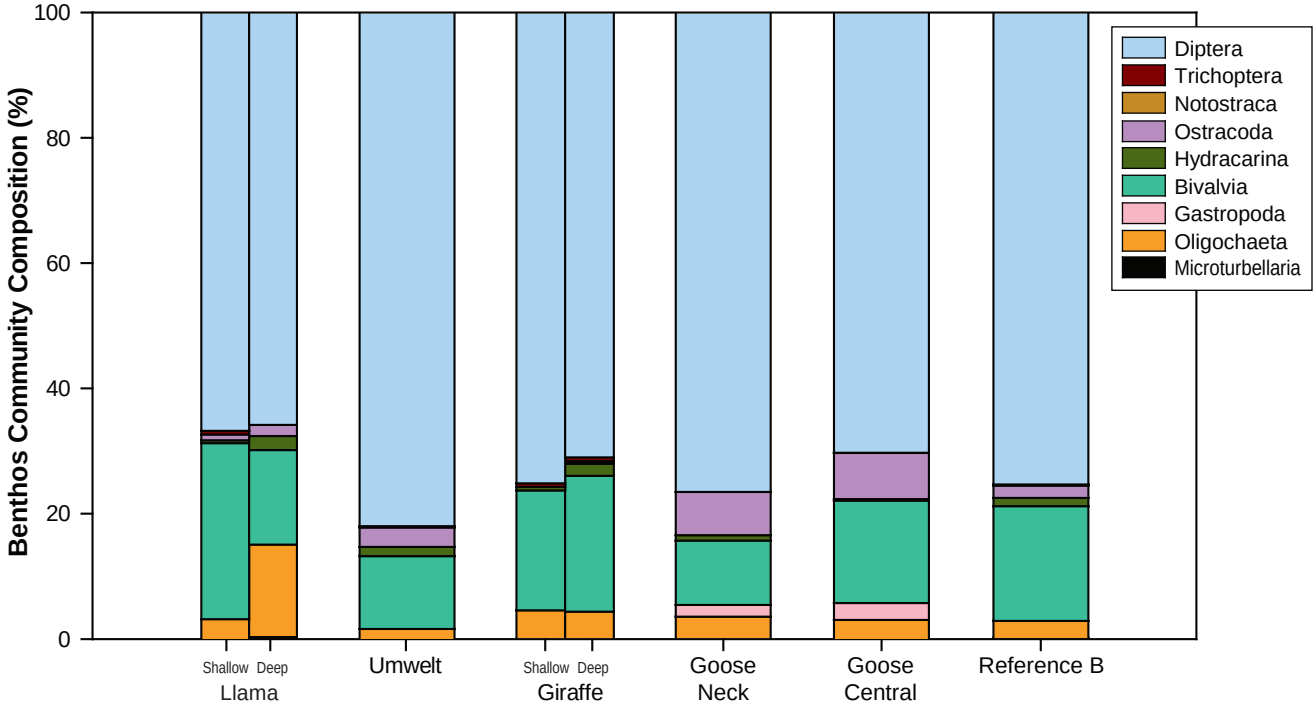
Benthos family richness ranged from 4.4 to 7.2 families/sample (see Figure 3.7-4). Goose Lake Neck, Goose Lake Central and Reference B Lake had slightly higher richness levels than the other lake sampling sites, ranging from 6.0 to 7.2 families/sample compared to between 4.4 and 5.8 families/sample. Benthos diversities were high across all lakes, with mean Simpson's index values ranging from 0.77 at Goose Lake Neck to 0.90 at Giraffe Lake (shallow). Richness and diversities showed no clear patterns with depth.

No individuals were excluded from the lake benthos richness and diversity analyses. Individuals in the clade Hydracarina and class Ostracoda (4% of total individuals) could not be resolved to family level, and so were each considered a single family for the richness and diversity analysis.

3.7.3 Stream Benthic Macroinvertebrates

Stream benthos samples were collected in August 2011. No benthos samples could be collected at Echo OF as it was dry during summer sampling. Figures 3.7-5 and 3.7-6 present 2011 results, and all raw data are presented in Appendix 3.7-5 and 3.7-6.





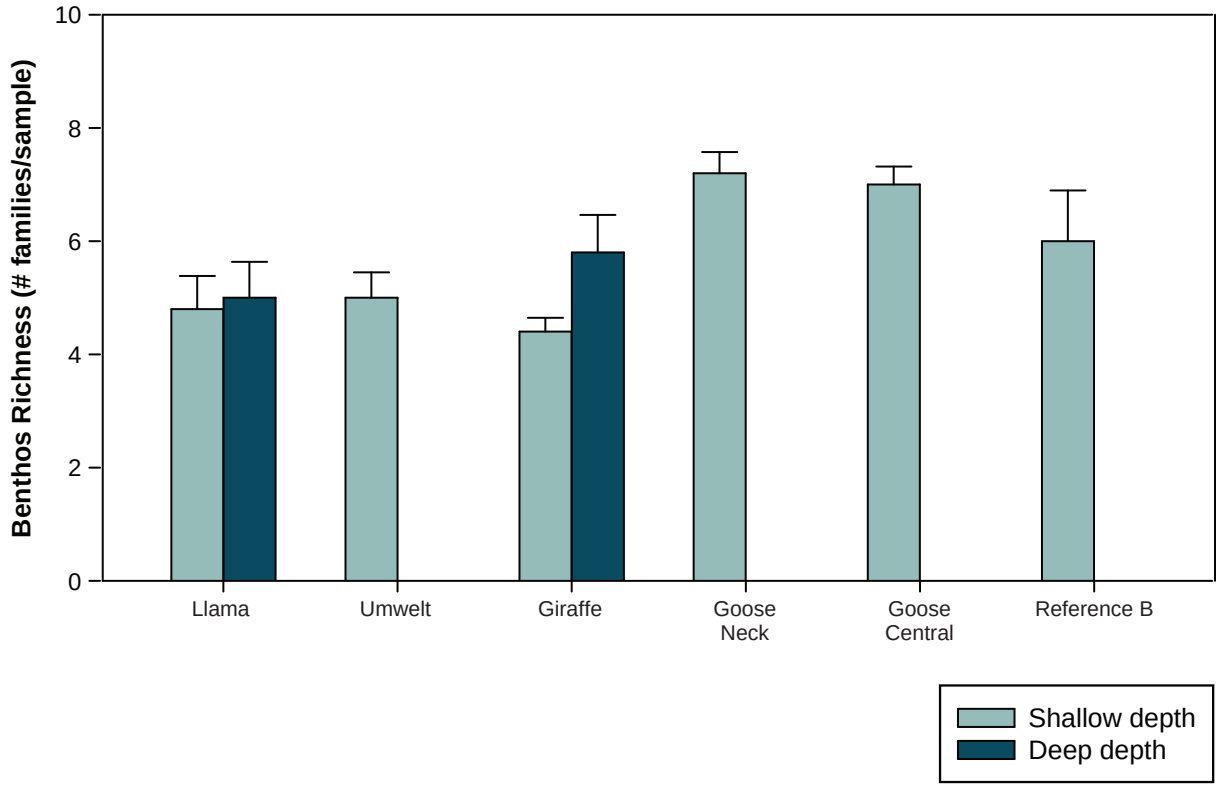
Note: Error bars represent standard error of the mean.
Community composition values represent the mean of replicates.

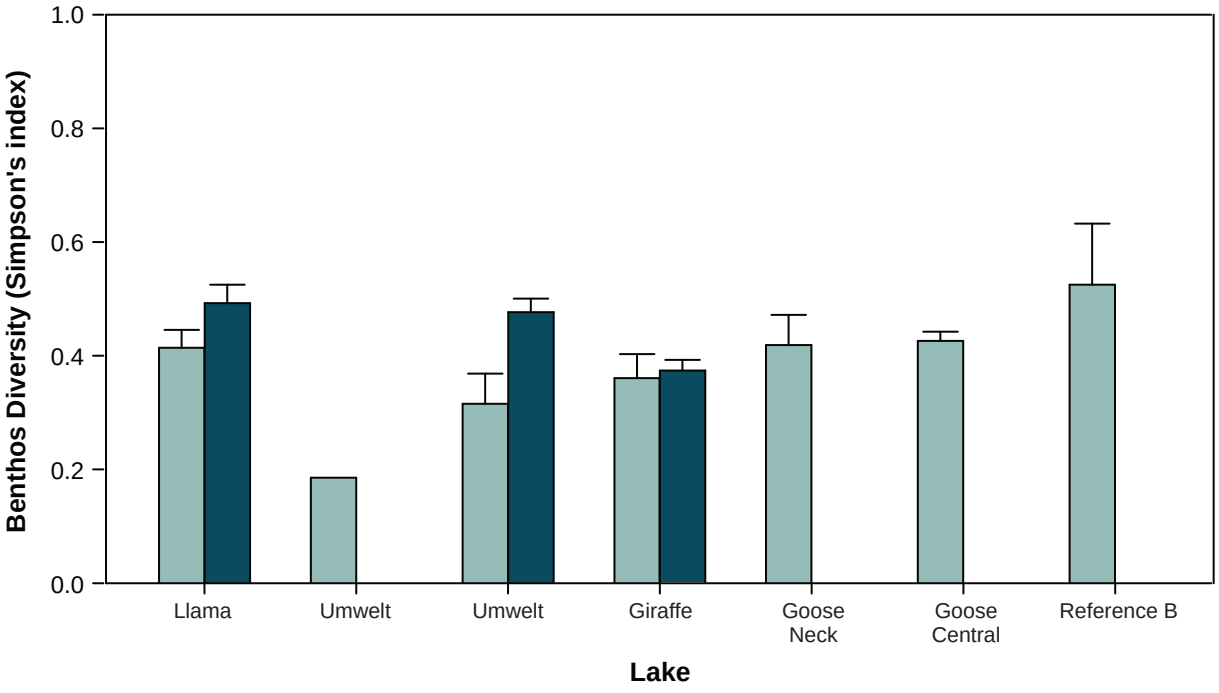
Sabina GOLD & SILVER CORP.

Benthos Density and Community Composition in Lakes, Back River Project, August 2011

Figure 3.7-3

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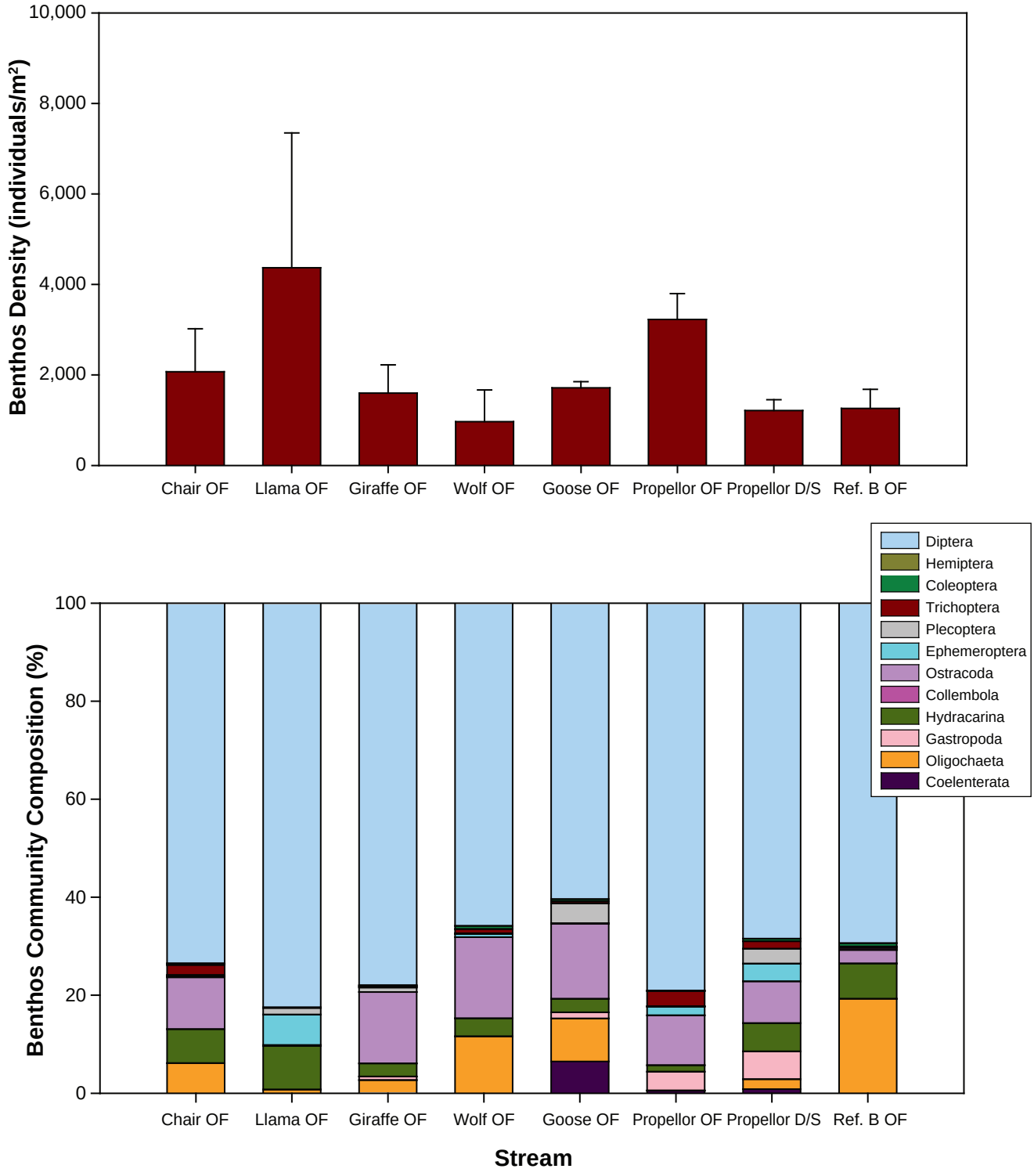




Note: Error bars represent standard error of the mean.
Diversity was analyzed at the family level.

Figure 3.7-4

Benthos Richness and Diversity in Lakes, Back River Project, August 2011



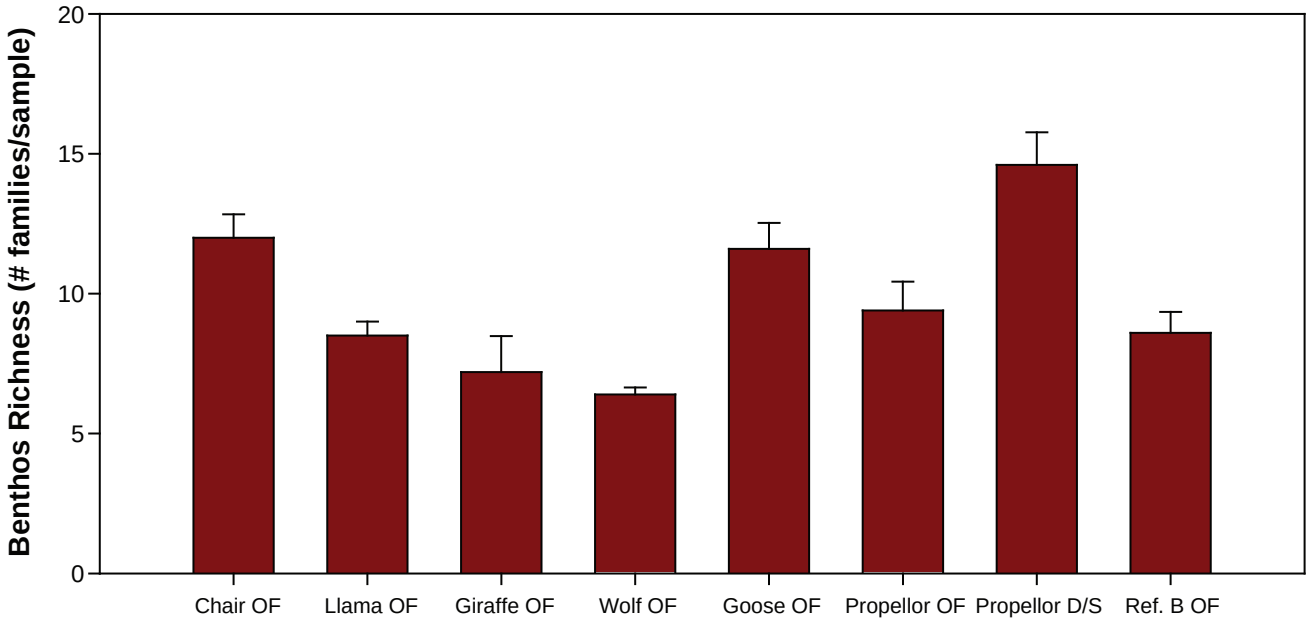
Note: Error bars represent standard error of the mean.
Community composition values represent mean of triplicate samples.

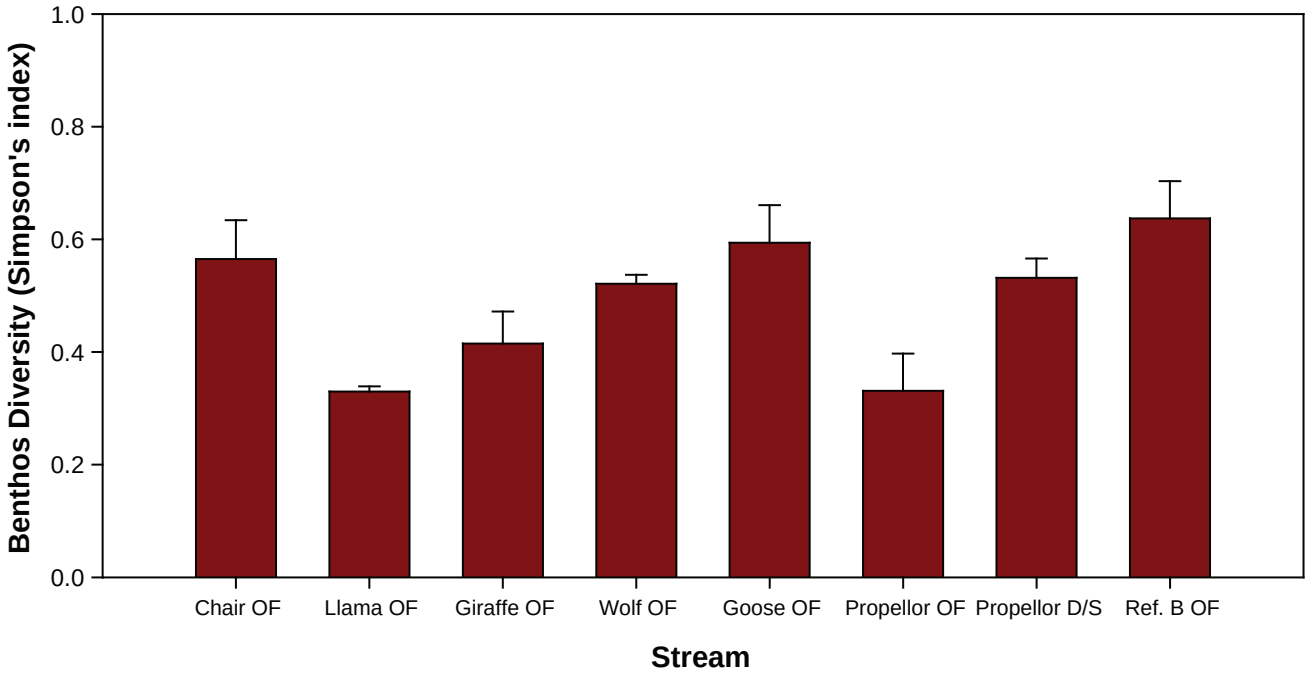
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Benthos Density and Community Composition in Streams, Back River Project, August 2011

Figure 3.7-5

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Note: Error bars represent standard error of the mean.
Diversity was analyzed at the family level.

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Benthos Richness and Diversity in Streams, Back River Project, August 2011

Figure 3.7-6

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Table 3.7-2. Most Abundant Benthic Macroinvertebrate Genera in Lakes, Back River Project, August 2011

Lake	Major Group	Family	Genus	% of Total Individuals
Llama Shallow	Diptera	Chironomidae	*Stictochironomus*	30.2
	Diptera	Chironomidae	*Psectrocladius*	12.4
	Bivalvia	Sphaeriidae	*Pisidium*	10.3
Llama Deep	Diptera	Chironomidae	*Heterotrissocladius*	21.1
	Bivalvia	Sphaeriidae	*Pisidium*	12.8
	Diptera	Chironomidae	*Procladius*	9.5
Umwelt	Diptera	Chironomidae	*Corynocera*	23.1
	Diptera	Chironomidae	*Cladopelma*	13.9
	Diptera	Chironomidae	*Polypedilum*	13.1
Giraffe Shallow	Diptera	Chironomidae	*Procladius*	14.5
	Diptera	Chironomidae	*Stictochironomus*	10.9
	Diptera	Chironomidae	*Psectrocladius*	10.1
Giraffe Deep	Diptera	Chironomidae	*Stictochironomus*	30.1
	Diptera	Chironomidae	*Pagastiella*	11.1
	Diptera	Chironomidae	*Psectrocladius*	10.8
Goose Neck	Diptera	Chironomidae	*Paratanytarsus*	42.6
	Diptera	Chironomidae	*Psectrocladius*	13.4
	Diptera	Chironomidae	*Stictochironomus*	4.6
Goose Central	Diptera	Chironomidae	*Stictochironomus*	24.1
	Diptera	Chironomidae	*Paratanytarsus*	12.4
	Diptera	Chironomidae	*Psectrocladius*	8.3
Reference B	Diptera	Chironomidae	*Corynocera*	35.9
	Diptera	Chironomidae	*Procladius*	23.3
	Bivalvia	Sphaeriidae	*Pisidium*	12.2

Note: None of the genera listed in this table were identified below genus level. Individuals not identified to genus level, which includes immature and damaged individuals, were not included in this table

3.7.3.1 Density and Community Composition

Mean benthos density in most streams ranged from 968 organisms/m^2 (Wolf OF) to 2,070 organisms/m^2 (Chair OF; Figure 3.7-5). The exceptions were Llama OF and Propellor OF, which tended to have higher densities, 4,370 organisms/m^2 and 3,230 organisms/m2, respectively. These two stream sites had the largest substrate size, with rocks tending to be larger than 50 cm at both sites, with no depositional material present.

Stream benthos communities were dominated by dipterans, which averaged between 61% and 83% of the stream benthic organisms sampled (Figure 3.7-6). Ostracods (seed shrimp), oligochaete worms, and hydracarina (water mites) were also present, averaging between 5% and 10% of the benthos community. The remainder of the community was made up of Coelenterata (*Hydra*), Gastrapoda (snails and slugs), Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).

Ephemeroptera, Plecoptera, and Trichoptera (together termed EPT) are pollution sensitive taxa, often used as indicators of ecosystem health. On average, EPT made up between 0.2% (Ref. B OF) and 8.2%

(Propellor D/S) of the benthos. EPT tended to make up a larger proportion of benthos in stream sites with larger stone or rock substrate (Llama OF, Propellor OF, Propellor D/S), rather than sediments made up of fines (e.g., Chair OF, Wolf OF, Ref. B OF).

The most abundant three genera at each site made up between 31% and 75% of all individuals (Table 3.7-3). These genera were mainly dipterans, with the Coelenterata *Hydra* also present at Goose OF. The dipterans were from the family Chironomidae (non-biting midges) at all stream sites, except in Ref. B OF where the two dominant genera were from the dipteran family Ceratopogonidae (biting midges). Ref. B OF had the lowest water levels of all stream sites sampled, with sections completely dried up, and was only able to be sampled for benthos after a week of rain.

Table 3.7-3. Most Abundant Benthic Macroinvertebrate Genera in Streams, Back River Project, August 2011

Stream	Major Group	Family	Genera	%
Chair OF	Diptera	Chironomidae	*Polypedilum*	27.4
	Diptera	Chironomidae	*Tanytarsus*	11.7
	Diptera	Chironomidae	*Thienemannimyia* group	11.5
Llama OF	Diptera	Chironomidae	*Diamesa*	35.8
	Diptera	Chironomidae	*Cricotopus/Orthocladius*	29.6
	Diptera	Chironomidae	*Eukiefferiella*	9.2
Giraffe OF	Diptera	Chironomidae	*Paratanytarsus*	51.2
	Diptera	Chironomidae	*Psectrocladius*	7.1
	Diptera	Chironomidae	*Zalutschia*	4.3
Wolf OF	Diptera	Chironomidae	*Dicrotendipes*	23.0
	Diptera	Chironomidae	*Thienemannimyia* group	12.1
	Diptera	Chironomidae	*Polypedilum*	7.5
Goose OF	Diptera	Chironomidae	*Paratanytarsus*	16.4
	Diptera	Chironomidae	*Cricotopus/Orthocladius*	8.4
	Coelenterata	Hydridae	*Hydra*	6.5
Propellor OF	Diptera	Chironomidae	*Cricotopus/Orthocladius*	26.7
	Diptera	Chironomidae	*Psectrocladius*	17.2
	Diptera	Chironomidae	*Paratanytarsus*	17.1
Propellor D/S	Diptera	Chironomidae	*Thienemannimyia* group	20.5
	Diptera	Chironomidae	*Euryhapsis*	16.3
	Diptera	Chironomidae	*Dicrotendipes*	10.8
Ref. B OF	Diptera	Ceratopogonidae	*Cladotanytarsus*	27.2
	Diptera	Ceratopogonidae	*Bezzia*	12.3
	Diptera	Chironomidae	*Tanytarsus*	10.2

Note: None of the genera listed in this table were identified below genus level. Individuals not identified to genus level, which includes immature and damaged individuals, were not included in this table.

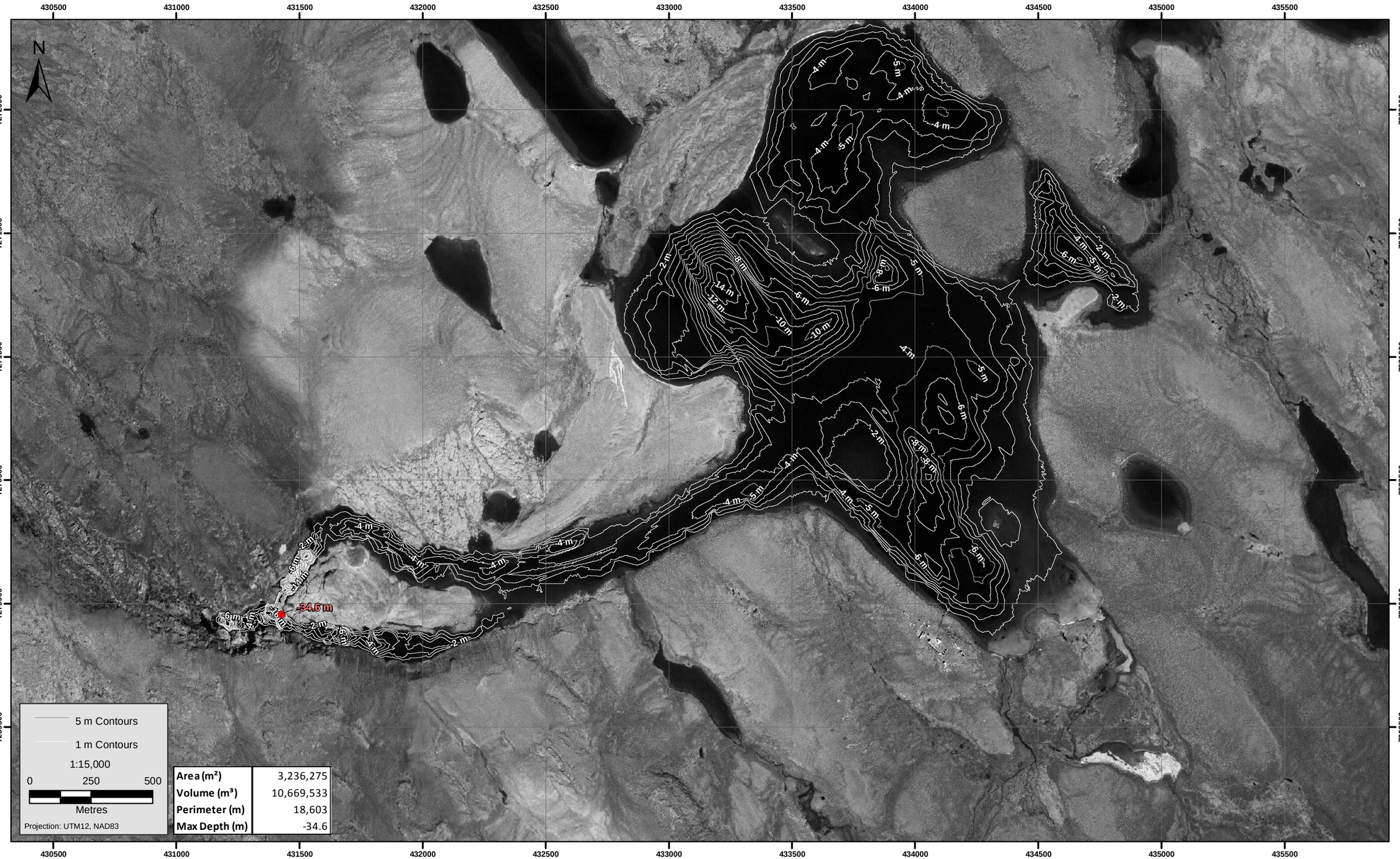
3.7.3.2 Richness and Diversity

Stream benthic richness was higher than lake richness, ranging from 6.4 to 14.6 families/sample and averaging 9.9 families/sample (Figure 3.7-6). The greatest family richness was recorded at Propellor D/S (15 families/sample), followed by Chair OF and Goose OF (both 12 families/sample). All other stream sampling sites had an average of less than 9.4 families/sample.

The mean diversity index ranged between 0.33 at Llama OF and Propellor OF, and 0.64 at Ref. B OF. The greatest diversity was seen at Ref. B OF, Goose OF, and Chair OF which had diversities of 0.64, 0.59 and 0.56, respectively. Diversity did not always correspond with richness, indicating that some family-rich sites were dominated numerically by a few families (or a single family) or, alternatively, that some family-poor sites contained a relatively even distribution of individuals amongst families.

3.8 BATHYMETRY

Figures 3.8-1 to 3.8-3 provide the bathymetric maps generated for: Goose Lake, Round Pond and the pond north east of Round Pond (see Figure 2.1-1 for location).

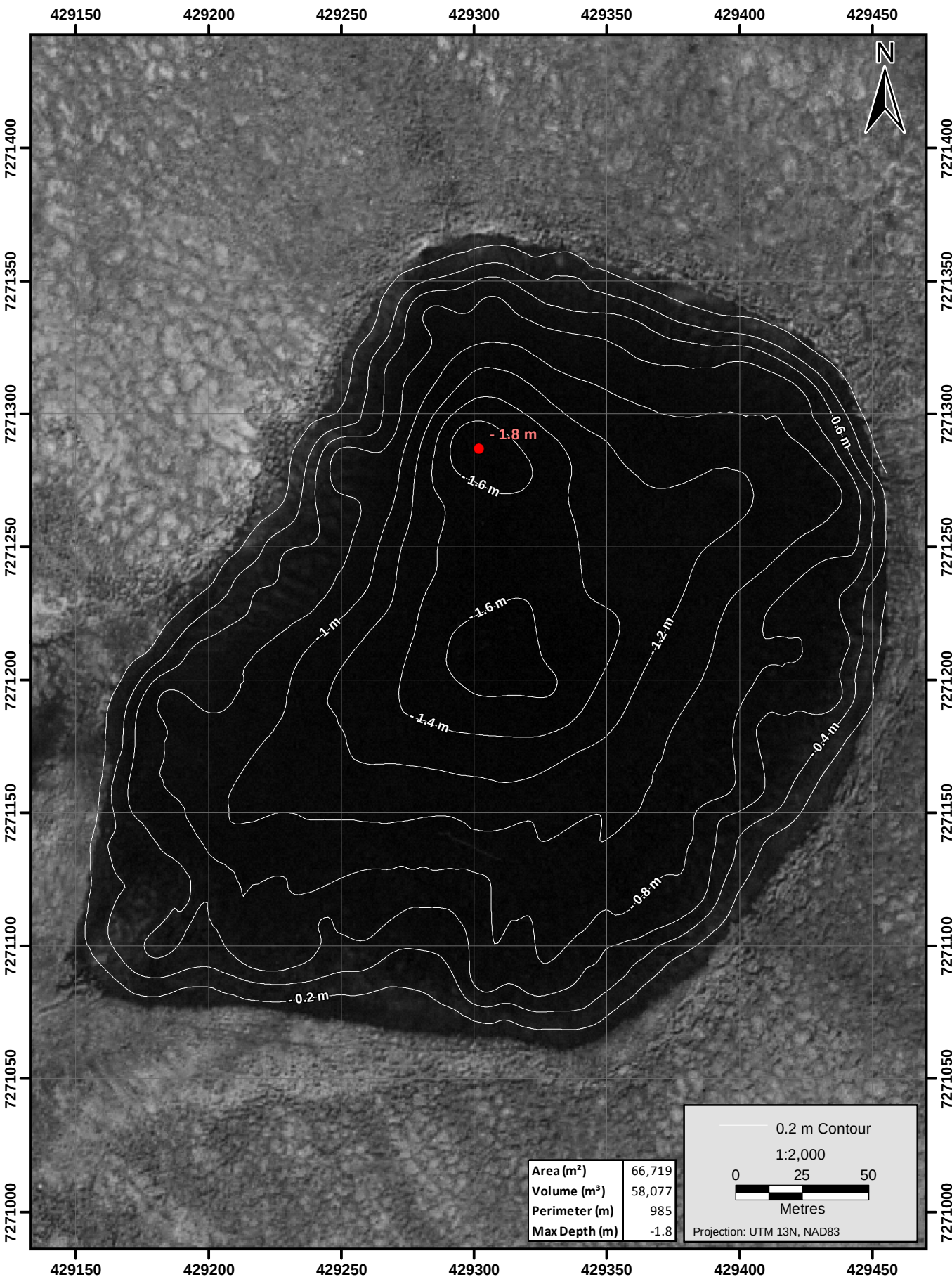


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Figure 3.8-1

Bathymetry of Goose Lake, Back River Project, 2011



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Bathymetry of Round Pond, Back River Project, 2011

Figure 3.8-2

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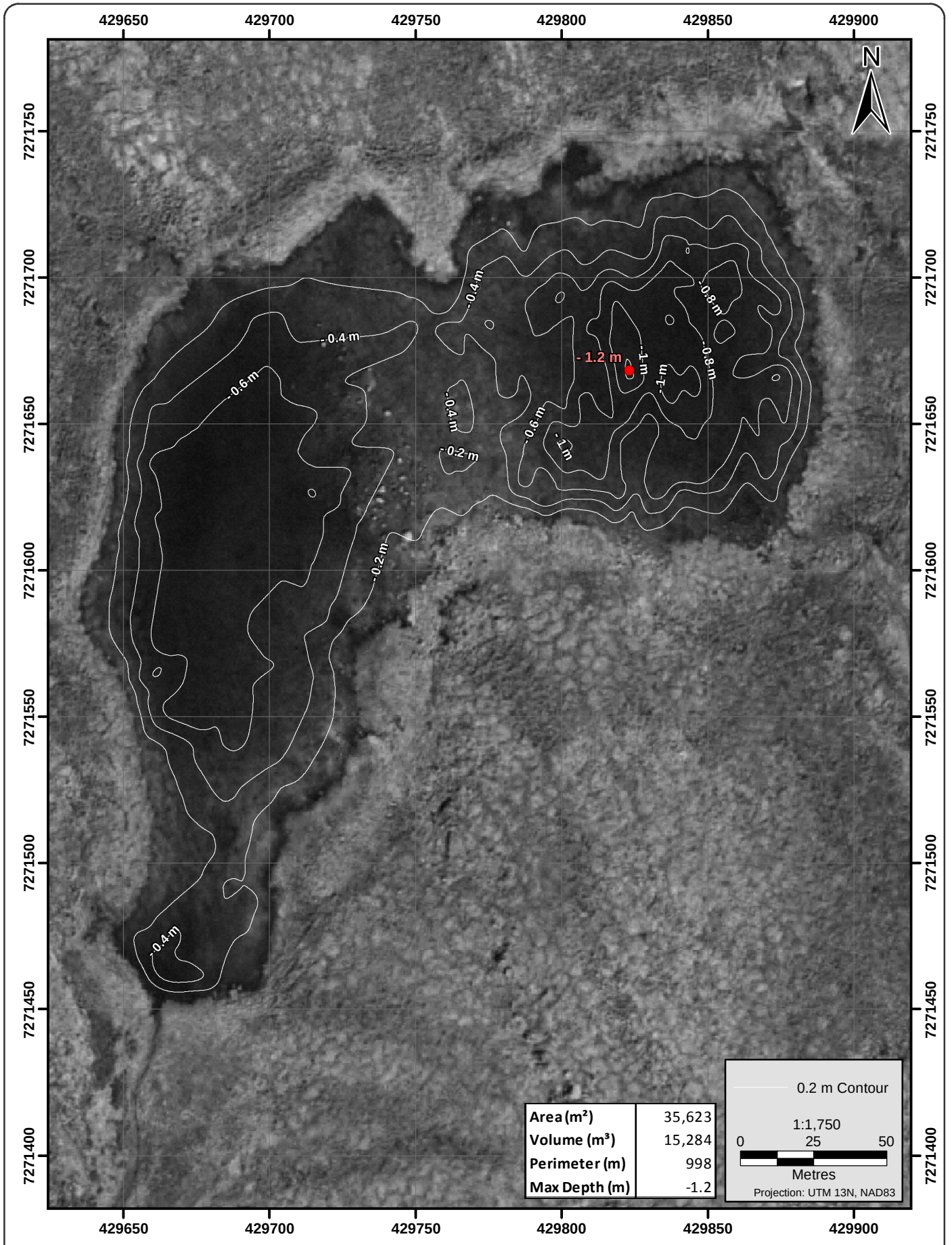


Figure 3.8-3

Bathymetry of Pond North East of Round Pond, Back River Project, 2011

4. Summary

4. Summary

Of the eight lake sites sampled, seven were less than 10 m deep. Dissolved oxygen concentrations at either bottom depths or all depths exceeded CCME guidelines at all lakes sampled. Lakes tended to have low nutrient levels, with the exception of Umwelt Lake. Umwelt Lake was a shallow lake with hard water, and high total dissolved sediments. Most lake sites exceeded CCME water quality guidelines for at least one parameter, commonly cadmium, with Llama Lake and Reference B Lake as exceptions. Most sites exceeded CCME guidelines for sediment quality, with exceptions being Goose Lake Tail and Reference B. Average sediment arsenic concentrations at Llama Lake exceeded PELs.

Lakes had similar phytoplankton biomasses and densities, with most of the community being made up of chrysophytes, green algae, diatoms and cyanobacteria. Zooplankton concentrations were greatest in Llama Lake, the deepest lake, and similar in all other lakes. Zooplankton communities were mainly composed of copepods and rotifers, with cladocerans being a significant component in Giraffe Lake. Benthos densities were highest in Umwelt, Goose Central and Reference B lakes, and mainly composed of dipterans at all lakes. A summary of the findings for lake sites sampled in the 2011 Freshwater Baseline Report is presented in Table 4.1-1.

Streams sampled varied from small streams with silt substrate, such as Chair OF, Echo OF, Wolf OF, and Ref. B OF, to larger cobble or boulder substrate streams, such as Llama OF, Giraffe OF, Goose OF, Propellor OF, and Propellor D/S. In August, dissolved oxygen concentrations exceeded CCME guidelines at all sites, with the lowest concentrations at Llama OF. Streams tended to have low nutrients, with exceptions being the smaller streams Chair OF and Ref. B OF. Water quality at Chair OF, Llama OF, Echo OF, Giraffe OF and Ref. B OF exceeded CCME guidelines for at least one parameter, often copper and cadmium. Sediment quality at Chair OF, Giraffe OF, Goose OF and Ref. B OF exceeded guidelines for arsenic or copper or both.

Periphyton biomass and density was similar across stream sites, with communities being dominated largely by diatoms and then cyanobacteria. Benthos densities were similar across streams, communities were mainly composed of dipterans, with smaller ammounts of ostracoda, hydracarina and oligochaeta. A summary of the findings for stream sites sampled in the 2011 Freshwater Baseline Report is presented in Table 4.1-2.

Table 4.1-1. Summary of 2011 Freshwater Baseline Results for Lakes

		Dissolved Oxygen	Water Quality			Sediment Quality	Primary production	Aquatic Macroinvertebrates	
Lake	Max Depth (m)	Seasons and Depths that Exceed CCME Guidelines*	General Description	Nutrient Status	Parameters that Exceed CCME Guidelines*	Parameters that Exceed CCME Guidelines	Phytoplankton	Zooplankton	Benthos
Llama	14.5	Early life stages: winter, bottom depths; summer, all depths	Slightly acidic, soft, low TDS	Ultra-oligotrophic	-	ISQGs: As, Cu; PELs: As	Low chl *a* biomass, 61% chrysophyte, lowest richness and diversity	Highest densities, dominated by copepods	Lowest densities, lowest proportion of dipterans (66%)
Umwelt	2.6	All life stages: winter, all depths; early life stages: summer, all depths	Neutral, soft to moderately hard, highest TDS	Oligotrophic to Mesotrophic	Cu	ISQGs: As, Cu	Highest chl *a* biomass and density, high richness and diversity	Intermediate densities, dominated by calanoid copepods, lowest diversity	Highest densities, highest proportion of dipterans (82%)
Giraffe	5.9	Early life stages: summer, all depths	Slightly acidic, soft, low TDS	Ultra-oligotrophic	Cd, Cu	ISQGs: As, Cu	Lowest chl *a* biomass, high richness and diversity	Intermediate densities, community most evenly split	Relatively low densities, dominated by dipterans
Goose Neck	3.5	Early life stages: summer, all depths	Slightly acidic, soft, low TDS	Ultra-oligotrophic	Cd	ISQGs: As, Cd, Cu	Low chl *a* biomass and lowest densities, 59% chrysophyte, high richness and diversity	Intermediate densities, dominated by calanoid copepods	Relatively low densities, dominated by dipterans
Goose Central	9.2 (winter location) or 5.2 (summer location)	Early life stages: winter, below 2 m; summer, all depths	Slightly acidic, soft, low TDS	Ultra-oligotrophic	Cd	ISQGs: As, Cu	Higher chl *a* biomass, 47% chrysophytes, high richness and diversity	Intermediate densities, dominated by calanoid copepods	Relatively high densities, dominated by dipterans
Goose Tail	2.5	Early life stages: summer, bottom depths	Slightly acidic, low TDS	Ultra-oligotrophic	pH, Al	-	nc	nc	nc
Propellor	7.9	Early life stages: winter, bottom depths; summer, all depths	Slightly acidic, soft, low TDS	Ultra-oligotrophic to Oligotrophic	Cd	ISQGs: Cu	nc	nc	nc
Reference B	5.3	Early life stages: winter, bottom depths; summer, all depths	Neutral, soft, low TDS	Ultra-oligotrophic to Oligotrophic	-	-	Higher chl *a* biomass and density, high richness and diversity	Lowest densities and richness, dominated by rotifers, smallest proportion of calanoid copepods	Relatively high densities, dominated by dipterans, biting midges abundant

nc = not collected

** CCME guidelines for the protection of aquatic life can be found on all graphs and appendices.*

Samples were only considered exceedences if they were above detection limits.

Table 4.1-2. Summary of 2011 Freshwater Baseline Results from Streams

			Dissolved Oxygen	Water Quality			Sediment Quality	Primary Production	Aquatic Macroinvertebrates
Stream	General Description	Substrate	Seasons that Exceed CCME Guidelines	General Description	Nutrient Status	Parameters that Exceed CCME Guidelines	Parameters that Exceed CCME Guidelines	Periphyton	Benthos
Chair OF	Small stream through floodplain.	Mainly silt, few small stones	Early life stages: summer	Slightly acidic, soft, low TDS	Oligotrophic to Mesotrophic	Cd, Cu	ISQGs: As	Low chl *a* biomass, higher densities, cyanobacteria (45%) and diatoms (46%) dominate, highest richness, high diversity	Lower densities, dominated by dipterans (74%), high diversity
Llama OF	Medium stream through large boulder field.	Cobbles, large stones, boulders	All life stages: summer	Slightly acidic, soft to hard depending on season, high TDS	Ultra-oligotrophic to Oligotrophic	pH, Al, Cd, Cu	nc	Intermediate chl *a* biomass, diatoms dominate (80%), lowest richness, lowest diversity	Highest densities, highest proportion of diptera (82%), lowest diversity
Echo OF	Very small stream through flood plain, dry during summer sampling.	Mainly silt, few small stones	Early life stages: summer	The most acidic of all streams sampled, soft, low TDS	Ultra-oligotrophic to Oligotrophic	pH, Al, Cd, Cu	nc	nc	nc
Giraffe OF	Short, medium-sized stream linking to close by lakes, cobbles.	Cobbles, large stones, boulders	Early life stages: summer	Slightly acidic, soft, low TDS	Ultra-oligotrophic to Oligotrophic	Cu	ISQGs: As	Intermediate chl *a* biomass, highest densities; cyanobacteria (40%) and diatoms (57%) dominate, high richness and diversity	Lower densities, dominated by dipterans (78%)
Wolf OF	Small stream running through flood plain	Mainly silt, few small stones	Early life stages: summer	Slightly acidic, soft, low TDS	Ultra-oligotrophic to Oligotrophic	-	nc	Lowest chl *a* biomass, diatoms dominate (66%), lowest richness, high richness and diversity	Lower densities, dominated by dipterans (66%), lowest family richness
Goose OF	Short, medium-sized stream linking to close by lakes, cobbles.	Cobbles, large stones, boulders	Early life stages: summer	Slightly acidic, soft, low TDS	Ultra-oligotrophic to Oligotrophic	-	ISQGs: As, Cu	Highest chl *a* biomass, diatoms dominate (79%), high richness and diversity	Lower densities, lowest proportion of diptera (60%), high diversity
Propellor OF	Large stream draining largest lake in the area. Runs through boulder field.	Large stones, boulders	Early life stages: summer	Slightly acidic, soft, low TDS	Ultra-oligotrophic to Oligotrophic	-	-	Intermediate chl *a* biomass, diatoms dominate (81%), high richness and diversity	Relatively high densities, dominated by dipterans (79%)
Propellor D/S	Large stream downstream from the source lake, cobbles and boulders.	Cobbles, large stones, boulders	Early life stages: summer	Slightly acidic, soft, low TDS	Ultra-oligotrophic to Oligotrophic	-	-	Highest chl *a* biomass, diatoms dominate (73%), high richness and diversity	Lower densities, dominated by dipterans (68%), highest richness, lowest diversity
Ref. B OF	Small stream through floodplain.	Mainly silt, few small stones	Early life stages: summer	Neutral, soft, low TDS	Oligotrophic to Mesoeutrophic	Fe	ISQGs: Cu	Intermediate chl *a* biomass, cyanobacteria (45%) and diatoms (52%) dominate, high richness and diversity	Lower densities, dominated by dipterans (69%), high diversity

nc = not collected

** CCME guidelines for the protection of aquatic life can be found on all graphs and appendices.*

Samples were only considered exceedences if they were above detection limits.

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Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.

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Appendix 3.1-1

Lakes Dissolved Oxygen/Temperature Profiles, Back River Project, 2011

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Appendix 3.1-1. Lakes Dissolved Oxygen/Temperature Profiles, Back River Project, 2011

Lake	Llama Lake					
Date	12-Apr-11			06-Aug-11		
Depth	Temp	Dissolved Oxygen	Dissolved Oxygen	Temp	Dissolved Oxygen	Dissolved Oxygen
(m)	(°C)	(mg/L)	(% Saturation)	(°C)	(mg/L)	(% Saturation)
0	ice thickness = 1.5 m			15	9.13	89.6
0.5						
1				14.9	8.77	86.7
1.5	0.2	15.06	103.9			
2	0.4	14.35	100.6	14.9	8.72	86.4
2.5	1.6	13.44	96.1			
3	2.5	12.44	90.6	14.9	8.66	85.0
3.5	2.4	11.13	87.2			
4	2.5	11.17	81.9	14.5	8.69	85.2
4.5	2.5	11.16	81.8			
5	2.5	11.21	82.2	14.4	8.68	84.5
5.5	2.5	11.20	82.1			
6	2.5	11.23	82.3	14	8.62	83.8
6.5	2.5	11.23	82.3			
7	2.5	11.30	82.8	13.5	8.62	82.8
7.5	2.5	11.38	83.4			
8	2.5	11.35	83.2	13.5	8.63	82.8
8.5	2.5	11.40	83.5			
9	2.5	11.52	84.5	13.4	8.61	82.3
9.5	2.5	11.49	84.2			
10	2.6	11.51	84.6	13.3	8.63	82.4
10.5	2.6	11.41	83.8			
11	2.6	11.40	83.7	13.3	8.60	82.1
11.5	2.5	10.84	79.4			
12	2.5	11.14	81.7	13.2	8.61	82.1
12.5	2.6	10.01	73.4			
13	2.6	8.53	63.3	13.1	8.52	80.5
13.5	2.7	9.31	68.6			
	bottom depth = 13.7 m			bottom depth = 14.5 m		

Lake	Umwelt Lake					
Date	13-Apr-11			05-Aug-11		
Depth	Temp	Dissolved Oxygen	Dissolved Oxygen	Temp	Dissolved Oxygen	Dissolved Oxygen
(m)	(°C)	(mg/L)	(% Saturation)	(°C)	(mg/L)	(% Saturation)
0	ice thickness = 1.5 m			15.2	8.95	89.1
0.5				15.1	9.00	89.5
1				15.1	9.01	89.0
1.5	0.1	3.83	26.3	15.1	8.87	88.2
2	0.9	3.73	26.1	15.4	8.91	88.1
2.5	2.1	3.26	23.6			
	bottom depth = 2.6 m			bottom depth = 2.0 m		

Appendix 3.1-1. Lakes Dissolved Oxygen/Temperature Profiles, Back River Project, 2011

Lake	Giraffe Lake					
Date	16-Apr-11			10-Aug-11		
Depth	Temp	Dissolved Oxygen	Dissolved Oxygen	Temp	Dissolved Oxygen	Dissolved Oxygen
(m)	(˚C)	(mg/L)	(% Saturation)	(˚C)	(mg/L)	(% Saturation)
0	ice thickness = 1.85 m			16.8	7.93	81.7
0.5				16.8	7.93	81.7
1				16.8	7.97	82.0
1.5				16.6	8.01	82.2
2	0.5	14.62	101.5	16.5	8.00	82.0
2.5	1.6	16.21	115.8	16.5	8.08	82.7
3	2.5	15.86	116.3	16.5	8.09	82.8
3.5				16.4	8.08	82.8
4				16.3	8.12	82.7
4.5				16.2	8.12	82.6
5				15.7	8.21	81.9
	bottom depth = 3.6 m			bottom depth = 5.9 m		

Lake	Goose Lake Neck					
Date	17-Apr-11			07-Aug-11		
Depth	Temp	Dissolved Oxygen	Dissolved Oxygen	Temp	Dissolved Oxygen	Dissolved Oxygen
(m)	(˚C)	(mg/L)	(% Saturation)	(˚C)	(mg/L)	(% Saturation)
0	ice thickness = 1.5			15.5	8.35	83.5
0.5				15.5	8.27	83.1
1				15.5	8.29	83.0
1.5	0.2	15.49	106.6	15.5	8.22	82.5
2	0.7	15.71	109.6	15.5	8.18	82.0
2.5	1.9	12.59	90.7	15.5	8.22	82.5
3	2.6	12.12	89.1	15.5	8.29	83.1
3.5				15.5	8.28	83.1
	bottom depth = 3.35 m			bottom depth = 3.5 m		

Lake	Goose Lake Central					
Date	14-Apr-11			07-Aug-11		
Depth	Temp	Dissolved Oxygen	Dissolved Oxygen	Temp	Dissolved Oxygen	Dissolved Oxygen
(m)	(˚C)	(mg/L)	(% Saturation)	(˚C)	(mg/L)	(% Saturation)
0	ice thickness = 1.5 m			15.5	8.33	84.1
0.5				15.5	8.38	84.0
1				15.5	8.42	84.4
1.5	0.1	14.49	99.4	15.5	8.40	84.2
2	0.6	13.37	99.3	15.5	8.40	84.3
2.5	1.4	11.92	84.8	15.5	8.41	84.3
3	1.9	10.38	74.8	15.5	8.40	84.3
3.5	2.1	8.65	62.7	15.5	8.41	84.3
4	2.2	8.26	60.1	15.5	8.42	84.3
4.5	2.3	8.00	58.3	15.3	8.43	83.9
5	2.4	8.31	60.7			
5.5	2.4	7.75	56.6			
6	2.4	8.29	60.7			
6.5	2.5	8.44	61.9			
7	2.5	8.82	64.6			
7.5	2.5	7.92	58.0			
8	2.5	8.82	64.6			
8.5	2.5	8.88	65.1			
9	2.5	8.12	59.5			
	bottom depth = 9.15 m			bottom depth = 5.2 m		

Appendix 3.1-1. Lakes Dissolved Oxygen/Temperature Profiles, Back River Project, 2011

Lake	Goose Lake Tail			Goose Lake Tail		
Date				17-Aug-11		
Depth				Temp	Dissolved Oxygen	Dissolved Oxygen
(m)				(°C)	(mg/L)	(% Saturation)
0	winter data not collected at this site			12.6	9.96	94.0
0.5				12.6	9.86	92.6
1				12.6	9.52	89.5
1.5				12.6	9.43	88.2
				bottom depth = 2.5 m		

Lake	Propellor Lake					
Date	16-Apr-11			11-Aug-11		
Depth	Temp	Dissolved Oxygen	Dissolved Oxygen	Temp	Dissolved Oxygen	Dissolved Oxygen
(m)	(°C)	(mg/L)	(% Saturation)	(°C)	(mg/L)	(% Saturation)
0	ice thickness = 1.4 m			16.0	8.10	84.2
0.5				16.0	8.06	82.1
1				16.0	8.01	81.2
1.5	0.1	15.69	107.7	16.0	8.01	81.2
2	0.5	15.13	104.4	16.0	8.07	81.6
2.5	0.9	13.47	94.4	16.0	8.08	81.8
3	1.2	12.22	86.4	16.0	8.09	82.0
3.5	1.4	11.72	83.4	16.0	8.10	82.2
4	1.6	11.49	82.2	16.0	8.13	82.1
4.5	1.7	10.84	77.7	15.9	8.14	82.4
5	1.8	10.34	74.3	15.9	8.16	82.6
5.5	2.0	10.22	73.9	15.9	8.18	82.6
6	2.1	9.90	71.7	15.9	8.17	82.7
6.5	2.3	7.46	58.0	15.9	8.25	83.1
7	2.5	7.98	58.5	15.7	8.26	83.2
7.5				15.7	7.70	80.0
	bottom depth = 7.9 m			bottom depth = 7.8 m		

Lake	Reference B Lake					
Date	12-Apr-11			08-Aug-11		
Depth	Temp	Dissolved Oxygen	Dissolved Oxygen	Temp	Dissolved Oxygen	Dissolved Oxygen
(m)	(°C)	(mg/L)	(% Saturation)	(°C)	(mg/L)	(% Saturation)
0	ice thickness = 1.3 m			16.0	8.26	83.7
0.5				16.0	8.21	83.2
1				15.9	8.33	84.4
1.5	0.0	13.47	92.2	15.9	8.36	84.5
2	0.0	12.21	83.3	15.9	8.32	84.1
2.5	1.4	10.47	75.6	15.9	8.32	84.2
3	2.6	7.02	51.4	15.9	8.35	84.4
3.5	3.1	2.95	22.1	15.8	8.35	84.2
4	3.4	1.38	10.4	15.8	8.36	84.5
4.5				15.8	8.34	84.8
	bottom depth 5.1 m			bottom depth = 5.3 m		

Appendix 3.2-1

Lake Water Quality Analytical Results, Back River Project, 2011

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Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2011

Site Abbreviation:				Llama Lake	Llama Lake	Umwelt Lake	Umwelt Lake	Giraffe Lake	Goose Lake Neck	Goose Lake Central	Goose Lake Central	Propellor Lake	Propellor Lake	Propellor Lake	Reference B Lake	Reference B Lake	Reference B Lake
Depth Zone:				Shallow	Bottom	Ice-water interface	Ice-water interface	Ice-water interface	Ice-water interface	Shallow	Bottom	Shallow	Bottom	Bottom	Shallow	Shallow	Bottom
Depth (m):				1	12	0	0	0.2	0	1	7.5	1	6	6	1	1	3.5
Replicate:				1	1	1	2	1	1	1	1	1	1	2	1	2	1
Date Sampled:		CCME Guideline for the Protection		12-Apr-11	12-Apr-11	13-Apr-11	13-Apr-11	16-Apr-11	17-Apr-11	14-Apr-11	14-Apr-11	16-Apr-11	16-Apr-11	16-Apr-11	13-Apr-11	13-Apr-11	13-Apr-11
ALS Sample ID:	Units	of Freshwater Aquatic Life[a]	RDL[h]	L995193-1	L995193-2	L995193-7	L995193-8	L996086-4	L996086-7	L996086-5	L996086-6	L996086-1	L996086-2	L996086-3	L995193-4	L995193-6	L995193-5
Physical Tests																	
Conductivity	µS/cm		2.0	65.3	74.6	173	175	62.9	48.6	34.4	29.2	20.5	18.0	18.6	31.0	29.1	28.6
Hardness (as $CaCO_3$)	mg/L		0.50	25.3	29.4	83.6	79.5	27.2	20.7	13.9	11.9	9.04	7.91	7.77	13.8	13.3	12.4
pH	pH	6.5-9.0	0.10	7.09	7.05	7.07	7.06	6.85	6.82	6.83	6.71	6.63	6.63	6.70	7.08	7.04	6.93
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	9.9	9.8	32.3	32.7	11.3	9.2	5.9	4.8	5.8	4.5	4.8	9.4	9.5	9.6
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	9.9	9.8	32.3	32.7	11.3	9.2	5.9	4.8	5.8	4.5	4.8	9.4	9.5	9.6
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	3.3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	46	55	127	129	31	33	30	27	14	21	21	26	25	19
Turbidity	NTU	dependent on background levels	0.10	0.26	1.11	0.65	0.62	0.33	0.57	0.31	0.24	0.33	0.25	0.29	0.26	0.32	0.35
Nutrients																	
Ammonia (as N)	mg/L	pH- and temperature-dependent	0.0050	0.0153	0.0113	0.0660	0.0682	0.0195	0.0094	0.0255	0.0219	0.0175	0.0143	0.0151	0.0567	0.0579	0.0812
Nitrate (as N)	mg/L	2.935[b]	0.01	0.0362	0.0822	0.0569	0.0487	0.0230	0.0249	0.0247	0.0312	<0.0050	0.0209	0.0210	0.0774	0.0260	0.0501
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.208	0.206	0.639	0.640	0.293	0.285	0.275	0.205	0.163	0.180	0.161	0.271	0.263	0.261
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus	mg/L	Trigger ranges from guidance framework	0.002	0.0025	0.0030	0.0137	0.0063	0.0025	0.0028	0.0032	0.0026	0.0021	0.0024	0.0029	0.0049	0.0031	0.0039
Anions																	
Bromide (Br)	mg/L		0.050	<0.050	<0.050	0.078	0.081	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L		0.50	8.78	9.99	23.3	23.6	1.22	3.35	2.21	1.78	0.87	0.74	0.76	0.77	0.71	0.60
Fluoride (F)	mg/L	0.12[b]	0.02	0.025	0.022	0.037	0.037	0.030	0.023	0.020	<0.020	<0.020	<0.020	<0.020	0.021	0.021	<0.020
Sulphate (SO_4)	mg/L		0.5	6.79	7.62	13.4	13.5	14.9	6.94	5.05	4.18	2.84	2.42	2.44	3.54	3.28	2.58
Cyanides																	
Cyanide, Total	mg/L		0.0010	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanide, Free	mg/L	0.005	0.0010 - 0.0050	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Organic / Inorganic Carbon																	
Total Organic Carbon	mg/L		0.50	4.30	3.90	10.6	10.9	6.15	5.50	4.41	3.50	3.93	3.20	3.19	3.62	3.45	3.14
Total Metals																	
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0068	0.0273	0.0108	0.0108	0.0225	0.0180	0.0158	0.0129	0.0117	0.0092	0.0082	0.0031	0.0042	0.0044
Antimony (Sb)	mg/L		0.00005 - 0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.005	0.000030	0.000305	0.000288	0.000612	0.000656	0.000370	0.000326	0.000296	0.000216	0.000203	0.000142	0.000133	0.000212	0.000213	0.000211
Barium (Ba)	mg/L		0.000050	0.0119	0.0145	0.0420	0.0429	0.00915	0.0109	0.00647	0.00606	0.00405	0.00393	0.00395	0.00604	0.00587	0.00648
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.001 - 0.005	0.0084	0.0091	0.0099	0.0096	0.0100	0.0093	0.0080	0.0081	0.0078	0.0078	0.0069	0.0081	0.0090	0.0086
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	<0.000010	<0.000010	0.000010	0.000014	0.000018	0.000010	0.000015	<0.000010	<0.000010	<0.000010	0.000018	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	6.12	6.78	17.8	17.2	4.84	4.41	3.01	2.58	1.56	1.34	1.50	2.27	2.44	2.39
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	<0.00010	0.00019	0.00019	0.00021	0.00037	0.00030	0.00026	0.00027	0.00016	0.00029	0.00023	0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	0.00027	0.00028	0.00040	0.00028	<0.00010	0.00026	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00023
Copper (Cu)	mg/L	≥0.002[e]	0.00050	0.00176	0.00183	0.00298	0.00310	0.00407	0.00277	0.00219	0.00170	0.00127	0.00110	0.00102	0.00104	0.00094	0.00083
Iron (Fe)	mg/L	0.3	0.010	<0.010	0.041	0.104	0.107	0.025	0.057	0.011	0.033	<0.010	0.013	0.014	0.015	0.013	0.070
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	2.78	3.06	9.42	9.39	3.77	2.46	1.79	1.48	1.17	0.990	1.00	1.79	1.78	1.65
Manganese (Mn)	mg/L		0.000050	0.00148	0.00611	0.0175	0.0172	0.00445	0.00631	0.00247	0.00981	0.00121	0.00373	0.00368	0.00383	0.00358	0.0190
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073[d]	0.000050	0.000059	0.000056	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

Winter surface water quality samples were collected from 1 m below the ice water interface, unless lakes were particularly shallow.

Winter bottom water quality samples were collected from 1.5 to 2 m above the sediments to avoid contamination.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2011

Site Abbreviation:				Llama Lake	Llama Lake	Umwelt Lake	Umwelt Lake	Giraffe Lake	Goose Lake Neck	Goose Lake Central	Goose Lake Central	Propellor Lake	Propellor Lake	Propellor Lake	Reference B Lake	Reference B Lake	Reference B Lake
Depth Zone:				Shallow	Bottom	Ice-water interface	Ice-water interface	Ice-water interface	Ice-water interface	Shallow	Bottom	Shallow	Bottom	Bottom	Shallow	Shallow	Bottom
Depth (m):				1	12	0	0	0.2	0	1	7.5	1	6	6	1	1	3.5
Replicate:				1	1	1	2	1	1	1	1	1	1	2	1	2	1
Date Sampled:		CCME Guideline for the Protection		12-Apr-11	12-Apr-11	13-Apr-11	13-Apr-11	16-Apr-11	17-Apr-11	14-Apr-11	14-Apr-11	16-Apr-11	16-Apr-11	16-Apr-11	13-Apr-11	13-Apr-11	13-Apr-11
ALS Sample ID:	Units	of Freshwater Aquatic Life[a]	RDL[h]	L995193-1	L995193-2	L995193-7	L995193-8	L996086-4	L996086-7	L996086-5	L996086-6	L996086-1	L996086-2	L996086-3	L995193-4	L995193-6	L995193-5
Total Metals (continued)																	
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00240	0.00263	0.00732	0.00747	0.0144	0.00733	0.00499	0.00479	0.00245	0.00221	0.00227	0.00135	0.00146	0.00164
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.929	0.982	2.29	2.27	0.775	0.690	0.493	0.405	0.381	0.319	0.311	0.552	0.507	0.488
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.577	0.693	1.52	1.56	1.10	0.520	0.398	0.434	0.134	0.136	0.145	0.218	0.209	0.261
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	1.28	1.39	3.86	3.86	1.61	1.23	0.883	0.709	0.627	0.525	0.526	0.852	0.848	0.746
Strontium (Sr)	mg/L		0.00010	0.0462	0.0495	0.0843	0.0843	0.0205	0.0192	0.0130	0.0113	0.00785	0.00688	0.00686	0.00866	0.00871	0.00839
Thallium (Tl)	mg/L	0.0008	0.00005 - 0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000016	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	0.000077	0.000067	0.000081	0.000051	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	0.0032	0.0033	0.0034	0.0051	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																	
Aluminum (Al)	mg/L		0.0030	0.0043	0.0064	0.0080	0.0070	0.0182	0.0164	0.0105	0.0109	0.0068	0.0062	0.0082	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L		0.00005 - 0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L		0.000030	0.000313	0.000282	0.000578	0.000559	0.000332	0.000296	0.000266	0.000202	0.000179	0.000120	0.000133	0.000217	0.000199	0.000172
Barium (Ba)	mg/L		0.000050	0.0114	0.0143	0.0430	0.0415	0.00873	0.0107	0.00632	0.00586	0.00416	0.00382	0.00375	0.00593	0.00577	0.00635
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.001 - 0.005	0.0071	0.0075	0.0077	0.0082	0.0086	0.0084	0.0093	0.0077	0.0065	0.0071	0.0068	0.0065	0.0069	0.0075
Cadmium (Cd)	mg/L		0.000010	<0.000010	<0.000010	0.000012	0.000018	0.000015	<0.000010	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	5.62	6.71	18.0	17.0	4.88	4.36	2.72	2.36	1.67	1.56	1.51	2.56	2.44	2.26
Chromium (Cr)	mg/L		0.00010	0.00014	0.00016	0.00024	0.00025	0.00023	0.00015	0.00019	0.00017	<0.00010	0.00015	0.00015	0.00015	<0.00010	0.00011
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	0.00020	0.00019	0.00032	0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L		0.00050	0.00162	0.00171	0.00324	0.00302	0.00421	0.00253	0.00248	0.00159	0.00119	0.00102	0.00110	0.00092	0.00085	0.00077
Iron (Fe)	mg/L		0.010	<0.010	<0.010	0.013	0.012	<0.010	0.014	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	2.74	3.07	9.37	8.98	3.65	2.37	1.73	1.46	1.18	0.974	0.973	1.81	1.75	1.64
Manganese (Mn)	mg/L		0.000050	0.00119	0.00306	0.0152	0.0145	0.00355	0.00509	0.000673	0.00403	0.000639	0.00191	0.00225	0.00155	0.00157	0.00783
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	0.000062	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.00245	0.00275	0.00735	0.00716	0.0140	0.00717	0.00459	0.00453	0.00242	0.00225	0.00222	0.00144	0.00141	0.00151
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.947	0.995	2.28	2.21	0.757	0.670	0.472	0.388	0.386	0.309	0.316	0.552	0.517	0.473
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.561	0.655	1.54	1.54	1.09	0.504	0.388	0.421	0.135	0.135	0.142	0.210	0.211	0.241
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	1.27	1.39	3.85	3.74	1.56	1.20	0.855	0.695	0.641	0.510	0.523	0.864	0.824	0.759
Strontium (Sr)	mg/L		0.00010	0.0448	0.0482	0.0823	0.0825	0.0195	0.0186	0.0126	0.0107	0.00775	0.00649	0.00655	0.00846	0.00854	0.00836
Thallium (Tl)	mg/L		0.00005 - 0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	0.000056	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.0030	<0.0030	<0.0030	0.0076	0.0037	0.0036	<0.0030	0.0040	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Winter surface water quality samples were collected from 1 m below the ice water interface, unless lakes were particularly shallow.

Winter bottom water quality samples were collected from 1.5 to 2 m above the sediments to avoid contamination.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2011

Site Abbreviation:				Llama Lake	Llama Lake	Llama Lake	Umwelt Lake	Giraffe Lake	Giraffe Lake	Goose Lake Neck	Goose Lake Neck	Goose Lake Central	Goose Lake Tail	Propellor Lake	Propellor Lake	Reference B Lake	Reference B Lake
Depth Zone:				Shallow	Mid	Mid	Shallow	Shallow	Mid	Shallow	Shallow	Shallow	Shallow	Shallow	Mid	Shallow	Shallow
Depth (m):				1	7	7	1	1	2.9	1	1	1	1	1	3.5	1	1
Replicate:		CCME Guideline		1	1	2	1	1	1	1	2	1	1	1	1	1	2
Date Sampled:		for the Protection		6-Aug-11	6-Aug-11	6-Aug-11	5-Aug-11	10-Aug-11	10-Aug-11	7-Aug-11	7-Aug-11	7-Aug-11	17-Aug-11	11-Aug-11	11-Aug-11	8-Aug-11	8-Aug-11
ALS Sample ID:	Units	of Freshwater Aquatic Life[a]	RDL[h]	L1041632-3	L1041632-4	L1041632-5	L1041632-2	L1043888-8	L1043888-9	L1043888-1	L1043888-2	L1043888-3	L1047401-8	L1047634-2	L1047634-1	L1043888-6	L1043888-7
Physical Tests																	
Conductivity	µS/cm		2.0	54.9	54.9	55.0	49.3	22.5	22.3	27.4	27.1	23.9	23.1	15.7	16.2	15.0	14.8
Hardness (as $CaCO_3$)	mg/L		0.50	20.3	20.3	20.2	17.7	9.02	8.99	10.8	10.2	9.45	10.7	6.27	6.29	6.39	6.38
pH	pH	6.5-9.0	0.10	6.93	6.93	6.93	6.91	6.77	6.80	6.61	6.68	6.70	6.46	6.74	6.76	6.85	6.87
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	4.8	4.8	5.1	4.5	4.6	4.4	3.7	3.4	3.5	3.3	3.8	3.7	5.0	5.2
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	4.8	4.8	5.1	4.5	4.6	4.4	3.7	3.4	3.5	3.3	3.8	3.7	5.0	5.2
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	4.0	<3.0
Total Dissolved Solids	mg/L		10	38	39	43	34	11	17	25	13	13	19	13	12	11	12
Turbidity	NTU	dependent on background levels	0.10	0.29	0.32	0.33	0.43	0.33	0.32	0.35	0.37	0.34	0.44	0.34	0.33	0.41	0.43
Nutrients																	
Ammonia (as N)	mg/L	pH- and temperature-dependent	0.0050	0.0138	<0.0050	<0.0050	<0.0050	0.0137	0.0071	0.0091	0.0098	0.0068	0.0055	<0.0050	0.0061	0.0089	0.0101
Nitrate (as N)	mg/L	2.935[b]	0.01	0.0111	0.0057	<0.0050	0.0063	0.0081	<0.0050	0.0055	0.0164	<0.0050	0.0059	0.0056	0.0074	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.157	0.130	0.144	0.233	0.227	0.205	0.181	0.215	0.218	0.185	0.181	0.201	0.209	0.246
Ortho Phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus	mg/L	Trigger ranges from guidance framework	0.002	0.0030	0.0026	0.0028	0.0064	0.0029	0.0024	0.0034	0.0029	0.0033	0.0038	0.0052	0.0035	0.0042	0.0044
Anions																	
Bromide (Br)	mg/L		0.050	0.055	0.074	0.072	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L		0.50	11.1	11.1	11.1	9.80	0.63	0.62		3.66	2.77	2.69	1.04	1.04	<0.50	<0.50
Fluoride (F)	mg/L	0.12[b]	0.02	<0.020	<0.020	<0.020	0.021	0.023	0.024	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Sulphate (SO_4)	mg/L		0.5	3.82	3.82	3.81	3.28	5.10	5.16	3.15	3.14	3.09	3.07	2.21	2.18	1.76	1.76
Cyanides																	
Cyanide, Total	mg/L		0.0010	0.0029	0.0029	0.0016	0.0016	0.0043	0.0012	0.0029	0.0027	0.0026	0.0025	0.0023	0.0024	0.0042	0.0040
Cyanide, Free	mg/L	0.005	0.0010 - 0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0029	<0.0010	<0.0010	<0.0050	<0.0050
Organic / Inorganic Carbon																	
Total Organic Carbon	mg/L		0.50	3.47	3.41	3.34	4.66	3.81	3.67	3.48	3.62	3.65	3.21	3.35	3.41	3.26	3.30
Total Metals																	
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0223	0.0150	0.0169	0.0164	0.0316	0.0260	0.0354	0.0169	0.0177	0.0197	0.0130	0.0141	0.0114	0.0119
Antimony (Sb)	mg/L		0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000095	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000275	0.000270	0.000265	0.000298	0.000191	0.000230	0.000240	0.000204	0.000195	0.000221	0.000125	0.000138	0.000138	0.000136
Barium (Ba)	mg/L		0.000050	0.00995	0.0101	0.0101	0.00895	0.00314	0.00313	0.00553	0.00506	0.00467	0.00405	0.00303	0.00309	0.00271	0.00269
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.001 - 0.005	<0.0050	<0.0050	0.0051	<0.0050	<0.0050	<0.0050	0.0081	<0.0050	<0.0050	0.0052	0.0037	0.0042	<0.0050	<0.0050
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	5.59	5.60	5.62	4.27	1.64	1.67	2.63	2.33	2.13	1.98	1.34	1.60	1.22	1.20
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00016	0.00017	0.00022	0.00015	0.00018	0.00012	0.00016	0.00011	0.00010	<0.00010	0.00012	<0.00010	0.00012	0.00011
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	0.00010	0.00012	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	≥0.002[e]	0.00050	0.00125	0.00119	0.00113	0.00133	0.00217	0.00219	0.00153	0.00156	0.00146	0.00137	0.00093	0.00096	0.00076	0.00073
Iron (Fe)	mg/L	0.3	0.010	0.021	0.021	0.022	0.086	0.043	0.043	0.033	0.034	0.026	0.049	0.022	0.022	0.047	0.046
Lead (Pb)	mg/L	≥0.001[f]	0.000050	0.000202	0.000082	<0.000050	0.000219	0.000320	0.000065	0.000102	0.000061	0.000220	0.000084	0.000230	0.000115	0.000165	0.000068
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.71	1.73	1.71	1.85	1.22	1.27	1.22	1.15	1.09	1.07	0.770	0.773	0.894	0.884
Manganese (Mn)	mg/L		0.000050	0.00230	0.00237	0.00230	0.00133	0.00179	0.00176	0.00297	0.00273	0.00252	0.00286	0.00265	0.00276	0.00181	0.00182
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073[d]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

Winter surface water quality samples were collected from 1 m below the ice water interface, unless lakes were particularly shallow.

Winter bottom water quality samples were collected from 1.5 to 2 m above the sediments to avoid contamination.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2011

Site Abbreviation:				Llama Lake	Llama Lake	Llama Lake	Umwelt Lake	Giraffe Lake	Giraffe Lake	Goose Lake Neck	Goose Lake Neck	Goose Lake Central	Goose Lake Tail	Propellor Lake	Propellor Lake	Reference B Lake	Reference B Lake
Depth Zone:				Shallow	Mid	Mid	Shallow	Shallow	Mid	Shallow	Shallow	Shallow	Shallow	Shallow	Mid	Shallow	Shallow
Depth (m):				1	7	7	1	1	2.9	1	1	1	1	1	3.5	1	1
Replicate:		CCME Guideline		1	1	2	1	1	1	1	2	1	1	1	1	1	2
Date Sampled:		for the Protection		6-Aug-11	6-Aug-11	6-Aug-11	5-Aug-11	10-Aug-11	10-Aug-11	7-Aug-11	7-Aug-11	7-Aug-11	17-Aug-11	11-Aug-11	11-Aug-11	8-Aug-11	8-Aug-11
ALS Sample ID:	Units	of Freshwater Aquatic Life[a]	RDL[h]	L1041632-3	L1041632-4	L1041632-5	L1041632-2	L1043888-8	L1043888-9	L1043888-1	L1043888-2	L1043888-3	L1047401-8	L1047634-2	L1047634-1	L1043888-6	L1043888-7
Total Metals (continued)																	
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00156	0.00160	0.00155	0.00143	0.00440	0.00449	0.00312	0.00310	0.00311	0.00229	0.00177	0.00181	0.00075	0.00072
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.598	0.609	0.601	0.579	0.324	0.337	0.383	0.344	0.333	0.305	0.285	0.290	0.303	0.296
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.290	0.287	0.292	0.314	0.239	0.240	0.217	0.197	0.178	0.180	0.092	0.099	0.109	0.111
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.791	0.797	0.791	0.850	0.654	0.669	0.661	0.609	0.589	0.565	0.474	0.482	0.496	0.499
Strontium (Sr)	mg/L		0.00010	0.0395	0.0399	0.0397	0.0263	0.00715	0.00736	0.0135	0.0120	0.0109	0.0101	0.00611	0.00728	0.00456	0.00454
Thallium (Tl)	mg/L	0.0008	0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000010	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																	
Aluminum (Al)	mg/L		0.0030	0.0145	0.0104	0.0081	0.0061	0.0141	0.0146	0.0111	0.0094	0.0127	0.0099	0.0072	0.0092	0.0087	0.0042
Antimony (Sb)	mg/L		0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000250	0.000239	0.000270	0.000269	0.000219	0.000239	0.000223	0.000200	0.000191	0.000228	0.000131	0.000123	0.000133	0.000150
Barium (Ba)	mg/L		0.000050	0.00979	0.00970	0.00971	0.00853	0.00307	0.00306	0.00520	0.00500	0.00461	0.00464	0.00297	0.00300	0.00268	0.00261
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.001 - 0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0033	0.0039	<0.0050	<0.0050
Cadmium (Cd)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	5.40	5.41	5.38	4.22	1.60	1.59	2.39	2.24	2.05	2.22	1.29	1.30	1.14	1.14
Chromium (Cr)	mg/L		0.00010	<0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L		0.00050	0.00097	0.00092	0.00094	0.00115	0.00164	0.00166	0.00113	0.00119	0.00107	0.00132	0.00076	0.00073	<0.00050	<0.00050
Iron (Fe)	mg/L		0.010	<0.010	<0.010	<0.010	0.013	0.022	0.023	0.014	0.014	<0.010	<0.010	<0.010	<0.010	0.017	0.017
Lead (Pb)	mg/L		0.000050	0.000067	<0.000050	<0.000050	0.000065	0.000172	<0.000050	<0.000050	<0.000050	0.000070	<0.000050	<0.000050	<0.000050	0.000078	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.66	1.64	1.65	1.75	1.22	1.22	1.17	1.13	1.05	1.25	0.740	0.740	0.859	0.856
Manganese (Mn)	mg/L		0.000050	0.00120	0.00108	0.000913	0.000937	0.00139	0.00139	0.00123	0.000782	0.000444	0.00127	0.000150	0.000212	0.000278	0.000143
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.00146	0.00153	0.00155	0.00136	0.00408	0.00424	0.00293	0.00297	0.00289	0.00264	0.00170	0.00170	0.00062	0.00063
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.586	0.581	0.589	0.555	0.323	0.323	0.351	0.337	0.328	0.357	0.286	0.279	0.287	0.279
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.285	0.279	0.274	0.295	0.235	0.233	0.210	0.191	0.168	0.168	0.086	0.097	0.106	0.100
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.766	0.763	0.767	0.813	0.641	0.640	0.613	0.592	0.574	0.653	0.469	0.458	0.481	0.476
Strontium (Sr)	mg/L		0.00010	0.0380	0.0378	0.0379	0.0259	0.00694	0.00691	0.0122	0.0114	0.0103	0.0113	0.00584	0.00592	0.00427	0.00426
Thallium (Tl)	mg/L		0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.0030	0.0036	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Winter surface water quality samples were collected from 1 m below the ice water interface, unless lakes were particularly shallow.

Winter bottom water quality samples were collected from 1.5 to 2 m above the sediments to avoid contamination.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.2-2

Lake Water Quality QA/QC Results, Back River Project, 2011

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Appendix 3.2-2. Lake Water Quality QA/QC Results, Back River Project, 2011

Site Abbreviation:				Winter Equipment Blank	Winter Field Blank	Winter Travel Blank	Summer Equipment Blank	Summer Field Blank*	Summer Travel Blank
Depth Zone:		CCME Guideline for the Protection		12-Apr-11	17-Apr-11	17-Apr-11	5-Aug-11	07-Aug-11 and 11-Aug-11	07-Aug-11 and 11-Aug-11
Depth (m):		of Freshwater Aquatic Life[a]	RDL[h]	L995193-3	L996086-8	L996086-9	L1041632-1	L1043888-4 and L1047634-4	L1043888-5 and L1047634-3
Physical Tests									
Conductivity	µS/cm		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Hardness (as $CaCO_3$)	mg/L		0.50	<0.50	-	-	<0.50	<0.50	<0.50
pH	pH	6.5-9.0	0.10	5.86	5.46	5.57	5.85	5.55	5.54
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10 - 13	<10	<13	<10	<10	<10	<10
Turbidity	NTU	dependent on background levels	0.10	<0.10	0.18	0.17	<0.10	<0.10	<0.10
Nutrients									
Ammonia (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0058
Nitrate (as N)	mg/L	2.935[b]	0.0050	0.0165	<0.0050	<0.0050	0.0123	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.050	<0.050	0.161	<0.050	<0.050	<0.050	<0.050
Ortho-phosphate (as P)	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus	mg/L	Trigger ranges from guidance framework	0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Anions									
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	0.12[b]	0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Sulphate (SO_4)	mg/L		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Cyanides									
Cyanide, Total	mg/L		0.0010	-	-	-	<0.0010	0.0020	<0.0010
Cyanide, Free	mg/L	0.005	0.0050	-	-	-	<0.0050	<0.0050	<0.0050
Organic / Inorganic Carbon									
Total Organic Carbon	mg/L		0.50	<0.50	<0.50	<0.50	0.72	<0.50	<0.50
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	<0.0030	<0.0030	<0.0030	0.0125	-	-
Antimony (Sb)	mg/L		0.000050 - 0.00010	<0.00010	<0.00010	<0.00010	<0.000050	-	-
Arsenic (As)	mg/L	0.005	0.000030	<0.000030	<0.000030	<0.000030	<0.000030	-	-
Barium (Ba)	mg/L		0.000050	0.00227	<0.000050	<0.000050	0.000236	-	-

Winter surface water quality samples were collected from 1 m below the ice water interface, unless lakes were particularly shallow.

Winter bottom water quality samples were collected from 1.5 to 2 m above the sediments to avoid contamination.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

Total metal blanks were not collected in summer as ALS did not send these blanks to site.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.2-2. Lake Water Quality QA/QC Results, Back River Project, 2011

Site Abbreviation:				Winter Equipment Blank	Winter Field Blank	Winter Travel Blank	Summer Equipment Blank	Summer Field Blank*	Summer Travel Blank
Depth Zone:		CCME Guideline for the Protection of Freshwater Aquatic Life[a]	RDL[h]	12-Apr-11	17-Apr-11	17-Apr-11	5-Aug-11	07-Aug-11 and 11-Aug-11	07-Aug-11 and 11-Aug-11
Depth (m):				L995193-3	L996086-8	L996086-9	L1041632-1	L1043888-4 and L1047634-4	L1043888-5 and L1047634-3
Total Metals *(continued)*									
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	-	-
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.0010 - 0.0050	0.0018	<0.0010	0.0024	<0.0050	-	-
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-
Calcium (Ca)	mg/L		0.020	<0.020	<0.020	<0.020	<0.020	-	-
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Copper (Cu)	mg/L	≥0.002[e]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	-	-
Iron (Fe)	mg/L	0.3	0.010	<0.010	<0.010	<0.010	<0.010	-	-
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	0.000194	-	-
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Magnesium (Mg)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	-
Manganese (Mn)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	0.000163	-	-
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-
Molybdenum (Mo)	mg/L	0.073[d]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	-	-
Potassium (K)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	-	-
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Silicon (Si)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	-	-
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-
Sodium (Na)	mg/L		0.010	<0.010	<0.010	<0.010	0.014	-	-
Strontium (Sr)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Thallium (Tl)	mg/L	0.0008	0.000050 - 0.00010	<0.00010	<0.00010	<0.00010	<0.000050	-	-
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	-	-
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	-	-
Uranium (U)	mg/L	short-term: 0.033; long-term:	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	-	-
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	-	-
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	-	-
Dissolved Metals									
Aluminum (Al)	mg/L		0.0030	<0.0030	-	-	0.0062	<0.0030	<0.0030
Antimony (Sb)	mg/L		0.000050 - 0.00010	<0.00010	-	-	<0.000050	<0.000050	<0.000050

Winter surface water quality samples were collected from 1 m below the ice water interface, unless lakes were particularly shallow.

Winter bottom water quality samples were collected from 1.5 to 2 m above the sediments to avoid contamination.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

Total metal blanks were not collected in summer as ALS did not send these blanks to site.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.2-2. Lake Water Quality QA/QC Results, Back River Project, 2011

Site Abbreviation:			Winter Equipment Blank	Winter Field Blank	Winter Travel Blank	Summer Equipment Blank	Summer Field Blank*	Summer Travel Blank
Depth Zone:	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	RDL[h]	12-Apr-11	17-Apr-11	17-Apr-11	5-Aug-11	07-Aug-11 and 11-Aug-11	07-Aug-11 and 11-Aug-11
Depth (m):			L995193-3	L996086-8	L996086-9	L1041632-1	L1043888-4 and L1047634-4	L1043888-5 and L1047634-3
Dissolved Metals *(cont'd)*								
Arsenic (As)	mg/L	0.000030	<0.000030	-	-	<0.000030	<0.000030	<0.000030
Barium (Ba)	mg/L	0.000050	0.00292	-	-	0.000147	<0.000050	<0.000050
Beryllium (Be)	mg/L	0.00020	<0.00020	-	-	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L	0.00050	<0.00050	-	-	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	0.0010 - 0.0050	<0.0010	-	-	<0.0050	<0.0010	<0.0010
Cadmium (Cd)	mg/L	0.000010	<0.000010	-	-	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L	0.020	<0.020	-	-	<0.020	<0.020	<0.020
Chromium (Cr)	mg/L	0.00010	<0.00010	-	-	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L	0.00010	<0.00010	-	-	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	0.00050	<0.00050	-	-	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.010	<0.010	-	-	<0.010	<0.010	<0.010
Lead (Pb)	mg/L	0.000050	<0.000050	-	-	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L	0.0050	<0.0050	-	-	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L	0.0050	<0.0050	-	-	<0.0050	<0.0050	<0.0050
Manganese (Mn)	mg/L	0.000050	<0.000050	-	-	0.000088	<0.000050	<0.000050
Mercury (Hg)	mg/L	0.000010	<0.000010	-	-	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.000050	<0.000050	-	-	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	0.00010	<0.00010	-	-	<0.00010	<0.00010	<0.00010
Phosphorus (P)	mg/L	0.30	<0.30	-	-	<0.30	<0.30	<0.30
Potassium (K)	mg/L	0.050	<0.050	-	-	<0.050	<0.050	<0.050
Selenium (Se)	mg/L	0.00010	<0.00010	-	-	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L	0.050	<0.050	-	-	<0.050	<0.050	<0.050
Silver (Ag)	mg/L	0.000010	<0.000010	-	-	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L	0.010	<0.010	-	-	0.012	<0.010	<0.010
Strontium (Sr)	mg/L	0.00010	<0.00010	-	-	<0.00010	<0.00010	<0.00010
Thallium (Tl)	mg/L	0.000050 - 0.00010	<0.00010	-	-	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L	0.00010	<0.00010	-	-	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L	0.010	<0.010	-	-	<0.010	<0.010	<0.010
Uranium (U)	mg/L	0.000010	<0.000010	-	-	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L	0.000050	<0.000050	-	-	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L	0.0030	<0.0030	-	-	<0.0030	<0.0030	<0.0030

Winter surface water quality samples were collected from 1 m below the ice water interface, unless lakes were particularly shallow.

Winter bottom water quality samples were collected from 1.5 to 2 m above the sediments to avoid contamination.

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

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c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

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g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.3-1

Stream Water Quality Analytical Results, Back River Project, 2011

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Appendix 3.3-1. Stream Water Quality Analytical Results, Back River Project, 2011

Site Abbreviation:				Chair OF	Chair OF	Llama OF	Llama OF	Echo OF	Echo OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor Downstream	Propellor Downstream	Ref. B OF	Ref. B OF
Replicate:		CCME Guideline		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Date Sampled:		for the Protection		18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11
ALS Sample ID:	Units	of Freshwater Aquatic Life[a]	RDL[h]	L1020118-3	L1020118-4	L1020118-5	L1020118-6	L1020118-7	L1020118-8	L1020118-9	10	11	12	13	14	15	16	17	18	19	20
Physical Tests																					
Conductivity	µS/cm		2	18.6	18.3	58.3	58.2	34.2	34.2	26.1	26.0	16.4	16.5	23.2	23.1	19.0	19.3	18.9	18.8	14.7	14.7
Hardness (as $CaCO_3$)	mg/L		0.5	7.31	7.20	21.5	21.4	13.6	13.0	10.2	10.2	6.70	6.63	8.67	9.35	7.95	7.57	7.86	7.43	6.03	6.05
pH	pH	6.5-9.0	0.1	6.67	6.65	6.60	6.60	5.99	5.89	6.66	6.65	6.52	6.57	6.71	6.70	6.54	6.50	6.56	6.64	6.61	6.60
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	5.8	4.8	4.5	4.7	2.9	3.1	5.6	5.5	4.8	4.9	5.1	5.0	5.0	5.3	6.6	5.2	5.6	5.8
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0 - 2.0	5.8	4.8	4.5	4.7	2.9	3.1	5.6	5.5	4.8	4.9	5.1	5.0	5.0	5.3	6.6	5.2	5.6	5.8
Total Suspended Solids	mg/L	dependent on background levels	3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	17	15	53	66	43	50	26	27	16	12	24	24	18	16	20	17	19	19
Turbidity	NTU	dependent on background levels	0.1	0.48	0.55	0.28	0.30	0.21	0.25	0.44	0.43	0.43	0.42	0.56	0.52	0.29	0.31	0.42	0.34	0.43	0.46
Nutrients																					
Ammonia (as N)	mg/L	pH- and temperature-dependent	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0116	0.0160	0.0059	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.246	0.206	0.169	0.176	0.268	0.272	0.195	0.276	0.235	0.277	0.264	0.250	0.145	0.171	0.239	0.176	0.253	0.276
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus	mg/L	Trigger ranges from guidance framework	0.002	0.0062	0.0060	0.0046	0.0042	0.0037	0.0040	0.0050	0.0049	0.0058	0.0049	0.0059	0.0057	0.0034	0.0035	0.0039	0.0040	0.0059	0.0060
Anions																					
Bromide (Br)	mg/L		0.05	<0.050	<0.050	0.051	0.051	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L		0.5	0.59	0.58	12.9	13.0	7.01	6.98	0.74	0.74	0.63	0.62	2.22	2.22	0.95	0.95	0.79	0.79	<0.50	<0.50
Fluoride (F)	mg/L	0.12[b]	0.02	<0.020	<0.020	<0.020	<0.020	0.026	0.024	0.022	0.021	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Sulphate (SO_4)	mg/L		0.5	2.88	2.89	2.78	2.79	1.72	1.72	6.16	6.12	2.31	2.31	2.86	2.84	2.73	2.72	2.47	2.46	1.17	1.17
Cyanides																					
Cyanide, Weak Acid Dissociable	mg/L		0.001 - 0.004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanide, Total	mg/L		0.001 - 0.0014084	0.0042	0.0040	0.0036	0.0038	0.0067	0.0060	0.0041	0.0039	<0.0010	0.0019	0.0031	0.0037	0.0028	0.0020	0.0030	0.0033	0.0042	0.0043
Cyanide, Free	mg/L	0.005	0.001 - 0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Organic / Inorganic Carbon																					
Total Organic Carbon	mg/L		0.5	4.39	4.34	3.72	3.60	8.26	8.62	4.49	4.56	4.12	4.14	4.75	4.80	3.48	3.50	3.95	3.96	4.75	4.74
Total Metals																					
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.003 - 0.009	0.0412	0.0434	0.0461	0.0451	0.113	0.109	0.0363	0.0356	0.0271	0.0198	0.0301	0.0309	0.0135	0.0172	0.0215	0.0230	0.0208	0.0224
Antimony (Sb)	mg/L		0.00005 - 0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L	0.005	0.00003	0.000351	0.000358	0.000249	0.000243	0.000356	0.000357	0.000217	0.000201	0.000195	0.000171	0.000175	0.000189	0.000133	0.000150	0.000141	0.000138	0.000117	0.000127
Barium (Ba)	mg/L		0.00005	0.00366	0.00371	0.0146	0.0144	0.0161	0.0157	0.00437	0.00414	0.00428	0.00386	0.00541	0.00579	0.00419	0.00437	0.00384	0.00394	0.00532	0.00524
Beryllium (Be)	mg/L		0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.001 - 0.005	0.0050	0.0060	0.0064	0.0064	0.0057	0.0067	0.0064	0.0059	0.0059	0.0057	0.0061	0.0065	0.0065	0.0052	0.0051	0.0050	0.0056	0.0051
Cadmium (Cd)	mg/L	equation[b,d]	0.00001	<0.000010	<0.000010	0.000031	0.000027	0.000023	0.000024	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.02	1.38	1.47	6.40	6.32	3.47	3.39	1.95	1.98	1.43	1.44	2.01	2.04	1.54	1.60	1.57	1.58	1.32	1.27
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.0001	0.00021	0.00025	0.00017	0.00023	0.00043	0.00056	0.00023	0.00022	0.00024	0.00022	0.00019	0.00032	0.00016	0.00015	0.00017	0.00017	0.00024	0.00021
Cobalt (Co)	mg/L		0.0001	0.00020	0.00021	0.00107	0.00105	0.00137	0.00130	0.00085	0.00060	<0.00010	<0.00010	0.00024	0.00025	0.00013	0.00013	<0.00010	<0.00010	0.00014	0.00013
Copper (Cu)	mg/L	≥0.002[e]	0.0005	0.00173	0.00189	0.00216	0.00210	0.00227	0.00214	0.00231	0.00226	0.00132	0.00119	0.00151	0.00152	0.00106	0.00112	0.00130	0.00130	0.00085	0.00083
Iron (Fe)	mg/L	0.3	0.01	0.094	0.099	0.022	0.021	0.151	0.158	0.062	0.055	0.089	0.069	0.074	0.075	0.034	0.032	0.038	0.035	0.162	0.165
Lead (Pb)	mg/L	≥0.001[f]	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000134	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.005	1.01	1.02	1.75	1.71	1.29	1.23	1.40	1.39	0.881	0.842	0.998	1.04	0.889	0.945	0.963	0.983	0.819	0.802
Manganese (Mn)	mg/L		0.00005	0.00262	0.00273	0.0103	0.00992	0.00787	0.00764	0.0106	0.00727	0.00100	0.000653	0.00578	0.00598	0.00790	0.00824	0.00180	0.00176	0.00340	0.00340
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073[d]	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000081	<0.000050	<0.000050

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ /1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ /1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ /1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River Project, 2011

Site Abbreviation:				Chair OF 1	Chair OF 2	Llama OF 1	Llama OF 2	Echo OF 1	Echo OF 2	Giraffe OF 1	Giraffe OF 2	Wolf OF 1	Wolf OF 2	Goose OF 1	Goose OF 2	Propellor OF 1	Propellor OF 2	Propellor Downstream 1	Propellor Downstream 2	Ref. B OF 1	Ref. B OF 2
Replicate:				1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Date Sampled:		CCME Guideline for the Protection		18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11	18-Jun-11
ALS Sample ID:	Units	of Freshwater Aquatic Life[a]	RDL[h]	L1020118-3	L1020118-4	L1020118-5	L1020118-6	L1020118-7	L1020118-8	L1020118-9	10	11	12	13	14	15	16	17	18	19	20
Total Metals *(continued)*																					
Nickel (Ni)	mg/L	≥0.025[g]	0.0001	0.00309	0.00314	0.00663	0.00650	0.00458	0.00445	0.00816	0.00808	0.00293	0.00268	0.00403	0.00426	0.00230	0.00244	0.00190	0.00189	0.00145	0.00143
Phosphorus (P)	mg/L		0.3	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.05	0.342	0.340	0.571	0.546	0.231	0.223	0.395	0.390	0.317	0.295	0.397	0.418	0.323	0.342	0.339	0.344	0.321	0.309
Selenium (Se)	mg/L	0.001	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.05	0.294	0.302	0.460	0.453	0.837	0.804	0.405	0.413	0.202	0.194	0.307	0.312	0.171	0.175	0.292	0.297	0.200	0.205
Silver (Ag)	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.01	0.548	0.555	0.781	0.763	0.758	0.725	0.718	0.712	0.568	0.541	0.635	0.665	0.529	0.563	0.557	0.559	0.476	0.463
Strontium (Sr)	mg/L		0.0001	0.00577	0.00612	0.0394	0.0390	0.0163	0.0157	0.00842	0.00847	0.00618	0.00616	0.0108	0.0110	0.00690	0.00718	0.00599	0.00615	0.00483	0.00474
Thallium (Tl)	mg/L	0.0008	0.00005 - 0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.00001	0.000013	0.000016	0.000012	0.000011	<0.000010	<0.000010	0.000014	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.00005	0.000113	0.000112	<0.000050	<0.000050	0.000109	0.000108	<0.000050	<0.000050	0.000064	<0.000050	<0.000050	0.000057	<0.000050	<0.000050	<0.000050	<0.000050	0.000064	0.000068
Zinc (Zn)	mg/L	0.03	0.003	<0.0030	<0.0030	0.0041	0.0038	0.0032	0.0076	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0031	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																					
Aluminum (Al)	mg/L		0.003	0.0269	0.0277	0.0362	0.0357	0.118	0.103	0.0264	0.0258	0.0154	0.0152	0.0202	0.0172	0.0051	0.0055	0.0177	0.0162	0.0159	0.0166
Antimony (Sb)	mg/L		0.00005 - 0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)	mg/L		0.00003	0.000320	0.000315	0.000212	0.000204	0.000382	0.000333	0.000190	0.000187	0.000146	0.000151	0.000185	0.000169	0.000130	0.000141	0.000131	0.000121	0.000111	0.000117
Barium (Ba)	mg/L		0.00005	0.00348	0.00341	0.0139	0.0139	0.0173	0.0153	0.00400	0.00397	0.00374	0.00377	0.00523	0.00609	0.00447	0.00391	0.00405	0.00356	0.00476	0.00492
Beryllium (Be)	mg/L		0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.001 - 0.005	0.0042	0.0053	0.0064	0.0057	0.0052	0.0052	0.0048	0.0043	0.0047	0.0052	0.0047	0.0041	0.0041	0.0032	0.0046	0.0048	0.0048	0.0049
Cadmium (Cd)	mg/L		0.00001	<0.000010	<0.000010	0.000027	0.000024	0.000024	0.000022	<0.000010	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.02	1.32	1.30	5.94	5.90	3.19	3.24	1.89	1.89	1.36	1.35	1.91	1.92	1.52	1.50	1.48	1.47	1.19	1.18
Chromium (Cr)	mg/L		0.0001	0.00015	0.00019	0.00016	0.00016	0.00045	0.00039	0.00015	0.00011	0.00014	0.00015	0.00014	<0.00010	<0.00010	<0.00010	0.00017	0.00013	0.00016	0.00017
Cobalt (Co)	mg/L		0.0001	0.00014	0.00014	0.00099	0.00097	0.00144	0.00125	0.00052	0.00052	<0.00010	<0.00010	0.00015	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L		0.0005	0.00146	0.00147	0.00189	0.00184	0.00231	0.00219	0.00205	0.00201	0.00120	0.00109	0.00133	0.00112	0.00095	0.00074	0.00127	0.00202	0.00066	0.00068
Iron (Fe)	mg/L		0.01	0.034	0.037	<0.010	0.010	0.098	0.097	0.014	<0.010	0.032	0.029	0.024	0.017	<0.010	<0.010	0.017	0.014	0.075	0.074
Lead (Pb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000084	<0.000050	<0.000050
Lithium (Li)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.005	0.973	0.961	1.63	1.62	1.36	1.20	1.34	1.33	0.801	0.791	0.948	1.11	1.01	0.930	1.01	0.915	0.742	0.757
Manganese (Mn)	mg/L		0.00005	0.00179	0.00187	0.00926	0.00914	0.00839	0.00730	0.00610	0.00601	0.000381	0.000360	0.00393	0.00457	0.00423	0.00369	0.000915	0.000798	0.00143	0.00153
Mercury (Hg)	mg/L		0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.0001	0.00298	0.00296	0.00629	0.00616	0.00496	0.00430	0.00761	0.00759	0.00269	0.00254	0.00385	0.00427	0.00246	0.00228	0.00204	0.00183	0.00131	0.00133
Phosphorus (P)	mg/L		0.3	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.05	0.330	0.328	0.531	0.516	0.256	0.221	0.379	0.375	0.287	0.284	0.382	0.445	0.381	0.343	0.363	0.324	0.288	0.295
Selenium (Se)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.05	0.259	0.265	0.433	0.421	0.762	0.779	0.376	0.374	0.186	0.183	0.278	0.286	0.158	0.165	0.269	0.268	0.180	0.187
Silver (Ag)	mg/L		0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.01	0.525	0.524	0.730	0.721	0.802	0.703	0.682	0.689	0.517	0.511	0.606	0.693	0.597	0.561	0.580	0.530	0.432	0.439
Strontium (Sr)	mg/L		0.0001	0.00553	0.00542	0.0368	0.0363	0.0150	0.0150	0.00891	0.00816	0.00587	0.00580	0.0103	0.0103	0.00681	0.00666	0.00571	0.00566	0.00446	0.00441
Thallium (Tl)	mg/L		0.00005 - 0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tin (Sn)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.00001	0.000012	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	0.000011	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.00005	0.000094	0.000082	<0.000050	<0.000050	0.000111	0.000102	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.003	<0.0030	<0.0030	0.0048	0.0031	<0.0030	0.0033	<0.0030	<0.0030	<0.0030	0.0038	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0077

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River Project, 2011

Site Abbreviation:				Chair OF	Chair OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor Downstream	Propellor Downstream	Ref. B OF	Ref. B OF	Chair OF	Chair OF
Replicate:		CCME Guideline		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Date Sampled:		for the Protection		13-Aug-11	13-Aug-11	17-Aug-11	17-Aug-11	12-Aug-11	12-Aug-11	13-Aug-11	13-Aug-11	16-Aug-11	16-Aug-11	15-Aug-11	15-Aug-11	15-Aug-11	15-Aug-11	14-Aug-11	14-Aug-11	8-Sep-11	8-Sep-11
ALS Sample ID:	Units	of Freshwater Aquatic Life[a]	RDL[h]	L1047634-5	L1047634-6	L1047401-9	10	L1047634-9	10	L1047634-7	L1047634-8	11	12	15	16	13	14	11	12	L1056717-1	L1056717-2
Physical Tests																					
Conductivity	µS/cm		2	25.2	25.3	321	328	22.6	22.6	21.1	21.4	22.9	22.7	16.6	16.6	18.2	18.2	34.6	35.3	49.3	35.8
Hardness (as $CaCO_3$)	mg/L		0.5	10.7	10.7	133	132	8.76	8.82	9.10	9.05	8.91	8.83	6.55	6.55	7.65	7.59	15.8	15.7	13.1	13.1
pH	pH	6.5-9.0	0.1	6.45	6.57	6.21	6.22	6.44	6.45	6.56	6.56	6.48	6.46	6.58	6.56	6.88	6.88	7.17	7.75	7.27	6.99
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	7.7	7.5	5.1	4.3	4.4	4.4	7.0	7.1	3.7	3.4	3.5	2.8	4.9	4.5	17.5	15.7	4.8	4.6
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0 - 2.0	7.7	7.5	5.1	4.3	4.4	4.4	7.0	7.1	3.7	3.4	3.5	2.8	4.9	4.5	17.5	15.7	4.8	4.6
Total Suspended Solids	mg/L	dependent on background levels	3	5.3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	3.3	4.4	7.7
Total Dissolved Solids	mg/L		10	17	16	398	407	18	15	12	11	19	19	11	14	14	13	30	39	38	33
Turbidity	NTU	dependent on background levels	0.1	2.15	1.66	0.16	0.14	0.29	0.29	0.59	0.54	0.42	0.41	0.19	0.19	0.25	0.23	2.40	2.11	2.02	1.74
Nutrients																					
Ammonia (as N)	mg/L	pH- and temperature-dependent	0.005	0.0108	0.0098	<0.0050	<0.0050	0.0055	<0.0050	0.0058	0.0055	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0146	0.0145	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.005	0.0072	0.0076	0.491	0.489	0.0148	0.0101	0.0383	0.0415	<0.0050	<0.0050	0.0952	0.0952	0.0342	0.0400	<0.0050	<0.0050	0.0069	0.0069
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.406	0.398	0.118	0.103	0.189	0.192	0.252	0.254	0.166	0.156	0.107	0.200	0.150	0.122	0.855	0.868	0.197	0.182
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus	mg/L	Trigger ranges from guidance framework	0.002	0.0139	0.0109	<0.0020	0.0024	0.0034	0.0033	0.0045	0.0041	0.0047	0.0044	0.0037	0.0032	0.0035	0.0033	0.0218	0.0191	0.0071	0.0071
Anions																					
Bromide (Br)	mg/L		0.05	<0.050	<0.050	0.479	0.531	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L		0.5	0.75	0.75	87.8	90.3	0.59	0.59	0.77	0.76	2.65	2.65	1.01	1.01	0.77	0.77	0.70	0.68	1.11	1.02
Fluoride (F)	mg/L	0.12[b]	0.02	0.021	0.021	<0.020	<0.020	0.022	0.022	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.027	0.031	0.022	0.022
Sulphate (SO_4)	mg/L		0.5	3.56	3.55	5.65	5.63	5.19	5.20	2.15	2.13	3.08	3.10	2.32	2.32	2.25	2.28	0.52	0.51	8.46	8.46
Cyanides																					
Cyanide, Weak Acid Dissociable	mg/L		0.001 - 0.004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.0010	<0.0010
Cyanide, Total	mg/L		0.001 - 0.0014084	0.0034	0.0035	0.0016	0.0011	0.0018	0.0026	0.0022	0.0020	0.0024	0.0024	0.0019	0.0012	0.0019	0.0021	0.0081	0.0076	0.0043	0.0049
Cyanide, Free	mg/L	0.005	0.001 - 0.005	<0.0010	<0.0010	<0.0010	0.0028	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon																					
Total Organic Carbon	mg/L		0.5	4.70	5.30	1.49	1.63	3.48	3.46	3.58	3.61	3.39	3.48	2.50	2.53	2.79	2.74	10.0	10.3	5.20	5.20
Total Metals																					
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.003 - 0.009	0.0643	0.0554	0.0149	0.0140	0.0144	0.0153	0.0114	0.0134	0.0125	0.0110	<0.0090	<0.0090	0.0075	<0.0090	0.0749	0.0687	0.112	0.111
Antimony (Sb)	mg/L		0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.00003	0.00124	0.00122	0.000161	0.000163	0.000205	0.000180	0.000216	0.000260	0.000223	0.000217	0.000237	0.000296	0.000150	0.000201	0.000482	0.000459	0.000526	0.000549
Barium (Ba)	mg/L		0.00005	0.00408	0.00397	0.0609	0.0634	0.00309	0.00298	0.00437	0.00469	0.00417	0.00377	0.00353	0.00327	0.00303	0.00332	0.0102	0.0101	0.00580	0.00577
Beryllium (Be)	mg/L		0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.001 - 0.005	0.0035	0.0035	0.0058	0.0054	0.0038	0.0042	0.0031	0.0034	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0032	0.0026	0.0056	0.0055
Cadmium (Cd)	mg/L	equation[b,d]	0.00001	<0.000010	<0.000010	0.000149	0.000162	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000022	<0.000010
Calcium (Ca)	mg/L		0.02	1.99	1.95	31.3	32.6	1.69	1.60	1.94	1.94	1.99	1.87	1.43	1.34	1.55	1.64	3.19	3.18	2.34	2.38
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.0001	0.00030	0.00027	0.00013	0.00011	0.00011	<0.00010	0.00013	0.00014	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00011	0.00043	0.00040	0.00059	0.00050
Cobalt (Co)	mg/L		0.0001	0.00049	0.00047	0.00492	0.00563	0.00013	0.00013	0.00010	0.00011	0.00013	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	0.00042	0.00042	0.00045	0.00045
Copper (Cu)	mg/L	≥0.002[e]	0.0005	0.00218	0.00210	0.00123	0.00128	0.00202	0.00198	0.00122	0.00139	0.00133	0.00121	0.00102	0.00098	0.00121	0.00120	0.00175	0.00172	0.00230	0.00237
Iron (Fe)	mg/L	0.3	0.01	0.490	0.460	<0.010	<0.010	0.055	0.054	0.227	0.223	0.055	0.053	0.013	0.013	0.030	0.026	2.04	1.97	0.217	0.211
Lead (Pb)	mg/L	≥0.001[f]	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000053	0.000050	0.000057	0.000055
Lithium (Li)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.005	1.54	1.49	12.4	13.1	1.25	1.21	1.13	1.26	1.08	1.01	0.859	0.782	0.943	1.03	2.05	2.02	1.89	1.91
Manganese (Mn)	mg/L		0.00005	0.00963	0.00936	0.0148	0.0175	0.00309	0.00286	0.00188	0.00196	0.00427	0.00391	0.00140	0.00134	0.00134	0.00150	0.00935	0.00922	0.00472	0.00457
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073[d]	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ /1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ /1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ /1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River Project, 2011

Site Abbreviation:				Chair OF	Chair OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor Downstream	Propellor Downstream	Ref. B OF	Ref. B OF	Chair OF	Chair OF
Replicate:				1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Date Sampled:		CCME Guideline for the Protection		13-Aug-11	13-Aug-11	17-Aug-11	17-Aug-11	12-Aug-11	12-Aug-11	13-Aug-11	13-Aug-11	16-Aug-11	16-Aug-11	15-Aug-11	15-Aug-11	15-Aug-11	15-Aug-11	14-Aug-11	14-Aug-11	8-Sep-11	8-Sep-11
ALS Sample ID:	Units	of Freshwater Aquatic Life[a]	RDL[h]	L1047634-5	L1047634-6	L1047401-9	10	L1047634-9	10	L1047634-7	L1047634-8	11	12	15	16	13	14	11	12	L1056717-1	L1056717-2
Total Metals *(continued)*																					
Nickel (Ni)	mg/L	≥0.025[g]	0.0001	0.00335	0.00317	0.0366	0.0400	0.00425	0.00413	0.00200	0.00227	0.00230	0.00215	0.00162	0.00143	0.00093	0.00103	0.00337	0.00329	0.00408	0.00409
Phosphorus (P)	mg/L		0.3	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.05	0.426	0.410	0.992	1.02	0.327	0.313	0.321	0.361	0.317	0.299	0.303	0.278	0.298	0.328	0.456	0.458	0.380	0.386
Selenium (Se)	mg/L	0.001	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.05	0.272	0.259	1.45	1.45	0.259	0.250	0.426	0.429	0.166	0.159	0.147	0.149	0.215	0.221	0.223	0.212	1.49	1.48
Silver (Ag)	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.01	0.777	0.758	2.04	2.15	0.658	0.641	0.628	0.701	0.576	0.537	0.481	0.444	0.470	0.512	0.902	0.889	0.847	0.861
Strontium (Sr)	mg/L		0.0001	0.00859	0.00841	0.155	0.166	0.00732	0.00696	0.00855	0.00855	0.0101	0.00945	0.00654	0.00621	0.00582	0.00614	0.0121	0.0121	0.00962	0.00963
Thallium (Tl)	mg/L	0.0008	0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.00001	0.000019	0.000018	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000014	0.000014	0.000022	0.000022
Vanadium (V)	mg/L		0.00005	0.000369	0.000322	<0.000050	<0.000050	<0.000050	<0.000050	0.000065	0.000069	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000706	0.000663	0.000339	0.000342
Zinc (Zn)	mg/L	0.03	0.003	<0.0030	<0.0030	0.0144	0.0155	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																					
Aluminum (Al)	mg/L		0.003	0.0116	0.0095	0.0120	0.0123	0.0083	0.0079	0.0050	0.0046	0.0050	0.0052	0.0053	0.0067	0.0043	0.0057	0.0360	0.0379	0.0308	0.0291
Antimony (Sb)	mg/L		0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.00003	0.000970	0.000913	0.000155	0.000157	0.000173	0.000174	0.000186	0.000187	0.000210	0.000209	0.000168	0.000121	0.000150	0.000240	0.000419	0.000379	0.000415	0.000413
Barium (Ba)	mg/L		0.00005	0.00355	0.00357	0.0631	0.0628	0.00293	0.00292	0.00409	0.00404	0.00369	0.00360	0.00329	0.00324	0.00305	0.00286	0.00896	0.00905	0.00521	0.00505
Beryllium (Be)	mg/L		0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.001 - 0.005	0.0029	0.0029	0.0052	0.0052	0.0028	0.0032	0.0027	0.0029	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0023	0.0026	<0.0050	0.0052
Cadmium (Cd)	mg/L		0.00001	<0.000010	<0.000010	0.000156	0.000159	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.02	1.87	1.88	32.5	32.1	1.56	1.56	1.85	1.84	1.87	1.86	1.33	1.35	1.50	1.54	3.06	3.06	2.28	2.24
Chromium (Cr)	mg/L		0.0001	0.00011	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	0.00011	0.00030	0.00034	0.00031	0.00028
Cobalt (Co)	mg/L		0.0001	0.00021	0.00021	0.00544	0.00530	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00018	0.00016	0.00035	0.00033
Copper (Cu)	mg/L		0.0005	0.00164	0.00162	0.00113	0.00115	0.00171	0.00173	0.00098	0.00098	0.00111	0.00110	0.00082	0.00123	0.00096	0.00146	0.00139	0.00140	0.00198	0.00197
Iron (Fe)	mg/L		0.01	0.141	0.102	<0.010	<0.010	0.014	0.013	0.076	0.079	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	1.01	1.01	0.047	0.044
Lead (Pb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.005	1.46	1.46	12.6	12.7	1.18	1.20	1.09	1.08	1.03	1.01	0.784	0.772	0.946	0.909	1.98	1.95	1.80	1.82
Manganese (Mn)	mg/L		0.00005	0.00511	0.00506	0.0167	0.0162	0.00217	0.00180	0.000684	0.000685	0.00111	0.00122	0.000558	0.000508	0.000711	0.00115	0.00454	0.00377	0.00309	0.00286
Mercury (Hg)	mg/L		0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.0001	0.00285	0.00296	0.0385	0.0383	0.00408	0.00405	0.00181	0.00188	0.00214	0.00216	0.00147	0.00144	0.00093	0.00088	0.00304	0.00305	0.00372	0.00367
Phosphorus (P)	mg/L		0.3	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.05	0.404	0.399	0.996	1.01	0.312	0.309	0.310	0.312	0.309	0.304	0.287	0.291	0.304	0.296	0.451	0.442	0.358	0.364
Selenium (Se)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.05	0.181	0.179	1.44	1.44	0.242	0.248	0.409	0.412	0.153	0.155	0.140	0.142	0.207	0.209	0.185	0.181	1.20	1.20
Silver (Ag)	mg/L		0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.01	0.749	0.744	2.06	2.06	0.631	0.637	0.600	0.603	0.550	0.545	0.451	0.438	0.471	0.455	0.880	0.870	0.826	0.826
Strontium (Sr)	mg/L		0.0001	0.00807	0.00799	0.161	0.158	0.00676	0.00680	0.00807	0.00802	0.00950	0.00943	0.00612	0.00751	0.00568	0.00584	0.0116	0.0116	0.00911	0.00903
Thallium (Tl)	mg/L		0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000015	0.000016
Vanadium (V)	mg/L		0.00005	0.000108	0.000097	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000335	0.000353	0.000128	0.000115
Zinc (Zn)	mg/L		0.003	<0.0030	<0.0030	0.0155	0.0152	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River Project, 2011

Site Abbreviation:				Llama OF	Llama OF	Echo OF	Echo OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor Downstream	Propellor Downstream	Ref. B OF	Ref. B OF
Replicate:				1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Date Sampled:		CCME Guideline for the Protection		8-Sep-11	8-Sep-11	8-Sep-11	8-Sep-11	8-Sep-11	8-Sep-11	9-Sep-11	9-Sep-11	8-Sep-11	8-Sep-11	9-Sep-11	9-Sep-11	9-Sep-11	9-Sep-11	9-Sep-11	9-Sep-11
ALS Sample ID:	Units	of Freshwater Aquatic Life[a]	RDL[h]	L1056717-3	L1056717-4	L1056717-5	L1056717-6	L1056717-7	L1056717-8	11	12	L1056717-9	10	13	14	15	16	17	18
Physical Tests																			
Conductivity	µS/cm		2	266	261	85.1	84.8	27.8	27.6	33.3	33.1	26.0	25.9	16.7	16.8	20.2	20.3	23.3	23.3
Hardness (as $CaCO_3$)	mg/L		0.5	99.5	105	31.9	32.1	10.7	10.7	13.4	13.1	9.89	10.1	6.73	6.66	8.53	8.54	10.0	9.92
pH	pH	6.5-9.0	0.1	6.53	6.51	5.88	5.72	6.85	6.89	6.88	6.91	6.80	6.81	6.84	6.61	7.06	7.08	7.05	7.00
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	3.4	3.2	<2.0	2.6	4.6	4.3	5.1	5.1	3.6	3.6	3.8	3.7	5.9	5.7	7.3	6.1
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0 - 2.0	3.4	3.2	<2.0	2.6	4.6	4.3	5.1	5.1	3.6	3.6	3.8	3.7	5.9	5.7	7.3	6.1
Total Suspended Solids	mg/L	dependent on background levels	3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	3.1	<3.0
Total Dissolved Solids	mg/L		10	291	309	93	111	24	25	36	37	23	25	16	17	17	23	31	29
Turbidity	NTU	dependent on background levels	0.1	0.25	0.25	0.31	0.30	0.80	0.76	0.48	0.46	0.78	0.78	0.31	0.34	0.42	0.38	1.12	1.62
Nutrients																			
Ammonia (as N)	mg/L	pH- and temperature-dependent	0.005	<0.0050	0.0063	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0076	0.0064
Nitrate (as N)	mg/L	2.935[b]	0.005	0.126	0.127	<0.0050	<0.0050	<0.0050	<0.0050	0.0063	0.0070	<0.0050	<0.0050	0.0239	0.0232	0.0147	0.0140	0.0106	0.0114
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.144	0.137	0.313	0.317	0.126	0.116	0.162	0.157	0.094	0.168	0.087	0.087	<0.050	0.067	0.297	0.281
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0011
Total Phosphorus	mg/L	Trigger ranges from guidance framework	0.002	0.0024	0.0025	0.0039	0.0039	0.0032	0.0032	0.0038	0.0036	0.0031	0.0035	0.0034	0.0026	0.0025	0.0023	0.0086	0.0090
Anions																			
Bromide (Br)	mg/L		0.05	0.101	0.109	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L		0.5	69.4	68.1	14.0	14.1	0.62	0.62	3.85	3.83	2.94	2.95	0.99	0.99	0.75	0.75	0.55	0.62
Fluoride (F)	mg/L	0.12[b]	0.02	0.023	0.022	0.024	0.024	0.026	0.027	0.021	0.021	<0.020	0.020	<0.020	<0.020	<0.020	<0.020	0.023	0.024
Sulphate (SO_4)	mg/L		0.5	9.37	9.38	11.4	11.4	6.68	6.67	3.98	3.96	3.45	3.47	2.44	2.44	2.69	2.69	2.61	2.61
Cyanides																			
Cyanide, Weak Acid Dissociable	mg/L		0.001 - 0.004	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0040	<0.0010
Cyanide, Total	mg/L		0.001 - 0.0014084	0.0046	0.0047	0.0100	0.0098	0.0028	0.0031	0.0044	0.0018	0.0022	0.0024	0.0027	0.0023	0.0023	0.0019	0.0058	0.0058
Cyanide, Free	mg/L	0.005	0.001 - 0.005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0027	0.0017
Organic / Inorganic Carbon																			
Total Organic Carbon	mg/L		0.5	3.88	3.90	10.4	10.7	4.29	3.95	5.11	4.92	3.71	3.87	3.41	3.33	3.14	3.16	7.31	7.33
Total Metals																			
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.003 - 0.009	0.0602	0.0600	0.163	0.160	0.0316	0.0334	0.0281	0.0280	0.0214	0.0183	0.0132	0.0137	0.0148	0.0152	0.0504	0.0476
Antimony (Sb)	mg/L		0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.00003	0.000228	0.000210	0.000331	0.000316	0.000225	0.000235	0.000227	0.000244	0.000213	0.000199	0.000142	0.000121	0.000130	0.000123	0.000227	0.000246
Barium (Ba)	mg/L		0.00005	0.0563	0.0540	0.0360	0.0347	0.00366	0.00364	0.00714	0.00713	0.00462	0.00439	0.00279	0.00276	0.00286	0.00291	0.00658	0.00674
Beryllium (Be)	mg/L		0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.001 - 0.005	0.0063	0.0063	0.0055	0.0059	0.0055	0.0057	0.0055	0.0054	0.0054	0.0052	0.0054	0.0056	0.0058	0.0059	0.0053	0.0055
Cadmium (Cd)	mg/L	equation[b,d]	0.00001	0.000203	0.000194	0.000038	0.000037	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.02	31.4	30.0	8.55	8.14	1.98	2.00	3.26	3.30	2.24	2.20	1.39	1.35	1.76	1.77	1.91	1.96
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.0001	0.00032	0.00030	0.00065	0.00075	0.00021	0.00026	0.00036	0.00035	0.00026	0.00028	0.00017	0.00021	0.00024	0.00026	0.00041	0.00047
Cobalt (Co)	mg/L		0.0001	0.00968	0.00904	0.00555	0.00531	0.00020	0.00020	0.00027	0.00029	0.00018	0.00016	<0.00010	<0.00010	<0.00010	<0.00010	0.00023	0.00023
Copper (Cu)	mg/L	≥0.002[e]	0.0005	0.00297	0.00294	0.00271	0.00269	0.00208	0.00214	0.00145	0.00148	0.00145	0.00134	0.00122	0.00122	0.00118	0.00118	0.00146	0.00140
Iron (Fe)	mg/L	0.3	0.01	0.012	0.012	0.143	0.140	0.082	0.081	0.113	0.111	0.072	0.062	0.026	0.028	0.031	0.031	0.332	0.312
Lead (Pb)	mg/L	≥0.001[f]	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.005	7.52	7.26	2.85	2.73	1.44	1.47	1.32	1.34	1.17	1.16	0.840	0.818	1.10	1.10	1.24	1.26
Manganese (Mn)	mg/L		0.00005	0.0716	0.0672	0.0518	0.0497	0.00225	0.00221	0.00390	0.00396	0.00439	0.00378	0.00243	0.00232	0.00152	0.00138	0.00345	0.00336
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073[d]	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ /1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ /1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ /1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River Project, 2011

Site Abbreviation:				Llama OF 1	Llama OF 2	Echo OF 1	Echo OF 2	Giraffe OF 1	Giraffe OF 2	Wolf OF 1	Wolf OF 2	Goose OF 1	Goose OF 2	Propellor OF 1	Propellor OF 2	Propellor Downstream 1	Propellor Downstream 2	Ref. B OF 1	Ref. B OF 2
Replicate:		CCME Guideline		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Date Sampled:		for the Protection		8-Sep-11	8-Sep-11	8-Sep-11	8-Sep-11	8-Sep-11	8-Sep-11	9-Sep-11	9-Sep-11	8-Sep-11	8-Sep-11	9-Sep-11	9-Sep-11	9-Sep-11	9-Sep-11	9-Sep-11	9-Sep-11
ALS Sample ID:	Units	of Freshwater Aquatic Life[a]	RDL[h]	L1056717-3	L1056717-4	L1056717-5	L1056717-6	L1056717-7	L1056717-8	11	12	L1056717-9	10	13	14	15	16	17	18
Total Metals *(continued)*																			
Nickel (Ni)	mg/L	≥0.025[g]	0.0001	0.0418	0.0396	0.00819	0.00785	0.00473	0.00486	0.00310	0.00307	0.00273	0.00263	0.00166	0.00157	0.00098	0.00158	0.00211	0.00204
Phosphorus (P)	mg/L		0.3	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.05	0.837	0.802	0.319	0.305	0.345	0.354	0.288	0.289	0.330	0.327	0.277	0.268	0.325	0.325	0.346	0.347
Selenium (Se)	mg/L	0.001	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.05	1.87	1.84	3.37	3.26	0.514	0.510	0.870	0.887	0.295	0.281	0.194	0.188	0.362	0.361	0.756	0.757
Silver (Ag)	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.01	2.23	2.13	1.41	1.35	0.717	0.822	0.777	0.801	0.635	0.615	0.494	0.510	0.529	0.571	0.749	0.772
Strontium (Sr)	mg/L		0.0001	0.110	0.106	0.0341	0.0328	0.00828	0.00831	0.0195	0.0197	0.0110	0.0109	0.00585	0.00558	0.00591	0.00593	0.00652	0.00669
Thallium (Tl)	mg/L	0.0008	0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.00001	0.000011	0.000010	<0.000010	<0.000010	0.000011	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000013	0.000013	<0.000010	<0.000010
Vanadium (V)	mg/L		0.00005	<0.000050	0.000051	0.000157	0.000173	0.000088	0.000084	0.000070	0.000061	0.000063	0.000073	<0.000050	<0.000050	<0.000050	0.000051	0.000210	0.000192
Zinc (Zn)	mg/L	0.03	0.003	0.0177	0.0165	0.0060	0.0055	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																			
Aluminum (Al)	mg/L		0.003	0.0475	0.0507	0.153	0.154	0.0151	0.0185	0.0182	0.0182	0.0077	0.0090	0.0083	0.0080	0.0095	0.0062	0.0269	0.0252
Antimony (Sb)	mg/L		0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.00003	0.000197	0.000198	0.000332	0.000317	0.000203	0.000209	0.000195	0.000200	0.000182	0.000182	0.000116	0.000122	0.000114	0.000124	0.000195	0.000215
Barium (Ba)	mg/L		0.00005	0.0518	0.0547	0.0356	0.0356	0.00332	0.00362	0.00689	0.00679	0.00425	0.00438	0.00271	0.00282	0.00272	0.00273	0.00642	0.00641
Beryllium (Be)	mg/L		0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.001 - 0.005	0.0052	0.0055	<0.0050	0.0052	0.0052	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cadmium (Cd)	mg/L		0.00001	0.000187	0.000196	0.000036	0.000036	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.02	28.3	30.1	8.19	8.29	1.94	1.94	3.22	3.14	2.13	2.15	1.36	1.33	1.69	1.70	1.95	1.92
Chromium (Cr)	mg/L		0.0001	0.00018	0.00023	0.00059	0.00060	0.00022	0.00015	0.00028	0.00019	0.00012	0.00015	0.00017	0.00013	0.00013	0.00014	0.00029	0.00029
Cobalt (Co)	mg/L		0.0001	0.00846	0.00900	0.00538	0.00536	0.00015	0.00015	0.00025	0.00023	<0.00010	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	0.00019	0.00018
Copper (Cu)	mg/L		0.0005	0.00258	0.00274	0.00264	0.00266	0.00184	0.00192	0.00134	0.00128	0.00116	0.00121	0.00092	0.00093	0.00114	0.00101	0.00123	0.00125
Iron (Fe)	mg/L		0.01	<0.010	<0.010	0.114	0.110	0.015	0.015	0.038	0.039	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.100	0.092
Lead (Pb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.005	7.03	7.17	2.77	2.77	1.41	1.43	1.31	1.28	1.11	1.15	0.807	0.811	1.05	1.04	1.26	1.24
Manganese (Mn)	mg/L		0.00005	0.0633	0.0674	0.0498	0.0499	0.00152	0.00164	0.00341	0.00332	0.00148	0.00148	0.000352	0.000385	0.000355	0.000320	0.00222	0.00218
Mercury (Hg)	mg/L		0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.0001	0.0380	0.0396	0.00808	0.00805	0.00449	0.00460	0.00298	0.00299	0.00258	0.00269	0.00157	0.00160	0.00104	0.00092	0.00201	0.00199
Phosphorus (P)	mg/L		0.3	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.05	0.798	0.793	0.313	0.316	0.340	0.343	0.287	0.274	0.318	0.327	0.270	0.270	0.315	0.314	0.361	0.354
Selenium (Se)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.05	1.81	1.81	3.35	3.32	0.469	0.472	0.857	0.854	0.262	0.258	0.185	0.184	0.344	0.344	0.759	0.751
Silver (Ag)	mg/L		0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.01	2.08	2.11	1.37	1.36	0.693	0.699	0.767	0.751	0.590	0.607	0.478	0.477	0.517	0.511	0.769	0.761
Strontium (Sr)	mg/L		0.0001	0.0995	0.105	0.0328	0.0331	0.00798	0.00799	0.0188	0.0187	0.0104	0.0105	0.00561	0.00554	0.00564	0.00567	0.00656	0.00652
Thallium (Tl)	mg/L		0.00005 - 0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.00005	<0.000050	<0.000050	0.000151	0.000135	<0.000050	<0.000050	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000090	0.000090
Zinc (Zn)	mg/L		0.003	0.0163	0.0174	0.0057	0.0058	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Shaded cells indicate values that are both above analytical detection limits and exceed CCME guidelines for the protection of freshwater aquatic life.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.3-2

Stream Water Quality QA/QC Results, Back River Project, 2011

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Engineers and Scientists

Appendix 3.3-2. Stream Water Quality QA/QC Results, Back River Project, 2011

Site Abbreviation: Replicate: Date Sampled: ALS Sample ID:		CCME Guideline for the Protection of Freshwater Aquatic Life[a]	RDL[h]	Freshet Field Blank 18-Jun-11 L1020118-1	Freshet Travel Blank 18-Jun-11 L1020118-2	Summer Field Blank 14-Aug-11 L1047634-14	Summer Travel Blank 14-Aug-11 L1047634-13	Fall Field Blank 09-Sep-11 L1056717-20	Fall Travel Blank 08-Sep-11 L1056717-19
Physical Tests									
Conductivity	µS/cm		2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Hardness (as $CaCO_3$)	mg/L		0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
pH	pH	6.5-9.0	0.1	5.72	5.49	5.66	5.76	5.68	5.71
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Suspended Solids	mg/L	dependent on background levels	3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	<10	<10	<10	<10	<10	<10
Turbidity	NTU	dependent on background levels	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nutrients									
Ammonia (as N)	mg/L	pH- and temperature-dependent	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0197
Nitrate (as N)	mg/L	2.935b	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Ortho Phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus	mg/L	Trigger ranges from guidance framework	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Anions									
Bromide (Br)	mg/L		0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L		0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	0.12[b]	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Sulphate (SO_4)	mg/L		0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Cyanides									
Cyanide, Weak Acid Dissociable	mg/L		0.001	-	-	-	-	<0.0010	<0.0010
Cyanide, Total	mg/L		0.001 - 0.002	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	**0.001 - 0.005**	<0.0050	<0.0050	<0.0010	<0.0010	<0.0010	0.0012
Organic / Inorganic Carbon									
Total Organic Carbon	mg/L		**0.5**	<0.50	<0.50	0.75	0.73	<0.50	1.14
Total Metals									
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.003	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L		0.00005 - 0.0001	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.00003	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.3-2. Stream Water Quality QA/QC Results, Back River Project, 2011

Site Abbreviation: Replicate: Date Sampled: ALS Sample ID:		CCME Guideline for the Protection of Freshwater Aquatic Life[a]	RDL[h]	Freshet Field Blank 18-Jun-11 L1020118-1	Freshet Travel Blank 18-Jun-11 L1020118-2	Summer Field Blank 14-Aug-11 L1047634-14	Summer Travel Blank 14-Aug-11 L1047634-13	Fall Field Blank 09-Sep-11 L1056717-20	Fall Travel Blank 08-Sep-11 L1056717-19
Total Metals *(continued)*									
Barium (Ba)	mg/L		0.00005	<0.000050	<0.000050	0.000131	<0.000050	<0.000050	<0.000050
Beryllium (Be)	mg/L		0.0002	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.001 - 0.005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0050	<0.0050
Cadmium (Cd)	mg/L	equation[b,d]	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.02	<0.020	<0.020	<0.020	<0.020	0.032	0.022
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	≥0.002[e]	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.3	0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)	mg/L	≥0.001[f]	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Manganese (Mn)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	0.000053	<0.000050	<0.000050
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073[d]	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Phosphorus (P)	mg/L		0.3	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)	mg/L	0.001	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Silver (Ag)	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.01	<0.010	<0.010	<0.010	<0.010	0.078	<0.010
Strontium (Sr)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Thallium (Tl)	mg/L	0.0008	0.00005 - 0.0001	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.01	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L	0.03	0.003	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals									
Aluminum (Al)	mg/L		0.003	-	-	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L		0.00005	-	-	<0.000050	<0.000050	<0.000050	<0.000050

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

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Dissolved Metals *(continued)*									
Arsenic (As)	mg/L		0.00003	-	-	<0.000030	<0.000030	<0.000030	<0.000030
Barium (Ba)	mg/L		0.00005	-	-	0.000112	<0.000050	0.000097	<0.000050
Beryllium (Be)	mg/L		0.0002	-	-	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.0005	-	-	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.001 - 0.005	-	-	<0.0010	<0.0010	<0.0050	<0.0050
Cadmium (Cd)	mg/L		0.00001	-	-	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.02	-	-	<0.020	<0.020	0.093	<0.020
Chromium (Cr)	mg/L		0.0001	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L		0.0001	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L		0.0005	-	-	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L		0.01	-	-	<0.010	<0.010	<0.010	<0.010
Lead (Pb)	mg/L		0.00005	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.005	-	-	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.005	-	-	<0.0050	<0.0050	0.009400	<0.0050
Manganese (Mn)	mg/L		0.00005	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Mercury (Hg)	mg/L		0.00001	-	-	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.00005	-	-	<0.000050	<0.000050	0.000087	<0.000050
Nickel (Ni)	mg/L		0.0001	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Phosphorus (P)	mg/L		0.3	-	-	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.05	-	-	<0.050	<0.050	<0.050	<0.050
Selenium (Se)	mg/L		0.0001	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.05	-	-	<0.050	<0.050	<0.050	<0.050
Silver (Ag)	mg/L		0.00001	-	-	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.01	-	-	<0.010	<0.010	0.171	<0.010
Strontium (Sr)	mg/L		0.0001	-	-	<0.00010	<0.00010	0.00014	<0.00010
Thallium (Tl)	mg/L		0.00005	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.0001	-	-	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.01	-	-	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.00001	-	-	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.00005	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.003	-	-	<0.0030	<0.0030	<0.0030	<0.0030

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011.

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

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g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realized detection limit

Appendix 3.4-1

Lake Sediment Quality Descriptions, Back River Project, August 2011

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Appendix 3.4-1. Lake Sediment Quality Descriptions, Back River Project, 2011

Lake	Date	Zone	Replicate	Depth (m)	Physical Description	Munsell Colour Classification	Biological Material	Debriss Notes	Photos
Llama	06-Aug-11	shallow	1	5	less prominent orange layer, very fine sediments below	10R 5/4 surface, greyish below	-	-	yes
			2	5	very fine sediments, less prominent orange layer	10R 5/4 surface, greyish below	-	-	yes
			3	5	very fine sediments, less prominent orange layer	10R 5/4 surface, greyish below	-	-	yes
Llama	06-Aug-11	deep	1	14	1 cm horizon, very fine sediments, silty, some black flecks in surface	2.5Y 3/1 over 5Y 5/1	-	orange debris	yes
			2	11.5	very fine sediments, layer of orange on top	10R 5/4 over 5Y 5/1	-	orange debris	yes
			3	12	top layer of orange, very fine sediments	10R 5/4 over 5Y 5/11	-	orange debris	yes
Umwelt	05-Aug-11	shallow	1	2	homogenous silt clay, no horizon, lots of detritus, small stones present	5Y 5/4		orange globs on surface	yes
			2	2	jelly like textured silt, yellow/orange detritus on surface, small stones present	5Y 4/3		orange globs on surface	yes
			3	2	jelly like textured silt, yellow/orange detritus on surface, small stones present	5Y 4/3		orange globs on surface	yes
Giraffe	11-Aug-11	shallow	1	3.6	silty, with black and orange flecks	10YR 2/2	worm casts present	orange debris	no
			2	3.7	silty, with black speckles and flecks of orange	5Y 3/2	worm casts present	orange debris	no
			3	3.7	silty, blacker than the other replicates	10Y 3/2	worm casts present	orange debris	no
	11-Aug-11	deep	1	5.8	very fine sediments, clay below dark brown layer	2.5Y 3/2 over 2.5Y 6/4	-	-	no
			2	5.8	very fine dark brown sediment, no horizons	5Y 3/2	few worm casts	-	no
			3	5.6	very fine, dark brown, soft	5Y 3/2	-	decomposing twigs present	no
Goose Neck	07-Aug-11	shallow	1						yes
			2						
			3						
Goose Central	14-Aug-11	shallow	1	4.5	orange surface over grey fine silt	5Y 4/2	-	-	no
			2	4.7	orange flecks over grey fine silt	5Y 4/2	surface algae present	orange debris	no
			3	4.5	orange flecks over grey fine silt	5Y 4/2	worm casts present	orange debris	no
Goose Tail	17-Aug-11	shallow	1	2.4	orange surface over fine silt sediments	2.5Y 4/2	worm casts present		no
			2	2.7	fine sediments with some sand and gravel presesnt	10YR 4/2	worm casts present		no
			3	2.6	orange surface over fine silt sediments	2.5Y 4/2	worm casts present		no
Propellor	11-Aug-11	deep	1	7.6	one layer of very fine silt (yellowish brown colour)	10YR 3/2	-	-	no
			2	7.5	one layer of very fine silt (yellowish brown colour)	2.5Y 3/2	-	some debris present, disintegrates in hands	no
			3	7.6	one layer of very fine silt (yellowish brown colour)	5Y 3/2	-	some debris present, disintegrates in hands	no
Reference B	08-Aug-11	shallow	1	4.5	reddy fine sediments over very fine silt/clay bottom	5YR 3/4 over 2.5Y 4/3	worm casts present	orange debris	yes
			2	4	thin orange surface layer over very fine silt/clay bottom	5YR 4/6 over 5Y 4/2	-	orange debris	yes
			3	4.5	orange girt and sand over very fine silt/clay bottom	10YR 3/4 over 2.5 Y 4/2	worm casets present	orange debris	yes

Appendix 3.4-2

Lake Sediment Quality Analytical Results, Back River Project, August 2011

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Appendix 3.4-2. Lake Sediment Quality Analytical Results, Back River Project, 2011

Site ID:		CCME Guidelines for the Protection of Aquatic Life[a]			Llama Lake	Llama Lake	Llama Lake	Llama Lake	Llama Lake	Llama Lake	Umwelt Lake	Umwelt Lake	Umwelt Lake	Giraffe Lake	Giraffe Lake	Giraffe Lake	Giraffe Lake	Giraffe Lake	Giraffe Lake
Depth (m):					5	5.1	5	14.1	11.6	12	2	2	2	3.7	3.7	3.7	5.9	5.9	5.7
Replicate:					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled:					06-Aug-11	06-Aug-11	06-Aug-11	06-Aug-11	06-Aug-11	06-Aug-11	05-Aug-11	05-Aug-11	05-Aug-11	11-Aug-11	11-Aug-11	11-Aug-11	11-Aug-11	11-Aug-11	11-Aug-11
ALS Sample ID:	Units	ISQG[b]	PEL[c]	RDL[d]	L1041632-15	L1041632-16	L1041632-17	L1041632-12	L1041632-13	L1041632-14	L1041632-9	L1041632-10	L1041632-11	L1043853-4	L1043853-5	L1043853-6	L1043853-7	L1043853-8	L1043853-9
Physical Tests																			
Moisture	%			0.25	84.4	83.9	85.1	77.1	76.1	72.9	83.9	79.2	78.4	87.7	87.6	87.8	67.0	62.5	84.0
pH	pH			0.10	6.40	6.62	6.51	6.33	6.66	6.41	6.45	6.22	6.68	5.61	5.56	6.04	5.90	5.89	5.90
Particle Size																			
% Gravel (>2 mm)	%			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	2.99	0.61	<0.10	<0.10	<0.10	16	0.55	<0.10
% Sand (2.0 mm - 0.063 mm)	%			0.10	8.72	23.30	12.30	9.16	12.50	10.50	20.10	35.30	42.30	5.43	5.94	5.46	44.50	61.70	19.30
% Silt (0.063 mm - 4 µm)	%			0.10	59.5	52.9	55.7	72.0	69.8	71.6	68.3	54.0	50.3	80.8	78.4	85.3	37.9	36.4	69.7
% Clay (<4 µm)	%			0.10	31.8	23.8	32.0	18.8	17.7	17.9	11.70	7.67	06.8	13.8	15.7	09.2	01.6	01.4	11.0
Leachable Nutrients																			
Total Nitrogen	%			0.020	0.643	0.486	0.601	0.335	0.277	0.327	0.694	0.383	0.484	0.897	0.818	0.822	0.164	0.215	0.640
Cyanides																			
Cyanide, Weak Acid Dissociable	mg/kg			3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Cyanide, Total	mg/kg			3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	3.1	<3.0	<3.0	<3.0	<3.0	<3.0
Organic / Inorganic Carbon																			
Total Organic Carbon	%			0.10	7.93	6.11	7.23	3.98	3.26	3.83	7.91	4.16	5.38	11.70	10.80	10.90	2.14	2.78	8.35
Plant Available Nutrients																			
Available Ammonium (as N)	mg/kg			1 - 6.4	36.1	27.4	31.2	33.8	17.4	18.2	37.0	28.6	30.4	15.6	9.3	13.3	2.1	4.7	15.7
Nitrate and Nitrite (as N)	mg/kg			2 - 20.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<2.0	<2.0	<6.0
Nitrate (as N)	mg/kg			2 - 20.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<2.0	<2.0	<6.0
Nitrite (as N)	mg/kg			0.4 - 4.0	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<0.40	<0.40	<1.2
Available Phosphate (as P)	mg/kg			2 - 10.0	6.7	4.5	5.3	7.7	36.6	25.5	14.1	7.4	10.3	<4.0	<4.0	<4.0	12.1	5.8	8.2
Metals																			
Aluminum (Al)	mg/kg			50	11000	10200	10100	11000	10200	9930	8090	8570	5550	10500	10600	10300	8210	5400	8910
Antimony (Sb)	mg/kg			0.10	0.1	0.11	0.1	<0.10	<0.10	<0.10	0.1	<0.10	<0.10	0.12	<0.10	0.11	<0.10	<0.10	0.1
Arsenic (As)	mg/kg	5.9	17	0.050	26.3	21	39.8	15.7	14.5	22.2	10.3	12.3	5.82	13.3	13.4	12.5	8.78	7.47	9.98
Barium (Ba)	mg/kg			0.50	82.7	76.4	80.5	62.7	61.1	58.3	65.9	54.8	45.1	54.9	56.7	66.9	47.7	26.9	65.6
Beryllium (Be)	mg/kg			0.20	0.45	0.44	0.41	0.33	0.31	0.31	0.29	0.29	<0.20	0.71	0.71	0.85	0.56	0.42	0.63
Bismuth (Bi)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.6	3.5	0.050	0.388	0.388	0.377	0.301	0.175	0.196	0.31	0.732	0.162	0.565	0.626	0.638	0.13	0.114	0.451
Calcium (Ca)	mg/kg			50	3090	2850	2900	2460	2370	2410	3350	2630	2700	2900	2650	3250	1860	1260	3070
Chromium (Cr)	mg/kg	37.3	90	0.50	32.2	30.8	30.8	38.5	32.3	31.6	26.9	29	18.1	25.6	28.3	26.2	25	14	24.4
Cobalt (Co)	mg/kg			0.10	15.2	12.4	17.6	22.4	12.1	14.5	8.57	10.5	5.81	16.9	13.6	16.1	11.1	7.26	19.3
Copper (Cu)	mg/kg	35.7	197	0.50	92.1	90.3	92.2	79.8	66.8	63.4	73.9	61.1	39.5	115	128	127	82.5	43.9	106
Iron (Fe)	mg/kg			50	27100	21900	34900	20100	21200	25500	14300	16100	9500	13900	14300	12500	17400	12200	13200
Lead (Pb)	mg/kg	35	91.3	0.5 - 0.7	5.96	5.73	5.39	5.52	4.91	5.09	5.1	4.67	3.73	5.4	4.88	5.6	4.45	2.69	5.47
Lithium (Li)	mg/kg			1.0	14.4	13.9	12.5	15.8	15	14.4	11.5	12.7	8.9	10.5	10.5	9.3	17.2	10.7	14.6
Magnesium (Mg)	mg/kg			20	4470	4400	4280	5720	4850	4870	3750	4090	2870	2680	3050	2850	3630	2090	2950
Manganese (Mn)	mg/kg			1.0	172	136	390	194	210	274	87.4	100	65.3	66.5	75.7	67.5	90	53.4	80.4
Mercury (Hg)	mg/kg	0.17	0.486	0.0050	0.0571	0.0454	0.0524	0.0658	0.0484	0.05	0.072	0.0457	0.04	0.103	0.0889	0.101	0.0352	0.0355	0.0892
Molybdenum (Mo)	mg/kg			0.50	1.09	1	1.16	0.73	0.7	0.71	0.6	0.78	<0.50	1.07	0.99	0.84	0.55	<0.50	0.68
Nickel (Ni)	mg/kg			0.50	70.2	65.7	69.7	54.9	39.4	39.7	55.1	47.8	28.7	135	117	127	82.8	45.1	102
Phosphorus (P)	mg/kg			50	616	543	635	788	730	731	656	554	521	554	574	579	636	435	590
Potassium (K)	mg/kg			100	980	1000	960	1040	890	880	840	830	600	610	660	630	720	340	580
Selenium (Se)	mg/kg			0.20	0.48	0.38	0.47	0.45	0.39	0.4	0.4	0.43	0.23	0.72	0.59	0.58	0.34	0.25	0.5
Silver (Ag)	mg/kg			0.10	0.18	0.18	0.2	0.23	0.16	0.15	0.1	<0.10	<0.10	0.28	0.28	0.28	0.16	0.11	0.22
Sodium (Na)	mg/kg			100	150	150	130	160	130	140	140	140	110	110	130	120	<100	<100	120
Strontium (Sr)	mg/kg			0.50	20.1	17.3	17.4	13.8	13.4	12.6	19	15.1	14	18.2	17.5	20.2	13.9	7.15	16.6
Sulphur (S)	mg/kg			500	2600	2100	2300	2100	1500	1600	5500	2300	2300	4100	4100	3900	700	1000	3200
Thallium (Tl)	mg/kg			0.050	0.114	0.105	0.101	0.127	0.089	0.096	0.083	0.165	0.054	0.115	0.109	0.115	0.068	<0.050	0.106
Tin (Sn)	mg/kg			2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0	326	310	265	419	393	417	317	361	263	208	232	217	352	172	274
Uranium (U)	mg/kg			0.050	1.42	1.37	1.33	1.16	1.15	1.05	1.02	1.02	0.617	2.1	2.17	2.12	1.58	0.839	1.66
Vanadium (V)	mg/kg			0.20	34.5	33.7	34.1	37.9	33.8	34.1	30.7	31	21.6	24.9	26.9	25.7	28.1	17.7	27.3
Zinc (Zn)	mg/kg	123	315	1.0	76.3	77.5	78.5	66.4	49.7	48.6	62.6	120	35.2	105	108	115	62.1	41.1	81.3

Notes:

Depths are the mean of the two grabs in each replicate.

Shaded cells indicate values that exceed CCME guidelines

a) Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

d) Realized Detection Limits

Appendix 3.4-2. Lake Sediment Quality Analytical Results, Back River Project, 2011

Site ID:		CCME Guidelines for the Protection of Aquatic Life[a]			Goose Lake Neck	Goose Lake Neck	Goose Lake Neck	Goose Lake Central	Goose Lake Central	Goose Lake Central	Goose Lake Tail	Goose Lake Tail	Goose Lake Tail	Propellor Lake	Propellor Lake	Propellor Lake	Reference B Lake	Reference B Lake	Reference B Lake
Depth (m):					3	3	3	4.5	4.8	4.5	2.5	2.7	2.7	7.6	7.5	7.7	4.4	4.4	4.5
Replicate:					1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled:					07-Aug-11	07-Aug-11	07-Aug-11	07-Aug-11	07-Aug-11	07-Aug-11	17-Aug-11	17-Aug-11	17-Aug-11	11-Aug-11	11-Aug-11	11-Aug-11	08-Aug-11	08-Aug-11	08-Aug-11
ALS Sample ID:	Units	ISQG[b]	PEL[c]	RDL[d]	L1041632-18	L1041632-19	L1041632-20	L1041632-6	L1041632-7	L1041632-8	L1047401-1	L1047401-2	L1047401-3	L1047656-10	L1047656-11	L1047656-12	L1043853-1	L1043853-2	L1043853-3
Physical Tests																			
Moisture	%			0.25	91.5	91.3	92.2	84.4	85.4	86.4	44.2	63.5	63.9	76.6	78.5	76.5	70.5	69.7	68.1
pH	pH			0.10	6.35	6.03	6.23	6.70	6.80	6.68	6.16	6.29	6.33	6.16	6.00	6.02	6.38	6.38	6.36
Particle Size																			
% Gravel (>2 mm)	%			0.10	<0.10	<0.10	<0.10	0.17	0.57	<0.10	3	2.66	0.97	<0.10	<0.10	<0.10	1.78	0.69	1.52
% Sand (2.0 mm - 0.063 mm)	%			0.10	5.21	9.86	2.43	6.80	6.57	7.17	70.70	66.00	64.60	20.90	18.20	23.60	68.10	75.90	77.00
% Silt (0.063 mm - 4 µm)	%			0.10	64.2	16.3	61.0	65.6	66.4	67.1	23.8	27.2	31.3	74.0	74.7	72.7	28.5	22.2	20.3
% Clay (<4 µm)	%			0.10	30.6	73.9	36.6	27.4	26.5	25.8	02.5	04.1	03.1	05.1	07.1	03.7	01.6	01.2	01.2
Leachable Nutrients																			
Total Nitrogen	%			0.020	1.160	1.240	1.130	0.468	0.496	0.583	0.095	0.151	0.182	0.345	0.361	0.302	0.358	0.327	0.279
Cyanides																			
Cyanide, Weak Acid Dissociable	mg/kg			3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Cyanide, Total	mg/kg			3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Organic / Inorganic Carbon																			
Total Organic Carbon	%			0.10	14.20	14.80	13.70	5.53	5.80	6.81	1.03	1.75	1.93	3.89	3.99	3.33	4.51	3.97	3.50
Plant Available Nutrients																			
Available Ammonium (as N)	mg/kg			1 - 6.4	54.1	68.6	58.8	43.8	51.9	50.7	2.0	2.3	4.4	5.9	8.8	4.8	15.4	15.2	8.8
Nitrate and Nitrite (as N)	mg/kg			2 - 20.0	<6.0	<16	<8.0	<8.0	<6.0	<8.0	<2.0	<2.0	<4.0	<4.0	<6.0	<4.0	<2.0	<2.0	<2.0
Nitrate (as N)	mg/kg			2 - 20.0	<6.0	<16	<8.0	<8.0	<6.0	<8.0	<2.0	<2.0	<4.0	<4.0	<6.0	<4.0	<2.0	<2.0	<2.0
Nitrite (as N)	mg/kg			0.4 - 4.0	<1.2	<3.2	<1.6	<1.6	<1.2	<1.6	<0.40	<0.40	<0.80	<0.80	<1.2	<0.80	<0.40	<0.40	<0.40
Available Phosphate (as P)	mg/kg			2 - 10.0	13.5	22	6.6	16.1	21.1	7.4	12.8	8.3	5.7	58.3	65.6	59.9	5.9	7.2	3
Metals																			
Aluminum (Al)	mg/kg			50	9590	8080	10600	11100	10800	9980	4190	5420	4530	7790	7220	7070	2430	2450	2510
Antimony (Sb)	mg/kg			0.10	0.14	<0.10	0.16	<0.10	0.11	0.12	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic (As)	mg/kg	5.9	17	0.050	8.15	6.98	10.8	11	17.1	22.8	2.74	4.39	3.06	4.31	4.02	3.59	3.05	3.03	3.51
Barium (Ba)	mg/kg			0.50	81.5	69.2	86.3	59.5	59.3	55	24.9	35.1	29.4	47.6	45.4	43.6	20.5	18.4	17.5
Beryllium (Be)	mg/kg			0.20	0.53	0.42	0.6	0.56	0.56	0.54	<0.20	0.24	0.21	0.33	0.29	0.27	<0.20	<0.20	<0.20
Bismuth (Bi)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.6	3.5	0.050	1.13	0.601	1.43	0.182	0.238	0.232	0.052	0.12	0.093	0.249	0.364	0.217	0.055	<0.050	0.058
Calcium (Ca)	mg/kg			50	3660	3370	3620	2590	2690	2650	1230	1620	1430	1980	1990	1960	1000	984	882
Chromium (Cr)	mg/kg	37.3	90	0.50	22.7	19.9	25.4	31.2	29.8	28	11.1	15.2	12.8	24.9	23	22	6.76	7.02	6.78
Cobalt (Co)	mg/kg			0.10	11.8	10.5	12.5	17.7	18.7	26.3	5.11	6.67	5.94	10.7	10.4	9.44	2.11	2.18	2.2
Copper (Cu)	mg/kg	35.7	197	0.50	146	108	166	77.2	79.5	78.2	15.8	34	25.7	46.6	41.7	38.4	12.4	11.1	12.3
Iron (Fe)	mg/kg			50	8430	8190	9500	19600	25100	31400	6130	8280	6420	11700	10100	10500	6640	6830	7110
Lead (Pb)	mg/kg	35	91.3	0.5 - 0.7	6.2	5.05	6.49	5.14	5.86	5.92	1.79	2.72	2.12	4.47	4.96	5.16	1.79	1.68	1.76
Lithium (Li)	mg/kg			1.0	8.5	7.4	9.2	11.1	10.3	9.2	7.1	7.7	6.8	7.7	6.9	6.8	3.1	4.3	3.6
Magnesium (Mg)	mg/kg			20	2520	2280	2730	3370	3170	2960	1850	2150	1770	2700	2590	2530	980	1120	1050
Manganese (Mn)	mg/kg			1.0	65.8	69.1	69.4	113	178	309	47.5	61.1	46.8	108	103	103	37.3	39.3	37.3
Mercury (Hg)	mg/kg	0.17	0.486	0.0050	0.0984	0.101	0.0873	0.0603	0.0718	0.0775	0.011	0.0253	0.0168	0.0306	0.0347	0.0324	0.012	0.0104	0.0122
Molybdenum (Mo)	mg/kg			0.50	0.73	0.6	0.97	1.15	1.16	1.18	<0.50	<0.50	<0.50	0.5	0.52	<0.50	<0.50	<0.50	<0.50
Nickel (Ni)	mg/kg			0.50	85.2	71	91.7	56.4	54.2	56	19.9	30.6	22.2	33.8	30.8	28.9	10.3	10.2	9.77
Phosphorus (P)	mg/kg			50	523	510	485	607	608	604	377	411	379	834	699	670	226	204	172
Potassium (K)	mg/kg			100	630	570	680	700	690	700	370	440	350	550	530	520	280	290	270
Selenium (Se)	mg/kg			0.20	0.61	0.54	0.84	0.48	0.49	0.51	<0.20	<0.20	<0.20	0.32	0.29	0.26	<0.20	<0.20	<0.20
Silver (Ag)	mg/kg			0.10	0.3	0.24	0.33	0.14	0.14	0.15	<0.10	<0.10	<0.10	<0.10	0.1	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg			100	<100	<100	110	130	130	130	<100	<100	<100	120	130	120	<100	<100	<100
Strontium (Sr)	mg/kg			0.50	22.9	21.3	23.5	17.4	17.8	17	6.25	9.05	7.66	11.7	11.6	11.4	6.21	5.92	5.48
Sulphur (S)	mg/kg			500	4600	4500	4500	4100	3800	7900	500	700	700	1300	1400	1200	1200	1000	900
Thallium (Tl)	mg/kg			0.050	0.117	0.08	0.177	0.072	0.074	0.074	<0.050	<0.050	<0.050	0.071	0.085	0.062	<0.050	<0.050	<0.050
Tin (Sn)	mg/kg			2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0	141	118	153	308	279	233	229	215	197	271	259	260	123	126	116
Uranium (U)	mg/kg			0.050	1.87	1.54	2.2	1.41	1.4	1.34	0.515	0.779	0.623	0.893	0.869	0.805	0.244	0.226	0.534
Vanadium (V)	mg/kg			0.20	18.6	15.8	21.9	34.5	33.3	31	13.1	17.5	15.5	30.4	27.9	26.4	11	12.1	13.1
Zinc (Zn)	mg/kg	123	315	1.0	92.9	66.9	142	64.7	72.1	70.8	25.5	37.5	29.6	48.7	49.8	41.2	11.1	10.8	11.2

Notes:

Depths are the mean of the two grabs in each replicate.

Shaded cells indicate values that exceed CCME guidelines

a) Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

d) Realized Detection Limits

Appendix 3.5-1

Stream Sediment Quality Analytical Results, Back River Project, August 2011

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Appendix 3.5-1. Stream Sediment Quality Analytical Results, Back River Project, 2011

Sample ID		CCME Guidelines for the Protection of Aquatic Life[a]			Chair OF 1	Chair OF 2	Chair OF 3	Giraffe OF 1	Giraffe OF 2	Giraffe OF 3	Wolf OF 1	Wolf OF 2	Wolf OF 3	Goose OF 1	Goose OF 2	Goose OF 3	Propellor Downstream 1	Ref. B OF 1	Ref. B OF 2	Ref. B OF 3
Date Sampled					13-Aug-11	13-Aug-11	13-Aug-11	12-Aug-11	12-Aug-11	12-Aug-11	13-Aug-11	13-Aug-11	13-Aug-11	16-Aug-11	16-Aug-11	16-Aug-11	15-Aug-11	14-Aug-11	14-Aug-11	14-Aug-11
Time Sampled																				
ALS Sample ID	Units	ISQG[b]	PEL[c]	RDL[d]	L1047656-13	L1047656-14	L1047656-15	L1047656-1	L1047656-2	L1047656-3	L1047656-4	L1047656-5	L1047656-6	L1047401-5	L1047401-6	L1047401-7	L1047401-4	L1047656-7	L1047656-8	L1047656-9
Physical Tests																				
Moisture	%			0.25	44.3	71.5	63.1	24.8	82.0	27.2	48.2	38.1	40.7	87.7	85.9	68.0	61.9	87.6	77.4	79.9
pH (1:2 soil:water)	pH			0.10	5.27	5.18	5.23	6.34	5.56	6.28	4.45	4.62	4.92	6.51	6.35	5.88	6.31	4.84	5.07	5.16
Particle Size																				
% Gravel (>2mm)	%			0.10	2.47	4.30	4.93	29.5	77.2	59.4	4.09	0.22	0.54	<0.10	<0.10	17.2	26.2	2.11	9.78	3.99
% Sand (2.0mm - 0.063mm)	%			0.10	76.3	51.0	64.1	65.7	16.9	34.1	80.5	82.6	78.9	18.8	64.8	69.7	53.1	57.9	74.1	78.2
% Silt (0.063mm - 4um)	%			0.10	20.1	34.2	25.5	4.22	4.28	5.56	14.8	16.5	19.6	62.3	29.1	12.8	9.82	32.3	13.8	16.9
% Clay (<4um)	%			0.10	1.16	10.5	5.40	0.57	1.64	0.95	0.63	0.63	0.95	18.9	6.13	0.43	10.9	7.68	2.37	0.86
Anions and Nutrients																				
Total Nitrogen by LECO	%			0.020	0.160	0.545	0.561	0.045	0.922	0.125	0.097	0.152	0.150	1.55	1.30	0.218	0.845	1.29	0.686	0.781
Cyanides																				
Cyanide, Weak Acid Dissociable				3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Cyanide, Total				3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Organic / Inorganic Carbon																				
Total Organic Carbon	%			0.10	2.93	8.66	8.66	0.54	15.9	1.62	1.43	2.29	2.26	23.4	21.4	3.41	9.78	23.3	11.0	14.5
Plant Available Nutrients																				
Available Ammonium (as N)	mg/kg			1.0 - 6.4	<2.4	35.4	16.5	1.7	31.0	5.9	3.4	12.9	20.8	41.2	15.1	5.6	21.6	41.5	30.6	38.6
Nitrate and Nitrite (as N)	mg/kg			2.0 - 20.0	<4.0	<6.0	<4.0	<2.0	<12	<2.0	<4.0	<4.0	<4.0	<12	<10	<4.0	<6.0	<20	<8.0	<10
Nitrate (as N)	mg/kg			2.0 - 20.0	<4.0	<6.0	<4.0	<2.0	<12	<2.0	<4.0	<4.0	<4.0	<12	<10	<4.0	<6.0	<20	<8.0	<10
Nitrite (as N)				0.4 - 4.0	<0.80	<1.2	<0.80	<0.40	<2.4	<0.40	<0.80	<0.80	<0.80	<2.4	<2.0	<0.80	<1.2	<4.0	<1.6	<2.0
Available Phosphate (as P)	mg/kg			2.0 - 8.0	<2.0	6.1	8.2	<2.0	<6.0	<2.0	<2.0	<2.0	<2.0	<8.0	<6.0	<2.0	<4.0	<8.0	<4.0	<6.0
Metals																				
Aluminum (Al)	mg/kg			50	5240	10800	9680	6760	5860	8730	2500	2990	2600	5080	3450	4170	5280	3990	3260	3460
Antimony (Sb)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic (As)	mg/kg	5.9	17.0	0.050	3.35	18.1	14.5	3.46	16.2	9.90	1.28	3.03	2.07	21.9	14.1	3.50	5.63	3.96	2.27	2.64
Barium (Ba)	mg/kg			0.50	19.3	58.9	39.7	23.8	81.0	29.8	15.5	16.9	14.8	88.4	78.7	32.9	65.0	77.3	50.0	36.2
Beryllium (Be)	mg/kg			0.20	<0.20	0.32	0.27	<0.20	0.25	<0.20	<0.20	<0.20	<0.20	0.29	0.22	<0.20	0.24	<0.20	<0.20	<0.20
Bismuth (Bi)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.6	3.5	0.050	0.057	0.161	0.187	<0.050	0.248	<0.050	<0.050	0.053	<0.050	0.711	0.341	0.102	0.116	0.296	0.292	0.131
Calcium (Ca)	mg/kg			50	811	1740	1460	1360	3120	1440	986	987	884	4340	4530	1830	2240	3250	2490	1430
Chromium (Cr)	mg/kg	37.3	90.0	0.50	15.9	34.7	31.7	22.2	17.7	28.8	6.37	8.06	6.46	15.7	11.1	11.4	23.2	12.8	9.04	13.1
Cobalt (Co)	mg/kg			0.10	2.13	8.71	6.66	7.86	8.39	8.59	1.79	2.54	1.89	118	25.2	8.41	10.0	4.78	3.61	3.41
Copper (Cu)	mg/kg	35.7	197	0.50	11.9	40.0	46.2	18.9	44.5	22.0	5.57	7.69	6.40	54.4	42.4	15.0	20.2	62.2	50.5	17.6
Iron (Fe)	mg/kg			50	6590	17200	13200	12000	26400	17300	4440	8660	6310	29700	27800	10900	23600	12900	8220	8730
Lead (Pb)	mg/kg	35	91.3	0.50	1.43	5.23	3.93	2.39	3.83	2.69	1.14	2.08	1.34	9.08	5.18	2.57	6.27	6.74	1.85	1.72
Lithium (Li)	mg/kg			1.0	10.6	18.1	17.0	13.9	7.0	18.0	4.9	5.4	4.8	4.3	3.0	7.7	8.8	2.3	2.5	4.8
Magnesium (Mg)	mg/kg			20	2970	5170	4740	4860	3120	6140	1360	1540	1330	2190	1800	2740	3440	1110	1200	1580
Manganese (Mn)	mg/kg			1.0	64.3	124	110	129	133	168	42.1	38.6	31.3	2880	573	172	328	65.0	51.5	48.9
Mercury (Hg)	mg/kg	0.17	0.486	0.0050	0.0066	0.0421	0.0337	0.0061	0.0460	0.0053	0.0051	0.0126	0.0074	0.111	0.0695	0.0244	0.0292	0.0824	0.0532	0.0366
Molybdenum (Mo)	mg/kg			0.50	<0.50	0.57	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.74	0.52	<0.50	1.01	1.24	<0.50	<0.50
Nickel (Ni)	mg/kg			0.50	12.1	40.6	31.1	22.5	54.3	27.5	7.42	11.4	8.59	122	68.8	22.1	28.0	26.5	16.2	14.8
Phosphorus (P)	mg/kg			50	193	543	482	282	481	410	207	249	206	912	601	406	372	698	533	417
Potassium (K)	mg/kg			100	130	570	500	710	640	690	150	180	140	640	490	490	980	250	150	170
Selenium (Se)	mg/kg			0.20	<0.20	0.27	0.25	<0.20	0.32	<0.20	<0.20	<0.20	<0.20	0.66	0.41	<0.20	<0.20	0.87	0.38	0.25
Silver (Ag)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	<0.10	<0.10	<0.10	0.14	<0.10	<0.10
Sodium (Na)	mg/kg			100	<100	100	<100	<100	<100	<100	<100	<100	<100	180	<100	<100	<100	<100	<100	<100
Strontium (Sr)	mg/kg			0.50	4.19	15.4	11.3	5.50	19.6	5.13	6.13	5.20	4.98	27.5	32.0	11.1	11.0	15.1	10.2	6.43
Sulfur (S)-Total	mg/kg			500	600	1700	1600	<500	3000	600	<500	700	600	3200	3100	700	2000	3000	1700	1900
Thallium (Tl)	mg/kg			0.050	<0.050	0.092	0.071	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.168	0.056	<0.050	0.054	<0.050	<0.050	<0.050
Tin (Sn)	mg/kg			2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0	154	377	334	330	237	327	160	165	130	134	107	255	278	125	101	162
Uranium (U)	mg/kg			0.050	0.412	1.07	1.00	0.422	0.793	0.608	0.226	0.254	0.272	0.972	0.613	0.388	0.691	0.654	0.662	0.521
Vanadium (V)	mg/kg			0.20	17.9	41.8	29.0	21.1	25.8	28.4	7.85	11.4	9.03	21.3	17.8	15.6	26.5	22.3	24.1	22.1
Zinc (Zn)	mg/kg	123	315	1.0	15.8	44.1	37.9	30.5	40.5	33.4	9.9	16.0	11.9	60.4	43.6	22.1	56.4	18.2	10.0	13.1

Notes:

Shaded cells indicate values that exceed CCME guidelines

a) Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, Updated January 2011

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

d) RDL = Realized detection limit

Appendix 3.6-1

Lake Phytoplankton Biomass as Chl a Results, Back River Project, 2011

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Appendix 3.6-1. Lake Phytoplankton Biomass as Chl *a* Results, Back River Project, 2011

Lake	Replicate	Date Sampled	ALS Sample ID	Chlorophyll *a* (µg/L)	Mean	SE
Llama Lake	1	06-Aug-11	L1043878-4	0.446	0.46	0.01
	2	06-Aug-11	L1043878-5	0.484		
	3	06-Aug-11	L1043878-6	0.444		
Umwelt Lake	1	05-Aug-11	L1043878-1	0.730	0.56	0.10
	2	05-Aug-11	L1043878-2	0.578		
	3	05-Aug-11	L1043878-3	0.384		
Giraffe Lake	1	10-Aug-11	L1043878-16	0.128	0.14	0.01
	2	10-Aug-11	L1043878-17	0.163		
	3	10-Aug-11	L1043878-18	0.132		
Goose Lake Neck	1	07-Aug-11	L1043878-10	0.538	0.35	0.13
	2	07-Aug-11	L1043878-11	0.113		
	3	07-Aug-11	L1043878-12	0.413		
Goose Lake Central	1	07-Aug-11	L1043878-7	0.542	0.55	0.06
	2	07-Aug-11	L1043878-8	0.650		
	3	07-Aug-11	L1043878-9	0.459		
Reference B Lake	1	08-Aug-11	L1043878-13	0.866	0.61	0.16
	2	08-Aug-11	L1043878-14	0.304		
	3	08-Aug-11	L1043878-15	0.651		

SE = standard error of the mean

All samples were from 1 m depth.

Appendix 3.6-2

Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2011

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Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2011

Site ID	Llama Lake	Llama Lake	Llama Lake	Umwelt Lake	Umwelt Lake	Umwelt Lake	Giraffe Lake	Giraffe Lake	Giraffe Lake	Goose Lake Neck	Goose Lake Neck	Goose Lake Neck	Goose Lake Central	Goose Lake Central	Goose Lake Central	Reference B Lake	Reference B Lake	Reference B Lake
Rep	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date sampled	6-Aug-11	6-Aug-11	6-Aug-11	5-Aug-11	5-Aug-11	5-Aug-11	10-Aug-11	10-Aug-11	10-Aug-11	7-Aug-11	7-Aug-11	7-Aug-11	7-Aug-11	7-Aug-11	7-Aug-11	8-Aug-11	8-Aug-11	8-Aug-11
LAB ID	BIO-04	BIO-05	BIO-06	BIO-01	BIO-02	BIO-03	BIO-16	BIO-17	BIO-18	BIO-10	BIO-11	BIO-12	BIO-07	BIO-08	BIO-09	BIO-13	BIO-14	BIO-15
	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density
DIATOMS																		
Achnanthes minutissima Kuetzing	0	0	7292	7292	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centric Diatom: 4 µm (*Cyclotella/Stephanodiscus*)	80222	116687	116687	123980	386528	306305	140997	153152	131273	29171	68067	63205	145859	72929	63205	116687	175031	145859
Centric Diatom: 10-16 µm (*Cyclotella/Stephanodiscus*)	80222	65636	80222	29171	21878	51050	29171	21878	7292	14585	38895	19447	102101	43757	24309	94807	58343	72929
Cocconeis sp	0	0	0	7292	0	0	0	0	0	0	0	0	0	0	0	7292	0	0
Eunotia spp	0	0	0	0	0	0	0	0	0	0	0	4861	0	0	0	0	0	0
Nitzschia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7292	0	14585
Synedra/Nitzschia sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7292	0
Synedra sp	0	0	0	0	0	0	0	0	0	0	0	4861	7292	0	4861	14585	0	0
Tabellaria flocculosa (Roth) Kuetzing	0	0	0	0	0	0	4861	0	0	7292	0	0	7292	0	4861	7292	0	0
GREEN ALGAE - CHLOROPHYCEAE																		
Ankistrodesmus bernardii Komarek	0	0	0	0	0	0	4861	0	0	0	0	0	7292	0	0	0	0	0
Ankistrodesmus falcatus (Corda) Ralfs	0	0	0	7292	7292	0	0	0	0	0	0	0	7292	14585	0	36464	14585	14585
Ankistrodesmus falcatus var. *mirabilis* West	0	0	0	0	0	0	4861	29171	7292	0	0	0	0	0	0	43757	189617	153152
Ankistrodesmus fasciculatus (Lundb.) Komarkova-Legenerova	0	0	0	21878	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ankistrodesmus gracilis (Reinsch) Kors.	0	0	0	0	0	0	0	7292	0	0	0	0	0	0	0	0	0	0
Ankistrodesmus spiralis (Turner) Lemmermann	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7292	0	0
Arthrodesmus incus (Brebisson) Hassall	0	14585	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arthrodesmus incus var. *ralfsii* (West) Teiling	0	0	0	7292	0	0	0	0	0	0	0	0	0	0	0	0	7292	0
Chlamydomonas sp	0	0	0	0	0	0	0	0	0	0	0	0	7292	0	0	0	0	7292
Cosmarium abbreviatum Raciborski	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7292	0
Cosmarium bioculatum Brebisson	0	0	0	0	0	0	4861	0	0	0	0	0	0	0	0	7292	0	0
Cosmarium sp	0	0	0	0	0	0	0	0	0	0	0	0	14585	0	0	7292	0	0
Crucigenia quadrata Morren	0	0	0	0	0	0	0	7292	0	0	0	0	0	0	0	0	0	0
Ecballocystis sp	0	0	0	0	0	0	0	0	7292	0	0	0	0	0	0	0	0	0
Elakatothrix gelatinosa Wille	0	0	0	0	0	0	4861	0	0	0	0	0	0	0	0	0	0	0
Elakatothrix genevensis (Reverdin) Hindak	43757	43757	51050	138566	102101	131273	68067	87515	87515	43757	19447	14585	58343	43757	9723	29171	29171	72929
Euastrum ansatum Ehrenberg	0	0	0	0	0	0	0	0	0	0	0	4861	0	0	0	0	0	0
Euastrum bidentatum Naegeli	0	0	0	0	0	0	0	0	0	0	4861	0	0	0	0	0	0	0
Gloeocystis sp	0	0	0	7292	7292	7292	19447	0	0	0	9723	0	14585	0	14585	7292	14585	0
Gloeotilia sp	0	0	0	0	0	7292	0	0	0	0	0	0	0	0	0	14585	0	29171
Korshikoviella sp	0	0	0	7292	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monoraphidium braunii Naegeli	0	0	7292	43757	14585	7292	0	0	0	0	0	0	0	0	0	0	0	0
Monoraphidium contortum (Thuret) Komarkova-Legenerova	0	0	0	0	0	0	0	0	0	7292	0	4861	7292	0	0	0	0	0
Monoraphidium convolutum (Corda)	21878	7292	14585	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monoraphidium dybowskii (Wolosz) Hindak et. Komarkova-Legenerova	0	0	51050	21878	0	7292	4861	21878	0	7292	14585	0	7292	21878	9723	7292	7292	14585
Monoraphidium griffithii (Berkeley) Komarkova-Legenerova	0	0	0	0	14585	14585	213927	116687	226082	7292	9723	9723	14585	7292	0	14585	0	0
Monoraphidium irregulare (G.M. Smith) Komarkova-Legenerova	0	0	0	29171	0	7292	4861	7292	0	0	0	4861	0	0	0	14585	65636	21878
Monoraphidium minutum (Nag.) Komarkova-Legenerova	0	0	0	0	0	0	0	0	0	0	9723	0	0	7292	0	0	0	0
Mougeotia sp	0	0	7292	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oocystis borgei Snow	7292	7292	0	0	0	0	0	0	0	7292	0	0	0	0	0	7292	7292	0
Oocystis gigas Archer	0	0	0	0	7292	0	0	0	0	0	0	0	0	0	0	0	0	0
Oocystis parva West & West	65636	36464	36464	21878	65636	87515	24309	7292	0	21878	0	9723	21878	7292	9723	0	14585	0
Oocystis solitaria Wittrock	0	0	0	0	0	0	0	0	0	0	0	0	0	7292	0	7292	0	0
Quadrigula pfitzeri (Schoeder) G. M. Smith	0	0	0	0	7292	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenedesmus ecornis var. *bicellularis* (Ehrenberg) Chodat	0	0	0	0	7292	0	0	0	0	0	0	0	0	0	0	0	0	0
Schroederia robusta Kors.	0	0	0	0	0	7292	0	0	0	0	0	0	0	0	0	0	0	0
Spondylosium planum (Wolle) West & West	0	0	0	0	0	7292	0	0	7292	0	0	0	7292	0	0	0	0	7292
Staurastrum alternans Brebisson	0	0	0	0	0	0	0	0	7292	0	0	0	0	0	0	0	0	0
Staurastrum sp	7292	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tetraedron muticum (A. Braun) Hansgrig	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4861	0	0	0
Tetraedron minimum (A. Braun) Hansgirg	0	0	7292	0	0	0	29171	0	14585	14585	0	0	14585	0	0	0	0	0
Tetraedron mimimum var. *tetralobulatum* Reins	7292	7292	0	0	0	0	0	0	7292	0	14585	4861	0	0	0	0	0	0

Note: all units are in cells/L

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2011

Site ID	Llama Lake	Llama Lake	Llama Lake	Umwelt Lake	Umwelt Lake	Umwelt Lake	Giraffe Lake	Giraffe Lake	Giraffe Lake	Goose Lake Neck	Goose Lake Neck	Goose Lake Neck	Goose Lake Central	Goose Lake Central	Goose Lake Central	Reference B Lake	Reference B Lake	Reference B Lake
Rep	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date sampled	6-Aug-11	6-Aug-11	6-Aug-11	5-Aug-11	5-Aug-11	5-Aug-11	10-Aug-11	10-Aug-11	10-Aug-11	7-Aug-11	7-Aug-11	7-Aug-11	7-Aug-11	7-Aug-11	7-Aug-11	8-Aug-11	8-Aug-11	8-Aug-11
LAB ID	BIO-04	BIO-05	BIO-06	BIO-01	BIO-02	BIO-03	BIO-16	BIO-17	BIO-18	BIO-10	BIO-11	BIO-12	BIO-07	BIO-08	BIO-09	BIO-13	BIO-14	BIO-15
	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density
CHRYSOPHYCEAE																		
Bitrichia chodatii (Reverdin) Chodat	0	0	0	0	7292	0	19447	14585	7292	7292	24309	14585	29171	0	24309	14585	0	0
Chromulina sp 1	7292	14585	29171	21878	21878	7292	0	0	0	21878	4861	4861	14585	7292	0	0	0	0
Chromulina sp 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4861	0	0	0
Dicronema cf. *vlklanum* Prauser	29171	14585	14585	14585	43757	21878	0	0	0	21878	4861	4861	7292	0	0	0	7292	0
Dinobryon acuminatum Ruttner	0	7292	0	0	0	0	0	0	0	7292	0	0	0	0	0	0	0	0
Dinobryon bavaricum var. *medium* (Lemmermann) Krieger	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21878	51050	0
Dinobryon bavaricum Imhof	7292	7292	0	0	0	0	0	0	0	0	0	0	0	7292	0	7292	0	51050
Dinobryon borgei Lemmermann	14585	0	0	0	7292	0	4861	7292	0	14585	0	0	7292	7292	4861	14585	14585	0
Dinobryon sp (loose monad)	0	0	0	7292	7292	14585	0	14585	21878	0	4861	0	0	0	4861	0	0	0
Dinobryon sertularia Ehrenberg	0	0	0	0	0	0	0	0	0	0	4861	0	0	0	0	0	0	0
Dinobryon sociale Ehrenberg	0	7292	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7292	0
Epipyxis sp	29171	14585	36464	14585	29171	14585	0	0	0	7292	0	0	0	0	4861	7292	7292	0
Kephyrion boreale Skuja	7292	0	0	0	7292	7292	14585	14585	14585	29171	9723	9723	14585	14585	0	0	7292	7292
Kephyrion sp	0	0	0	7292	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mallomonas pseudocoronata Prescott	0	0	0	0	0	0	0	0	0	0	0	9723	0	0	4861	0	0	7292
Mallomonas sp	0	0	7292	14585	0	0	0	0	0	0	0	0	0	7292	4861	0	0	0
Ochromonas sp	0	0	14585	0	0	0	0	0	0	0	0	0	0	0	0	7292	0	0
Pedinella sp	0	0	7292	0	7292	0	0	0	7292	0	0	4861	7292	0	0	0	0	0
Pseudokephyrion ellipsoideum (Pascher) Schmid	0	7292	7292	7292	0	7292	0	0	0	7292	4861	4861	0	0	0	7292	0	0
Pseudokephyrion minutissimum Conrad	0	0	0	0	0	0	0	0	0	0	0	9723	0	0	0	0	0	0
Stichogloea doederleinii (Schmidle) Wille	0	0	0	7292	0	0	0	0	14585	7292	0	9723	29171	14585	4861	0	14584	7292
Unidentified naked Chrysophyte sp (*Ochromonas* / *Chromulina*) - large	175031	255254	233375	284426	160445	131273	58343	80222	102101	211496	121549	136135	218789	160445	131273	175031	291719	233375
Unidentified naked Chrysophyte sp (*Ochromonas* / *Chromulina*) - small	386528	342770	269840	138566	145859	160445	121549	131273	182324	87515	106963	145859	160445	123980	97239	94808	160445	131273
Haptophyte *(Erkenia/Chrysochromulina)*	7292	7292	7292	29171	0	0	0	21878	7292	7292	4861	34033	14585	0	14585	0	21878	0
CRYPTOPHYCEAE																		
Cryptomonas marsonii Skuja	0	0	0	109394	51050	109394	0	0	7292	7292	4861	19447	7292	7292	0	7292	7292	0
Cryptomonas pyrenoidifera Geitler	7292	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cryptomonas reflexa Skuja	0	0	0	7292	0	0	0	0	0	0	0	0	7292	0	0	0	0	0
Cryptomonas tenuis Pascher	0	0	0	0	0	0	0	0	0	7292	0	0	0	0	4861	0	0	0
Katablepharis ovalis Skuja	7292	0	43757	21878	0	0	0	0	0	0	4861	4861	0	14585	9723	7292	0	0
Rhodomonas lens Pascher & Ruttner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7292	0	0
Rhodomonas minuta Skuja	29171	21878	36463	21878	14585	43757	19447	58343	36464	43757	14585	24309	21878	29171	24309	14585	0	36464
CYANOBACTERIA																		
Anabaena flos-aquae Brebisson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7292	0
Aphanocapsa delicatissima West & West	58343	14585	21878	80222	87515	109394	97239	80222	94808	58343	0	19447	58343	43757	9723	29171	58343	36464
Aphanocapsa elachista West & West	14585	0	0	7292	14585	29171	4861	7292	0	0	4861	4861	14585	21878	4861	7292	7292	14585
Aphanothece clathrata West & West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7292	0	0
Aphanothece sp	0	0	0	0	7292	7292	4861	0	0	7292	0	0	0	0	0	21878	0	14585
Chroococcus limneticus Lemmermann	0	0	0	7292	0	0	0	0	7292	0	0	0	0	0	0	0	0	0
Limnothrix sp	0	7292	0	14585	7292	7292	4861	0	7292	0	4861	0	51050	0	29171	116687	299012	306305
Merismopedia tenuissima Lemmermann	0	0	0	0	0	29171	19447	14585	58343	14585	0	0	7292	21878	0	0	0	7292
Phormidium formosum (Bory ex Gomont) Anagnostidis et Komarek	0	0	0	0	0	0	0	0	7292	0	0	0	0	0	0	0	0	0
Pseudanabaena limnetica Komarek	0	0	0	0	0	0	0	0	0	0	0	4861	0	0	0	0	0	0
Rhabdoderma lineare Schmidle & Lauterborn	7292	0	0	0	0	0	19447	58343	7292	7292	0	0	21878	0	4861	0	7292	0
Snowella lacustris (Chodat) Komarek et Hindak	0	0	0	0	0	0	0	0	0	0	0	0	29171	0	4861	0	0	0
EUGLENOIDS - EUGLENOPHYCEAE																		
Phacus acuminatus Stokes	7292	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DINOFLAGELLATES - DINOPHYCEAE																		
Glenodinium sp	7292	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gymnodinium ordinatum Skuja	0	7292	0	72929	21878	36464	0	0	7292	7292	9723	4861	0	14585	9723	21878	7292	7292
Gymnodinium sp	0	0	0	0	0	0	0	0	0	0	0	0	7292	0	0	0	0	0
Peridinium pusillum (Penard) Lemmermann	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7292	0
TOTAL	**1115804**	**1028291**	**1108512**	**1363757**	**1283540**	**1378349**	**948064**	**962654**	**1093923**	**743856**	**525071**	**617444**	**1174137**	**721983**	**549377**	**1042860**	**1582549**	**1414818**

Note: all units are in cells/L

Appendix 3.6-3

Lake Phytoplankton Richness and Diversity Results, Back River Project, 2011

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Appendix 3.6-3. Lake Phytoplankton Richness and Diversity Results, Back River Project, 2011

Lake	Replicate	Date Sampled	Richness (genera/sample)	Diversity (Simpson's Index)
Llama Lake	1	06-Aug-11	21	0.82
	2	06-Aug-11	18	0.79
	3	06-Aug-11	20	0.85
Umwelt Lake	1	05-Aug-11	28	0.90
	2	05-Aug-11	23	0.85
	3	05-Aug-11	23	0.88
Giraffe Lake	1	10-Aug-11	20	0.87
	2	10-Aug-11	16	0.89
	3	10-Aug-11	25	0.89
Goose Lake Neck	1	07-Aug-11	24	0.88
	2	07-Aug-11	21	0.85
	3	07-Aug-11	25	0.87
Goose Lake Central	1	07-Aug-11	30	0.89
	2	07-Aug-11	18	0.87
	3	07-Aug-11	25	0.87
Reference B Lake	1	08-Aug-11	26	0.89
	2	08-Aug-11	23	0.87
	3	08-Aug-11	20	0.87

Appendix 3.6-4

Stream Periphyton Biomass Results, Back River Project, 2011

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Appendix 3.6-4. Stream Periphyton Biomass Results, Back River Project, 2011

Site ID	Replicate	Sampling Date	Area sampled (cm^2)	ALS Sample ID	Chlorophyll *a* ($\mu g/cm^2$)	Mean	SE
Chair OF	1	13-Aug-11	47.7 cm^2	L1047626-13	3.67	2.51	0.61
	2	13-Aug-11	47.7 cm^2	L1047626-14	2.22		
	3	13-Aug-11	47.7 cm^2	L1047626-15	1.63		
Llama OF	1	17-Aug-11	47.7 cm^2	L1047626-4	3.90	1.81	1.04
	2	17-Aug-11	47.7 cm^2	L1047626-5	0.82		
	3	17-Aug-11	47.7 cm^2	L1047626-6	0.71		
Giraffe OF	1	12-Aug-11	47.7 cm^2	L1047626-22	1.26	1.28	0.07
	2	12-Aug-11	47.7 cm^2	L1047626-23	1.18		
	3	12-Aug-11	47.7 cm^2	L1047626-24	1.41		
Wolf OF	1	13-Aug-11	47.7 cm^2	L1047626-7	1.56	1.40	0.17
	2	13-Aug-11	47.7 cm^2	L1047626-8	1.06		
	3	13-Aug-11	47.7 cm^2	L1047626-9	1.57		
Goose OF	1	16-Aug-11	47.7 cm^2	L1047626-1	1.93	1.03	0.46
	2	16-Aug-11	47.7 cm^2	L1047626-2	0.42		
	3	16-Aug-11	47.7 cm^2	L1047626-3	0.74		
Propellor OF	1	15-Aug-11	47.7 cm^2	L1047626-19	3.12	2.16	0.75
	2	16-Aug-11	47.7 cm^2	L1047626-20	2.66		
	3	16-Aug-11	47.7 cm^2	L1047626-21	0.69		
Propellor D/S	1	15-Aug-11	47.7 cm^2	L1047626-16	1.30	1.58	0.14
	2	15-Aug-11	47.7 cm^2	L1047626-17	1.68		
	3	15-Aug-11	47.7 cm^2	L1047626-18	1.76		
Ref. B OF	1	14-Aug-11	47.7 cm^2	L1047626-10	0.59	0.96	0.37
	2	14-Aug-11	47.7 cm^2	L1047626-11	0.60		
	3	14-Aug-11	47.7 cm^2	L1047626-12	1.70		

SE = standard error of the mean

Note: Echo OF was dry in August so no data could be collected.

Appendix 3.6-5

Stream Periphyton Density and Taxonomic Results, Back River Project, 2011

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Appendix 3.6-5. Stream Periphyton Density and Taxonomic Results, Back River Project, 2011

Site ID		Chair OF	Chair OF	Chair OF	Llama OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Wolf OF
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled		13-Aug-11	13-Aug-11	13-Aug-11	17-Aug-11	17-Aug-11	17-Aug-11	12-Aug-11	12-Aug-11	12-Aug-11	13-Aug-11	13-Aug-11	13-Aug-11
		BIO-01	BIO-02	BIO-03	BIO-04	BIO-05	BIO-06	BIO-07	BIO-08	BIO-09	BIO-10	BIO-11	BIO-12
OLD NAME	NEW NAME	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density
DIATOMS	DIATOMS												
Achananthes delicatula (Kuetzing) Grunow	*Planothidium delicatulum* (Kuetzing) Round & Bukht.	0	0	0	0	0	0	0	0	0	0	0	0
Achnanthes detha Hohn & Hellerman	*Planothidium subatomoides* (Hustedt) Round & Bukht.	52977	50836	39706	5137	4195	10702	24972	14269	0	10702	6992	16053
Achnanthes exigua Grunow	*Achnanthidium exiguum* (Grunow) Czarn.	0	0	0	0	0	0	0	0	0	0	0	0
Achnanthes flexella (Kuetzing) Brun	*Eucocconeis flexella* (Kuetzing) Cleve	5886	5351	28361	0	0	0	0	0	0	32107	6992	16053
Achnanthes kriegeri Krasske	*Achnanthes kriegeri* Krasske	11772	8026	11344	20548	33563	42809	0	57079	0	14269	0	0
Achnanthes lanceolata (Brebisson) Grunow	*Planothidium lanceolatum* (Breb.) Round & Bukht.	0	0	0	0	0	0	0	0	0	0	0	0
Achnanthes lapisosa Krasske	*Achnanthes lapisosa* Krasske	0	0	0	0	0	0	0	0	0	0	0	0
Achnanthes levanderi Hustedt	*Psammothidium levanderi* (Hust.) Bukht. & Round	0	5351	11344	0	0	5351	7134	0	0	0	3496	5351
Achnanthes minutissima Kuetzing	*Achnanthidium minutissimum* (Kuetzing) Czarn.	1353865	489638	1372701	1926448	356606	888306	659986	1255758	647500	870469	895013	1519753
Achnanthes pusilla (Grunow) De Toni	*Achnanthes pusilla* (Grunow) De Toni	11772	2675	17016	5137	10488	21404	0	14269	0	0	0	0
Achnanthes sp	*Achnanthes* sp	0	0	0	0	0	0	0	0	0	0	0	0
Anomoeoneis brachysira (Brebisson) Grunow	*Anomoeoneis brachysira* (Brebisson) Grunow	0	0	0	15411	0	0	21404	28539	5351	17837	3496	10702
Anomoeoneis procera Lange-Bertalot & Moser	*Anomoeoneis procera* Lange-Bertalot & Moser	176591	123078	260926	82195	4195	90971	420964	913279	294318	160537	118868	165888
Anomoeoneis vitrea (Grunow) Ross	*Brachysira vitrea* (Grunow) Ross in Hartley	0	0	0	0	0	0	3567	14269	0	0	0	5351
Anomoeoneis zellensis (Grunow) Cleve	*Brachysira zellensis* (Grunow) Round & Mann	0	0	0	0	0	0	0	0	0	7134	0	0
Asterionella ralfsii W. Smith	*Asterionella ralfsii* W. Smith	0	2675	0	0	0	0	0	0	0	0	0	0
Aulacoseira distans (Ehrenberg) Simonsen	*Aulacoseira distans* (Ehrenberg) Simonsen	0	0	0	0	0	16053	0	0	0	0	0	0
Caloneis bacillum (Grunow) Cleve	*Caloneis bacillum* (Grunow) Cleve	0	0	0	0	0	0	0	0	0	0	0	0
Caloneis silicula (Ehrenberg) Cleve	*Caloneis ventricosa* (Ehren.) Meister	0	0	0	0	0	0	0	0	0	0	3496	0
Caloneis sp	*Caloneis* sp	0	0	0	0	0	0	0	0	0	0	0	0
Cyclotella ocellata Pantocsek	*Cyclotella ocellata* Pantocsek	0	2675	0	0	0	0	0	14269	10702	0	0	0
Cyclotella pseudostelligera Hustedt	*Cyclotella pseudostelligera* Hustedt	0	5351	0	0	0	0	0	28539	0	0	0	0
Cymbella arctica (Lagerstedt) Schmidt	*Cymbella arctica* (Lagerstedt) Schmidt	0	2675	0	0	0	0	0	0	0	0	0	0
Cymbella cesatii (Rabenhorst) Grunow	*Cymbella cesatii* (Rabenhorst) Grunow	17659	58863	73740	0	0	32107	121294	142699	230103	107024	76915	96322
Cymbella gracilis (Ehrenberg) Kuetzing	*Encyonema gracilis* Rabenh.	0	0	0	0	0	0	3567	28539	0	0	3496	0
Cymbella microcephala Grunow	*Cymbella microcephala* Grunow	0	0	0	0	0	0	3567	0	0	0	0	0
Cymbella incerta (Grunow) Cleve	Cymbella incerta (Grunow) Cleve	0	0	0	0	0	0	0	0	0	0	3496	5351
Cymbella minuta Hilse	*Encyonema minutum* (Hilse ex Rabenh.) Mann in Round, Crawford & Mann	0	0	0	46234	4195	101673	3567	0	0	0	0	0
Cymbella naviculiformis Auersw ex Heib.	*Cymbella naviculiformis* Auersw ex Heib.	0	0	0	0	0	0	0	0	0	3567	0	0
Cymbella pusilla Grunow	*Cymbella pusilla* Grunow	23545	0	0	0	0	0	0	0	0	0	0	0
Cymbella minuta var. silesiaca (Bleisch ex. Rabenhorst) Reimer	*Encyonema silesiacum* (Bleisch ex. Rabenh.) Mann in Round, Crawford & Mann	35318	0	0	0	0	0	3567	28539	0	3567	0	0
Cymbella sp	*Cymbella* sp Agardh	5886	2675	0	0	0	0	0	0	0	0	0	0
Eunotia arcus Ehrenberg	*Eunotia arcus* Ehrenberg	0	5351	0	10274	81809	0	3567	0	0	0	3496	0
Eunotia bidentula W. Smith	*Eunotia bidentula* W. Smith	0	0	0	0	0	0	0	0	0	0	0	3496
Eunotia bilunaris var. *mucophila* Lange-Bertalot & Norpel	*Eunotia bilunaris* var. *mucophila* Lange-Bertalot & Norpel	0	2675	0	0	2097	0	0	0	0	3567	0	0
Eunotia diodon Ehrenberg	*Eunotia diodon* Ehrenberg	0	0	0	0	0	0	0	0	0	0	0	0
Eunotia exigua Brebisson (Rabenhorst)	*Eunotia exigua* Brebisson (Rabenhorst)	35318	0	0	0	2097	0	0	0	0	0	17480	5351
Eunotia incisa W. Smith	*Eunotia incisa* W. Smith	11772	18729	0	0	4195	16053	3567	14269	0	0	3496	10702
Eunotia monodon Ehrenberg	*Eunotia monodontiforma* Lange-Bert & Nopel	0	0	0	0	0	0	0	0	0	0	0	5351
Eunotia naegeli Migula	*Eunotia naegelii* Migula	5886	0	0	0	0	0	0	0	0	3567	0	0
Eunotia paludosa var trincaria (Krasske) Norpel	*Eunotia paludosa var trincaria* (Krasske) Norpel	23545	18729	5672	0	0	10702	10702	0	0	0	0	5351
Eunotia pectinalis (O. Mull.) Rabenhorst	*Eunotia pectinalis* (O. Mull.) Rabenhorst	0	0	11344	0	0	0	7134	0	0	0	3496	0
Eunotia sp	*Eunotia* sp	0	0	11344	20548	8390	0	0	0	0	7134	0	0
Eunotia steineckii Petersen	*Eunotia steineckii* Petersen	0	0	0	0	0	0	0	0	0	0	3496	0
Eunotia subarcuatoides Alles, Norpel & Lange-Bertalot	*Eunotia subarcuatoides* Alles, Norpel & Lange-Bertalot	0	0	0	5137	0	0	0	0	0	0	0	0
Eunotia triodon Ehrenberg	*Eunotia triodon* Ehrenberg	0	2675	0	0	0	0	0	0	0	0	0	0
Fragilaria brevistriata Grunow	*Pseudostaurosira brevistriata* (Grunow in VanHeurck) Williams & Round	0	26756	0	0	0	0	0	0	0	0	0	0
Fragilaria pinnata (Ehrenberg)	*Staurosirella pinnata* (Ehreb.) Williams & Round	0	0	0	0	0	0	0	0	0	0	0	0
Fragilaria vaucheriae (Kuetzing) Petersen	*Fragilaria vaucheriae* (Kuetzing) Petersen	176591	58863	96429	10274	6293	10702	21404	0	0	7134	27969	0
Fragilaria virescens var. *exigua*	*Fragilariforma virescens* var exigua (Ralfs) Williams & Round	0	0	0	0	0	0	3567	0	21404	0	0	0
Frustulia pseudomagaliesmontana Camburn & Charles	*Frustulia pseudomagaliesmontana* Camburn & Charles	11772	8026	0	0	0	0	0	0	0	0	0	0
Frustulia rhomboides var. saxonica (Ehrenberg) de Toni	*Frustulia rhomboides var. saxonica* (Ehrenberg) de Toni	0	5351	5672	0	0	0	64214	71349	117727	32107	34961	42809
Gomphonema acuminatum Ehrenberg	*Gomphonema acuminatum* Ehrenberg	0	0	0	0	0	0	0	0	0	0	0	0
Gomphonema parvulum (Kuetzing) Kuetzing	*Gomphonema parvulum* (Kuetzing) Kuetzing	0	0	0	5137	0	0	0	0	0	0	0	0
Gomphonema pumilum (Grunow) Reichardt & Lange-Bertalot	*Gomphonema pumilum* (Grunow) Reichardt & Lange-Bertalot	0	0	0	0	0	0	0	0	0	7134	0	0
Gomphonema sp	*Gomphonema* sp	11772	0	0	0	0	0	0	0	0	0	0	10702
Hannaea arcus (Ehrenberg) Patrick	*Hannaea arcus* (Ehrenberg) Patrick	0	0	0	15411	0	0	0	0	0	0	0	0
Navicula cryptocephala Kuetzing	*Navicula cryptocephala* Lange-Bertlot	0	2675	0	0	0	0	0	0	0	3567	0	0

Note: all units are in cells/cm ^{2}

Echo OF was dry during summer sampling, so no periphyton data could be collected.

Appendix 3.6-5. Stream Periphyton Density and Taxonomic Results, Back River Project, 2011

Site ID		Chair OF	Chair OF	Chair OF	Llama OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Wolf OF
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled		13-Aug-11	13-Aug-11	13-Aug-11	17-Aug-11	17-Aug-11	17-Aug-11	12-Aug-11	12-Aug-11	12-Aug-11	13-Aug-11	13-Aug-11	13-Aug-11
		BIO-01	BIO-02	BIO-03	BIO-04	BIO-05	BIO-06	BIO-07	BIO-08	BIO-09	BIO-10	BIO-11	BIO-12
OLD NAME	NEW NAME	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density
DIATOMS (continued)													
Navicula cryptotenella Lange-Bertalot	*Navicula cryptotenella* Lange-Bertalot	0	0	0	0	0	0	0	0	0	0	0	0
Navicula gregaria Donkin	*Navicula gregaria* Donkin	0	0	0	0	0	0	0	0	0	3567	0	0
Navicula pupula Kuetzing	*Sellaphora mutata* (Kuetz.) Mereschk	0	8026	0	0	0	0	0	0	0	0	0	0
Navicula subtilissima Cleve	*Kobayasia subtilissima* (Cleve) Lange-Bertalot	0	0	0	0	0	0	0	0	0	0	0	5351
Navicula sp	*Navicula* sp	0	0	0	0	0	0	0	0	0	3567	0	0
Neidium bisculatum (Lagerstedt) Cleve	*Neidium bisculatum* (Lagerstedt) Cleve	0	0	0	0	0	0	0	0	0	0	0	0
Neidium sp.	*Neidium* sp.	0	0	5672	0	0	0	0	0	0	0	0	0
Nitzschia angustata Grunow	*Tryblionella angustata* W. Smith	0	0	0	0	0	0	42809	0	26756	3567	0	53512
Nitzschia dissipata (Kuetzing) Grunow	*Nitzschia dissipata* (Kuetzing) Grunow	0	5351	0	0	0	0	0	14269	0	0	0	0
Nitzschia fonticola Grunow	*Nitzschia fonticola* Grunow	0	0	0	0	0	0	0	0	0	0	0	0
Nitzschia frustulum (Kuetzing) Grunow	*Nitzschia frustulum* (Kuetzing) Grunow	0	0	0	0	0	0	0	114159	10702	0	17480	0
Nitzschia gracilis Hantzsch	*Nitzschia gracilis* Hantzsch	0	2675	0	0	0	0	21404	0	0	0	0	0
Nitzschia heufleriana Grunow	*Nitzschia heufleriana* Grunow	0	0	0	0	0	0	0	0	0	0	0	0
Nitzschia inconspicua Grunow	*Nitzschia inconspicua* Grunow	5886	8026	17016	0	0	0	39242	256859	101673	7134	0	16053
Nitzschia palea (Kuetzing) W. Smith	*Nitzschia palea* (Kuetzing) W. Smith	5886	0	0	0	0	0	0	0	0	0	0	0
Nitzschia perminuta (Grunow) Perag.	*Nitzschia perminuta* (Grunow) M.Perag.	347295	232779	346011	184939	83907	342479	570799	2468707	802686	292534	139845	278264
Peronia fibula (Brebisson) Ross	*Peronia fibula* (Brebisson) Ross	0	0	0	0	0	0	7134	0	5351	0	3496	0
Pinnularia abaujensis (Pantocsek) Ross	*Pinnularia abaujensis* (Pantocsek) R. Ross	0	0	0	0	0	0	0	0	0	0	0	0
Pinnularia divergentissima (Grunow) Cleve	*Pinnularia divergentissima* (Grunow) Cleve	11772	10702	0	0	0	0	0	0	0	0	3496	0
Pinnularia sp.	*Pinnularia* sp.	0	0	0	0	0	0	0	0	0	0	0	0
Stauroneis anceps Ehrenberg	*Stauroneis anceps* Ehrenberg	17659	0	22689	0	0	0	0	0	0	3567	0	5351
Stauroneis phoenicenteron (Nitzsch) Ehrenberg	*Stauroneis phoenicenteron* (Nitzsch) Ehrenberg	0	0	0	0	0	0	0	0	0	0	0	0
Stephanodiscus binderanus (Kuetzing) Krieger	*Stephanodiscus binderanus* (Kuetzing) Krieger	23545	0	0	0	0	0	0	0	0	0	0	0
Stenopterobia curvala (W. Smith) Hustedt	*Stenopterobia curvala* (W. Smith) Hustedt	0	0	0	0	0	0	0	28539	5351	0	0	0
Synedra famelica Kuetzing	*Synedra famelica* Kuetzing	64750	96322	73740	0	44051	117727	14269	0	5351	32107	6992	10702
Synedra filiformis Grunow	*Synedra filiformis* Grunow	0	0	0	0	0	0	0	0	0	0	0	0
Synedra ostenfeldii Sommer & Yang	*Synedra ostenfeldii* Sommer & Yang	0	0	0	0	0	0	0	0	0	0	0	0
Synedra rumpens Kuetzing	*Synedra rumpens* Kuetzing	105954	32107	68067	5137	6293	53512	39242	0	5351	7134	13984	26756
Tabellaria flocculosa (Roth) Kuetzing	*Tabellaria flocculosa* (Roth) Kuetzing	364954	171239	181514	231173	117470	984628	321074	1569698	171239	214049	248226	224752
CHLOROPHYCEAE	**GREEN ALGAE - CHLOROPHYCEAE**												
Ankistrodesmus spiralis (Turner) Lemmermann	*Ankistrodesmus spiralis* (Turner) Lemmermann	129500	0	113446	0	0	0	0	0	0	0	0	0
Ankistrodesmus stipitatus (Chodat)	*Ankistrodesmus stipitatus* (Chodat)	5886	0	5672	0	0	0	0	0	5351	0	0	0
Arthrodesmus crassus West	*Arthrodesmus crassus* West	0	0	5672	0	0	0	0	0	0	0	0	0
Arthrodesmus incus var. *ralfsii* (West) Teiling	*Arthrodesmus incus* var. *ralfsii* (West) Teiling	5886	0	0	0	0	0	3567	0	0	0	0	0
Bulbochaete De Bary	*Bulbochaete* De Bary	0	0	85084	0	0	0	14269	0	0	0	0	0
Chlamydomonas sp	*Chlamydomonas* sp	0	0	5672	0	0	0	0	0	0	0	0	0
Cladophora sp	*Cladophora* sp	0	0	0	0	0	0	0	0	0	0	0	0
Closterium dianae Ehrenberg	*Closterium dianae* Ehrenberg	5886	2675	5672	0	0	5351	0	14269	5351	3567	0	0
Cosmarium abbreviatum Raciborski	*Cosmarium abbreviatum* Raciborski	0	0	0	0	0	0	7134	0	0	0	0	0
Cosmarium bioculatum Brebisson	*Cosmarium bioculatum* Brebisson	0	0	11344	0	0	0	0	0	0	0	0	0
Cosmarium formosulum Hoff	*Cosmarium formosulum* Hoff	0	0	0	0	0	0	0	0	0	0	3496	5351
Cosmarium granatum Brebisson	*Cosmarium granatum* Brebisson	0	0	0	0	0	0	3567	0	0	0	0	0
Cosmarium impressulum Elfv.	*Cosmarium impressulum* Elfv.	0	0	0	0	0	0	0	0	0	3567	0	0
Cosmarium phaseolus Brebisson	*Cosmarium phaseolus* Brebisson	5886	0	0	0	0	0	0	0	5351	3567	0	0
Cosmarium subcrenatum Hantz.	*Cosmarium subcrenatum* Hantz.	0	0	0	0	0	0	0	0	0	0	0	0
Cosmarium sp	*Cosmarium* sp	5886	0	5672	0	0	0	3567	0	0	3567	0	0
Cosmarium subcrenatum Hantz.	*Cosmarium subcrenatum* Hantz.	0	0	0	0	0	0	0	0	0	3567	0	0
Cylindrocystis brebissonii (Menegh. ex Ralfs) De Bary	*Cylindrocystis brebissonii* (Menegh. ex Ralfs) De Bary	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Elakatothrix genevensis (Reverdin) Hindak	*Elakatothrix genevensis* (Reverdin) Hindak	0	0	0	0	0	0	3567	0	5351	0	6992	0
Euastrum ansatum Ehrenberg	*Euastrum ansatum* Ehrenberg	0	2675	5672	0	0	0	0	28539	0	3567	0	0
Euastrum bidentatum Naegeli	*Euastrum bidentatum* Naegeli	11772	0	0	0	0	0	0	0	0	0	0	0
Euastrum insulare (Wittrock) Roy	*Euastrum insulare* (Wittrock) Roy	0	0	5672	0	0	0	3567	0	5351	0	3496	0
Gloeocystis sp	*Gloeocystis* sp	0	0	0	0	0	0	0	285399	0	0	0	0
Monoraphidium griffithii (Berkeley) Komarkova-Legenerova	*Monoraphidium griffithii* (Berkeley) Komarkova-Legenerova	58863	2675	5672	0	0	0	3567	0	5351	0	0	5351
Monoraphidium irregulare (G.M. Smith) Komarkova-Legenerova	*Monoraphidium irregulare* (G.M. Smith) Komarkova-Legenerova	5886	0	0	0	0	0	0	0	0	0	6992	0
Mougeotia sp	*Mougeotia* sp	58863	2675	17016	0	0	0	57079	142699	10702	0	0	0
Oocystis borgei Snow	*Oocystis borgei* Snow	23545	0	0	0	0	0	0	0	0	0	0	0
Oocystis gigas Archer	*Oocystis gigas* Archer	23545	0	0	0	0	0	0	0	0	0	3496	0
Oocystis lacustris Chodat	*Oocystis lacustris* Chodat	11772	0	0	0	0	0	0	0	0	0	0	0
Oocystis parva West & West	*Oocystis parva* West & West	141272	0	45378	0	0	0	0	0	0	14269	0	0
Oocystis solitaria Wittrock	*Oocystis solitaria* Wittrock	0	2675	11344	0	0	0	0	14269	0	0	0	0
Pediastrum tetras (Ehrenberg) Ralfs	*Pediastrum tetras* (Ehrenberg) Ralfs	0	0	0	0	0	5351	0	0	0	0	0	0
Penium polymorphum (Perty) Perty	*Penium polymorphum* (Perty) Perty	0	0	0	0	0	0	0	0	0	0	0	0
Scenedesmus bijuga (Turp.) Lagerheim	*Scenedesmus bijuga* (Turp.) Lagerheim	11772	0	0	0	0	0	0	0	0	0	0	0
Scenedesmus ecornis (Ehrenberg) Chodat	*Scenedesmus ecornis* (Ehrenberg) Chodat	23545	0	0	0	0	0	0	0	0	0	0	0
Scenedesmus obliquus (Turpin) Kuetzing	*Scenedesmus obliquus* (Turpin) Kuetzing	105954	32107	34033	0	0	0	0	0	0	14269	6992	0
Scenedesmus ovalternus Chodat	*Scenedesmus ovalternus* Chodat	0	42809	0	0	0	0	0	0	0	0	0	0

Note: all units are in cells/cm ^{2}

Echo OF was dry during summer sampling, so no periphyton data could be collected.

Appendix 3.6-5. Stream Periphyton Density and Taxonomic Results, Back River Project, 2011

Site ID		Chair OF	Chair OF	Chair OF	Llama OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Wolf OF
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled		13-Aug-11	13-Aug-11	13-Aug-11	17-Aug-11	17-Aug-11	17-Aug-11	12-Aug-11	12-Aug-11	12-Aug-11	13-Aug-11	13-Aug-11	13-Aug-11
		BIO-01	BIO-02	BIO-03	BIO-04	BIO-05	BIO-06	BIO-07	BIO-08	BIO-09	BIO-10	BIO-11	BIO-12
OLD NAME	NEW NAME	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density
CHLOROPHYCEAE (continued)	**GREEN ALGAE - CHLOROPHYCEAE (continued)**												
Schizomeris cf. *leibleinii* Kuetzing	*Schizomeris* cf. *leibleinii* Kuetzing	0	0	0	0	0	0	0	0	0	356749	0	0
Spondylosium planum (Wolle) West & West	*Spondylosium planum* (Wolle) West & West	88294	13377	51050	10274	2097	0	35674	0	10702	0	0	0
Staurastrum alternans Brebisson	*Staurastrum alternans* Brebisson	0	0	0	0	0	0	0	0	0	0	0	0
Staurastrum muticum Brebisson	*Staurastrum muticum* Brebisson	0	0	0	0	0	0	3567	14269	0	0	0	0
Staurastrum sp	*Staurastrum* sp	5886	0	5672	0	0	0	0	0	0	0	0	0
Tetraedron triangulare Korshikov	*Tetraedron triangulare* Korshikov	0	0	0	0	0	0	0	0	5351	0	0	0
Ulothrix sp	*Ulothrix* sp	0	0	170169	25685	10488	32107	0	0	0	0	0	0
Zygnema sp	*Zygnema* sp	0	0	0	0	0	10702	0	0	0	32107	0	0
CHRYSOPHYCEAE	**CHRYSOPHYCEAE**												
Chromulina sp	*Chromulina* sp.	0	0	0	0	0	0	0	0	0	0	0	0
Dinobryon setularia Ehrenberg	*Dinobryon setularia* Ehrenberg	0	0	0	0	0	0	7134	0	0	0	0	0
Unidentified naked Chrysophyte sp (*Ochromonas* / *Chromulina*) - large	Unidentified naked Chrysophyte sp (*Ochromonas* / *Chromulina*) - large	0	0	0	0	0	0	3567	0	0	0	0	0
Ochromonas sp	*Ochromonas* sp	0	0	0	0	0	0	0	0	0	0	0	0
Stichogloea doederleinii (Schmidle) Wille	*Stichogloea doederleinii* (Schmidle) Wille	0	0	0	0	0	0	0	0	26756	0	0	0
Synura sp	*Synura* sp	5886	0	0	0	0	0	0	0	0	0	0	0
CRYPTOPHYCEAE	**CRYPTOPHYCEAE**												
Cryptomonas erosa Ehrenberg	*Cryptomonas erosa* Ehrenberg	0	0	0	0	0	0	0	14269	0	0	0	0
CYANOBACTERIA	**CYANOBACTERIA**												
Anabaena inaequalis (Kuetzing) Bornet & Flahault	*Anabaena inaequalis* (Kuetzing) Bornet & Flahault	0	0	56723	0	0	0	0	0	0	0	0	0
Aphanocapsa delicatissima West & West	*Aphanocapsa delicatissima* West & West	0	0	0	0	0	0	0	570799	0	0	0	0
Aphanocapsa elachista West & West	*Aphanocapsa elachista* West & West	0	107024	0	0	0	0	0	0	0	0	0	0
Aphanocapsa sp	*Aphanocapsa* sp	0	0	170169	0	0	0	0	0	0	0	0	0
Calothrix sp	*Calothrix* sp	0	0	0	0	0	0	0	0	0	0	0	0
Chroococcus dispersus (Keissler) Lemmermann	*Chroococcus dispersus* (Keissler) Lemmermann	0	0	0	0	0	0	0	0	0	0	0	0
Chroococcus limneticus Lemmermann	*Chroococcus limneticus* Lemmermann	0	0	22689	0	0	0	0	0	21404	0	0	0
Chroococcus sp	*Chroococcus* sp	0	0	0	0	0	0	0	0	0	0	0	0
Cylindrospermum sp	*Cylindrospermum* sp	0	0	0	0	0	0	0	0	0	0	0	0
Leibleinia sp	*Leibleinia* sp	0	0	0	123292	0	0	107024	3139397	240806	374587	104884	278264
Limnothrix sp	*Limnothrix* sp	1088978	93646	0	190076	125861	535124	767011	2425897	668905	71349	727198	802686
Merismopedia glauca (Ehrenberg) Naegeli	*Merismopedia glauca* (Ehrenberg) Naegeli	376727	42809	90757	0	0	0	0	0	0	228319	0	0
Merismopedia tenuissima Lemmermann	*Merismopedia tenuissima* Lemmermann	0	0	0	0	0	0	0	0	0	0	0	0
Oscillatoria sp	*Oscillatoria* sp	0	0	0	0	0	0	0	0	107024	0	0	0
Phormidium chalybeum (Mertens ex Gomont) Anagnostidis et Komarek	*Phormidium chalybeum* (Mertens ex Gomont) Anagnostidis et Komarek	0	0	0	0	0	0	0	0	0	0	0	0
Phormidium formosum (Bory ex Gomont) Anagnostidis et Komarek	*Phormidium formosum* (Bory ex Gomont) Anagnostidis et Komarek	559205	321074	2263255	0	41953	267562	0	0	374587	0	0	0
Phormidium sp	*Phormidium* sp	0	0	0	0	20976	160537	0	0	0	0	0	0
Rhabdoderma lineare Schmidle & Lauterborn	*Rhabdoderma lineare* Schmidle & Lauterborn	188363	42809	0	0	0	0	0	0	21404	0	0	10702
Snowella lacustris (Chodat) Komarek et Hindak	*Snowella lacustris* (Chodat) Komarek et Hindak	1707047	0	0	0	0	0	0	0	0	0	0	0
EUGLENOPHYCEAE	**EUGLENOIDS - EUGLENOPHYCEAE**												
Euglena acus Ehrenberg	*Euglena acus* Ehrenberg	0	2675	0	0	0	0	0	0	0	0	0	0
Trachemolomas volvocina Ehrenberg	*Trachemolomas volvocina* Ehrenberg	0	0	0	0	0	0	0	0	0	0	0	0
	XANTHOPHYCEAE												
Characiopsis pyriformis (A. Braun) Borzi	*Characiopsis pyriformis* (A. Braun) Borzi	0	0	0	0	0	0	0	0	0	0	0	0
Ophiocytium majus Nageli	*Ophiocytium majus* Nageli	0	0	0	0	0	0	0	0	0	0	0	5351
TOTAL		**7575733**	**2188631**	**5853813**	**2938467**	**971219**	**3761913**	**3467578**	**13727702**	**3981312**	**2971700**	**2513719**	**3653032**

Note: all units are in cells/cm ^{2}

Echo OF was dry during summer sampling, so no periphyton data could be collected.

Appendix 3.6-5. Stream Periphyton Density and Taxonomic Results, Back River Project, 2011

Site ID		Goose OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor OF	Propellor D/S	Propellor D/S	Propellor D/S	Ref. B OF	Ref. B OF	Ref. B OF
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled		16-Aug-11	16-Aug-11	16-Aug-11	15-Aug-11	16-Aug-11	16-Aug-11	15-Aug-11	15-Aug-11	15-Aug-11	14-Aug-11	14-Aug-11	14-Aug-11
		BIO-13	BIO-14	BIO-15	BIO-16	BIO-17	BIO-18	BIO-19	BIO-20	BIO-21	BIO-22	BIO-23	BIO-24
OLD NAME	NEW NAME	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density
DIATOMS	DIATOMS												
Achananthes delicatula (Kuetzing) Grunow	*Planothidium delicatulum* (Kuetzing) Round & Bukht.	0	0	0	0	0	0	5137	0	0	0	0	0
Achnanthes detha Hohn & Hellerman	*Planothidium subatomoides* (Hustedt) Round & Bukht.	5244	2268	19103	0	5351	0	0	0	0	749	4195	0
Achnanthes exigua Grunow	*Achnanthidium exiguum* (Grunow) Czarn.	0	0	2729	1872	5351	0	0	0	0	0	0	0
Achnanthes flexella (Kuetzing) Brun	*Eucocconeis flexella* (Kuetzing) Cleve	0	4537	0	0	0	0	10274	0	7848	0	2097	3496
Achnanthes kriegeri Krasske	*Achnanthes kriegeri* Krasske	20976	0	13645	13110	32107	0	5137	25525	0	0	8390	3496
Achnanthes lanceolata (Brebisson) Grunow	*Planothidium lanceolatum* (Breb.) Round & Bukht.	0	0	0	1872	0	0	0	0	0	0	0	0
Achnanthes lapisosa Krasske	*Achnanthes lapisosa* Krasske	0	2268	0	0	0	0	0	0	0	0	0	0
Achnanthes levanderi Hustedt	*Psammothidium levanderi* (Hust.) Bukht. & Round	2622	2268	0	3745	0	0	0	0	0	749	0	0
Achnanthes minutissima Kuetzing	*Achnanthidium minutissimum* (Kuetzing) Czarn.	765656	258657	281100	267829	872252	117727	498307	777107	945743	65178	520226	230745
Achnanthes pusilla (Grunow) De Toni	*Achnanthes pusilla* (Grunow) De Toni	2622	0	2729	1872	5351	0	2568	0	3924	0	0	0
Achnanthes sp	*Achnanthes* sp	0	0	0	0	0	0	0	0	0	0	2097	0
Anomoeoneis brachysira (Brebisson) Grunow	*Anomoeoneis brachysira* (Brebisson) Grunow	0	4537	0	1872	0	0	15411	113446	0	749	2097	0
Anomoeoneis procera Lange-Bertalot & Moser	*Anomoeoneis procera* Lange-Bertalot & Moser	5244	22689	38207	164818	722418	313939	226036	201367	196212	40455	102786	69922
Anomoeoneis vitrea (Grunow) Ross	*Brachysira vitrea* (Grunow) Ross in Hartley	0	2268	10916	0	5351	3567	2568	8508	39242	0	0	0
Anomoeoneis zellensis (Grunow) Cleve	*Brachysira zellensis* (Grunow) Round & Mann	0	0	0	0	0	0	0	0	0	0	0	0
Asterionella ralfsii W. Smith	*Asterionella ralfsii* W. Smith	0	0	0	0	0	0	0	0	0	0	0	0
Aulacoseira distans (Ehrenberg) Simonsen	*Aulacoseira distans* (Ehrenberg) Simonsen	0	0	0	0	0	0	0	0	0	0	0	0
Caloneis bacillum (Grunow) Cleve	*Caloneis bacillum* (Grunow) Cleve	0	0	2729	0	0	0	0	0	0	0	0	0
Caloneis silicula (Ehrenberg) Cleve	*Caloneis ventricosa* (Ehren.) Meister	5244	0	0	0	5351	0	7705	0	0	0	0	0
Caloneis sp	*Caloneis* sp	0	0	0	0	0	0	0	0	0	0	4195	0
Cyclotella ocellata Pantocsek	*Cyclotella ocellata* Pantocsek	2622	9075	8187	13110	0	0	0	0	0	0	0	0
Cyclotella pseudostelligera Hustedt	*Cyclotella pseudostelligera* Hustedt	0	4537	5458	5618	0	0	0	0	0	0	0	0
Cymbella arctica (Lagerstedt) Schmidt	*Cymbella arctica* (Lagerstedt) Schmidt	0	0	0	0	0	0	5137	0	0	0	2097	10488
Cymbella cesatii (Rabenhorst) Grunow	*Cymbella cesatii* (Rabenhorst) Grunow	28843	47647	60040	31839	133781	3567	179801	181514	200136	15732	44051	31465
Cymbella gracilis (Ehrenberg) Kuetzing	*Encyonema gracilis* Rabenh.	2622	9075	2729	5618	0	0	0	0	0	0	0	0
Cymbella microcephala Grunow	*Cymbella microcephala* Grunow	0	0	0	0	0	0	0	0	0	0	0	0
Cymbella incerta (Grunow) Cleve	Cymbella incerta (Grunow) Cleve	2622	4537	2729	0	0	0	0	0	0	0	0	0
Cymbella minuta Hilse	*Encyonema minutum* (Hilse ex Rabenh.) Mann in Round, Crawford & Mann	0	0	0	1872	0	0	0	0	7848	0	0	0
Cymbella naviculiformis Auersw ex Heib.	*Cymbella naviculiformis* Auersw ex Heib.	0	2268	0	0	0	0	0	0	0	0	2097	0
Cymbella pusilla Grunow	*Cymbella pusilla* Grunow	0	0	0	0	0	0	0	0	0	0	0	0
Cymbella minuta var. silesiaca (Bleisch ex. Rabenhorst) Reimer	*Encyonema silesiacum* (Bleisch ex. Rabenh.) Mann in Round, Crawford & Mann	0	13613	0	0	0	0	10274	2836	15696	0	0	0
Cymbella sp	*Cymbella* sp Agardh	0	0	0	0	0	0	0	0	0	0	2097	6992
Eunotia arcus Ehrenberg	*Eunotia arcus* Ehrenberg	0	0	0	0	0	0	2568	8508	0	1498	2097	3496
Eunotia bidentula W. Smith	*Eunotia bidentula* W. Smith	0	0	0	0	0	0	0	0	0	0	0	0
Eunotia bilunaris var. *mucophila* Lange-Bertalot & Norpel	*Eunotia bilunaris* var. *mucophila* Lange-Bertalot & Norpel	0	2268	13645	0	0	0	0	2836	0	2247	2097	0
Eunotia diodon Ehrenberg	*Eunotia diodon* Ehrenberg	0	4537	10916	0	0	0	0	0	0	0	0	0
Eunotia exigua Brebisson (Rabenhorst)	*Eunotia exigua* Brebisson (Rabenhorst)	0	9075	5458	0	0	0	0	0	0	5993	0	13984
Eunotia incisa W. Smith	*Eunotia incisa* W. Smith	2622	0	2729	1872	0	0	0	0	0	2996	31465	0
Eunotia monodon Ehrenberg	*Eunotia monodontiforma* Lange-Bert & Nopel	0	0	0	0	0	0	0	0	0	0	0	0
Eunotia naegeli Migula	*Eunotia naegelii* Migula	0	2268	2729	0	10702	0	0	0	0	0	0	0
Eunotia paludosa var trincaria (Krasske) Norpel	*Eunotia paludosa var trincaria* (Krasske) Norpel	5244	6806	5458	0	0	0	0	0	3924	749	10488	10488
Eunotia pectinalis (O. Mull.) Rabenhorst	*Eunotia pectinalis* (O. Mull.) Rabenhorst	0	0	0	0	0	0	0	0	0	0	0	0
Eunotia sp	*Eunotia* sp	2622	2268	0	5618	0	7134	0	5672	0	0	0	0
Eunotia steineckii Petersen	*Eunotia steineckii* Petersen	0	0	0	0	0	0	0	0	0	0	0	0
Eunotia subarcuatoides Alles, Norpel & Lange-Bertalot	*Eunotia subarcuatoides* Alles, Norpel & Lange-Bertalot	0	0	0	0	0	0	0	0	0	0	0	0
Eunotia triodon Ehrenberg	*Eunotia triodon* Ehrenberg	0	0	0	0	0	0	0	0	0	0	0	0
Fragilaria brevistriata Grunow	*Pseudostaurosira brevistriata* (Grunow in VanHeurck) Williams & Round	0	9075	0	0	0	0	0	0	0	0	0	0
Fragilaria pinnata (Ehrenberg)	*Staurosirella pinnata* (Ehreb.) Williams & Round	0	0	0	0	0	0	0	0	3924	0	0	0
Fragilaria vaucheriae (Kuetzing) Petersen	*Fragilaria vaucheriae* (Kuetzing) Petersen	18354	4537	0	0	5351	0	0	0	0	2247	2097	31465
Fragilaria virescens var. *exigua*	*Fragilariforma virescens* var exigua (Ralfs) Williams & Round	0	0	0	0	0	0	0	0	0	0	0	0
Frustulia pseudomagaliesmontana Camburn & Charles	*Frustulia pseudomagaliesmontana* Camburn & Charles	0	0	0	0	0	0	0	0	0	0	0	0
Frustulia rhomboides var. saxonica (Ehrenberg) de Toni	*Frustulia rhomboides var. saxonica* (Ehrenberg) de Toni	2622	9075	16374	1872	16053	35674	66783	45378	0	5993	25172	20976
Gomphonema acuminatum Ehrenberg	*Gomphonema acuminatum* Ehrenberg	0	0	0	0	0	0	0	0	3924	0	0	0
Gomphonema parvulum (Kuetzing) Kuetzing	*Gomphonema parvulum* (Kuetzing) Kuetzing	0	0	0	0	0	0	0	0	0	0	0	0
Gomphonema pumilum (Grunow) Reichardt & Lange-Bertalot	*Gomphonema pumilum* (Grunow) Reichardt & Lange-Bertalot	0	0	0	0	0	0	0	0	0	0	0	0
Gomphonema sp	*Gomphonema* sp	0	0	0	0	0	0	0	0	3924	1498	0	0
Hannaea arcus (Ehrenberg) Patrick	*Hannaea arcus* (Ehrenberg) Patrick	0	0	0	0	0	0	0	0	0	0	0	0
Navicula cryptocephala Kuetzing	*Navicula cryptocephala* Lange-Bertlot	0	0	0	0	0	0	0	0	0	0	0	0

Note: all units are in cells/cm ^{2}

Echo OF was dry during summer sampling, so no periphyton data could be collected.

Appendix 3.6-5. Stream Periphyton Density and Taxonomic Results, Back River Project, 2011

Site ID		Goose OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor OF	Propellor D/S	Propellor D/S	Propellor D/S	Ref. B OF	Ref. B OF	Ref. B OF
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled		16-Aug-11	16-Aug-11	16-Aug-11	15-Aug-11	16-Aug-11	16-Aug-11	15-Aug-11	15-Aug-11	15-Aug-11	14-Aug-11	14-Aug-11	14-Aug-11
		BIO-13	BIO-14	BIO-15	BIO-16	BIO-17	BIO-18	BIO-19	BIO-20	BIO-21	BIO-22	BIO-23	BIO-24
OLD NAME	NEW NAME	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density
DIATOMS (continued)													
Navicula cryptotenella Lange-Bertalot	*Navicula cryptotenella* Lange-Bertalot	0	0	0	0	0	0	0	2836	0	0	0	0
Navicula gregaria Donkin	*Navicula gregaria* Donkin	0	0	0	0	0	0	0	0	0	0	0	0
Navicula pupula Kuetzing	*Sellaphora mutata* (Kuetz.) Mereschk	0	0	2729	0	0	0	0	0	0	0	4195	6992
Navicula subtilissima Cleve	*Kobayasia subtilissima* (Cleve) Lange-Bertalot	0	0	0	0	0	0	0	0	0	0	6292	3496
Navicula sp	*Navicula* sp	0	0	0	0	0	0	0	0	0	0	0	0
Neidium bisculatum (Lagerstedt) Cleve	*Neidium bisculatum* (Lagerstedt) Cleve	0	2268	0	0	0	0	0	0	0	0	0	0
Neidium sp.	*Neidium* sp.	0	0	0	0	0	0	0	0	0	0	0	0
Nitzschia angustata Grunow	*Tryblionella angustata* W. Smith	7866	2268	5458	3745	0	0	64214	65231	35318	749	8390	3496
Nitzschia dissipata (Kuetzing) Grunow	*Nitzschia dissipata* (Kuetzing) Grunow	0	0	0	0	0	0	0	0	0	0	0	0
Nitzschia fonticola Grunow	*Nitzschia fonticola* Grunow	0	2268	0	0	0	0	2568	0	0	0	0	0
Nitzschia frustulum (Kuetzing) Grunow	*Nitzschia frustulum* (Kuetzing) Grunow	10488	18151	2729	3745	0	3567	0	5672	0	0	2097	0
Nitzschia gracilis Hantzsch	*Nitzschia gracilis* Hantzsch	0	0	0	0	0	0	2568	0	0	0	0	0
Nitzschia heufleriana Grunow	*Nitzschia heufleriana* Grunow	0	0	0	0	0	0	10274	0	0	0	0	0
Nitzschia inconspicua Grunow	*Nitzschia inconspicua* Grunow	0	6806	0	11237	21404	0	0	2836	15696	0	0	0
Nitzschia palea (Kuetzing) W. Smith	*Nitzschia palea* (Kuetzing) W. Smith	0	0	2729	0	0	0	0	0	0	0	4195	0
Nitzschia perminuta (Grunow) Perag.	*Nitzschia perminuta* (Grunow) M.Perag.	83907	47647	57311	237862	369235	67782	156684	323322	294318	20227	121665	48946
Peronia fibula (Brebisson) Ross	*Peronia fibula* (Brebisson) Ross	0	0	0	0	0	0	0	0	0	0	0	0
Pinnularia abaujensis (Pantocsek) Ross	*Pinnularia abaujensis* (Pantocsek) R. Ross	0	0	0	0	0	0	0	0	0	749	0	0
Pinnularia divergentissima (Grunow) Cleve	*Pinnularia divergentissima* (Grunow) Cleve	0	0	0	0	0	0	0	0	0	0	0	0
Pinnularia sp.	*Pinnularia* sp.	0	0	0	0	0	0	0	0	0	749	4195	0
Stauroneis anceps Ehrenberg	*Stauroneis anceps* Ehrenberg	0	2268	0	0	0	0	0	0	0	0	0	0
Stauroneis phoenicenteron (Nitzsch) Ehrenberg	*Stauroneis phoenicenteron* (Nitzsch) Ehrenberg	0	0	2729	0	0	0	0	0	0	0	0	0
Stephanodiscus binderanus (Kuetzing) Krieger	*Stephanodiscus binderanus* (Kuetzing) Krieger	0	0	0	0	0	0	0	0	0	0	0	0
Stenopterobia curvala (W. Smith) Hustedt	*Stenopterobia curvala* (W. Smith) Hustedt	0	0	0	0	0	0	0	0	0	0	0	0
Synedra famelica Kuetzing	*Synedra famelica* Kuetzing	41953	18151	16374	11237	112376	21404	17980	2836	11772	1498	4195	0
Synedra filiformis Grunow	*Synedra filiformis* Grunow	0	0	0	0	0	0	0	0	0	0	2097	0
Synedra ostenfeldii Sommer & Yang	*Synedra ostenfeldii* Sommer & Yang	0	0	0	0	0	0	2568	0	0	0	0	0
Synedra rumpens Kuetzing	*Synedra rumpens* Kuetzing	83907	11344	40937	20602	112376	24972	7705	0	3924	0	2097	0
Tabellaria flocculosa (Roth) Kuetzing	*Tabellaria flocculosa* (Roth) Kuetzing	133727	181512	139185	187292	856198	153402	48803	53887	121651	28468	67126	87403
CHLOROPHYCEAE	**GREEN ALGAE - CHLOROPHYCEAE**												
Ankistrodesmus spiralis (Turner) Lemmermann	*Ankistrodesmus spiralis* (Turner) Lemmermann	0	0	0	0	0	0	0	0	11772	0	0	0
Ankistrodesmus stipitatus (Chodat)	*Ankistrodesmus stipitatus* (Chodat)	0	0	0	0	0	0	0	0	0	0	0	0
Arthrodesmus crassus West	*Arthrodesmus crassus* West	0	0	0	0	0	0	0	0	0	0	0	0
Arthrodesmus incus var. *ralfsii* (West) Teiling	*Arthrodesmus incus* var. *ralfsii* (West) Teiling	0	0	0	0	0	0	0	0	0	0	0	0
Bulbochaete De Bary	*Bulbochaete* De Bary	5244	0	0	5618	0	0	5137	0	0	0	0	0
Chlamydomonas sp	*Chlamydomonas* sp	0	0	0	0	0	0	0	0	0	0	0	0
Cladophora sp	*Cladophora* sp	0	0	0	0	32107	0	0	0	0	0	0	0
Closterium dianae Ehrenberg	*Closterium dianae* Ehrenberg	0	0	0	0	0	0	0	0	0	0	0	0
Cosmarium abbreviatum Raciborski	*Cosmarium abbreviatum* Raciborski	0	0	0	0	0	0	0	0	0	0	0	0
Cosmarium bioculatum Brebisson	*Cosmarium bioculatum* Brebisson	0	0	0	0	0	0	0	2836	0	0	0	0
Cosmarium formosulum Hoff	*Cosmarium formosulum* Hoff	0	0	0	0	0	0	0	0	0	0	0	0
Cosmarium granatum Brebisson	*Cosmarium granatum* Brebisson	0	0	0	0	5351	0	0	0	0	0	0	0
Cosmarium impressulum Elfv.	*Cosmarium impressulum* Elfv.	0	0	0	0	0	0	0	0	0	0	0	0
Cosmarium phaseolus Brebisson	*Cosmarium phaseolus* Brebisson	0	0	0	0	0	0	0	0	0	0	0	0
Cosmarium subcrenatum Hantz.	*Cosmarium subcrenatum* Hantz.	0	2268	0	0	0	0	0	0	0	0	0	0
Cosmarium sp	*Cosmarium* sp	0	0	0	0	0	0	0	0	0	0	0	0
Cosmarium subcrenatum Hantz.	*Cosmarium subcrenatum* Hantz.	0	0	0	0	0	0	0	0	0	0	0	0
Cylindrocystis brebissonii (Menegh. ex Ralfs) De Bary	*Cylindrocystis brebissonii* (Menegh. ex Ralfs) De Bary	**0**	**0**	**0**	**1872**	**0**	**0**	**0**	**0**	**0**	**0**	0	**0**
Elakatothrix genevensis (Reverdin) Hindak	*Elakatothrix genevensis* (Reverdin) Hindak	0	0	0	0	0	0	0	0	11772	0	0	0
Euastrum ansatum Ehrenberg	*Euastrum ansatum* Ehrenberg	0	0	0	0	0	0	0	0	0	0	0	0
Euastrum bidentatum Naegeli	*Euastrum bidentatum* Naegeli	0	0	0	0	0	0	0	0	0	0	0	0
Euastrum insulare (Wittrock) Roy	*Euastrum insulare* (Wittrock) Roy	0	0	0	0	0	0	0	0	0	0	0	0
Gloeocystis sp	*Gloeocystis* sp	0	0	0	0	0	0	0	0	0	0	0	0
Monoraphidium griffithii (Berkeley) Komarkova-Legenerova	*Monoraphidium griffithii* (Berkeley) Komarkova-Legenerova	2622	0	2729	0	0	0	0	0	0	0	0	0
Monoraphidium irregulare (G.M. Smith) Komarkova-Legenerova	*Monoraphidium irregulare* (G.M. Smith) Komarkova-Legenerova	0	0	0	0	0	0	0	0	0	0	0	0
Mougeotia sp	*Mougeotia* sp	0	0	0	1872	53512	10702	0	0	7848	0	0	17480
Oocystis borgei Snow	*Oocystis borgei* Snow	0	0	0	0	0	0	0	0	0	0	0	0
Oocystis gigas Archer	*Oocystis gigas* Archer	0	0	0	0	0	0	0	0	0	0	0	0
Oocystis lacustris Chodat	*Oocystis lacustris* Chodat	0	0	0	0	0	0	0	0	0	0	0	0
Oocystis parva West & West	*Oocystis parva* West & West	0	0	0	0	0	0	0	0	0	0	2097	0
Oocystis solitaria Wittrock	*Oocystis solitaria* Wittrock	0	0	0	0	0	0	2568	0	0	0	4195	0
Pediastrum tetras (Ehrenberg) Ralfs	*Pediastrum tetras* (Ehrenberg) Ralfs	0	0	0	0	0	0	0	0	0	0	0	0
Penium polymorphum (Perty) Perty	*Penium polymorphum* (Perty) Perty	0	0	0	0	0	0	0	0	0	749	0	0
Scenedesmus bijuga (Turp.) Lagerheim	*Scenedesmus bijuga* (Turp.) Lagerheim	0	0	0	0	0	0	0	0	0	0	0	0
Scenedesmus ecornis (Ehrenberg) Chodat	*Scenedesmus ecornis* (Ehrenberg) Chodat	0	0	0	0	0	0	0	0	0	0	0	0
Scenedesmus obliquus (Turpin) Kuetzing	*Scenedesmus obliquus* (Turpin) Kuetzing	0	0	0	0	0	0	0	0	15696	2996	8390	41953
Scenedesmus ovalternus Chodat	*Scenedesmus ovalternus* Chodat	0	0	0	0	0	0	0	0	0	0	0	0

Note: all units are in cells/cm ^{2}

Echo OF was dry during summer sampling, so no periphyton data could be collected.

Appendix 3.6-5. Stream Periphyton Density and Taxonomic Results, Back River Project, 2011

Site ID		Goose OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor OF	Propellor D/S	Propellor D/S	Propellor D/S	Ref. B OF	Ref. B OF	Ref. B OF
Replicate		1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled		16-Aug-11	16-Aug-11	16-Aug-11	15-Aug-11	16-Aug-11	16-Aug-11	15-Aug-11	15-Aug-11	15-Aug-11	14-Aug-11	14-Aug-11	14-Aug-11
		BIO-13	BIO-14	BIO-15	BIO-16	BIO-17	BIO-18	BIO-19	BIO-20	BIO-21	BIO-22	BIO-23	BIO-24
OLD NAME	NEW NAME	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density	Density
CHLOROPHYCEAE (continued)	**GREEN ALGAE - CHLOROPHYCEAE (continued)**												
Schizomeris cf. *leibleinii* Kuetzing	*Schizomeris* cf. *leibleinii* Kuetzing	0	0	0	0	0	0	0	0	0	0	0	0
Spondylosium planum (Wolle) West & West	*Spondylosium planum* (Wolle) West & West	0	0	0	0	0	0	0	5672	11772	0	0	0
Staurastrum alternans Brebisson	*Staurastrum alternans* Brebisson	0	0	0	0	0	0	2568	0	7848	0	0	0
Staurastrum muticum Brebisson	*Staurastrum muticum* Brebisson	0	0	0	0	0	0	0	0	0	0	0	0
Staurastrum sp	*Staurastrum* sp	2622	0	0	0	0	0	0	0	0	0	2097	0
Tetraedron triangulare Korshikov	*Tetraedron triangulare* Korshikov	0	0	0	0	0	0	0	0	0	0	0	0
Ulothrix sp	*Ulothrix* sp	0	0	0	0	0	0	12842	0	0	0	0	0
Zygnema sp	*Zygnema* sp	0	0	0	0	149834	0	0	11344	0	0	0	0
CHRYSOPHYCEAE	**CHRYSOPHYCEAE**												
Chromulina sp	*Chromulina* sp.	0	0	0	0	0	0	0	0	0	749	0	0
Dinobryon setularia Ehrenberg	*Dinobryon setularia* Ehrenberg	0	0	0	5618	0	0	0	0	0	0	0	0
Unidentified naked Chrysophyte sp (*Ochromonas* / *Chromulina*) - large	Unidentified naked Chrysophyte sp (*Ochromonas* / *Chromulina*) - large	0	0	0	0	0	0	0	0	0	0	0	0
Ochromonas sp	*Ochromonas* sp	0	0	0	0	0	0	0	0	0	749	0	0
Stichogloea doederleinii (Schmidle) Wille	*Stichogloea doederleinii* (Schmidle) Wille	0	0	0	0	0	0	0	0	0	0	0	0
Synura sp	*Synura* sp	0	0	0	0	0	0	0	0	0	0	0	0
CRYPTOPHYCEAE	**CRYPTOPHYCEAE**												
Cryptomonas erosa Ehrenberg	*Cryptomonas erosa* Ehrenberg	0	0	0	0	0	0	0	0	0	0	0	0
CYANOBACTERIA	**CYANOBACTERIA**												
Anabaena inaequalis (Kuetzing) Bornet & Flahault	*Anabaena inaequalis* (Kuetzing) Bornet & Flahault	0	0	0	0	0	0	0	0	0	0	0	0
Aphanocapsa delicatissima West & West	*Aphanocapsa delicatissima* West & West	0	45378	81874	0	0	0	513719	0	0	0	629306	0
Aphanocapsa elachista West & West	*Aphanocapsa elachista* West & West	0	0	0	0	0	0	0	0	0	0	0	0
Aphanocapsa sp	*Aphanocapsa* sp	0	0	0	0	0	0	0	0	0	0	0	0
Calothrix sp	*Calothrix* sp	78663	0	0	0	0	0	0	85084	0	0	0	0
Chroococcus dispersus (Keissler) Lemmermann	*Chroococcus dispersus* (Keissler) Lemmermann	0	45378	0	0	0	0	0	0	0	0	0	0
Chroococcus limneticus Lemmermann	*Chroococcus limneticus* Lemmermann	0	0	0	0	0	14269	0	0	0	0	0	0
Chroococcus sp	*Chroococcus* sp	0	0	0	0	0	0	0	5672	0	0	0	0
Cylindrospermum sp	*Cylindrospermum* sp	0	0	0	0	0	0	0	0	0	0	41953	0
Leibleinia sp	*Leibleinia* sp	117994	0	0	112376	187293	53512	51371	0	0	0	73419	209768
Limnothrix sp	*Limnothrix* sp	91773	79412	111894	103011	107024	71349	89900	141808	274697	49445	83907	122365
Merismopedia glauca (Ehrenberg) Naegeli	*Merismopedia glauca* (Ehrenberg) Naegeli	0	0	0	0	0	0	0	0	0	0	0	0
Merismopedia tenuissima Lemmermann	*Merismopedia tenuissima* Lemmermann	0	0	0	0	0	0	0	0	0	0	0	59434
Oscillatoria sp	*Oscillatoria* sp	0	0	0	0	0	0	0	0	0	0	0	0
Phormidium chalybeum (Mertens ex Gomont) Anagnostidis et Komarek	*Phormidium chalybeum* (Mertens ex Gomont) Anagnostidis et Komarek	0	0	0	37458	0	0	0	170169	0	11237	0	0
Phormidium formosum (Bory ex Gomont) Anagnostidis et Komarek	*Phormidium formosum* (Bory ex Gomont) Anagnostidis et Komarek	0	0	0	162945	0	35674	179801	0	235454	2996	41953	0
Phormidium sp	*Phormidium* sp	0	0	0	0	0	0	0	0	0	59933	0	34961
Rhabdoderma lineare Schmidle & Lauterborn	*Rhabdoderma lineare* Schmidle & Lauterborn	0	72605	0	0	0	0	0	0	0	0	0	0
Snowella lacustris (Chodat) Komarek et Hindak	*Snowella lacustris* (Chodat) Komarek et Hindak	0	0	0	0	0	0	0	0	0	0	125861	0
EUGLENOPHYCEAE	**EUGLENOIDS - EUGLENOPHYCEAE**												
Euglena acus Ehrenberg	*Euglena acus* Ehrenberg	0	0	0	0	0	0	0	0	0	0	0	0
Trachemolomas volvocina Ehrenberg	*Trachemolomas volvocina* Ehrenberg	0	0	0	0	0	0	0	0	0	749	0	0
	XANTHOPHYCEAE												
Characiopsis pyriformis (A. Braun) Borzi	*Characiopsis pyriformis* (A. Braun) Borzi	0	0	0	0	5351	0	0	0	0	0	0	0
Ophiocytium majus Nageli	*Ophiocytium majus* Nageli	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL		**1536547**	**977877**	**974288**	**1430899**	**3831480**	**938241**	**2208976**	**2251902**	**2491883**	**328876**	**2009563**	**1073307**

Note: all units are in cells/cm ^{2}

Echo OF was dry during summer sampling, so no periphyton data could be collected.

Appendix 3.6-6

Stream Periphyton Richness and Diversity Results, Back River Project, 2011

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Appendix 3.6-6. Stream Periphyton Richness and Diversity Results, Back River Project, 2011

Stream	Replicate	Date Sampled	Richness (genera/sample)	Diversity (Simpson's Index)
Chair OF	1	13-Aug-11	36	0.87
	2	13-Aug-11	33	0.88
	3	13-Aug-11	36	0.77
Llama OF	1	17-Aug-11	18	0.52
	2	17-Aug-11	16	0.81
	3	17-Aug-11	20	0.82
Giraffe OF	1	12-Aug-11	30	0.83
	2	12-Aug-11	24	0.83
	3	12-Aug-11	31	0.85
Wolf OF	1	13-Aug-11	29	0.84
	2	13-Aug-11	26	0.75
	3	13-Aug-11	24	0.74
Goose OF	1	16-Aug-11	23	0.72
	2	16-Aug-11	26	0.86
	3	16-Aug-11	20	0.85
Propellor OF	1	15-Aug-11	23	0.85
	2	16-Aug-11	20	0.81
	3	16-Aug-11	16	0.86
Propellor D/S	1	15-Aug-11	23	0.84
	2	15-Aug-11	21	0.78
	3	15-Aug-11	23	0.78
Ref. B OF	1	14-Aug-11	24	0.83
	2	14-Aug-11	27	0.80
	3	14-Aug-11	21	0.87

Note: Echo OF was dry during summer sampling, so no periphyton data could be collected.

Appendix 3.7-1

Lake Zooplankton Density and Taxonomic Results, Back River Project, 2011

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Appendix 3.7-1. Lake Zooplankton Density and Taxonomic Results, Back River Project, 2011

Lake/Sample ID		Llama Lake						Umwelt Lake						Giraffe Lake					
Date		9-Aug-11						5-Aug-11						10-Aug-11					
Tow type		Vertical from 11.5 m depth			Mean			Horizontal tow at 0.5 m depth			Mean			Vertical tow from 4 m depth			Mean		
Volume sampled (m^3)		0.63982	0.62463	0.47844	(Org/m^3)	SE	%	0.71423	0.66104	0.60595	(Org/m^3)	SE	%	0.25834	0.23934	0.23364	(Org/m^3)	SE	%
Replicate		**3**	**4**	**5**				**1**	**2**	**3**				**1**	**2**	**3**			
ROTIFERA																			
Kellicottia longispina		3437	4320	3551				1400	2269	1485				1974	3134	2782			
Keratella cochlearis		47	160	418				0	0	0				0	0	0			
Conochilus sp.	colony	78	64	63				0	15	33				31	63	17			
Plautius		16	160	0				0	151	0				0	0	0			
Subtotal Rotifers		**3577**	**4704**	**4032**	**4105**	**327**	**10%**	**1400**	**2436**	**1518**	**1785**	**327**	**9%**	**2005**	**3196**	**2799**	**2667**	**350**	**18%**
CLADOCERA																			
Holopedium gibberum		17	77	132				64	17	18				1277	2549	3552			
Daphnia middendorffiana		106	50	40				1	0	0				116	192	235			
Bosmina longirostris		5	6	4				0	2	0				619	794	471			
Subtotal Cladocerans		**128**	**133**	**175**	**145**	**15**	**0%**	**66**	**18**	**18**	**34**	**16**	**0%**	**2013**	**3535**	**4259**	**3269**	**662**	**22%**
COPEPODS - CALANOIDA																			
Leptodiaptomus pribilofensis	M	547	464	480				1540	182	297				1277	1212	642			
Leptodiaptomus pribilofensis	F	719	656	564				1680	1498	1881				697	543	984			
Leptodiaptomus ashlandi	M	47	64	0				0	0	0				0	0	0			
Leptodiaptomus ashlandi	F	47	64	84				0	15	0				0	0	0			
Leptodiaptomus sicilis	M	0	0	0				0	0	0				0	0	0			
Leptodiaptomus sicilis	F	0	16	0				0	0	0				0	8	4			
Leptodiaptomus sp.	V	30462	20642	10863				12041	16035	11387				3213	3802	3467			
Leptodiaptomus sp.	IV	1718	1440	1253				294	424	825				426	292	385			
Leptodiaptomus sp.	III	0	48	0				0	76	50				0	0	0			
Leptodiaptomus sp.	II	0	0	0				14	0	33				0	0	0			
Leptodiaptomus sp.	I	0	0	0				0	0	17				0	0	0			
Heterocope septentrionalis	M	9	6	8				90	18	10				8	33	4			
Heterocope septentrionalis	F	17	11	13				15	5	8				35	8	30			
Epischura lacustris	M	109	112	146				6	0	3				62	38	13			
Epischura lacustris	F	156	352	125				53	29	40				58	29	77			
Epischura lacustris	V	0	10	19				6	2	2				0	0	0			
Epischura lacustris	IV	0	0	0				0	0	0				0	0	0			
Epischura lacustris	III	0	0	0				0	15	0				0	0	0			
Epischura lacustris	II	16	0	0				28	61	0				0	0	0			
Epischura lacustris	I	0	0	0				0	15	0				0	0	0			
Unidentified Calanoida*	nauplius	0	0	0				0	0	0				0	0	0			
Subtotal Copepods - Calanoida		**33847**	**23885**	**13556**	**23763**	**5858**	**59%**	**15767**	**18373**	**14552**	**16230**	**1127**	**85%**	**5775**	**5966**	**5607**	**5783**	**104**	**38%**
COPEPODS - CYCLOPOIDA																			
Cyclops bicuspidatus thomasi	F	0	0	0				0	0	0				0	4	0			
Cyclops scutifer	M	0	3	2				0	0	0				0	0	0			
Cyclops scutifer	F	28	37	209				0	0	0				0	4	0			
Cyclops sp.	copepodite	5311	5600	7312				210	333	396				1858	1838	2739			
Unidentified Cyclopoida*	nauplius	2499	10081	5432				210	1513	792				890	1128	1926			
Subtotal Copepods - Cyclopoida		**7839**	**15721**	**12954**	**12171**	**2309**	**30%**	**420**	**1846**	**1188**	**1151**	**412**	**6%**	**2748**	**2975**	**4665**	**3463**	**605**	**23%**
TOTAL DENSITY		**45391**	**44444**	**30718**	**40184**	**4741**	**100%**	**17653**	**22672**	**17277**	**19200**	**1739**	**100%**	**12542**	**15672**	**17330**	**15181**	**1404**	**100%**

Note: Data represent numbers of zooplankton/m^3

Volume sampled is calculated based on flowmeter readings as outlined in methods section.

**these taxa were excluded from the diversity analyses as they could not be accurately assigned to a genera*

Appendix 3.7-1. Lake Zooplankton Density and Taxonomic Results, Back River Project, 2011

Lake/Sample ID		Goose Lake Neck						Goose Lake Central						Reference B Lake					
Date		14-Aug-11						7-Aug-11						8-Aug-11					
Tow type		Horizontal tow at 0.5 m depth			Mean			Horizontal tow at 0.5 m depth			Mean			Horizontal tow at 0.5 m depth			Mean		
Volume sampled (m^3)		0.26974	0.37041	0.38751	(Org/m^3)	SE	%	0.42170	0.24124	0.22795	(Org/m^3)	SE	%	0.22795	0.21845	0.20705	(Org/m^3)	SE	%
Replicate		**4**	**5**	**6**				**1**	**2**	**3**				**1**	**2**	**3**			
ROTIFERA																			
Kellicottia longispina		1780	2673	1961				6640	5223	7458				2544	2426	4781			
Keratella cochlearis		0	0	0				0	0	0				0	0	0			
Conochilus sp.	colony	44	57	103				26	12	70				0	0	0			
Plautius		0	0	0				0	0	0				0	0	0			
Subtotal Rotifers		**1824**	**2729**	**2064**	**2206**	**271**	**20%**	**6666**	**5235**	**7528**	**6476**	**669**	**28%**	**2544**	**2426**	**4781**	**3251**	**766**	**51%**
CLADOCERA																			
Holopedium gibberum		15	0	28				28	33	101				0	0	0			
Daphnia middendorffiana		11	0	0				0	0	0				9	0	0			
Bosmina longirostris		100	270	0				50	12	0				0	0	5			
Subtotal Cladocerans		**126**	**270**	**28**	**141**	**70**	**1%**	**78**	**46**	**101**	**75**	**16**	**0%**	**9**	**0**	**5**	**5**	**3**	**0%**
COPEPODS - CALANOIDA																			
Leptodiaptomus pribilofensis	M	297	270	387				28	37	219				746	60	77			
Leptodiaptomus pribilofensis	F	779	837	723				26	8	307				790	238	82			
Leptodiaptomus ashlandi	M	1817	1053	774				1660	1824	1360				0	0	5			
Leptodiaptomus ashlandi	F	408	999	1135				2134	788	2018				0	0	0			
Leptodiaptomus sicilis	M	0	0	0				0	4	0				0	0	0			
Leptodiaptomus sicilis	F	0	0	0				0	4	0				0	0	0			
Leptodiaptomus sp.	V	3077	4023	4516				6166	6798	13600				1492	412	353			
Leptodiaptomus sp.	IV	37	162	77				1423	912	834				0	5	0			
Leptodiaptomus sp.	III	37	27	0				0	41	0				0	0	0			
Leptodiaptomus sp.	II	74	189	0				0	0	0				0	0	0			
Leptodiaptomus sp.	I	0	81	181				0	0	0				0	0	0			
Heterocope septentrionalis	M	7	11	39				7	4	4				4	0	0			
Heterocope septentrionalis	F	22	13	59				0	17	9				4	0	0			
Epischura lacustris	M	7	13	23				2	12	13				0	0	0			
Epischura lacustris	F	41	24	49				57	29	53				0	0	0			
Epischura lacustris	V	4	0	0				17	4	26				0	0	0			
Epischura lacustris	IV	0	0	0				0	0	0				0	0	0			
Epischura lacustris	III	0	0	0				0	0	0				0	0	0			
Epischura lacustris	II	0	0	0				0	0	0				0	0	0			
Epischura lacustris	I	0	0	0				0	0	0				0	0	0			
Unidentified Calanoida*	nauplius	37	27	0				142	41	132				0	0	0			
Subtotal Copepods - Calanoida		**6644**	**7729**	**7964**	**7446**	**407**	**67%**	**11662**	**10525**	**18575**	**13587**	**2515**	**59%**	**3036**	**714**	**517**	**1422**	**809**	**22%**
COPEPODS - CYCLOPOIDA																			
Cyclops bicuspidatus thomasi	F	0	0	0				0	0	0				0	0	0			
Cyclops scutifer	M	0	0	0				0	0	0				0	0	0			
Cyclops scutifer	F	41	135	77				38	29	79				0	0	0			
Cyclops sp.	copepodite	741	918	1316				1897	1700	2808				1623	778	227			
Unidentified Cyclopoida*	nauplius	185	189	310				949	580	219				132	1236	1063			
Subtotal Copepods - Cyclopoida		**968**	**1242**	**1703**	**1304**	**215**	**12%**	**2884**	**2309**	**3106**	**2766**	**237**	**12%**	**1755**	**2014**	**1290**	**1686**	**212**	**26%**
TOTAL DENSITY		**9561**	**11970**	**11760**	**11097**	**770**	**100%**	**21290**	**18115**	**29310**	**22905**	**3331**	**100%**	**7344**	**5155**	**6593**	**6364**	**642**	**100%**

Note: Data represent numbers of zooplankton/m^3

Volume sampled is calculated based on flowmeter readings as outlined in methods section.

**these taxa were excluded from the diversity analyses as they could not be accurately assigned to a genera*

Appendix 3.7-2

Lake Zooplankton Richness and Diversity Results, Back River Project, 2011

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Appendix 3.7-2. Lake Zooplankton Richness and Diversity Results, Back River Project, 2011

Lake	Replicate	Date Sampled	Richness (genera/sample)	Diversity (Simpson's Index)
Llama Lake	3	06-Aug-11	11	0.37
	4	06-Aug-11	11	0.49
	5	06-Aug-11	10	0.62
Umwelt Lake	1	05-Aug-11	7	0.20
	2	05-Aug-11	9	0.25
	3	05-Aug-11	7	0.22
Giraffe Lake	1	10-Aug-11	9	0.70
	2	10-Aug-11	9	0.74
	3	10-Aug-11	9	0.75
Goose Lake Neck	1	07-Aug-11	9	0.47
	2	07-Aug-11	7	0.52
	3	07-Aug-11	7	0.49
Goose Lake Central	1	07-Aug-11	8	0.56
	2	07-Aug-11	8	0.55
	3	07-Aug-11	7	0.52
Reference B Lake	1	08-Aug-11	5	0.65
	2	08-Aug-11	3	0.54
	3	08-Aug-11	4	0.24

Note: Zooplankton tows were vertical at the deeper Llama Lake and Giraffe Lake, and horizontal at all other lakes.

Appendix 3.7-3

Lake Benthos Density and Taxonomic Results, Back River Project, 2011

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Appendix 3.7-3. Lake Benthos Density and Taxonomic Results, Back River Project, 2011

Site					Llama Lake Shallow					Llama Lake Deep					Umwelt Lake					Giraffe Lake Shallow				
Date Sampled					9-Aug-11					9-Aug-11					10-Aug-11					11-Aug-11				
Depth (m)					5	5	5	5	5	13.8	13.4	14.5	14	13.8	2	2	2	2	2	3.7	3.7	3.7	3.7	3.7
Major Group	Family	Subfamily	Tribe	Genus	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5
Microturbellaria	Typhloplanidae	-	-	*Mesostoma*	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Microturbellaria Subtotal	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***14.3***	***0.0***	***0.0***	***14.3***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
Oligochaeta	Enchytraeidae	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Lumbriculidae	-	-	-	86.0	43.0	57.3	57.3	28.7	0.0	14.3	0.0	0.0	0.0	43.0	157.7	114.7	172.0	43.0	30.7	46.0	30.7	30.7	61.3
	Naididae	Tubificinae	-	-	14.3	14.3	0.0	0.0	0.0	114.7	114.7	86.0	286.7	215.1	0.0	0.0	0.0	0.0	0.0	0.0	76.6	46.0	46.0	0.0
				Oligochaeta Subtotal	***100.4***	***57.3***	***57.3***	***57.3***	***28.7***	***114.7***	***129.0***	***86.0***	***286.7***	***215.1***	***43.0***	***157.7***	***114.7***	***172.0***	***43.0***	***30.7***	***122.6***	***76.6***	***76.6***	***61.3***
Gastropoda	Valvatidae	-	-	*Valvata sincera*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Gastropoda Subtotal	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
Bivalvia	Sphaeriidae	-	-	(i/d)	229.4	358.4	157.7	157.7	587.8	0.0	14.3	28.7	0.0	86.0	258.1	215.1	172.0	315.4	0.0	137.9	199.2	199.2	76.6	107.3
		-	-	*Sphaerium*	43.0	43.0	28.7	28.7	57.3	0.0	0.0	0.0	0.0	0.0	57.3	28.7	14.3	28.7	14.3	30.7	46.0	15.3	0.0	46.0
		-	-	*Pisidium*	301.1	344.1	114.7	86.0	129.0	172.0	172.0	114.7	129.0	143.4	329.7	974.9	487.5	487.5	487.5	168.6	153.3	122.6	137.9	92.0
				Bivalvia Subtotal	***573.5***	***745.5***	***301.1***	***272.4***	***774.2***	***172.0***	***186.4***	***143.4***	***129.0***	***229.4***	***645.2***	***1218.6***	***673.8***	***831.5***	***501.8***	***337.2***	***398.5***	***337.2***	***214.6***	***245.2***
Hydracarina	-	-	-	-	0.0	28.7	0.0	0.0	14.3	14.3	57.3	28.7	0.0	28.7	143.4	157.7	100.4	28.7	57.3	15.3	30.7	0.0	0.0	0.0
				Hydracarina Subtotal	***0.0***	***28.7***	***0.0***	***0.0***	***14.3***	***14.3***	***57.3***	***28.7***	***0.0***	***28.7***	***143.4***	***157.7***	***100.4***	***28.7***	***57.3***	***15.3***	***30.7***	***0.0***	***0.0***	***0.0***
Ostracoda	-	-	-	-	43.0	0.0	0.0	0.0	43.0	0.0	28.7	0.0	43.0	28.7	243.7	774.2	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Ostracoda Subtotal	***43.0***	***0.0***	***0.0***	***0.0***	***43.0***	***0.0***	***28.7***	***0.0***	***43.0***	***28.7***	***243.7***	***774.2***	***14.3***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
Notostraca	Triopsidae	-	-	*Lepidurus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Notostraca Subtotal	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
Trichoptera	Limnephilidae	-	-	(i/d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-	-	*Grensia praeterica*	0.0	28.7	0.0	14.3	14.3	0.0	0.0	0.0	0.0	0.0	14.3	57.3	0.0	0.0	0.0	15.3	0.0	0.0	0.0	30.7
				Trichoptera Subtotal	***0.0***	***28.7***	***0.0***	***14.3***	***14.3***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***14.3***	***57.3***	***0.0***	***0.0***	***0.0***	***15.3***	***0.0***	***0.0***	***0.0***	***30.7***
Diptera	Chironomidae	-	-	(pupa)	14.3	28.7	28.7	43.0	14.3	43.0	100.4	86.0	86.0	157.7	0.0	14.3	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0
		Tanypodinae	Pentaneurini	(i/d)	0.0	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	15.3	0.0	0.0
				Ablabesmyia	43.0	28.7	71.7	100.4	43.0	0.0	14.3	0.0	0.0	14.3	71.7	272.4	157.7	57.3	71.7	0.0	0.0	0.0	0.0	0.0
				Thienemannimyia group	14.3	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Procladiini	*Procladius*	71.7	157.7	186.4	57.3	100.4	71.7	86.0	86.0	172.0	129.0	430.1	888.9	444.4	587.8	702.5	199.2	199.2	306.5	291.2	168.6
		Diamesinae	Protanypini	*Protanypus*	28.7	0.0	0.0	0.0	14.3	14.3	28.7	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.7	0.0	0.0	15.3	30.7
		Prodiamesinae		*Monodiamesa*	129.0	28.7	43.0	157.7	129.0	86.0	71.7	215.1	71.7	43.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.3	0.0	0.0
		Orthocladiinae	Orthocladiini	*Cricotopus/Orthocladius*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Heterotanytarsus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.3	15.3	0.0
				Heterotrissocladius	0.0	0.0	0.0	0.0	14.3	186.4	215.1	186.4	200.7	415.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.7
				Hydrobaenus	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Psectrocladius	243.7	258.1	157.7	315.4	200.7	14.3	86.0	100.4	272.4	28.7	372.8	1548.4	501.8	444.4	817.2	122.6	275.9	137.9	153.3	122.6
				Zalutschia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.3	0.0	15.3	30.7	46.0
		Chironominae	Chironomini	*Chironomus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	86.0	129.0	57.3	157.7	243.7	0.0	15.3	0.0	0.0	0.0
				Cladopelma	0.0	28.7	14.3	14.3	0.0	0.0	0.0	0.0	0.0	0.0	602.2	1749.1	917.6	731.2	630.8	30.7	46.0	92.0	92.0	46.0
				Cryptochironomus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	129.0	86.0	71.7	157.7	100.4	0.0	0.0	0.0	0.0	15.3
				Dicrotendipes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.7	28.7	14.3	100.4	0.0	15.3	0.0	0.0	0.0
				Microtendipes	71.7	114.7	0.0	28.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.3	0.0	0.0	0.0
				Pagastiella	0.0	0.0	14.3	14.3	28.7	0.0	0.0	0.0	0.0	0.0	0.0	14.3	14.3	14.3	0.0	199.2	92.0	46.0	122.6	107.3
				Polypedilum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	888.9	1376.3	1161.3	473.1	444.4	0.0	15.3	0.0	15.3	0.0
				Sergenta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Stictochironomus	688.2	1362.0	215.1	215.1	387.1	0.0	14.3	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	122.6	76.6	30.7	275.9	367.8
			Tanytarsini	(i/d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Cladotanytarsus	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.7	143.4	100.4	57.3	0.0	229.9	168.6	46.0	107.3	15.3
				Corynocera	172.0	71.7	0.0	14.3	0.0	0.0	57.3	0.0	0.0	0.0	444.4	1161.3	3096.8	2222.2	759.9	137.9	92.0	46.0	183.9	76.6
				Micropsectra	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.3	0.0	0.0	0.0	0.0
				Micropsectra / Tanytarsus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.3	0.0	0.0	0.0	0.0
				Paratanytarsus	14.3	14.3	14.3	0.0	43.0	0.0	0.0	0.0	0.0	0.0	14.3	14.3	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Tanytarsus	0.0	0.0	0.0	14.3	0.0	100.4	71.7	14.3	43.0	129.0	100.4	372.8	387.1	100.4	344.1	137.9	214.6	92.0	199.2	153.3
	Empididae	-	-	*Chelifera*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Diptera Subtotal	***1505.4***	***2121.9***	***745.5***	***989.2***	***974.9***	***516.1***	***745.5***	***716.8***	***860.2***	***917.6***	***3182.8***	***7885.3***	***6953.4***	***5017.9***	***4229.4***	***1256.7***	***1226.1***	***858.2***	***1501.9***	***1180.1***
				TOTAL BENTHOS	***2222.2***	***2982.1***	***1103.9***	***1333.3***	***1849.5***	***817.2***	***1161.3***	***974.9***	***1319.0***	***1433.7***	***4272.4***	***10250.9***	***7856.6***	***6050.2***	***4831.5***	***1655.2***	***1777.8***	***1272.0***	***1793.1***	***1517.2***
Non Macrobenthic Invertebrates*																								
Nematoda	-	-	-	-	28.7	0.0	0.0	0.0	14.3	14.3	43.0	14.3	0.0	0.0	0.0	14.3	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0
				Nematoda Subtotal	***28.7***	***0.0***	***0.0***	***0.0***	***14.3***	***14.3***	***43.0***	***14.3***	***0.0***	***0.0***	***0.0***	***14.3***	***0.0***	***14.3***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
Copepoda - Calanoida	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	43.0	14.3	14.3	14.3	28.7	14.3	14.3	28.7	57.3	15.3	0.0	0.0	15.3	0.0
				Copepoda - Calanoida Subtotal	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***43.0***	***14.3***	***14.3***	***14.3***	***28.7***	***14.3***	***14.3***	***28.7***	***57.3***	***15.3***	***0.0***	***0.0***	***15.3***	***0.0***
Copepoda - Cyclopoida	Cyclopidae	Cyclopinae	-	*Acanthocyclops*	43.0	14.3	14.3	0.0	14.3	0.0	0.0	14.3	0.0	0.0	28.7	86.0	28.7	71.7	0.0	0.0	30.7	0.0	0.0	0.0
				Copepoda - Cyclopoida Subtotal	***43.0***	***14.3***	***14.3***	***0.0***	***14.3***	***0.0***	***0.0***	***14.3***	***0.0***	***0.0***	***28.7***	***86.0***	***28.7***	***71.7***	***0.0***	***0.0***	***30.7***	***0.0***	***0.0***	***0.0***
Cladocera	Bosminidae	-	-	*Bosmina*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Chydoridae	-	-	*Eurycercus*	258.1	57.3	114.7	57.3	86.0	0.0	0.0	0.0	0.0	0.0	157.7	100.4	172.0	86.0	14.3	183.9	183.9	122.6	137.9	153.3
	Chydoridae	-	-	-	28.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Daphnidae	-	-	*Daphnia*	0.0	0.0	0.0	0.0	14.3	28.7	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Macrothricidae	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Cladocera Subtotal	***286.7***	***57.3***	***114.7***	***57.3***	***100.4***	***28.7***	***14.3***	***0.0***	***0.0***	***0.0***	***157.7***	***100.4***	***172.0***	***86.0***	***14.3***	***183.9***	***183.9***	***122.6***	***137.9***	***153.3***
Terrestrial	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				TOTAL CAPTURED	***2580.6***	***3053.8***	***1233.0***	***1390.7***	***1978.5***	***860.2***	***1261.6***	***1017.9***	***1333.3***	***1448.0***	***4487.5***	***10465.9***	***8071.7***	***6250.9***	***4903.2***	***1854.4***	***1992.3***	***1394.6***	***1946.4***	***1670.5***

Data represents organisms/m²

i/d = immature or damaged individuals

**These taxa were not included in the total density calculation or other data analysis.*

Environment Canada (2011) states that as nematodes and copepods are meiofauna, samples using 500 µm mesh will not be representative so should be excuded from analysis.

Cladocera (water fleas) are mobile, and were not considered permanent members of the benthos so were excluded form analysis.

The terrestrial organisms found in these samples were adult chironomids or midges which probably got into to sample during sieving.

Appendix 3.7-3. Lake Benthos Density and Taxonomic Results, Back River Project, 2011

Site					Giraffe Lake Deep					Goose Lake Neck					Goose Lake Central					Reference B Lake				
Date Sampled					11-Aug-11					7-Aug-11 and 14-Aug-11					7-Aug-11					8-Aug-11				
Depth (m)					5.8	5.8	5.8	5.8	5.8	3.5	3.5	3.5	3.5	3.5	5	5.4	5.2	5.2	5.2	4.8	4.8	4.8	4	4.7
Major Group	Family	Subfamily	Tribe	Genus	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5
Microturbellaria	Typhloplanidae	-	-	*Mesostoma*	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.7	0.0
				Microturbellaria Subtotal	***15.3***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***71.7***	***0.0***
Oligochaeta	Enchytraeidae	-	-	-	0.0	0.0	0.0	0.0	0.0	43.0	0.0	15.3	0.0	61.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Lumbriculidae	-	-	-	61.3	76.6	122.6	30.7	122.6	86.0	61.3	76.6	76.6	61.3	28.7	129.0	28.7	57.3	43.0	0.0	129.0	100.4	157.7	157.7
	Naididae	Tubificinae	-	-	0.0	61.3	46.0	30.7	0.0	14.3	15.3	15.3	46.0	0.0	143.4	28.7	100.4	172.0	157.7	0.0	43.0	57.3	114.7	57.3
				Oligochaeta Subtotal	***61.3***	***137.9***	***168.6***	***61.3***	***122.6***	***143.4***	***76.6***	***107.3***	***122.6***	***122.6***	***172.0***	***157.7***	***129.0***	***229.4***	***200.7***	***0.0***	***172.0***	***157.7***	***272.4***	***215.1***
Gastropoda	Valvatidae	-	-	*Valvata sincera*	0.0	0.0	0.0	0.0	0.0	57.3	30.7	107.3	30.7	76.6	86.0	258.1	200.7	157.7	86.0	0.0	0.0	0.0	0.0	0.0
				Gastropoda Subtotal	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***57.3***	***30.7***	***107.3***	***30.7***	***76.6***	***86.0***	***258.1***	***200.7***	***157.7***	***86.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
Bivalvia	Sphaeriidae	-	-	(i/d)	352.5	413.8	183.9	306.5	367.8	387.1	0.0	122.6	137.9	306.5	587.8	1175.6	587.8	659.5	845.9	415.8	258.1	372.8	401.4	358.4
		-	-	*Sphaerium*	15.3	0.0	0.0	0.0	0.0	43.0	0.0	0.0	15.3	0.0	28.7	57.3	57.3	43.0	28.7	0.0	14.3	0.0	28.7	0.0
		-	-	*Pisidium*	291.2	183.9	214.6	183.9	306.5	286.7	46.0	168.6	61.3	76.6	186.4	215.1	143.4	57.3	86.0	960.6	688.2	874.6	573.5	645.2
				Bivalvia Subtotal	***659.0***	***597.7***	***398.5***	***490.4***	***674.3***	***716.8***	***46.0***	***291.2***	***214.6***	***383.1***	***802.9***	***1448.0***	***788.5***	***759.9***	***960.6***	***1376.3***	***960.6***	***1247.3***	***1003.6***	***1003.6***
Hydracarina	-	-	-	-	46.0	15.3	61.3	0.0	122.6	14.3	0.0	30.7	61.3	30.7	0.0	14.3	28.7	14.3	14.3	43.0	71.7	186.4	28.7	71.7
				Hydracarina Subtotal	***46.0***	***15.3***	***61.3***	***0.0***	***122.6***	***14.3***	***0.0***	***30.7***	***61.3***	***30.7***	***0.0***	***14.3***	***28.7***	***14.3***	***14.3***	***43.0***	***71.7***	***186.4***	***28.7***	***71.7***
Ostracoda	-	-	-	-	30.7	0.0	0.0	0.0	15.3	186.4	168.6	321.8	183.9	245.2	845.9	573.5	401.4	0.0	315.4	0.0	0.0	86.0	114.7	401.4
				Ostracoda Subtotal	***30.7***	***0.0***	***0.0***	***0.0***	***15.3***	***186.4***	***168.6***	***321.8***	***183.9***	***245.2***	***845.9***	***573.5***	***401.4***	***0.0***	***315.4***	***0.0***	***0.0***	***86.0***	***114.7***	***401.4***
Notostraca	Triopsidae	-	-	*Lepidurus*	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Notostraca Subtotal	***15.3***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
Trichoptera	Limnephilidae	-	-	(i/d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0
		-	-	*Grensia praeterica*	30.7	30.7	0.0	0.0	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	14.3	28.7
				Trichoptera Subtotal	***30.7***	***30.7***	***0.0***	***0.0***	***15.3***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***14.3***	***0.0***	***0.0***	***14.3***	***14.3***	***28.7***
Diptera	Chironomidae	-	-	(pupa)	30.7	0.0	15.3	76.6	30.7	57.3	0.0	30.7	30.7	61.3	71.7	200.7	28.7	71.7	114.7	57.3	0.0	186.4	14.3	71.7
		Tanypodinae	Pentaneurini	(i/d)	0.0	0.0	46.0	0.0	0.0	43.0	0.0	0.0	0.0	0.0	0.0	28.7	0.0	43.0	14.3	0.0	14.3	0.0	0.0	0.0
				Ablabesmyia	30.7	15.3	15.3	15.3	61.3	114.7	76.6	76.6	153.3	76.6	86.0	329.7	43.0	129.0	143.4	0.0	43.0	71.7	0.0	71.7
				Thienemannimyia group	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	14.3	57.3	0.0
			Procladiini	*Procladius*	61.3	30.7	61.3	61.3	30.7	28.7	46.0	46.0	46.0	46.0	200.7	516.1	229.4	286.7	315.4	1046.6	903.2	1935.5	1333.3	1906.8
		Diamesinae	Protanypini	*Protanypus*	0.0	0.0	0.0	0.0	0.0	28.7	0.0	0.0	0.0	0.0	28.7	0.0	0.0	14.3	71.7	0.0	0.0	0.0	0.0	0.0
		Prodiamesinae		*Monodiamesa*	30.7	76.6	61.3	46.0	15.3	0.0	0.0	0.0	0.0	0.0	43.0	0.0	28.7	57.3	71.7	0.0	0.0	0.0	0.0	0.0
		Orthocladiinae	Orthocladiini	*Cricotopus/Orthocladius*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0
				Heterotanytarsus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.3	0.0	0.0	0.0	0.0	0.0	0.0	28.7	0.0	0.0	57.3	0.0
				Heterotrissocladius	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	129.0	172.0	114.7	71.7	71.7	0.0	0.0	0.0	0.0	28.7
				Hydrobaenus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Psectrocladius	107.3	245.2	275.9	260.5	521.1	229.4	199.2	567.0	337.2	827.6	372.8	530.5	215.1	415.8	874.6	229.4	200.7	415.8	272.4	86.0
				Zalutschia	15.3	76.6	15.3	15.3	76.6	0.0	0.0	0.0	0.0	0.0	43.0	86.0	57.3	28.7	57.3	0.0	0.0	0.0	0.0	0.0
		Chironominae	Chironomini	*Chironomus*	0.0	0.0	0.0	0.0	15.3	0.0	0.0	0.0	0.0	30.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Cladopelma	137.9	122.6	76.6	107.3	413.8	0.0	15.3	46.0	0.0	0.0	28.7	28.7	0.0	28.7	14.3	172.0	0.0	329.7	57.3	71.7
				Cryptochironomus	0.0	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.7	0.0	0.0	0.0	71.7	71.7	0.0	86.0	28.7
				Dicrotendipes	15.3	0.0	0.0	0.0	0.0	28.7	0.0	92.0	30.7	46.0	71.7	100.4	186.4	28.7	71.7	0.0	0.0	0.0	0.0	0.0
				Microtendipes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.7	71.7	57.3	71.7	0.0	28.7	28.7	114.7	57.3	0.0
				Pagastiella	199.2	321.8	199.2	291.2	429.1	0.0	15.3	15.3	0.0	61.3	57.3	100.4	57.3	57.3	14.3	0.0	0.0	0.0	0.0	0.0
				Polypedilum	0.0	0.0	0.0	0.0	0.0	516.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	86.0	0.0	129.0	71.7	172.0	114.7	0.0
				Sergenta	15.3	0.0	0.0	0.0	0.0	0.0	0.0	30.7	15.3	92.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	114.7	71.7	57.3
				Stictochironomus	582.4	643.7	689.7	567.0	1425.3	57.3	30.7	122.6	30.7	490.4	974.9	2107.5	1304.7	1118.3	1519.7	0.0	0.0	0.0	57.3	129.0
			Tanytarsini	(i/d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	14.3	28.7	14.3	0.0	0.0	0.0	0.0	114.7
				Cladotanytarsus	15.3	15.3	15.3	30.7	122.6	0.0	0.0	15.3	30.7	0.0	28.7	0.0	28.7	14.3	57.3	28.7	0.0	71.7	57.3	0.0
				Corynocera	30.7	0.0	30.7	46.0	61.3	0.0	229.9	30.7	30.7	61.3	329.7	243.7	272.4	186.4	114.7	989.2	1648.7	3828.0	1175.6	3340.5
				Micropsectra	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Micropsectra / Tanytarsus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0
				Paratanytarsus	0.0	0.0	0.0	0.0	15.3	989.2	597.7	1256.7	674.3	3325.7	573.5	831.5	702.5	587.8	917.6	28.7	0.0	28.7	57.3	0.0
				Tanytarsus	92.0	15.3	15.3	0.0	30.7	57.3	0.0	46.0	46.0	0.0	71.7	315.4	215.1	100.4	129.0	43.0	157.7	114.7	172.0	57.3
	Empididae	-	-	*Chelifera*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0
				Diptera Subtotal	***1364.0***	***1578.5***	***1517.2***	***1517.2***	***3249.0***	***2150.5***	***1210.7***	***2375.5***	***1440.6***	***5118.8***	***3139.8***	***5706.1***	***3555.6***	***3455.2***	***4602.2***	***2853.0***	***3154.1***	***7397.8***	***3641.6***	***5964.2***
				TOTAL BENTHOS	***2222.2***	***2360.2***	***2145.6***	***2069.0***	***4199.2***	***3268.8***	***1532.6***	***3233.7***	***2053.6***	***5977.0***	***5046.6***	***8157.7***	***5103.9***	***4616.5***	***6193.5***	***4272.4***	***4358.4***	***9089.6***	***5147.0***	***7684.6***
Non Macrobenthic Invertebrates*																								
Nematoda	-	-	-	-	0.0	0.0	0.0	0.0	0.0	71.7	15.3	0.0	15.3	15.3	57.3	86.0	86.0	114.7	71.7	0.0	0.0	14.3	0.0	0.0
				Nematoda Subtotal	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***71.7***	***15.3***	***0.0***	***15.3***	***15.3***	***57.3***	***86.0***	***86.0***	***114.7***	***71.7***	***0.0***	***0.0***	***14.3***	***0.0***	***0.0***
Copepoda - Calanoida	-	-	-	-	0.0	15.3	15.3	0.0	0.0	0.0	0.0	0.0	0.0	15.3	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	14.3	14.3
				Copepoda - Calanoida Subtotal	***0.0***	***15.3***	***15.3***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***15.3***	***0.0***	***14.3***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***14.3***	***14.3***
Copepoda - Cyclopoida	Cyclopidae	Cyclopinae	-	*Acanthocyclops*	0.0	15.3	0.0	0.0	0.0	71.7	0.0	0.0	15.3	30.7	129.0	258.1	86.0	28.7	43.0	0.0	86.0	57.3	57.3	0.0
				Copepoda - Cyclopoida Subtotal	***0.0***	***15.3***	***0.0***	***0.0***	***0.0***	***71.7***	***0.0***	***0.0***	***15.3***	***30.7***	***129.0***	***258.1***	***86.0***	***28.7***	***43.0***	***0.0***	***86.0***	***57.3***	***57.3***	***0.0***
Cladocera	Bosminidae	-	-	*Bosmina*	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Chydoridae	-	-	*Eurycercus*	137.9	122.6	137.9	153.3	92.0	0.0	0.0	15.3	0.0	15.3	0.0	0.0	0.0	0.0	0.0	57.3	215.1	243.7	28.7	272.4
	Chydoridae	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	57.3
	Daphnidae	-	-	*Daphnia*	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0	14.3
	Macrothricidae	-	-	-	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.7	172.0	86.0	0.0	57.3	0.0	0.0	0.0	0.0	0.0
				Cladocera Subtotal	***183.9***	***122.6***	***137.9***	***153.3***	***92.0***	***0.0***	***0.0***	***15.3***	***0.0***	***15.3***	***71.7***	***172.0***	***86.0***	***14.3***	***57.3***	***57.3***	***215.1***	***258.1***	***28.7***	***344.1***
Terrestrial	-	-	-	-	0.0	0.0	0.0	0.0	15.3	0.0	0.0	0.0	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				TOTAL CAPTURED	***2406.1***	***2513.4***	***2298.9***	***2222.2***	***4306.5***	***3412.2***	***1547.9***	***3249.0***	***2084.3***	***6053.6***	***5319.0***	***8688.2***	***5362.0***	***4774.2***	***6365.6***	***4329.7***	***4659.5***	***9419.4***	***5247.3***	***8043.0***

Data represents organisms/m²

i/d = immature or damaged individuals

**These taxa were not included in the total density calculation or other data analysis.*

Environment Canada (2011) states that as nematodes and copepods are meiofauna, samples using 500 µm mesh will not be representative so should be excuded from analysis.

Cladocera (water fleas) are mobile, and were not considered permanent members of the benthos so were excluded form analysis.

The terrestrial organisms found in these samples were adult chironomids or midges which probably got into to sample during sieving.

Appendix 3.7-4

Lake Benthos Richness and Diversity Results, Back River Project, 2011

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Appendix 3.7-4. Lake Benthos Richness and Diversity Results, Back River Project, 2011

Lake	Shallow or Deep	Date Sampled	Richness (families/sample)	Diversity (Simpson's Index)
Llama	Shallow	09-Aug-11	5	0.86
	Shallow	09-Aug-11	6	0.71
	Shallow	09-Aug-11	3	0.87
	Shallow	09-Aug-11	4	0.85
	Shallow	09-Aug-11	6	0.87
Llama	Deep	09-Aug-11	4	0.85
	Deep	09-Aug-11	7	0.90
	Deep	09-Aug-11	4	0.85
	Deep	09-Aug-11	4	0.84
	Deep	09-Aug-11	6	0.81
Umwelt	Shallow	10-Aug-11	6	0.89
	Shallow	10-Aug-11	6	0.89
	Shallow	10-Aug-11	5	0.80
	Shallow	10-Aug-11	4	0.81
	Shallow	10-Aug-11	4	0.88
Giraffe	Shallow	11-Aug-11	5	0.91
	Shallow	11-Aug-11	5	0.91
	Shallow	11-Aug-11	4	0.88
	Shallow	11-Aug-11	4	0.90
	Shallow	11-Aug-11	4	0.89
Giraffe	Deep	11-Aug-11	8	0.87
	Deep	11-Aug-11	6	0.85
	Deep	11-Aug-11	5	0.84
	Deep	11-Aug-11	4	0.84
	Deep	11-Aug-11	6	0.81
Goose Neck	Shallow	07-Aug-11	8	0.83
	Shallow	14-Aug-11	6	0.79
	Shallow	14-Aug-11	8	0.78
	Shallow	14-Aug-11	7	0.82
	Shallow	14-Aug-11	7	0.63
Goose Central	Shallow	07-Aug-11	6	0.89
	Shallow	07-Aug-11	7	0.88
	Shallow	07-Aug-11	7	0.88
	Shallow	07-Aug-11	7	0.87
	Shallow	07-Aug-11	8	0.85
Reference B	Shallow	08-Aug-11	3	0.79
	Shallow	08-Aug-11	5	0.78
	Shallow	08-Aug-11	7	0.75
	Shallow	08-Aug-11	8	0.84
	Shallow	08-Aug-11	7	0.72

Appendix 3.7-5

Stream Benthos Density and Taxonomic Results, Back River Project, 2011

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Appendix 3.7-5. Stream Benthos Density and Taxonomic Results, Back River Project, 2011

					Chair OF					Llama OF		Giraffe OF					Wolf Of					Goose OF				
					13-Aug-11					17-Aug-11		12-Aug-11					13-Aug-11					16-Aug-11				
Major Group	Family	Subfamily	Tribe	Genus	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5
Coelenterata	Hydridae	-	-	*Hydra*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	555.6	0.0
				Coelenterata Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**555.6**	**0.0**
Oligochaeta	Enchytraeidae	-	-	-	3.5	6.9	38.2	10.4	3.5	27.8	34.7	0.0	13.9	0.0	0.0	41.7	3.5	0.0	0.0	0.0	0.0	31.3	59.0	138.9	20.8	34.7
	Lumbriculidae	-	-	-	6.9	6.9	27.8	13.9	13.9	0.0	3.5	79.9	0.0	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.2	38.2	34.7	10.4	72.9
	Naididae	Naidinae	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.4	0.0	420.1	24.3	66.0	48.6	0.0	27.8	27.8	215.3	3.5
		Tubificinae	-	-	222.2	31.3	34.7	180.6	34.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Oligochaeta Subtotal	**232.6**	**45.1**	**100.7**	**204.9**	**52.1**	**27.8**	**38.2**	**79.9**	**13.9**	**10.4**	**0.0**	**111.1**	**3.5**	**420.1**	**24.3**	**66.0**	**48.6**	**69.4**	**125.0**	**201.4**	**246.5**	**111.1**
Gastropoda	Physidae	-	-	*Physa*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.1	0.0	0.0	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0	3.5	55.6	17.4	31.3
	Valvatidae	-	-	*Valvata sincera*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Gastropoda Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**45.1**	**0.0**	**0.0**	**0.0**	**13.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**3.5**	**55.6**	**17.4**	**31.3**
Hydracarina	-	-	-	-	93.8	180.6	69.4	218.8	156.3	666.7	111.1	69.4	41.7	41.7	27.8	31.3	3.5	166.7	6.9	0.0	0.0	62.5	145.8	27.8	0.0	0.0
				Hydracarina Subtotal	**93.8**	**180.6**	**69.4**	**218.8**	**156.3**	**666.7**	**111.1**	**69.4**	**41.7**	**41.7**	**27.8**	**31.3**	**3.5**	**166.7**	**6.9**	**0.0**	**0.0**	**62.5**	**145.8**	**27.8**	**0.0**	**0.0**
Ostracoda	-	-	-	-	277.8	48.6	191.0	555.6	20.8	0.0	13.9	277.8	361.1	222.2	250.0	55.6	6.9	694.4	34.7	6.9	59.0	444.4	194.4	253.5	312.5	111.1
				Ostracoda Subtotal	**277.8**	**48.6**	**191.0**	**555.6**	**20.8**	**0.0**	**13.9**	**277.8**	**361.1**	**222.2**	**250.0**	**55.6**	**6.9**	**694.4**	**34.7**	**6.9**	**59.0**	**444.4**	**194.4**	**253.5**	**312.5**	**111.1**
Collembola	Sminthuridae	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Collembola Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Ephemeroptera	Ameletidae	-	-	*Ameletus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Baetidae	-	-	*Baetis*	0.0	3.5	0.0	0.0	0.0	41.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Ephemerellidae	-	-	*Ephemerella*	3.5	3.5	3.5	0.0	6.9	472.2	31.3	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0	3.5	20.8	3.5	0.0	0.0	0.0	0.0
	Heptageniidae	-	-	*Heptagenia*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Ephemeroptera Subtotal	**3.5**	**6.9**	**3.5**	**0.0**	**6.9**	**513.9**	**31.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**6.9**	**0.0**	**3.5**	**20.8**	**3.5**	**0.0**	**0.0**	**0.0**	**0.0**
Plecoptera	Nemouridae	-	-	*Nemoura*	27.8	0.0	0.0	0.0	0.0	97.2	20.8	66.0	3.5	0.0	3.5	0.0	0.0	0.0	0.0	3.5	3.5	17.4	72.9	138.9	55.6	62.5
	Perlodidae	-	-	*Isoperla*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0
		-	-	*Skwala*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Plecoptera Subtotal	**27.8**	**0.0**	**0.0**	**0.0**	**0.0**	**97.2**	**20.8**	**66.0**	**3.5**	**0.0**	**3.5**	**0.0**	**0.0**	**0.0**	**0.0**	**3.5**	**3.5**	**17.4**	**72.9**	**142.4**	**55.6**	**62.5**
Trichoptera		-	-	(i/d)	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Brachycentridae	-	-	*Brachycentrus*	0.0	31.3	3.5	17.4	93.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Hydroptilidae	-	-	*Agraylea*	0.0	0.0	0.0	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	3.5	6.9	0.0	0.0	0.0	0.0	3.5	0.0
		-	-	*Oxyethira*	3.5	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Leptoceridae			*Ceraclea*	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-	-	*Mystacides*	0.0	0.0	0.0	10.4	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Limnephilidae	-	-	(i/d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0
				Limnephilus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0
		-	-	*Grensia praeterica*	10.4	0.0	0.0	3.5	13.9	0.0	10.4	6.9	0.0	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.3	0.0	0.0
	Phryganeidae	-	-	*Agrypnia*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Trichoptera Subtotal	**13.9**	**41.7**	**3.5**	**41.7**	**111.1**	**0.0**	**10.4**	**6.9**	**0.0**	**10.4**	**3.5**	**0.0**	**3.5**	**27.8**	**3.5**	**6.9**	**0.0**	**6.9**	**0.0**	**24.3**	**3.5**	**0.0**
Coleoptera	Dytiscidae	-	-	*Agabus*	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-	-	*Hydroporus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-	-	*Oreodytes*	0.0	10.4	0.0	3.5	3.5	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	3.5	0.0	0.0
	Haliplidae	-	-	*Haliplus*	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	0.0	0.0	0.0	0.0	0.0	31.3	3.5	0.0
				Coleoptera Subtotal	**0.0**	**13.9**	**0.0**	**3.5**	**10.4**	**0.0**	**0.0**	**17.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**27.8**	**0.0**	**0.0**	**3.5**	**0.0**	**0.0**	**34.7**	**3.5**	**0.0**
Hemiptera	Corixidae	-	-	(i/d)	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Hemiptera Subtotal	**0.0**	**0.0**	**0.0**	**3.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Diptera	Chironomidae	-	-	(pupa)	0.0	0.0	0.0	69.4	0.0	83.3	41.7	27.8	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	27.8
		Tanypodinae	Pentaneurini	*Ablabesmyia*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.7	0.0
				Thienemannimyia group	503.5	180.6	277.8	100.7	128.5	111.1	27.8	163.2	76.4	41.7	17.4	0.0	27.8	420.1	27.8	34.7	76.4	66.0	72.9	166.7	48.6	3.5
			Procladiini	*Procladius*	0.0	0.0	17.4	97.2	0.0	13.9	27.8	38.2	0.0	149.3	6.9	13.9	3.5	0.0	0.0	0.0	0.0	3.5	10.4	0.0	6.9	62.5
		Diamesinae	Diamesini	*Diamesa*	0.0	0.0	0.0	0.0	0.0	2805.6	319.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Potthastia longimana group	0.0	0.0	0.0	0.0	10.4	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	27.8	6.9	3.5	10.4	27.8	0.0	55.6	0.0	0.0
		Orthocladiinae	Orthocladiini	(i/d)	0.0	0.0	0.0	0.0	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	55.6	0.0	0.0
				Acamptocladius dentolatens	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Cricotopus/Orthocladius	0.0	0.0	0.0	0.0	10.4	2194.4	388.9	197.9	0.0	27.8	0.0	41.7	0.0	55.6	10.4	45.1	48.6	222.2	27.8	222.2	191.0	55.6
				Corynoneura	0.0	0.0	17.4	0.0	0.0	0.0	13.9	0.0	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Eukiefferiella	0.0	6.9	34.7	6.9	27.8	680.6	125.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Euryhapsis	3.5	17.4	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	0.0	0.0	17.4	3.5	0.0	0.0	0.0	0.0
				Heterotanytarsus	0.0	6.9	0.0	6.9	10.4	0.0	17.4	27.8	0.0	0.0	0.0	13.9	3.5	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Data represents organisms/m²

i/d = immature or damaged individuals

**These taxa were not included in the total density calculation or other data analysis.*

Environment Canada (2011) states that as nematodes and copepods are meiofauna, samples using 500µm mesh will not be representative so should be excuded from analysis.

Cladocera (water fleas) are mobile, and were not considered permanent members of the benthos so were excluded form analysis.

The terrestrial organisms found in these samples were adult chironomids or midges which probably got into to sample during sieving.

Appendix 3.7-5. Stream Benthos Density and Taxonomic Results, Back River Project, 2011

					Chair OF					Llama OF		Giraffe OF					Wolf Of					Goose OF				
					13-Aug-11					17-Aug-11		12-Aug-11					13-Aug-11					16-Aug-11				
Major Group	Family	Subfamily	Tribe	Genus	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5
Diptera	Chironomidae	Orthocladiinae	Orthocladiini	*Heterotrissocladius*	0.0	0.0	17.4	69.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	0.0	0.0	0.0
				Parakiefferiella	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	13.9	27.8	0.0	0.0	0.0	0.0	86.8	0.0	0.0	194.4
				Psectrocladius	27.8	0.0	0.0	0.0	3.5	13.9	0.0	368.1	13.9	86.8	69.4	27.8	6.9	0.0	0.0	0.0	3.5	145.8	83.3	59.0	20.8	3.5
				Pseudosmittia	0.0	0.0	0.0	0.0	72.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	6.9	6.9	6.9	0.0	0.0	6.9	0.0	0.0
				Tvetenia	0.0	0.0	34.7	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Zalutschia	0.0	0.0	0.0	0.0	3.5	0.0	138.9	0.0	41.7	166.7	69.4	69.4	0.0	0.0	0.0	0.0	0.0	27.8	27.8	0.0	0.0	55.6
		Chironominae	Chironomini	(i/d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	0.0	0.0
				Chironomus	31.3	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Cryptochironomus	3.5	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4	0.0	0.0	3.5	10.4
				Demicryptochironomus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	3.5	83.3	3.5	0.0	0.0	0.0	3.5	3.5	0.0	0.0
				Dicrotendipes	0.0	3.5	10.4	69.4	83.3	0.0	0.0	34.7	41.7	17.4	0.0	6.9	10.4	861.1	90.3	79.9	69.4	0.0	0.0	3.5	3.5	0.0
				Parachironomus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	454.9	52.1	27.8
				Polypedilum	430.6	3.5	225.7	2152.8	24.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	364.6	0.0	0.0	0.0	111.1	0.0	0.0	17.4	0.0
				Saetheria	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.3	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0
				Stictochironomus	0.0	0.0	0.0	6.9	0.0	0.0	3.5	0.0	0.0	0.0	3.5	0.0	13.9	156.3	0.0	0.0	0.0	52.1	107.6	6.9	13.9	364.6
			Pseudochironomini	*Pseudochironomus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Tanytarsini	(i/d)	3.5	0.0	0.0	69.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Cladotanytarsus	111.1	3.5	86.8	972.2	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Micropsectra	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Micropsectra / Tanytarsus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Paratanytarsus	0.0	3.5	0.0	0.0	45.1	0.0	13.9	2506.9	322.9	527.8	125.0	618.1	3.5	253.5	17.4	13.9	24.3	267.4	204.9	111.1	322.9	500.0
				Rheotanytarsus	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Stempellina	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Tanytarsus	138.9	0.0	34.7	1041.7	0.0	69.4	0.0	55.6	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0	13.9	0.0	55.6	3.5	0.0	27.8
	Ceratopogonidae	Ceratopogoninae	-	*Bezzia*	0.0	0.0	0.0	3.5	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	10.4	34.7	13.9	3.5
			-	*Culicoides*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Empididae	-	-	(pupa)	3.5	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-	-	*Chelifera*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4	3.5	3.5	0.0	13.9
		-	-	*Clinocera*	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Muscidae	-	-	*Limnophora*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.3	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Simulidae	-	-	(pupa)	0.0	0.0	0.0	0.0	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Tipulidae	-	-	*Limnophila*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0
		-	-	*Tipula*	104.2	34.7	31.3	55.6	0.0	27.8	41.7	17.4	0.0	0.0	0.0	3.5	27.8	0.0	0.0	0.0	27.8	20.8	31.3	111.1	38.2	3.5
				Diptera Subtotal	**1361.1**	**260.4**	**791.7**	**4729.2**	**465.3**	**6041.7**	**1163.2**	**3479.2**	**510.4**	**1107.6**	**291.7**	**850.7**	**114.6**	**2416.7**	**170.1**	**184.0**	**302.1**	**972.2**	**756.9**	**1326.4**	**770.8**	**1354.2**
				TOTAL BENTHOS	**2010.4**	**597.2**	**1159.7**	**5756.9**	**822.9**	**7347.2**	**1388.9**	**4041.7**	**930.6**	**1392.4**	**576.4**	**1062.5**	**131.9**	**3760.4**	**239.6**	**270.8**	**437.5**	**1576.4**	**1298.6**	**2066.0**	**1965.3**	**1670.1**
Non Macrobenthic Invertebrates*																										
Nematoda	-	-	-	-	34.7	52.1	24.3	3.5	34.7	69.4	34.7	27.8	13.9	0.0	0.0	0.0	34.7	229.2	0.0	6.9	31.3	170.1	111.1	232.6	118.1	0.0
				Nematoda Subtotal	**34.7**	**52.1**	**24.3**	**3.5**	**34.7**	**69.4**	**34.7**	**27.8**	**13.9**	**0.0**	**0.0**	**0.0**	**34.7**	**229.2**	**0.0**	**6.9**	**31.3**	**170.1**	**111.1**	**232.6**	**118.1**	**0.0**
Copepoda - Cyclopoida	Cyclopidae	Cyclopinae	-	*Acanthocyclops*	444.4	38.2	208.3	763.9	66.0	0.0	69.4	194.4	125.0	55.6	13.9	69.4	10.4	416.7	24.3	10.4	27.8	166.7	31.3	27.8	34.7	27.8
	Ergasilidae	-	-	*Ergasilus*	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	0.0	0.0	0.0
				Copepoda - Cyclopoida Subtotal	**444.4**	**38.2**	**208.3**	**763.9**	**66.0**	**0.0**	**72.9**	**194.4**	**125.0**	**55.6**	**13.9**	**69.4**	**10.4**	**416.7**	**24.3**	**10.4**	**27.8**	**166.7**	**59.0**	**27.8**	**34.7**	**27.8**
Cladocera	Chydoridae	-	-	*Eurycercus*	121.5	62.5	114.6	802.1	62.5	69.4	45.1	90.3	48.6	111.1	17.4	13.9	3.5	656.3	17.4	20.8	24.3	118.1	118.1	55.6	0.0	201.4
	Chydoridae	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	138.9	27.8	0.0	0.0	13.9	52.1	27.8	6.9	3.5	3.5	138.9	194.4	111.1	17.4	0.0
	Macrothricidae	-	-	-	250.0	3.5	34.7	416.7	0.0	0.0	0.0	250.0	222.2	305.6	250.0	97.2	0.0	55.6	3.5	3.5	0.0	194.4	222.2	222.2	17.4	555.6
				Cladocera Subtotal	**371.5**	**66.0**	**149.3**	**1218.8**	**62.5**	**69.4**	**45.1**	**479.2**	**298.6**	**416.7**	**267.4**	**125.0**	**55.6**	**739.6**	**27.8**	**27.8**	**27.8**	**451.4**	**534.7**	**388.9**	**34.7**	**756.9**
Terrestrial	-	-	-	-	13.9	0.0	3.5	17.4	3.5	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish	Gasterosteidae	-	-	*Pungitius pungitius* (Ninespine Stickleback)	0.0	0.0	17.4	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				TOTAL CAPTURED	2875.0	753.5	1562.5	7763.9	989.6	7500.0	1541.7	4743.1	1368.1	1864.6	857.6	1256.9	232.6	5145.8	291.7	316.0	524.3	2364.6	2003.5	2715.3	2152.8	2454.9

Data represents organisms/m²

i/d = immature or damaged individuals

**These taxa were not included in the total density calculation or other data analysis.*

Environment Canada (2011) states that as nematodes and copepods are meiofauna, samples using 500 µm mesh will not be representative so should be excuded from analysis.

Cladocera (water fleas) are mobile, and were not considered permanent members of the benthos so were excluded form analysis.

The terrestrial organisms found in these samples were adult chironomids or midges which probably got into to sample during sieving.

Appendix 3.7-5. Stream Benthos Density and Taxonomic Results, Back River Project, 2011

					Propellor OF					Propellor D/S					Ref. B OF				
					16-Aug-11					15-Aug-11					17-Aug-11				
Major Group	Family	Subfamily	Tribe	Genus	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5
Coelenterata	Hydridae	-	-	*Hydra*	0.0	0.0	0.0	0.0	83.3	10.4	13.9	0.0	13.9	13.9	0.0	0.0	0.0	0.0	0.0
				Coelenterata Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**83.3**	**10.4**	**13.9**	**0.0**	**13.9**	**13.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Oligochaeta	Enchytraeidae	-	-	-	0.0	0.0	0.0	0.0	0.0	3.5	0.0	6.9	3.5	13.9	55.6	10.4	6.9	27.8	83.3
	Lumbriculidae	-	-	-	3.5	3.5	0.0	3.5	0.0	6.9	3.5	20.8	17.4	17.4	59.0	27.8	31.3	52.1	72.9
	Naididae	Naidinae	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9	13.9	27.8	0.0	0.0	0.0	0.0
		Tubificinae	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	281.3	142.4	66.0	55.6	215.3
				Oligochaeta Subtotal	**3.5**	**3.5**	**0.0**	**3.5**	**0.0**	**10.4**	**3.5**	**27.8**	**34.7**	**45.1**	**423.6**	**180.6**	**104.2**	**135.4**	**371.5**
Gastropoda	Physidae	-	-	*Physa*	0.0	0.0	0.0	0.0	0.0	72.9	41.7	45.1	27.8	138.9	0.0	0.0	0.0	0.0	0.0
	Valvatidae	-	-	*Valvata sincera*	55.6	118.1	3.5	97.2	340.3	0.0	3.5	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0
				Gastropoda Subtotal	**55.6**	**118.1**	**3.5**	**97.2**	**340.3**	**72.9**	**45.1**	**45.1**	**41.7**	**138.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Hydracarina	-	-	-	-	0.0	3.5	0.0	83.3	128.5	34.7	62.5	72.9	145.8	34.7	86.8	62.5	166.7	0.0	138.9
				Hydracarina Subtotal	**0.0**	**3.5**	**0.0**	**83.3**	**128.5**	**34.7**	**62.5**	**72.9**	**145.8**	**34.7**	**86.8**	**62.5**	**166.7**	**0.0**	**138.9**
Ostracoda	-	-	-	-	114.6	250.0	361.1	138.9	777.8	107.6	66.0	62.5	197.9	83.3	27.8	62.5	0.0	27.8	55.6
				Ostracoda Subtotal	**114.6**	**250.0**	**361.1**	**138.9**	**777.8**	**107.6**	**66.0**	**62.5**	**197.9**	**83.3**	**27.8**	**62.5**	**0.0**	**27.8**	**55.6**
Collembola	Sminthuridae	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8
				Collembola Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**27.8**
Ephemeroptera	Ameletidae	-	-	*Ameletus*	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0
	Baetidae	-	-	*Baetis*	0.0	3.5	0.0	0.0	27.8	3.5	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0
	Ephemerellidae	-	-	*Ephemerella*	0.0	38.2	3.5	55.6	152.8	38.2	31.3	6.9	31.3	38.2	3.5	0.0	0.0	0.0	0.0
	Heptageniidae	-	-	*Heptagenia*	0.0	0.0	0.0	0.0	0.0	10.4	10.4	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0
				Ephemeroptera Subtotal	**0.0**	**41.7**	**3.5**	**55.6**	**180.6**	**55.6**	**41.7**	**6.9**	**76.4**	**38.2**	**3.5**	**0.0**	**0.0**	**0.0**	**0.0**
Plecoptera	Nemouridae	-	-	*Nemoura*	6.9	3.5	0.0	3.5	6.9	24.3	10.4	6.9	45.1	52.1	0.0	3.5	3.5	0.0	0.0
	Perlodidae	-	-	*Isoperla*	0.0	0.0	0.0	0.0	0.0	10.4	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-	-	*Skwala*	0.0	0.0	0.0	0.0	0.0	0.0	10.4	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0
				Plecoptera Subtotal	**6.9**	**3.5**	**0.0**	**3.5**	**6.9**	**34.7**	**38.2**	**10.4**	**48.6**	**52.1**	**0.0**	**3.5**	**3.5**	**0.0**	**0.0**
Trichoptera		-	-	(i/d)	0.0	0.0	0.0	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Brachycentridae	-	-	*Brachycentrus*	3.5	17.4	10.4	232.6	55.6	0.0	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Hydroptilidae	-	-	*Agraylea*	10.4	59.0	10.4	41.7	27.8	10.4	6.9	10.4	34.7	6.9	0.0	0.0	0.0	0.0	0.0
		-	-	*Oxyethira*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Leptoceridae			*Ceraclea*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-	-	*Mystacides*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0
	Limnephilidae	-	-	(i/d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Limnephilus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-	-	*Grensia praeterica*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Phryganeidae	-	-	*Agrypnia*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0
				Trichoptera Subtotal	**13.9**	**76.4**	**20.8**	**274.3**	**111.1**	**10.4**	**10.4**	**17.4**	**48.6**	**6.9**	**0.0**	**6.9**	**0.0**	**0.0**	**0.0**
Coleoptera	Dytiscidae	-	-	*Agabus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-	-	*Hydroporus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0
		-	-	*Oreodytes*	0.0	3.5	3.5	3.5	0.0	0.0	0.0	0.0	6.9	24.3	0.0	0.0	0.0	0.0	0.0
	Haliplidae	-	-	*Haliplus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.2
				Coleoptera Subtotal	**0.0**	**3.5**	**3.5**	**3.5**	**0.0**	**0.0**	**0.0**	**0.0**	**6.9**	**24.3**	**0.0**	**0.0**	**3.5**	**0.0**	**38.2**
Hemiptera	Corixidae	-	-	(i/d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Hemiptera Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Diptera	Chironomidae	-	-	(pupa)	0.0	31.3	0.0	0.0	55.6	3.5	10.4	6.9	17.4	13.9	0.0	27.8	0.0	0.0	0.0
		Tanypodinae	Pentaneurini	*Ablabesmyia*	55.6	31.3	0.0	55.6	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Thienemannimyia group	20.8	125.0	62.5	55.6	76.4	187.5	156.3	232.6	319.4	350.7	55.6	34.7	66.0	3.5	17.4
			Procladiini	*Procladius*	31.3	27.8	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	66.0	6.9	6.9	128.5
		Diamesinae	Diamesini	*Diamesa*	3.5	10.4	6.9	17.4	13.9	0.0	3.5	0.0	0.0	0.0	59.0	0.0	0.0	0.0	0.0
				Potthastia longimana group	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Orthocladiinae	Orthocladiini	(i/d)	0.0	0.0	3.5	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Acamptocladius dentolatens	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Cricotopus/Orthocladius	441.0	770.8	454.9	1423.6	1208.3	66.0	145.8	111.1	204.9	97.2	0.0	3.5	0.0	55.6	0.0
				Corynoneura	0.0	0.0	0.0	27.8	55.6	0.0	0.0	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0
				Eukiefferiella	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Euryhapsis	0.0	0.0	0.0	0.0	0.0	125.0	208.3	100.7	441.0	114.6	0.0	0.0	0.0	0.0	0.0
				Heterotanytarsus	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Data represents organisms/m²

i/d = immature or damaged individuals

**These taxa were not included in the total density calculation or other data analysis.*

Environment Canada (2011) states that as nematodes and copepods are meiofauna, samples using 500µm mesh will not be representative so should be excuded from analysis.

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Major Group	Family	Subfamily	Tribe	Genus	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5	Rep-1	Rep-2	Rep-3	Rep-4	Rep-5
Diptera	Chironomidae	Orthocladiinae	Orthocladiini	*Heterotrissocladius*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Parakiefferiella	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0
				Psectrocladius	524.3	1270.8	281.3	277.8	423.6	3.5	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0
				Pseudosmittia	27.8	0.0	0.0	0.0	0.0	0.0	0.0	6.9	13.9	0.0	0.0	0.0	0.0	0.0	0.0
				Tvetenia	0.0	31.3	0.0	0.0	27.8	0.0	0.0	6.9	17.4	0.0	0.0	0.0	0.0	0.0	0.0
				Zalutschia	586.8	55.6	27.8	166.7	347.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Chironominae	Chironomini	(i/d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Chironomus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8
				Cryptochironomus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4	3.5	0.0	20.8
				Demicryptochironomus	0.0	0.0	0.0	0.0	0.0	6.9	0.0	3.5	0.0	0.0	0.0	0.0	0.0	6.9	3.5
				Dicrotendipes	90.3	111.1	17.4	229.2	243.1	0.0	6.9	191.0	201.4	253.5	0.0	3.5	31.3	0.0	3.5
				Parachironomus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Polypedilum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.3	38.2	0.0	0.0	336.8
				Saetheria	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Stictochironomus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	17.4	6.9	0.0	27.8
			Pseudochironomini	*Pseudochironomus*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8
			Tanytarsini	(i/d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0
				Cladotanytarsus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.6	208.3	27.8	309.0	1114.6
				Micropsectra	0.0	0.0	3.5	0.0	0.0	0.0	0.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Micropsectra / Tanytarsus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Paratanytarsus	597.2	708.3	159.7	586.8	708.3	0.0	6.9	34.7	86.8	27.8	0.0	0.0	0.0	0.0	0.0
				Rheotanytarsus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	0.0	0.0	0.0
				Stempellina	0.0	0.0	0.0	0.0	0.0	38.2	10.4	0.0	27.8	41.7	0.0	0.0	0.0	0.0	0.0
				Tanytarsus	83.3	0.0	0.0	0.0	0.0	13.9	20.8	20.8	69.4	0.0	0.0	173.6	55.6	83.3	333.3
	Ceratopogonidae	Ceratopogoninae	-	*Bezzia*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	149.3	357.6	59.0	31.3	180.6
			-	*Culicoides*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	0.0	3.5
	Empididae	-	-	(pupa)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-	-	*Chelifera*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		-	-	*Clinocera*	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Muscidae	-	-	*Limnophora*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0
	Simulidae	-	-	(pupa)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Tipulidae	-	-	*Limnophila*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	0.0	0.0	0.0	10.4
		-	-	*Tipula*	0.0	3.5	0.0	0.0	0.0	6.9	0.0	6.9	27.8	17.4	3.5	0.0	0.0	0.0	0.0
				Diptera Subtotal	**2489.6**	**3177.1**	**1017.4**	**2840.3**	**3229.2**	**458.3**	**569.4**	**739.6**	**1468.8**	**916.7**	**385.4**	**972.2**	**284.7**	**496.5**	**2236.1**
				TOTAL BENTHOS	**2684.0**	**3677.1**	**1409.7**	**3500.0**	**4857.6**	**795.1**	**850.7**	**982.6**	**2083.3**	**1354.2**	**927.1**	**1288.2**	**562.5**	**659.7**	**2868.1**
Non Macrobenthic Invertebrates*																			
Nematoda	-	-	-	-	59.0	194.4	27.8	27.8	55.6	59.0	142.4	45.1	121.5	55.6	256.9	576.4	291.7	645.8	753.5
				Nematoda Subtotal	**59.0**	**194.4**	**27.8**	**27.8**	**55.6**	**59.0**	**142.4**	**45.1**	**121.5**	**55.6**	**256.9**	**576.4**	**291.7**	**645.8**	**753.5**
Copepoda - Cyclopoida	Cyclopidae	Cyclopinae	-	*Acanthocyclops*	55.6	0.0	0.0	0.0	27.8	38.2	0.0	41.7	69.4	27.8	83.3	281.3	361.1	83.3	388.9
	Ergasilidae	-	-	*Ergasilus*	0.0	10.4	3.5	0.0	20.8	0.0	0.0	0.0	0.0	0.0	27.8	83.3	83.3	55.6	0.0
				Copepoda - Cyclopoida Subtotal	**55.6**	**10.4**	**3.5**	**0.0**	**48.6**	**38.2**	**0.0**	**41.7**	**69.4**	**27.8**	**111.1**	**364.6**	**444.4**	**138.9**	**388.9**
Cladocera	Chydoridae	-	-	*Eurycercus*	34.7	222.2	0.0	0.0	83.3	0.0	3.5	0.0	45.1	0.0	0.0	0.0	0.0	0.0	3.5
	Chydoridae	-	-	-	222.2	305.6	111.1	0.0	0.0	0.0	0.0	6.9	13.9	27.8	0.0	0.0	0.0	27.8	0.0
	Macrothricidae	-	-	-	444.4	194.4	27.8	0.0	55.6	0.0	0.0	6.9	0.0	0.0	0.0	27.8	27.8	55.6	55.6
				Cladocera Subtotal	**701.4**	**722.2**	**138.9**	**0.0**	**138.9**	**0.0**	**3.5**	**13.9**	**59.0**	**27.8**	**0.0**	**27.8**	**27.8**	**83.3**	**59.0**
Terrestrial	-	-	-	-	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	3.5	0.0	3.5	0.0
Fish	Gasterosteidae	-	-	*Pungitius pungitius* (Ninespine Stickleback)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				TOTAL CAPTURED	3500.0	4604.2	1579.9	3527.8	5100.7	892.4	1000.0	1083.3	2333.3	1465.3	1295.1	2260.4	1326.4	1531.3	4069.4

Data represents organisms/m²

i/d = immature or damaged individuals

**These taxa were not included in the total density calculation or other data analysis.*

Environment Canada (2011) states that as nematodes and copepods are meiofauna, samples using 500 µm mesh will not be representative so should be excuded from analysis.

Cladocera (water fleas) are mobile, and were not considered permanent members of the benthos so were excluded form analysis.

The terrestrial organisms found in these samples were adult chironomids or midges which probably got into to sample during sieving.

Appendix 3.7-6

Stream Benthos Richness and Diversity Results, Back River Project, 2011

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Appendix 3.7-6. Stream Benthos Richness and Diversity Results, Back River Project, 2011

Stream	Replicate	Date Sampled	Richness (families/sample)	Diversity (Simpson's Index)
Chair OF	1	13-Aug-11	12	0.57
	2	13-Aug-11	13	0.75
	3	13-Aug-11	9	0.54
	4	13-Aug-11	14	0.33
	5	13-Aug-11	12	0.63
Llama OF	1	17-Aug-11	8	0.32
	2	17-Aug-11	9	0.34
Giraffe OF	1	12-Aug-11	12	0.28
	2	12-Aug-11	5	0.55
	3	12-Aug-11	7	0.34
	4	12-Aug-11	5	0.55
	5	12-Aug-11	7	0.35
Wolf OF	1	13-Aug-11	6	0.52
	2	13-Aug-11	7	0.54
	3	13-Aug-11	6	0.50
	4	13-Aug-11	6	0.48
	5	13-Aug-11	7	0.57
Goose OF	1	16-Aug-11	10	0.56
	2	16-Aug-11	11	0.66
	3	16-Aug-11	15	0.65
	4	16-Aug-11	12	0.75
	5	16-Aug-11	10	0.35
Propellor OF	1	16-Aug-11	7	0.14
	2	16-Aug-11	12	0.25
	3	16-Aug-11	7	0.41
	4	16-Aug-11	10	0.33
	5	16-Aug-11	11	0.52
Propellor D/S	1	15-Aug-11	15	0.64
	2	15-Aug-11	13	0.54
	3	15-Aug-11	13	0.43
	4	15-Aug-11	19	0.51
	5	15-Aug-11	13	0.54
Ref. B OF	1	17-Aug-11	10	0.80
	2	17-Aug-11	9	0.68
	3	17-Aug-11	8	0.75
	4	17-Aug-11	6	0.48
	5	17-Aug-11	10	0.48

Appendix 3.7-7

Lake and Stream Benthos Sorting Efficiencies, Back River Project, 2011

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Appendix 3.7-7. Lake and Stream Benthos Sorting Efficiencies, Back River Project, 2011

Lake, Depth and Replicate	% Sorting Efficiency
Llama Lake - shallow – C	[1-(0/(86+0))]*100 = 100
Giraffe Lake - shallow - B	[1-(1/(130+1))]*100 = 99.2
Goose Lake Central – deep - D	[1-(3/(333+3))]*100 = 99.1
Reference B Lake - shallow - B	[1-(4/(325+4))]*100 = 98.8
	Average efficiency - 99.3%
Stream and Replicate	
Propellor D/S – A	[1-(4/(257+4))]*100 = 98.5
Wolf OF – E	[1-(3/(151+3))]*100 = 98.1
Chair OF – E	[1-(6/(285+6))]*100 = 97.9
Giraffe OF – B	[1-(8/(394+8))]*100 = 98.0
	Average efficiency - 98.1%

% Sorting Efficiency = [1-(# in QA/AC re-sort / (# sorted originally + # QA/QC resort))] 100*

Appendix V6-3C

Back River Project: 2012 Freshwater Baseline Report

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Sabina Gold & Silver Corp.

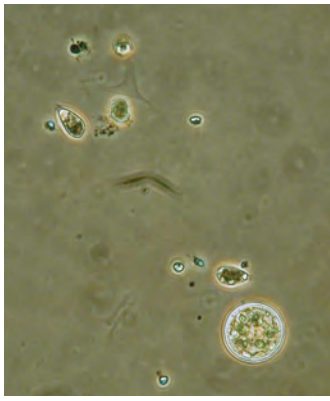
BACK RIVER PROJECT
2012 Freshwater Baseline Report

Sabina
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Rescan™ Engineers & Scientists

December 2012

BACK RIVER PROJECT
2012 FRESHWATER BASELINE REPORT

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Vancouver, British Columbia

Executive Summary

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Executive Summary

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. For 2012, Sabina contracted Rescan Environmental Services (Rescan) to conduct a comprehensive baseline program that covered the geographical area of the Goose Property, the George Property, and a Marine Laydown Area located on the southern part of Bathurst Inlet.

The 2012 baseline program was designed around potential infrastructure and known deposits at the Goose Property, the George Property, and the Marine Laydown Area along Bathurst Inlet. It was assumed that access from the Marine Laydown Area to George and Goose properties would be by winter road, and that access between the George and Goose properties would also be by winter road.

This report presents the results from the freshwater portion of the 2012 baseline program. The freshwater baseline program included the sampling of lakes and streams in the Goose and George properties and at two far-field reference locations.

The 2012 freshwater baseline program involved collecting information for the following: lake water quality and physical limnology (under-ice and open water), lake sediment quality, lake phytoplankton, lake zooplankton, lake benthos, stream water quality (freshet, summer and fall), stream sediment quality, stream periphyton, and stream benthos. The program included collecting samples from lakes and streams in areas that could potentially be influenced by the development of known deposits and proposed infrastructure. A reference lake and two reference streams, located well away from known deposits and proposed infrastructure, were also sampled.

A total of 20 lakes (24 sampling sites) and 16 streams (17 sampling sites) were sampled in the Goose and George areas in 2012. Lakes sampled in the Goose Property included Moby, Gander, Pond 19, Big, Rabbit, Fox, Echo, Rascal, Giraffe, Goose and Propellor. Lakes sampled in the George Property included Lower Long, Fold, George, Lytle, Occurrence, Sleigh, Dragon, Komatic and Reference C. Streams sampled in the Goose Property were Moby Outflow, Gander River, Pond 19 Outflow, Chair Watershed Outflow, Llama Watershed Outflow, Echo Watershed Outflow, Giraffe Watershed Outflow, Wolf Watershed Outflow, Goose Watershed Outflow, Propellor Watershed Outflow and Reference B Outflow. Streams sampled within the George Property were George Outflow, Sleigh Outflow, Dragon Outflow, Komatic Inflow and Reference C Outflow.

Lakes tended to be stratified in April and well mixed in August. Dissolved oxygen concentrations at bottom depths were below CCME minimum dissolved oxygen guidelines at most lakes sampled, with lakes in the George Property tending to be below guidelines at all depths in August. Lakes in the study area had slightly acidic to slightly basic pH, with Rabbit Lake and Rascal Lake in August being slightly below the CCME guideline of 6.5. Generally, lakes sampled had low hardness and conductivity. Reference Lake C in April and August and Dragon and Komatic lakes in April had higher hardness values and could be classified as moderately hard. Nutrients were generally low at all lake sampling sites, particularly bioavailable forms, and lake trophic status was usually ultra-oligotrophic to oligotrophic.

All lakes except Lower Long had naturally occurring waters that were higher than CCME guidelines in at least one sample for at least one of the following metals: total aluminum, total cadmium, total copper, total iron, total lead and total nickel. Average concentrations were naturally greater than CCME guidelines for at least one parameter out of aluminum, cadmium, copper, iron and lead at over two

thirds of lakes. The soft waters meant lower hardness-dependent CCME guideline concentrations, which were in some cases lower than achievable analytical detection limits (e.g., for cadmium at Big Lake, Rabbit Lake and Propellor Lake). Goose Property lakes tended to have higher naturally occurring metal concentrations compared to George Property Lakes.

Lake sediments had high concentrations of arsenic, cadmium, chromium, copper, and zinc that often were greater than their respective CCME ISQG. All lakes except Pond 19 had at least one sample greater than the CCME ISQGs for at least one metal, with most lakes having naturally elevated arsenic or copper. Over half of the sampled lakes had average lake sediment arsenic concentrations that were greater than CCME PELs, with the highest average concentrations 16.5 and 20.3 times the PEL (found at Fold and Komatic lakes, within the George Property).

Phytoplankton communities were made up of Chlorophyceae (green algae), Myxophyceae (cyanobacteria), Cryptophyceae (a class of flagellated algae), Bacillariophyceae (diatoms) and Chrysophyceae (golden algae) with compositions and densities varying between April and August samples, and between lakes. Zooplankton communities were mainly composed of rotifers and crustaceans. Rotifers tended to be more dominant in Goose Property lakes, while crustaceans tended to be more dominant in George Property lakes. Benthic communities at all lake sites were dominated by dipterans (true flies) and bivalves (small to tiny clams from the family Sphaeriidae), and densities varied between lakes.

Echo Outflow in the Goose Property was dry during the August sampling, and many of the other streams in both the Goose Property and George Property had dry or underground sections. Streams in August had dissolved oxygen concentrations below 10.0 mg/L, with a third of the sampling sites below the CCME minimum dissolved oxygen guideline for the protection of freshwater aquatic life for early life stages (9.5 mg/L).

Streams and rivers in the study area had slightly acidic to slightly basic pH. The lowest pH values observed were outside of the CCME guideline range for freshwater aquatic health (pH range 6.5 to 9), at Chair Outflow in June (6.1), and Echo Outflow in June and Sept (6.0). Hardness, conductivity and total dissolved solids were low in most streams, although considerably higher in Llama OF and also Reference C Outflow during August and September (moderately hard). Nitrate, nitrite and ammonia concentrations were generally low, often near or below detection limits, with most sites reflecting ultra-oligotrophic to oligotrophic conditions.

All streams except Dragon Outflow and Reference C Outflow had naturally occurring waters that were greater than CCME guidelines in at least one sample for at least one of the following metals: total aluminum, total cadmium, total copper, total iron and total nickel. Average concentrations were greater than CCME guidelines for at least one metal parameter at most streams. Parameters where average stream concentrations were naturally greater than guidelines included aluminum (two streams), cadmium (most streams), copper (almost a third of streams), iron (one stream) and nickel (one stream).

Goose Property streams tended to have higher naturally occurring metal concentrations compared to George Property streams. The small Echo Outflow in the Goose Property had the greatest number of naturally elevated parameters (aluminum, cadmium and copper) with average aluminum concentrations 22 times higher and average cadmium concentrations 18 times higher than the CCME guidelines.

Stream sediments had metal concentrations that were similar or lower than in lake sediments, and in some cases were greater than the CCME ISQGs. Over half of the streams had at least one sediment sample that was naturally greater than the CCME ISQG for at least one of the following metals; arsenic,

chromium and copper. Arsenic was the most commonly naturally elevated metal, with almost half of streams having average concentrations that were greater than ISQGs. Arsenic was the metal most naturally elevated in sediments, and concentrations were above the CCME PEL at Propellor Outflow, George Outflow and Dragon Outflow with the maximum concentration being 3.4 times the PEL.

Periphyton communities were dominated by cyanobacteria and diatoms, and densities varied between streams. Benthos communities were mainly composed of chironomid dipterans (nonbiting midges), and densities also varied between streams with highest densities at Pond 19 Outflow (Goose Property) and Sleigh Outflow (George Property).

A comprehensive summary table of results from all lake and streams sampled in 2012 is included in this report.

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BACK RIVER PROJECT
2012 FRESHWATER BASELINE REPORT

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Appendix 4-1. Summary of 2012 Freshwater Baseline Results for Lakes

Appendix 4-2. Summary of 2012 Freshwater Baseline Results for Streams

Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

°C	Degrees Celsius
ALS	ALS Environmental Services
Autotrophic	Organisms which manufacture their food, usually via photosynthesis
$CaCO_3$	Calcium carbonate
CCME	Canadian Council of Ministers of the Environment
Chl *a*	Chlorophyll *a*
DDI	Double de-ionized water
DGPS	Differential Global Positioning System
EZD	Euphotic Zone Depth
Heterotrophic	Organisms unable to synthesize their own food, e.g., animals and fungi
IDW	Inverse Distance Weighting
IF	Inflow
ISQG	Interim Sediment Quality Guideline
NTU	Nephelometric Turbidity Unit
OF	Outflow
PEL	Probable Effects Level
QA/QC	Quality Assurance and Quality Control
RDL	Realized Detection Limit
RPD	Relative Percent Difference
sp.	Refers to a single species in a genus
spp.	Refers to multiple species within a genus
Thermocline	A section of the water column where the temperature changes rapidly with depth
TIN	Triangular Irregular Network
TKN	Total Kjeldahl Nitrogen
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
TOC	Total Organic Carbon
WAD Cyanide	Weak Acid Dissociable Cyanide

1. Introduction

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1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. Exploration programs were run out of both the Goose and George camps in 2012 (Figure 1-1).

For 2012, Sabina contracted Rescan Environmental Services (Rescan 2011; Rescan 2012a) to conduct a comprehensive baseline program that covered the geographical area of the Goose Property, the George Property, and a Marine Laydown Area located on the southern part of Bathurst Inlet. The following components were included in the 2012 baseline program:

- Meteorology
- Air Quality & Dust
- Noise
- Hydrology & Bathymetry
- Freshwater Water Quality, Sediment Quality, Aquatic Biology
- Freshwater Fish & Fish Habitat
- Marine Water Quality, Sediment Quality, Aquatic Biology
- Marine Fish & Fish Habitat
- Wildlife (Terrestrial & Marine)
- Wildlife DNA Study (Grizzly Bear & Wolverine)
- Ecosystem Mapping
- Vegetation & Wetlands (including Rare Plants)
- Soils & Terrain
- Country Foods
- Archaeology
- Socio-Economics
- Land Use
- Metal Leaching/Acid Rock Drainage (ML/ARD)

The 2012 baseline program was designed around potential infrastructure and known deposits at the Goose Property, the George Property, and the Marine Laydown Area along Bathurst Inlet. It was assumed that access from the Marine Laydown Area to George and Goose properties would be by winter road, and that access between the George and Goose properties would also be by winter road.

This report presents the results from the freshwater portion of the 2012 baseline program. The freshwater baseline program included the sampling of lakes and streams in the Goose and George properties and at two far-field reference locations.



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Back River Project Location

Figure 1-1

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For lakes, the sampling program included bathymetry, physical limnology, water quality, sediment quality, phytoplankton communities, zooplankton communities and benthic macroinvertebrate communities.

For streams, the sampling program included temperature and dissolved oxygen, water quality, sediment quality, periphyton communities and benthic macroinvertebrate communities.

Chapter 2 of this report presents the methods, and Chapter 3 of this report presents the results. Chapter 4 presents a summary of all results, and all raw data collected are included as appendices to this report.

2. Methods

2. Methods

2.1 SAMPLING DESIGN

In 2012, baseline data were collected from lakes and streams within the Goose and George Properties. Sampling sites were selected based on the proposed infrastructure and known deposits as shown in Figure 2.1-1. A reference lake (George Property) and two reference streams (Goose and George Properties) well away from potential infrastructure were also sampled. Two years of baseline data are already available for the reference lake associated with the Goose Property, Reference Lake B (Rescan 2011; Rescan 2012a).

The following components were sampled as part of the 2012 freshwater baseline program.

Lakes

- Bathymetry
- Physical Limnology
- Water Quality
- Sediment Quality
- Phytoplankton Communities
- Zooplankton Communities
- Benthic Macroinvertebrate Communities

Streams

- Water Quality
- Temperature And Dissolved Oxygen
- Sediment Quality
- Periphyton Communities
- Benthic Macroinvertebrate Communities

The sampling locations for lakes and streams are shown in Figure 2.1-1 and presented in Tables 2.1-1 and 2.1-2. The dates when each component was sampled are provided in Tables 2.1-3 and 2.1-4, and sampling details are provided in Table 2.1-5.

Sampling was conducted during April (under-ice) and August (open-water) of 2012 at lakes, and during June (freshet), August (summer), and September (fall) of 2012 at streams. Overall 24 lakes and 17 streams were sampled in total.

Lakes were selected that could be affected by proposed infrastructure (Figure 2.1-1). Table 2.1-6 outlines the rationale for each lake site. Within each lake, sampling locations were selected either where historical data existed, or in the deepest section in the lake, or in a spatially significant location (i.e., a central location where water from multiple inflows mix). April sampling occurred near the middle of the lake, or in the middle of any obvious basins as estimated by the topography if no bathymetric information or prior sampling history was available. August sampling locations were moved when new bathymetric information collected in July found deeper or more suitable sites.

Table 2.1-1. Sampling Locations in Lakes, Back River Project, 2012

Watershed	Lake Site Name	Abbreviated Name	April		August	
			Easting	Northing	Easting	Northing
Goose Area						
Moby	Moby Lake	Moby	419608	7267004	419683	7267187
Gander	Gander Lake	Gander	424020	7261516	424915	7261016
Big	Pond 19	Pond 19	430324	7265782	430338	7265844
Big	Big Lake	Big	426647	7269386	425421	7269247
Llama	Rabbit Lake	Rabbit	431916	7265216	431382	7265621
Llama	Fox Lake	Fox	431051	7266506	431248	7266944
Echo	Echo Lake	Echo	432425	7268344	432401	7268312
Wolf	Rascal Lake	Rascal	434056	7267445	434107	7267369
Giraffe	Giraffe Lake North	Giraffe North	432210	7272642	same as winter	
Giraffe	Giraffe Lake South	Giraffe South	432709	7271906	432730	7271819
Goose	Goose Lake Neck	Goose Neck	432944	7270323	same as winter	
Goose	Goose Lake Central	Goose Central	433887	7270990	same as winter	
Goose	Goose Lake Tail	Goose Tail	434645	7271418	434487	7271355
Propellor	Propellor Lake	Propellor	435154	7274437	same as winter	
George Area						
Long	Lower Long Lake	Lower Long	387165	7316913	same as winter	
George	Fold Lake	Fold	388780	7314053	same as winter	
George	George Lake Central	George Central	388063	7313739	388076	7313844
George	George Lake South	George South	388271	7313310	388274	7313299
George	Lytle Lake	Lytle	386924	7313881	386867	7314138
George	Occurrence Lake	Occurrence	387540	7313175	387692	7313112
George	Sleigh Lake	Sleigh	387945	7312652	388005	7312627
George	Dragon Lake	Dragon	390729	7310736	same as winter	
George	Komatic Lake	Komatic	391575	7308605	same as winter	
Reference C	Reference Lake C	Reference C	395127	7336790	395766	7336279

Notes:

April sampling at the Goose Lake Central and George Lake Central sites were moved by approximately 75 m to avoid ice airstrips.

All co-ordinates are UTM Zone 13N.

PROJECT #0833-002 GIS # BAC-01-027 January 14 2013

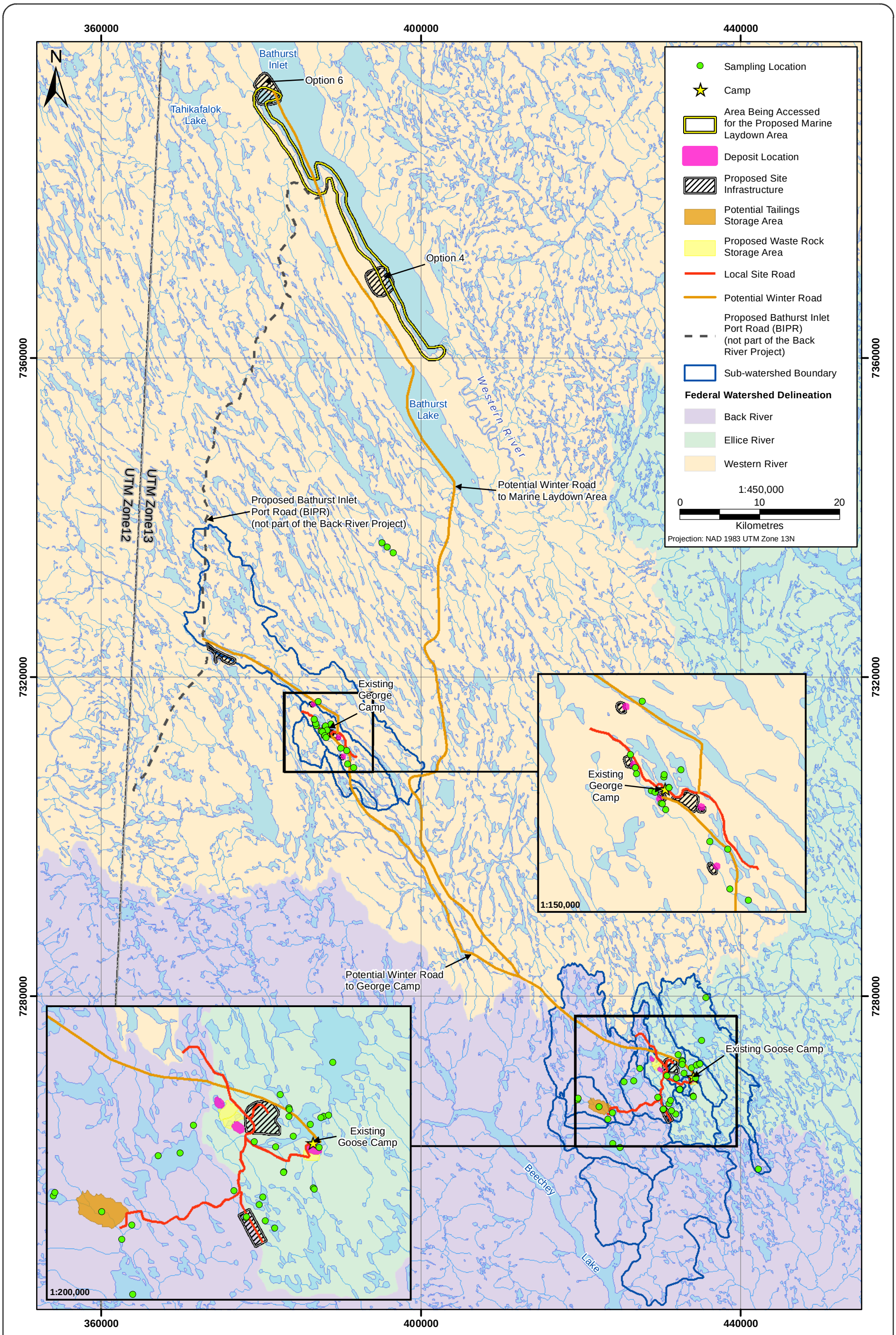


Figure 2.1-1

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Overview of Lake and Stream Sampling Locations, Back River Project, 2012

Figure 2.1-1

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Table 2.1-2. Sampling Locations in Streams, Back River Project, 2012

Watershed	Stream Site Name	Abbreviated Name	Name Used on Field Sheets, Workplan etc.	June		August		September	
				Easting	Northing	Easting	Northing	Easting	Northing
Goose Area									
Moby	Moby Outflow	Moby OF	Mn-01 OF	422563	7266158	422297	7266127	422367	7266117
Moby	Gander Inflow	Gander IF	Mn-02 OF	423350	7264244	423413	7264584	423413	7264456
Swan	Gander River Upstream	Gander US	Mn-02 US	423952	7265362	423968	7265386	423925	7265342
Big	Pond 19 Outflow	Pond 19 OF	-	429629	7267368	429650	7267296	429637	7267316
Chair	Chair Watershed Outflow	Chair OF	-	427380	7270929	427385	7270934	427382	7270928
Llama	Llama Watershed Outflow	Llama OF	-	430778	7270008	430776	7270012	430785	7270001
Echo	Echo Watershed Outflow	Echo OF	-	431993	7269678	431972	7269728	431985	7269715
Giraffe	Giraffe Watershed Outflow	Giraffe OF	-	432743	7271454	432709	7271427	432779	7271448
Wolf	Wolf Watershed Outflow	Wolf OF	-	434364	7269670	434379	7269696	434366	7269664
Goose	Goose Watershed Outflow	Goose OF	-	434904	7271495	434908	7271500	434853	7271453
Propellor	Propellor Watershed Outflow	Propellor OF	-	435684	7279797	435671	7279808	435705	7279836
Reference B	Reference B Outflow	Reference B OF	-	442556	725779	442226	7258310	442547	7257779
George Area									
George	George Outflow	George OF	-	386695	7314655	386671	7314688	386657	7314585
George	Sleigh Outflow	Sleigh OF	-	388153	7312405	388141	7312386	388489	7312024
George	Dragon Outflow	Dragon OF	-	390003	7311042	389983	7311054	389996	7311036
George	Komatic Inflow	Komatic IF	-	391021	7309005	390823	7309071	390909	7309035
Reference C	Reference C Outflow	Reference C OF	-	396595	7335509	396532	7335544	396543	7335549

Notes:

Echo OF was completely dry during August sampling.

All co-ordinates are UTM Zone 13N.

Table 2.1-3. Sampling Dates for Lakes, Back River Project, 2012

Watershed	Site	Bathymetry	Water Quality and Limnology		Sediment Quality	August Aquatic Biology		
			April	August	August	Phytoplankton	Zooplankton	Benthos
Goose Area								
Moby	Moby	nc	10-Apr	22-Aug	nc	nc	nc	nc
Gander	Gander	15-Jul, 16-Jul, and 18-Jul	10-Apr	18-Aug	18-Aug	18-Aug	18-Aug	18-Aug
Big	Pond 19	nc	10-Apr	21-Aug	21-Aug	nc	nc	21-Aug
Big	Big	17-Jul	10-Apr	16-Aug	16-Aug	16-Aug	16-Aug	16-Aug
Llama	Rabbit	18-Jul	10-Apr	15-Aug	15-Aug	15-Aug	15-Aug	15-Aug
Llama	Fox	13-Jul and 17-Jul	10-Apr	20-Aug	20-Aug	20-Aug	20-Aug	20-Aug
Echo	Echo	nc	12-Apr	17-Aug	17-Aug	nc	nc	nc
Wolf	Rascal	nc	11-Apr	15-Aug	15-Aug	nc	nc	15-Aug
Giraffe	Giraffe North	13-Jul	11-Apr	19-Aug	19-Aug	nc	nc	19-Aug
Giraffe	Giraffe South	13-Jul	11-Apr	19-Aug	19-Aug	19-Aug	19-Aug	19-Aug*
Goose	Goose Neck	nc	11-Apr	14-Aug	14-Aug	14-Aug	14-Aug	14-Aug
Goose	Goose Central	nc	11-Apr	17-Aug	17-Aug	17-Aug	17-Aug	17-Aug
Goose	Goose Tail	nc	11-Apr	18-Aug	18-Aug	nc	nc	nc
Propellor	Propellor	nc	12-Apr	21-Aug	21-Aug	nc	nc	21-Aug
George Area								
Long	Lower Long	nc	13-Apr	21-Aug	21-Aug	21-Aug	21-Aug	21-Aug
George	Fold	nc	15-Apr	19-Aug	19-Aug	19-Aug	19-Aug	19-Aug
George	George Central	10-Jul	13-Apr	18-Aug	18-Aug	18-Aug	18-Aug	18-Aug
George	George South	10-Jul	13-Apr	18-Aug	18-Aug	nc	nc	17-Aug
George	Lytle	12-Jul	15-Apr	23-Aug	23-Aug	23-Aug	23-Aug	23-Aug
George	Occurrence	7-Jul and 9-Jul	15-Apr	21-Aug	21-Aug	21-Aug	21-Aug	21-Aug
George	Sleigh	9-Jul	15-Apr	22-Aug	22-Aug	22-Aug	22-Aug	22-Aug
George	Dragon	nc	15-Apr	20-Aug	20-Aug	20-Aug	20-Aug	20-Aug
George	Komatic	nc	13-Apr	20-Aug and 21-Aug	20-Aug	20-Aug	21-Aug	21-Aug
Reference C	Reference C	8-Jul	13-Apr	22-Aug	22-Aug	22-Aug	22-Aug	22-Aug

Notes:

nc = not collected

April sampling at the central Goose and George Lake sites were moved by approximately 75 m to avoid ice airstrips.

** Could only collect four benthos samples at Giraffe South site due to sediment type.*

Table 2.1-4. Sampling Dates for Streams, Back River Project, 2012

Watershed	Site	Name Used on Field Sheets, etc.	Water Quality			Sediment Quality	August Aquatic Biology	
			June	August	September	August	Periphyton	Benthos
Goose Area								
Moby	Moby OF	Mn-01 OF	12-Jun	12-Aug	18-Sep	12-Aug	12-Aug	12-Aug
Moby	Gander IF	Mn-02 OF	12-Jun	11-Aug	18-Sep	11-Aug	11-Aug	11-Aug
Swan	Gander US	Mn-02 US	12-Jun	11-Aug	18-Sep	11-Aug	11-Aug	11-Aug
Big	Pond 19 OF	-	12-Jun	13-Aug	18-Sep	13-Aug	13-Aug	13-Aug*
Chair	Chair OF	-	12-Jun	12-Aug	18-Sep	13-Aug	12-Aug	13-Aug
Llama	Llama OF	-	12-Jun	8-Aug	18-Sep	nc	8-Aug	nc
Echo	Echo OF	-	13-Jun	nc	18-Sep	nc	nc	nc
Giraffe	Giraffe OF	-	13-Jun	8-Aug	19-Sep	8-Aug	8-Aug	8-Aug
Wolf	Wolf OF	-	12-Jun	7-Aug	18-Sep	7-Aug	8-Aug	7-Aug
Goose	Goose OF	-	13-Jun	7-Aug	19-Sep	7-Aug	9-Aug	7-Aug
Propellor	Propellor OF	-	12-Jun	9-Aug	17-Sep	9-Aug	9-Aug	9-Aug
Reference B	Reference B OF	-	12-Jun	10-Aug	17-Sep	10-Aug	10-Aug	10-Aug
George Area								
George	George OF	-	13-Jun	5-Aug	19-Sep	5-Aug	5-Aug	5-Aug
George	Sleigh OF	-	13-Jun	5-Aug	19-Sep	5-Aug	5-Aug	5-Aug
George	Dragon OF	-	13-Jun	5-Aug	19-Sep	5-Aug	5-Aug	5-Aug
George	Komatic IF	-	13-Jun	6-Aug	19-Sep	6-Aug	6-Aug^	6-Aug
Reference C	Reference C OF	-	13-Jun	6-Aug	19-Sep	6-Aug	6-Aug	6-Aug

Notes:

Echo OF was completely dry during August sampling.

nc = data could not be collected at these sites due to either low water levels, lack of fine sediments, or unsuitable sediment at the site.

** Only two benthos samples could be collected due to low water levels and flow.*

^ Periphyton was collected using a modified method at Komatic due to the absense of rocks.

Table 2.1-5. Sampling Details for Lakes and Streams, Back River Project, 2012

Monitoring Parameter	Sampling Frequency	Sampling Replication	Sampling Equipment	Sampling Dates/Timing
LAKES				
Winter Physical Limnology				
Dissolved oxygen/temperature profile	1 x	n=1	ODO Probe	April
Summer Physical Limnology				
Dissolved oxygen/temperature profile; Secchi depth	1 x	n=1	ODO Probe	August
Winter Lake Water Quality				
Physical, cyanides, total & dissolved metals, nutrients and total organic carbon	1 x	n=1 at 1 m below the ice and at 1.5 m to 2 m above the water-sediment interface in lake sites deeper than approximately 6 m, + 20% replication	Modified 2.5 L Niskin bottle; preservatives	April
Summer Lake Water Quality				
Physical, cyanides, total & dissolved metals, nutrients and total organic carbon	1 x	n=1 at 1 m depth and at mid depth in lake sites deeper than approximately 6 m), + 20% replication. Surface grabs at lake sites shallower than 2 m.	5 L GO-FLO bottle; preservatives	August
Lake Sediment Quality				
Physical, nutrients, cyanide, and metals	1 x	n=3, each replicate was from a single grab	Ekman Grab	August
Phytoplankton				
Biomass (as chlorophyll *a*)	1 x	n=3 at 1 m below surface	5 L GO-FLO bottle; filtration with 0.45 µm filters	April, August
Abundance and taxonomy	1 x	April, n=1 at 1 m below surface; August n=3 at 1 m below surface	5 L GO-FLO bottle; Lugols solution to preserve	April, August
Zooplankton				
Abundance and taxonomy	1 x	n=3 horizontal tows at 30 cm depth where lake site was <2 m depth, oblique tows where lake site was 2 m to 6 m depth, or vertical hauls where lake site was <6 m depth from approximately 1.5 m above the water sediment interface	120 µm mesh with a 30 cm mouth diameter; with General Oceanics flow meter attached to calculate volume filtered	August
Lake Benthos				
Density and taxonomy	1 x	n=5, each sample was a composite samples of three grabs	Ekman grab and 500 µm seive bucket; formalin to preserve	August
STREAMS				
Stream Water Quality				
Dissolved oxygen and temperature	1 x	n=1	ODO Probe, CTD	August, September
Physical, cyanides, total & dissolved metals, nutrients and total organic carbon	3 x	n=2	grab samples; preservatives	June, August, September
Stream Sediment Quality				
Physical, nutrients, cyanide, metals	1 x	n=3	Ekman sampler where possible, alternatively bowl and spoon	August
Periphyton				
Biomass (as chlorophyll *a*)	1 x	n=3, periphyton collected from 4.5 cm diameter circle templates; periphyton from six circles from a single rock were pooled and then split in half for biomass and density/taxonomy samples	4.5 cm diameter template and scrubber; filtration with 0.45 µm filters	August
Density and taxonomy	1 x		4.5 cm diameter template and scrubber; Lugols solution to preserve	August
Stream Benthos				
Density and taxonomy	1 x	n=5; each a composite of three Ekman grabs	Hess sampler; 500 µm seive bucket; formalin to preserve	August

Table 2.1-6. Sampling Rationale for Lakes, Back River Project, 2012

Watershed	Lake Site Name	Summer Max Depth (m)	Sampling Program	Reason for Site Selection in Early 2012
Goose Area				
Moby	Moby Lake	14.8	WQ, UIP	Upstream of TSF Alternative 1
Gander	Gander Lake	2.4	Bath, WQ, SQ, UIP, OWP, Z, B	Large lake in same watershed as proposed Tailings Storage Facilities alternatives
Big	Pond 19	1.5	WQ, SQ, B	Under proposed Tailings Facility Prefered alternative
Big	Big Lake	5.0	Bath, WQ, SQ, UIP, OWP, Z, B	Large lake in same watershed as Proposed Tailings Facilities alternatives
Llama	Rabbit Lake	3.6	Bath, WQ, SQ, OWP, Z, B	Lake that could be influenced by flow from proposed nearby development
Llama	Fox Lake	5.8	Bath, WQ, SQ, UIP, OWP, Z, B	Lake that could be influenced by flow from proposed nearby development
Echo	Echo Lake	0.4	WQ, SQ	Lake upstream of the Echo deposit
Wolf	Rascal Lake	2.8	WQ, SQ, UIP, B	Lake that could be influenced by flow from proposed nearby development
Giraffe	Giraffe Lake North	3.7	Bath, WQ, SQ, UIP, B	Lake that could be influenced by flow from proposed nearby development (shallow site)
Giraffe	Giraffe Lake South	7.7	Bath, WQ, SQ, UIP, OWP, Z, B	Lake that could be influenced by flow from proposed nearby development (deep site)
Goose	Goose Lake Neck	3.0	WQ, SQ, UIP, OWP, Z, B	Downstream of deposits and near future proposed Project activities
Goose	Goose Lake Central	4.7	WQ, SQ, UIP, OWP, Z, B	Downstream of deposits and near future proposed Project activities
Goose	Goose Lake Tail	2.8	WQ, SQ, UIP	Downstream of deposits and near future proposed Project activities
Propellor	Propellor Lake	7.8	WQ, SQ, UIP B	Lake downstream of watersheds with proposed developments
George Area				
Long	Lower Long Lake	5.2	WQ, SQ, UIP, OWP, Z, B	Lake near potential underground development
George	Fold Lake	9.8	WQ, SQ, UIP, OWP, Z, B	Lake near potential underground development
George	George Lake Central	14.5	Bath, WQ, SQ, UIP, OWP, Z, B	Lake near potential underground development
George	George Lake South	3.0	Bath, WQ, SQ, B	Lake near potential underground development
George	Lytle Lake	1.4	Bath, WQ, SQ, OWP, Z, B	Lake near potential underground development
George	Occurrence Lake	1.5	Bath, WQ, SQ, OWP, Z, B	Lake near potential underground development
George	Sleigh Lake	1.5	Bath, WQ, SQ, OWP, Z, B	Lake near potential underground development
George	Dragon Lake	3.4	WQ, SQ, UIP, OWP, Z, B	Lake near potential underground development
George	Komatic Lake	7.0	WQ, SQ, UIP, OWP, Z, B	Lake near potential underground development
Reference C	Reference Lake C	35.0	Bath, WQ, SQ, UIP, OWP, Z, B	Reference lake away from potential development

Notes:

Bath = bathymetry; WQ = water quality and limnology, SQ = sediment quality; UIP = under-ice phytoplankton; OWP= open-water phytoplankton; Z = zooplankton; B = benthos

Sampling locations in streams were selected to be on the outflows of the major watersheds and lakes in the area, and in areas upstream and downstream of proposed infrastructure (Figure 2.1-1). At a local scale, sites were chosen to be close to hydrometric stations and in areas of laminar flow to avoid suspended sediments.

Figures 2.1-2 and 2.1-3 present sampling locations within the Goose and George Properties. Arrows show the direction of water flow. Note that the stream locations are shown at their August sampling site, which in some cases differed from water quality collection sites in June and September due to the flow and water level requirements of biological sampling. Figures 2.1-4 through to 2.1-14 show sampling locations on lakes with known bathymetry.

2.2 BATHYMETRY

2.2.1 Field Data Collection

Bathymetric surveys of ten lakes were undertaken in July 2012. Lakes surveyed in the Goose area were Gander Lake, Big Lake, Fox Lake, Rabbit Lake and Giraffe Lake. Lakes surveyed in the George area were George Lake, Lytle Lake, Occurrence Lake, Sleigh Lake and Reference Lake C. Bathymetric maps for the surveyed lakes are shown in Figures 2.1-3 through to 2.1-13.

The surveys consisted of two parts:

1. The collection of continuous depth measurements along perpendicular and perimeter transects on the lake and pond surfaces using Differential Global Positioning System (DGPS) and Garmin depth sounder; and
2. Establishing on-land benchmarks via DGPS surveys of the lake shorelines.

A Trimble PF Power Differential Global Positioning System (DGPS) was used for positioning during the depth survey, and a Garmin depth sounder and a Trimble TSC1 datalogger were used to collect and store the depth data in electronic files. The DGPS and sounder were mounted on the boat for surveys along the lake surfaces (Plate 2.2-1).

Depth surveys were carried out by navigating a course of regular spaced transects across the width of each lake, followed by a longitudinal transect through the long-axis of the lake (i.e., e-line). A hand-held GPS, pre-loaded with transect tracks, was used to maintain the correct course with the boat. An example of a typical track is shown in Plate 2.2-2 for Occurrence Lake. Manual survey methods (entering single-point measurements manually) were used along shorelines and in areas too shallow for reliable depth readings.

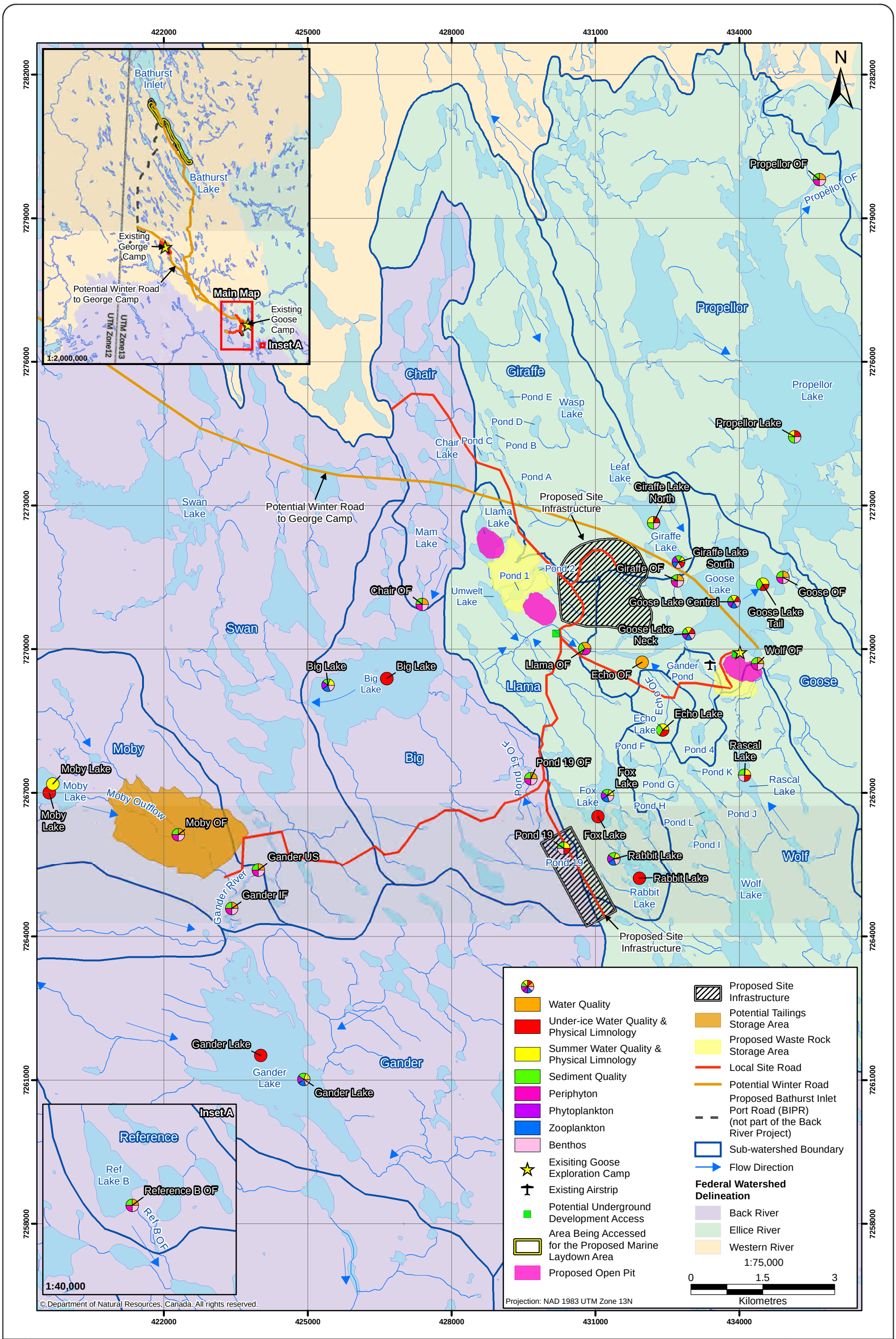
2.2.2 Map Creation

To create bathymetric contours, the depth data (saved as .ssf files) were converted into shapefiles using GPS Pathfinder Office. Outlier points were screened for accuracy and removed from the dataset based on whether the difference in depth between the closest surveyed location and distance to surface was largely different from the outlier point. This was done to account for sampling errors associated with boat movement (i.e., pitch and roll of the boat).

A Triangular Irregular Network (TIN) model was then created using the surveyed depth locations to model lake morphology. To smooth out the results, locations and depths were then taken from the TIN and interpolated into a surface raster using an inverse distance weighting (IDW) approach. The IDW interpolation method uses the assumption that all predicted values within the surface will be influenced more by the measured values that are closest to it. The interpolated surface raster was then converted into bathymetric contours (line features) to be used for the mapping of all ten lakes.

Results are presented in sampling maps in Methods section, complete with morphometric characteristics. Note these maps provide bathymetry to help illustrate the freshwater data collected, and are not intended for engineering use.

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Figure 2.1-2

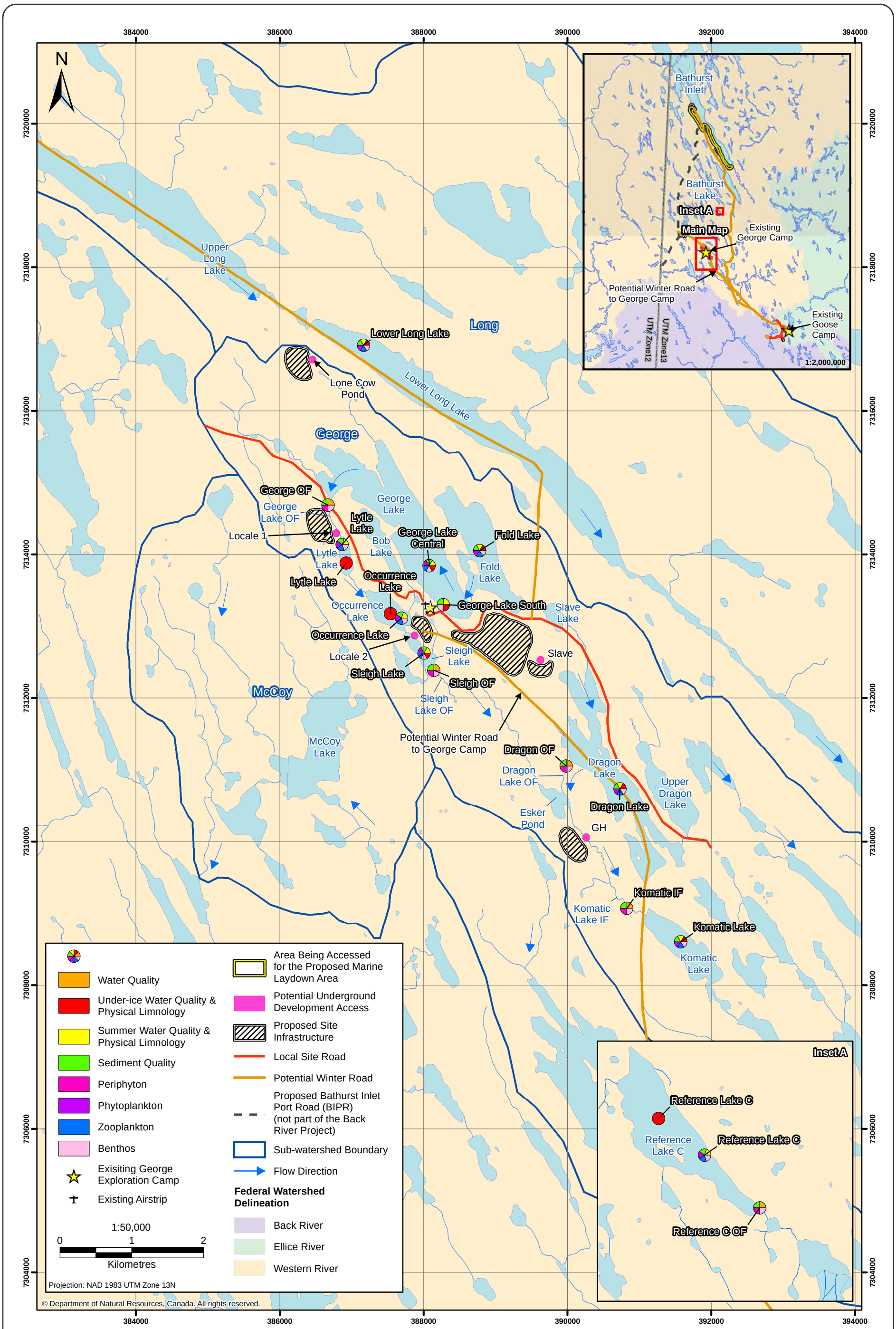
Sabina GOLD & SILVER CORP

Lake and Stream Sampling Locations within the Goose Property, Back River Project, 2012

Figure 2.1-2

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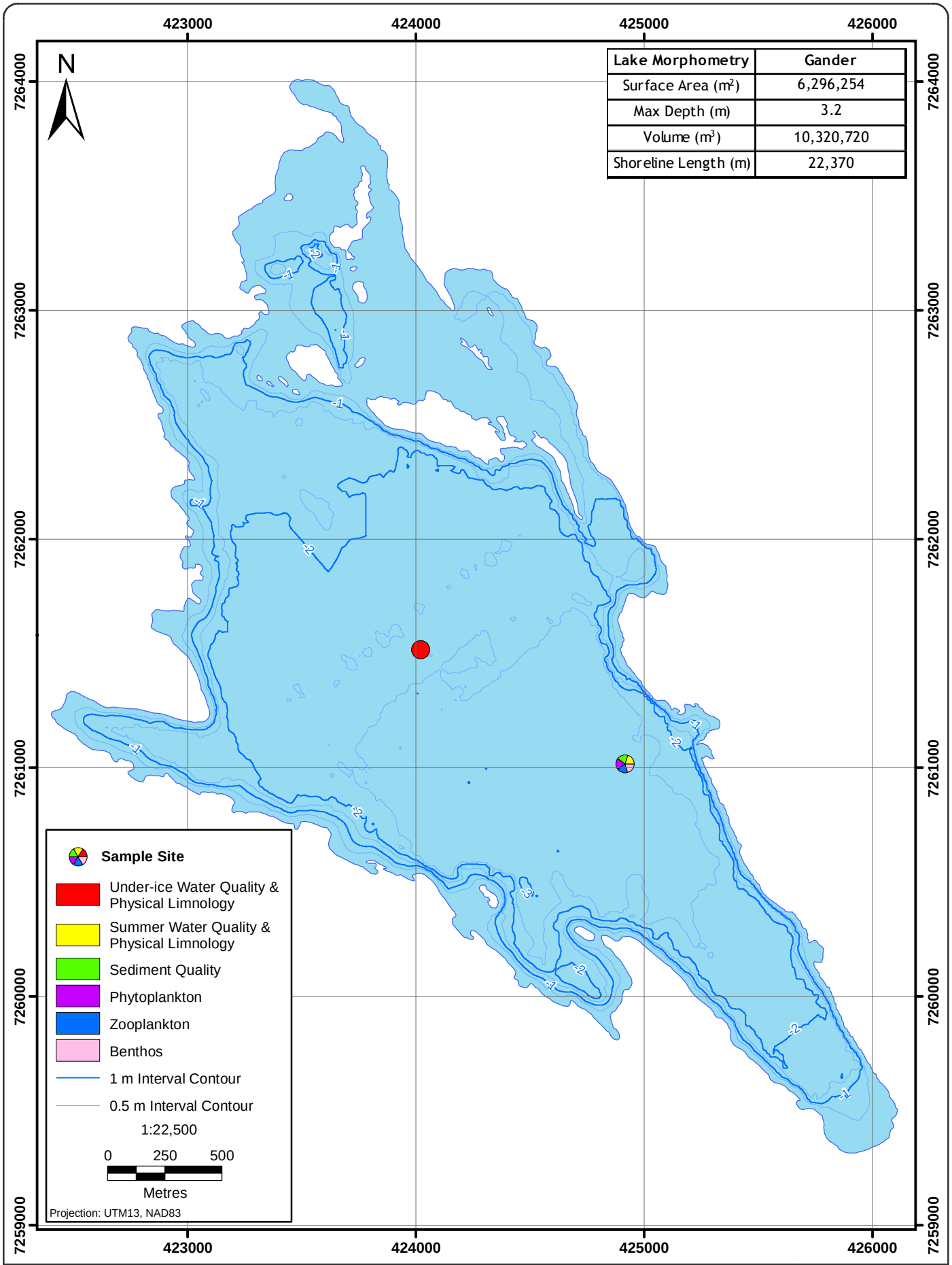
Figure 2.1-3

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Lake and Stream Sampling Locations within the George Property, Back River Project, 2012

Figure 2.1-3

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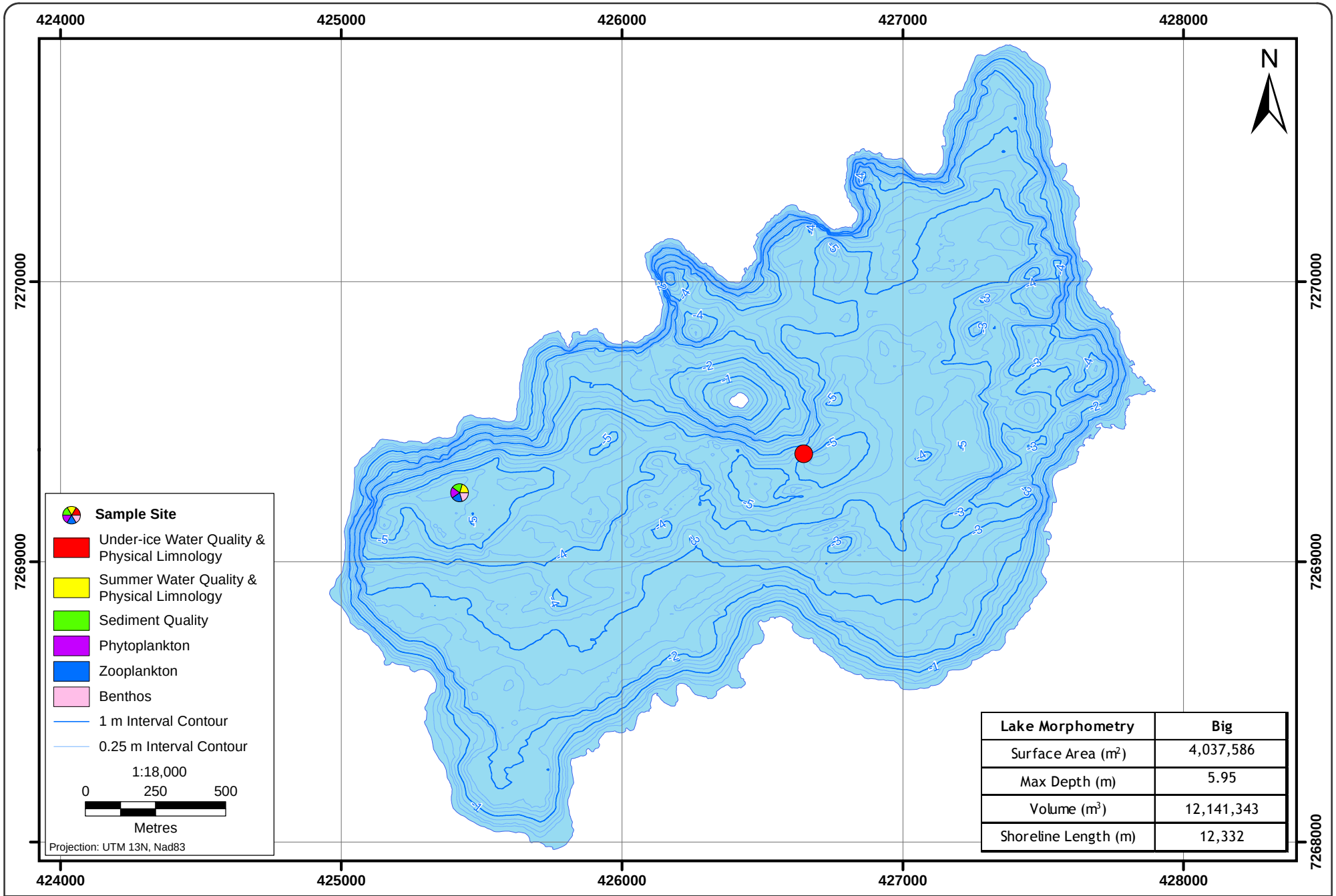
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Bathymetry and Sampling Locations in Gander Lake, Back River Project, 2012

Figure 2.1-4

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Lake Morphometry	Big
Surface Area (m^2)	4,037,586
Max Depth (m)	5.95
Volume (m^3)	12,141,343
Shoreline Length (m)	12,332

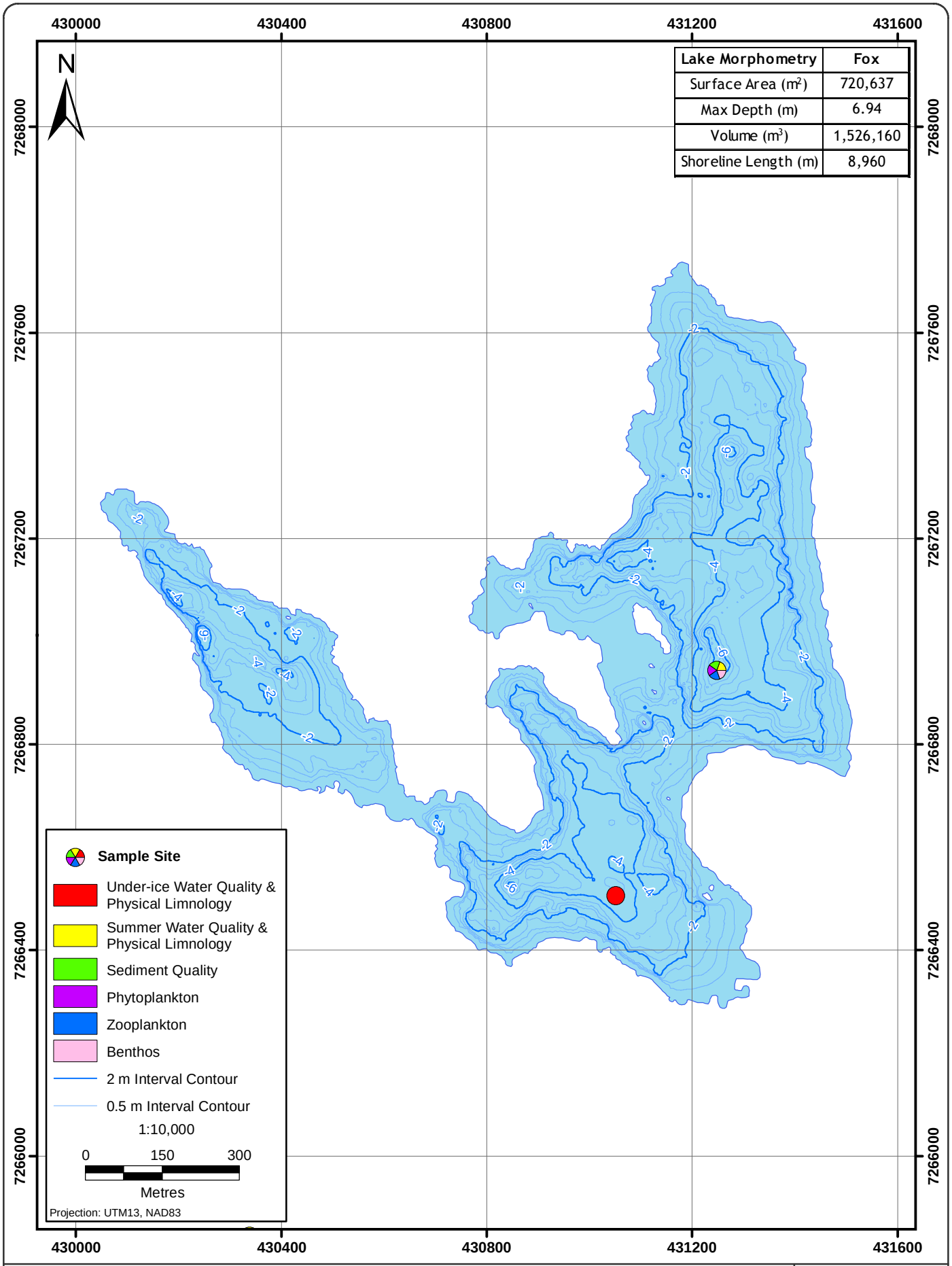
Figure 2.1-5

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Bathymetry and Sampling Locations in Big Lake, Back River Project, 2012

Figure 2.1-5

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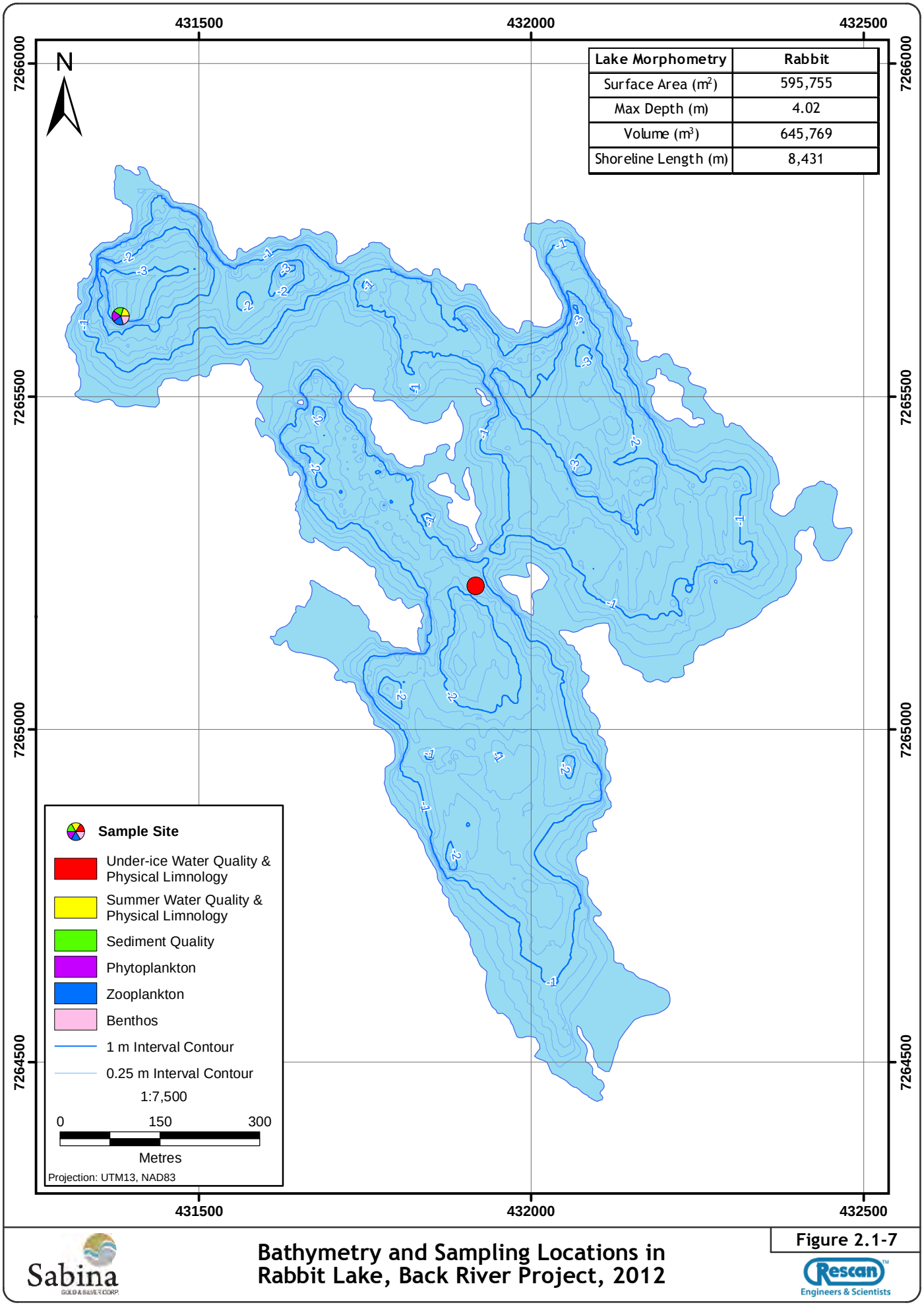
Sabina GOLD & SILVER CORP.

Bathymetry and Sampling Locations in Fox Lake, Back River Project, 2012

Figure 2.1-6

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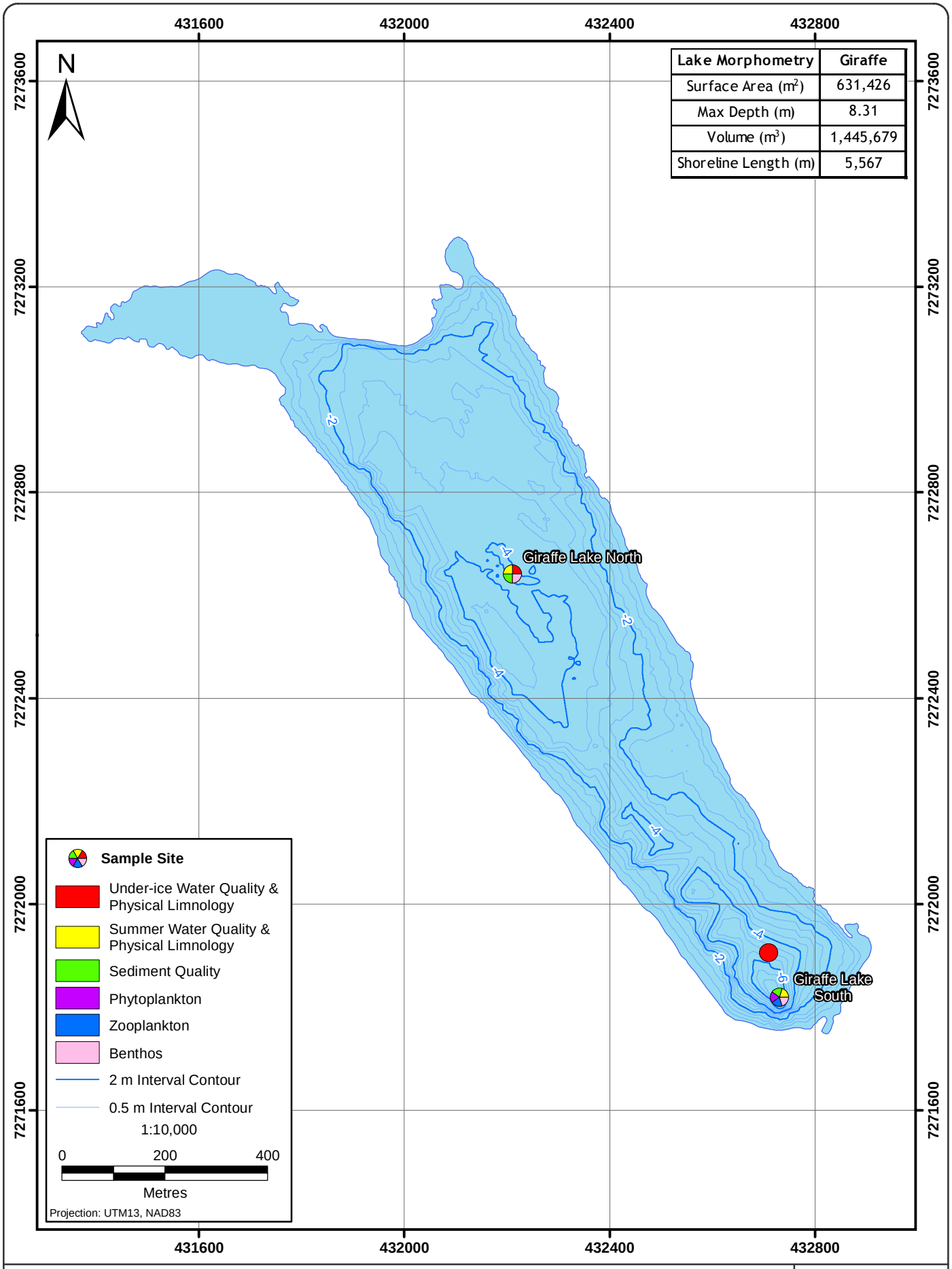


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Bathymetry and Sampling Locations in Rabbit Lake, Back River Project, 2012

Figure 2.1-7

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Bathymetry and Sampling Locations in Giraffe Lake, Back River Project, 2012

Figure 2.1-8

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2.3 TEMPERATURE AND DISSOLVED OXYGEN

Dissolved oxygen and temperature profiles were collected in April and August of 2012. Secchi depth measurements were recorded in August. Surface temperature and dissolved oxygen concentrations were measured at each stream during the reduced flow periods of August and September 2012.

2.3.1 Under-ice Field Data Collection

Lake sampling sites were accessed by helicopter or snowmobile during April. Before collecting the physical profiles (and later water samples), an ice auger was used to drill a 25-cm diameter hole through the ice (Plate 2.3-1). Snow and loose ice were cleared from the hole with a slotted spoon.

Temperature and dissolved oxygen profiles were recorded at 0.5 m intervals down the water column using a calibrated YSI Pro-ODO optical dissolved oxygen meter (Plate 2.3-2). The profiles ended at approximately 0.5 m above the sediment surface to avoid suspension of bottom sediments.

2.3.2 Open-water Lake Field Data Collection

Open-water temperature and dissolved oxygen profiles were collected from boat in August at the same locations that under-ice samples were collected, unless new bathymetric information prompted relocation to a more suitable location (see bathymetry maps). Data was collected using a calibrated YSI Pro-ODO optical dissolved oxygen meter as described above in the under-ice section.

Light attenuation was estimated in each lake using a 20-cm, black and white Secchi disk. Measurements were collected at each site by lowering the disk on a metred line through the water column on the shaded side of the boat until it disappeared from sight. The depth of disappearance was identified as the Secchi depth.

2.3.3 Stream Data Collection

Surface temperature and dissolved oxygen concentrations were measured using a calibrated YSI Pro-ODO optical dissolved oxygen meter (Plate 2.3-2) or a RBR-420 conductivity, temperature, and depth probe fitted with an Aanderaa Optode dissolved oxygen sensor (model# 3835) (in George area streams in August).

2.3.4 Quality Assurance/Quality Control (QA/QC)

The YSI Pro-ODO optical dissolved oxygen meters were calibrated before each sampling trip to ensure accurate readings. Measurements were only taken after probe had stabilized.

2.3.5 Data Management

Dissolved oxygen and temperature profiles were graphed for each lake. Canadian Council for Ministers of the Environment (CCME) dissolved oxygen guidelines for the protection of aquatic life were included on graphs for reference (CCME 2012). Stream data is presented in Table 3.1-2, and compared against CCME guidelines.

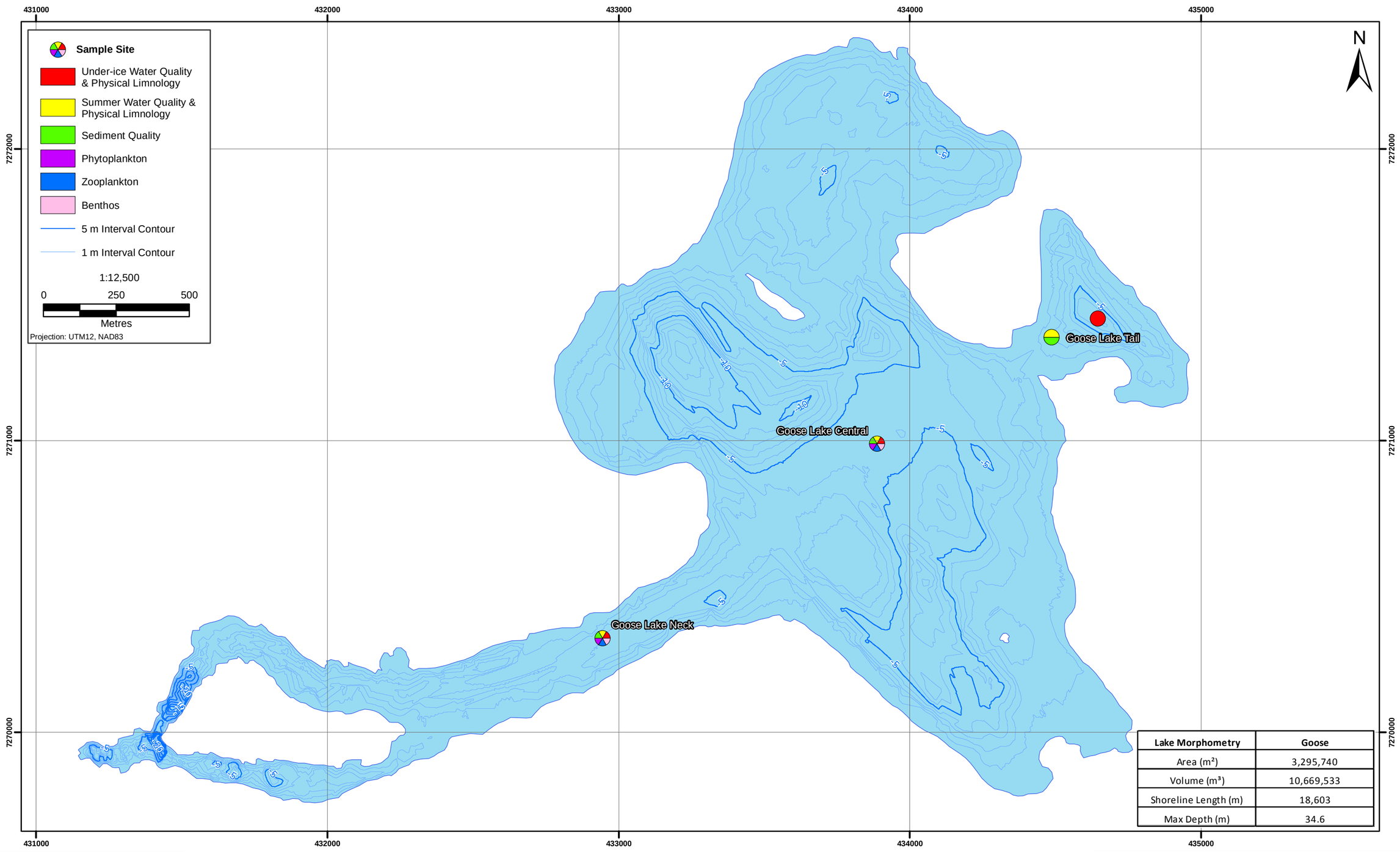
Secchi depths were used to calculate the euphotic zone depth (EZD), which is defined in this report as the depth at which 1% of surface radiation occurs. This generally represents the zone in a waterbody where integrated photosynthesis equals the integrated respiration (i.e., compensation depth). Above this depth net primary production is possible given sufficient nutrients. The EZD was calculated as follows:

$$k' = 1.7/D_s \ ;$$

where k' = light extinction coefficient, D_s is the Secchi depth, and 1.7 is a constant derived from experimental data (Parsons, Maita, and Lalli 1984).

$$EZD = 4.6/k'$$

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Lake Morphometry	Goose
Area (m²)	3,295,740
Volume (m³)	10,669,533
Shoreline Length (m)	18,603
Max Depth (m)	34.6

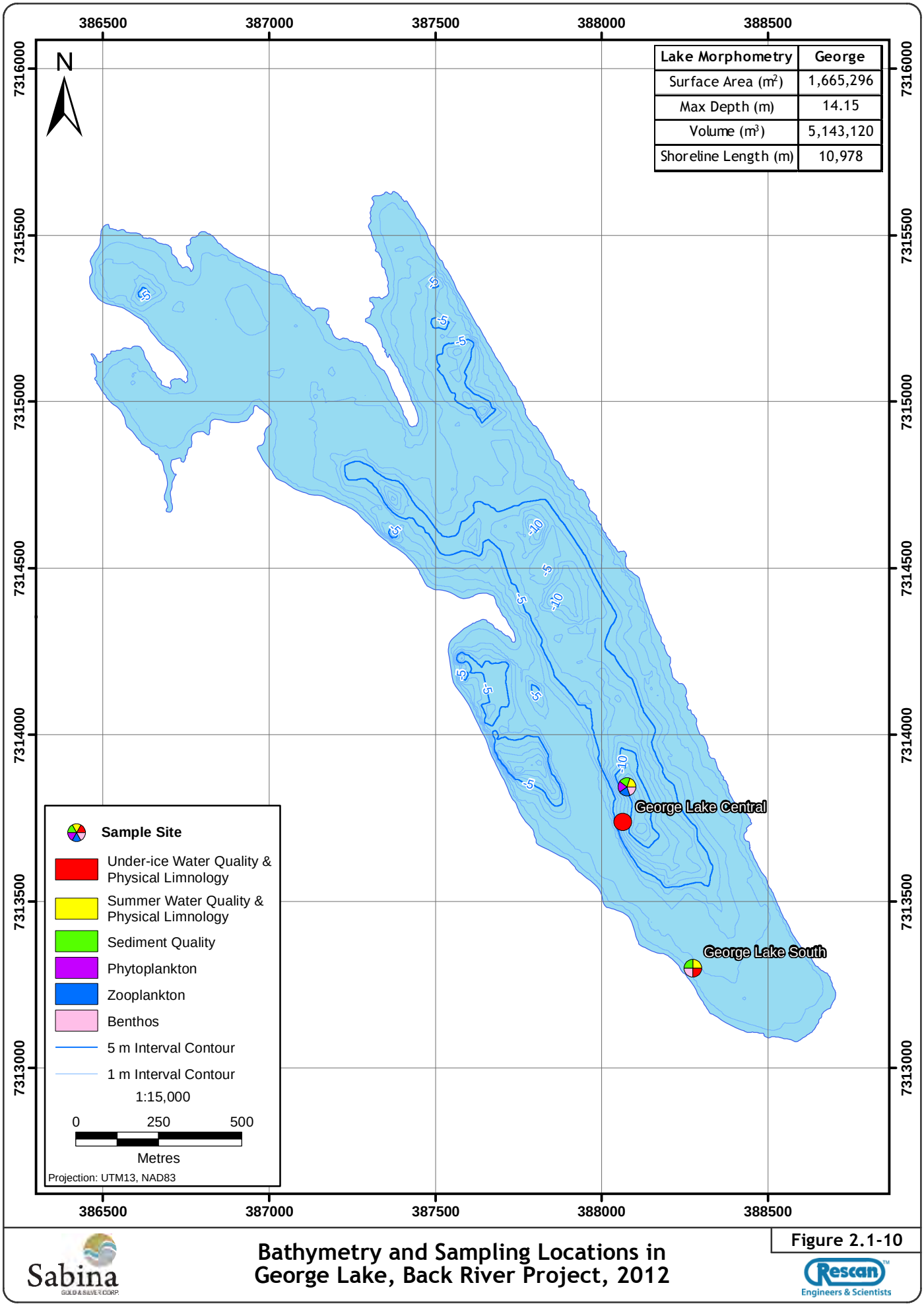
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Figure 2.1-9

Bathymetry and Sampling Locations in Goose Lake, Back River Project, 2012

PROJECT #0833-002-03 GIS # BAC-01-020 December 22 2012

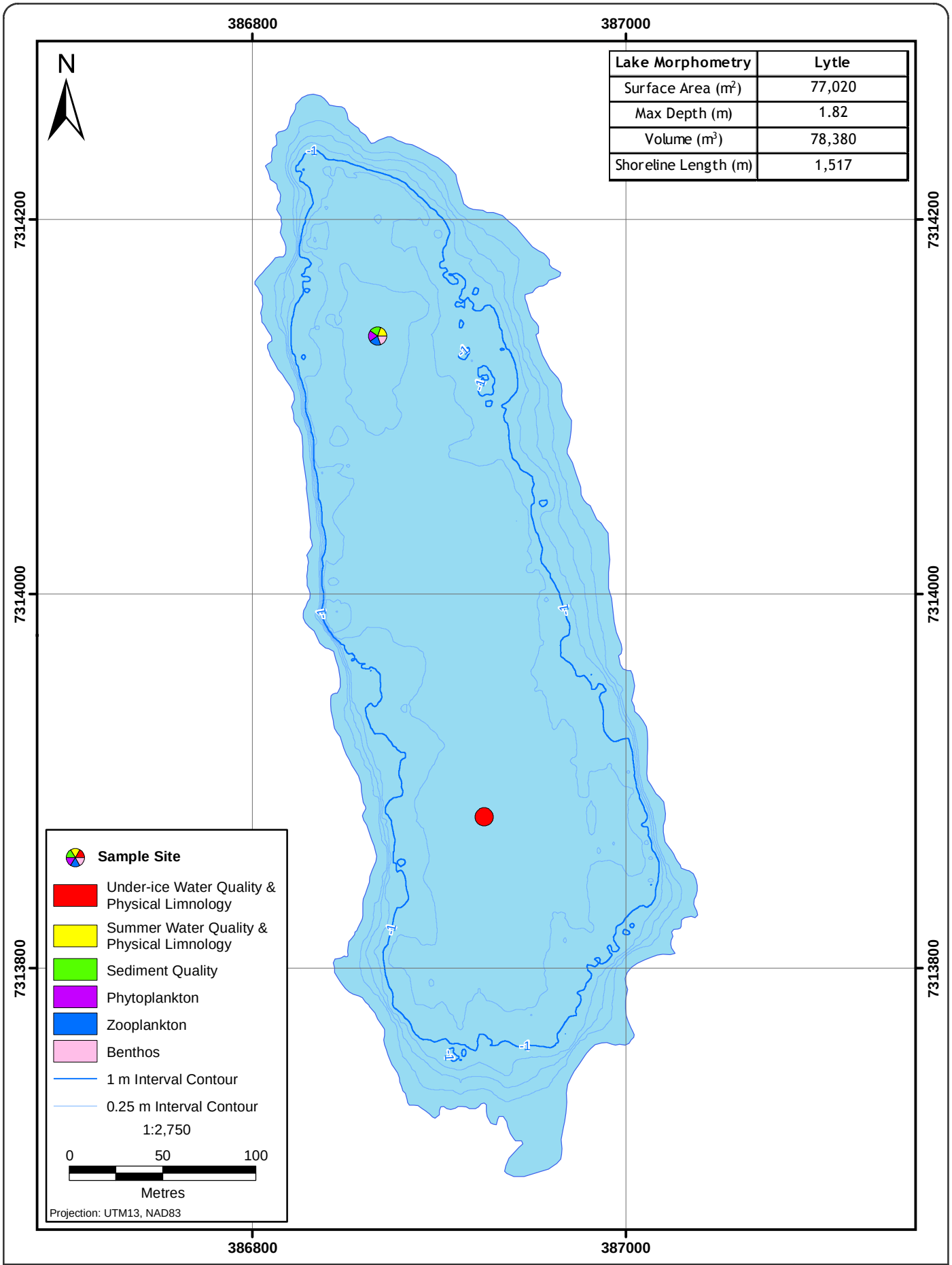


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Bathymetry and Sampling Locations in George Lake, Back River Project, 2012

Figure 2.1-10

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Bathymetry and Sampling Locations in Lytle Lake, Back River Project, 2012

Figure 2.1-11

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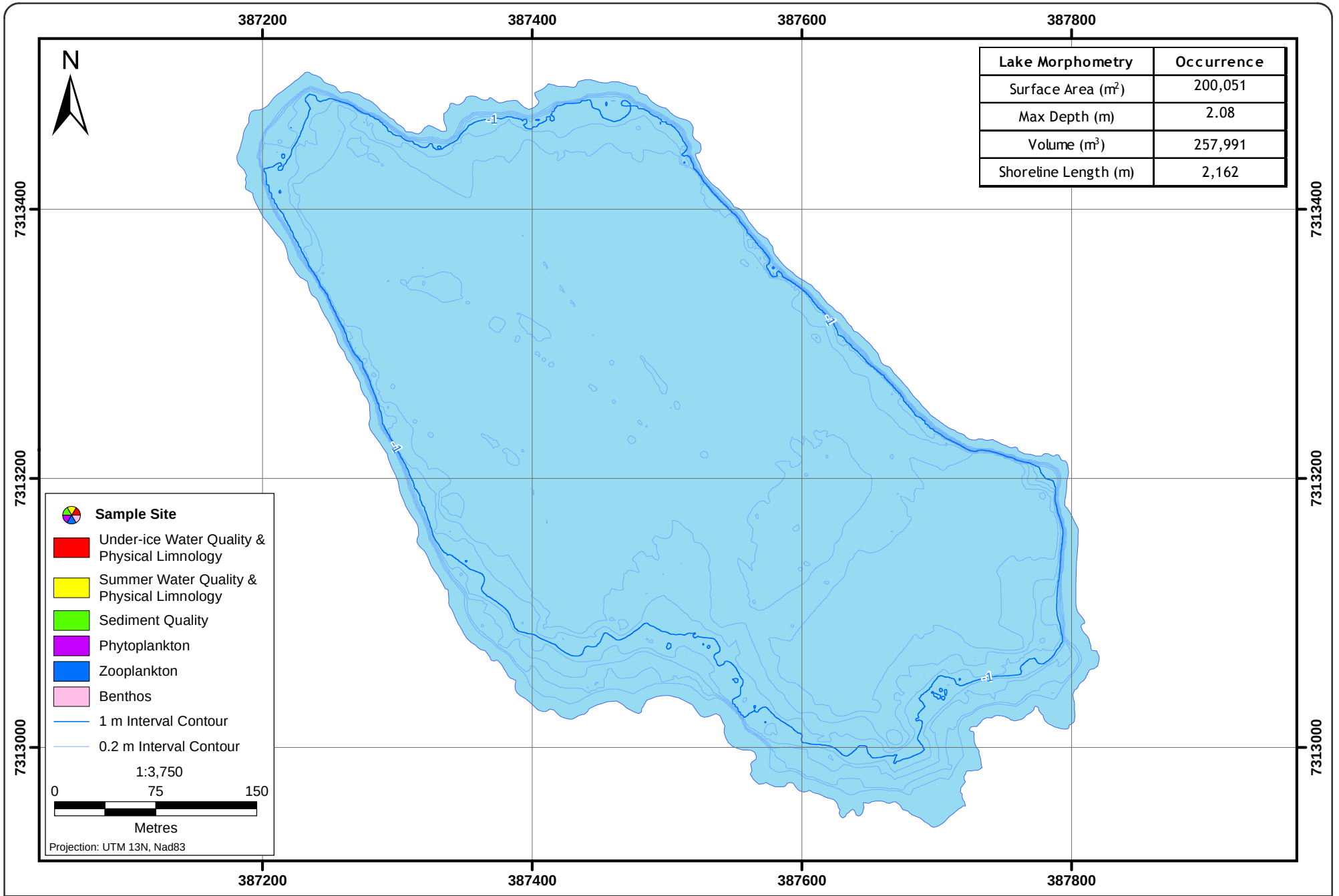


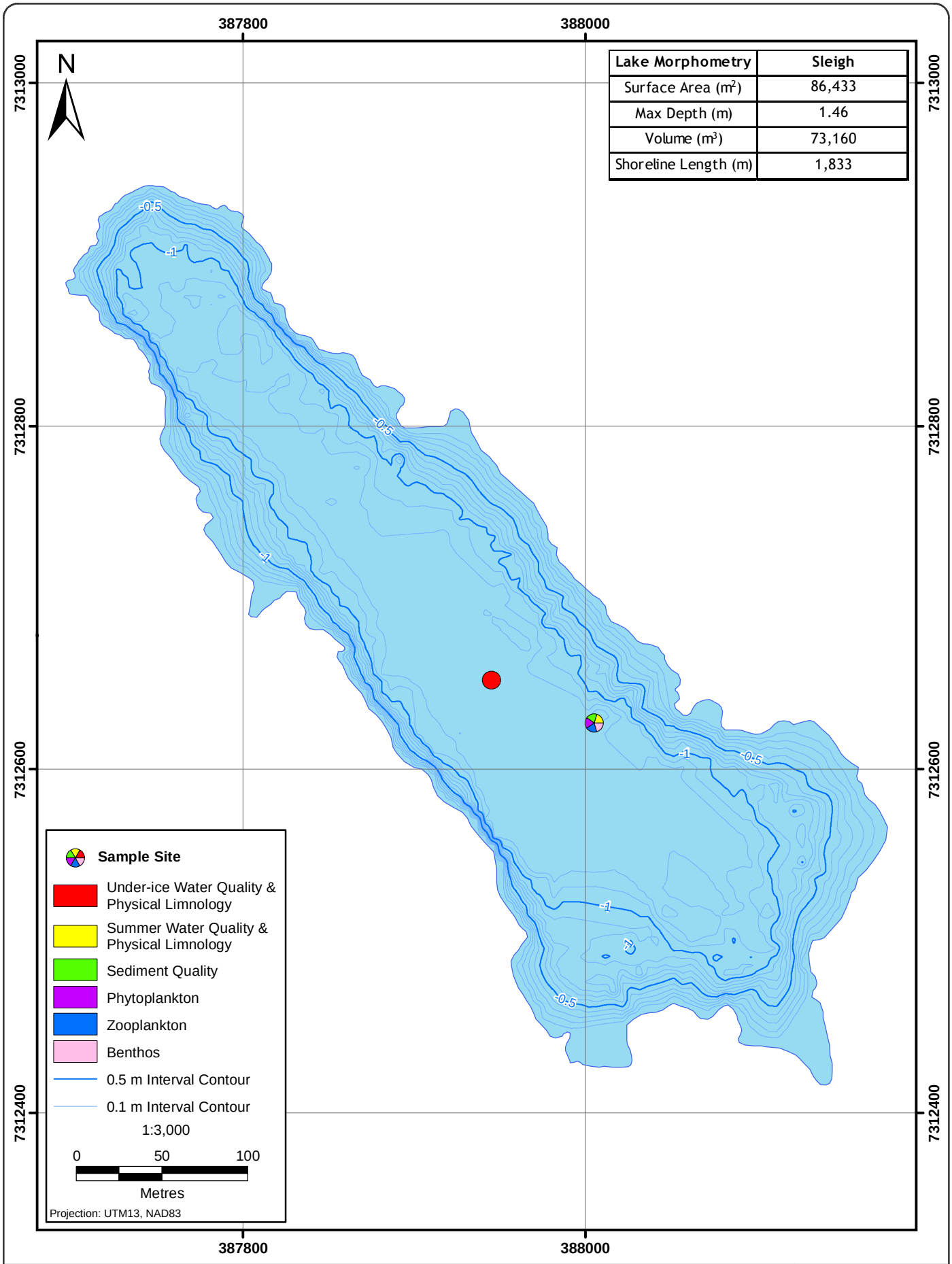
Figure 2.1-12

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Bathymetry and Sampling Locations in Occurrence Lake, Back River Project, 2012

Figure 2.1-12

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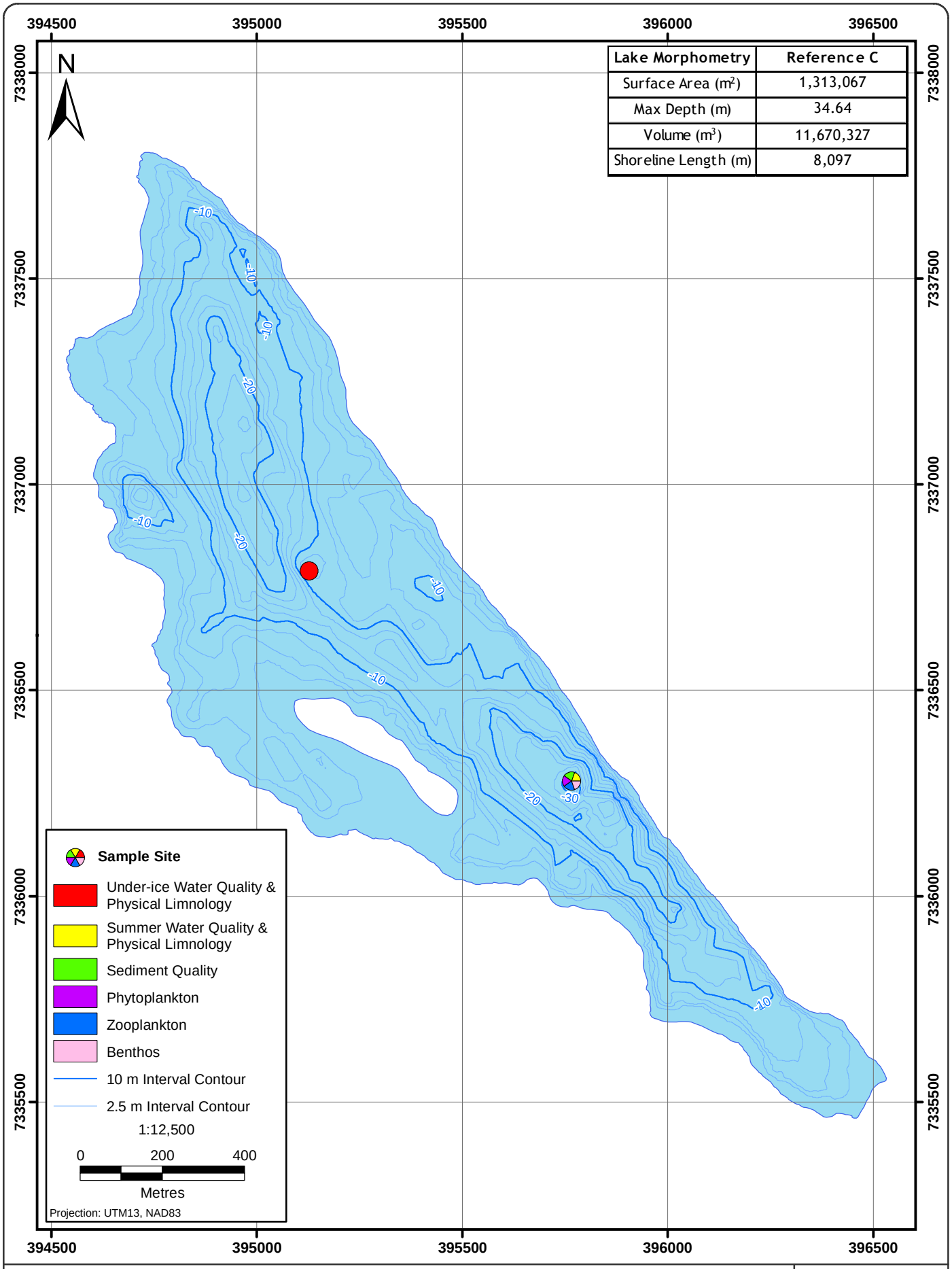


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Bathymetry and Sampling Locations in Sleigh Lake, Back River Project, 2012

Figure 2.1-13

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Bathymetry and Sampling Locations in Reference Lake C, Back River Project, 2012

Figure 2.1-14

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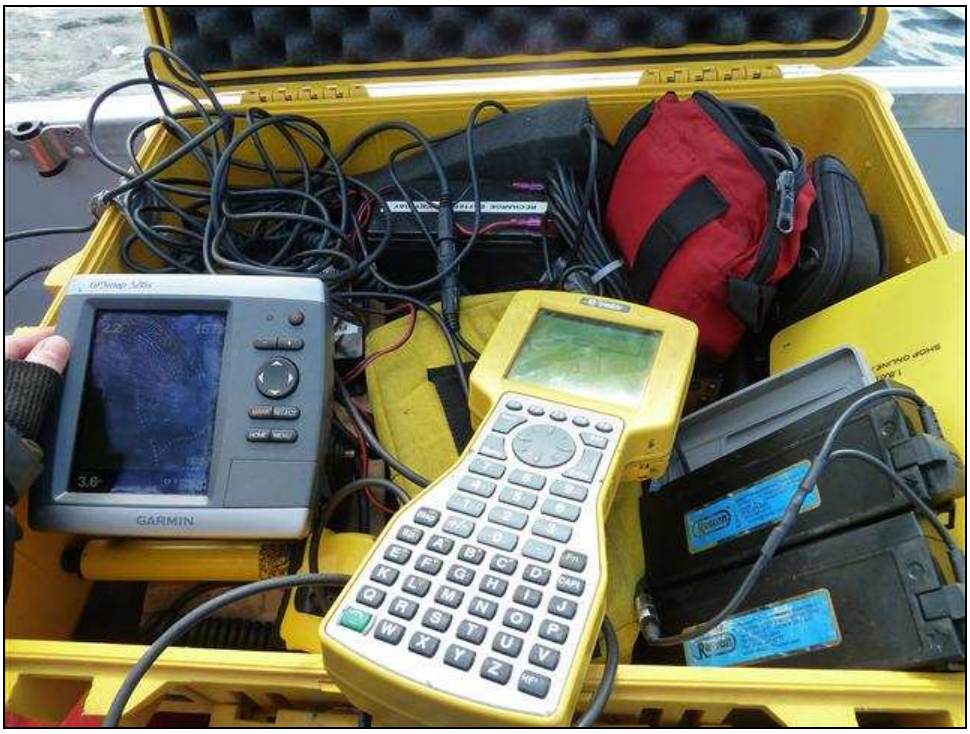


Plate 2.2-1. A Trimble DGPS was used to collect global northing and easting positions and a Garmin depth sounder was used to collect lake-bottom depths. A TSC1 data collector was used to record the positions and depths.



Plate 2.2-2. A pre-loaded transect route was used to collect bathymetric data in lakes; above is Occurrence Lake, July 2012.

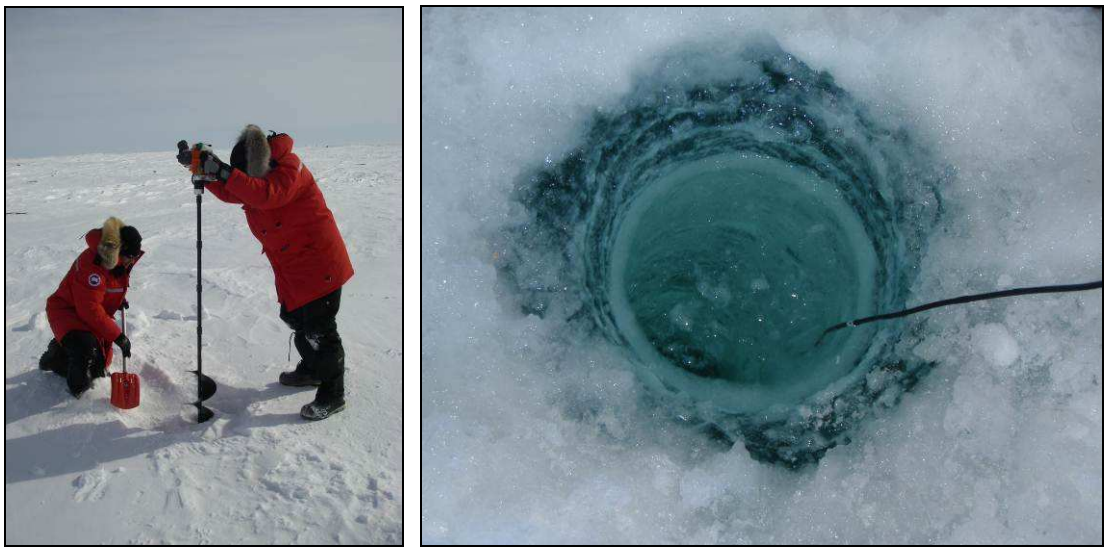


Plate 2.3-1. Left, auguring through the ice; right, measuring dissolved oxygen and temperature through the augered hole.

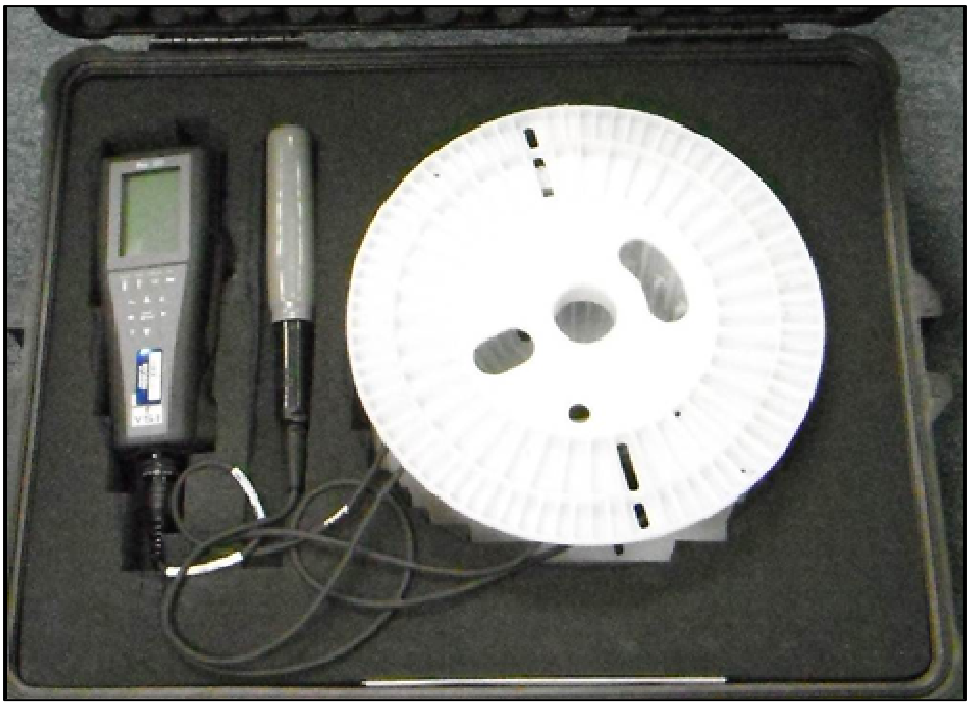


Plate 2.3-2. A calibrated YSI Pro-ODO optical dissolved oxygen meter was used to collect dissolved oxygen and temperature data.

2.4 LAKE WATER QUALITY

The 2012 lake water quality sampling focused on characterizing the natural variation in water quality with water column depth, time of year (under ice and open water), and geographical location. A total of twenty four lake sampling sites in twenty lakes in the Back River area were sampled, including one reference lake located approximately 25 km away from George Camp. Fourteen of the lake sites were

in the Goose area, and ten in the George area. All sites were sampled in both April (under ice) and August (open water).

2.4.1 Under-ice Field Sample Collection

Under-ice water quality samples were collected in April from the ice hole augered for the physical limnology measurements. Samples were collected from 1 m below the base of the ice layer and from 1.5 m from the bottom where lake sites were deep enough (> 6 m). One sample was collected at each depth with 25% replication for QA/QC. At the shallow Rascal Lake, water quality samples were taken at the ice-water interface to avoid disturbing sediments

A modifed 2.5 L "skinny" Niskin bottle was used for April sampling as GO-FLO sampling bottles (generally preferred for sampling waters with low metal concentrations) are prone to freezing open in cold waters.

The Niskin bottles were acid-cleaned at ALS Environmental Services (ALS), Burnaby, British Columbia (BC), and contained acid-cleaned clear silicone tubing in the interior of the bottle to reduce potential metal contamination. A dual rope system was used for bottle closure (Plate 2.4-1).

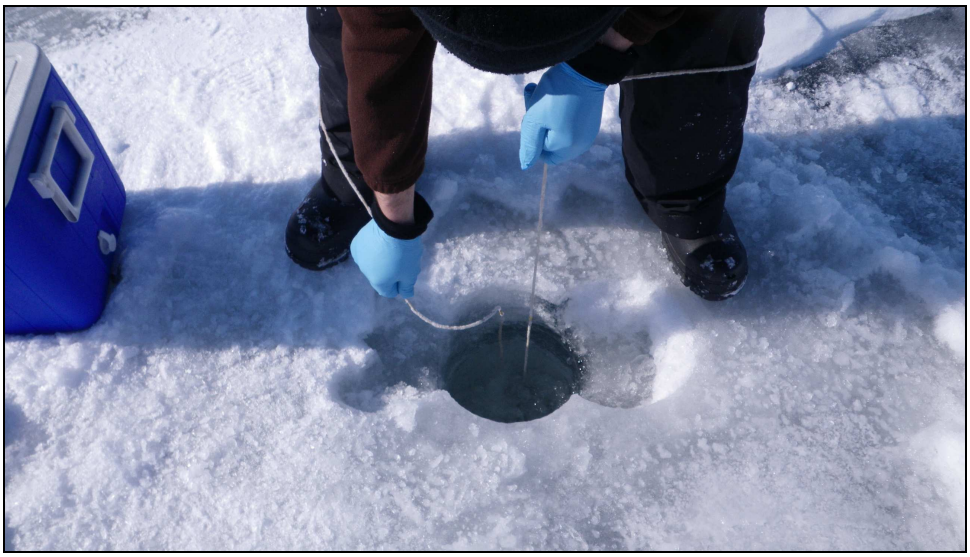


Plate 2.4-1. Under-ice water quality samples were collected with a modified 'skinny' Niskin, using a dual rope triggering system instead of a messenger.

The water collected in the Niskin was used to fill the appropriate laboratory-provided sample containers (Plate 2.4-2). All water samples were analyzed for general physical parameters, cyanides, nutrients, total organic carbon (TOC), and total and dissolved metals at the lowest feasible detection limits by ALS (Table 2.4-1). Preservatives were added in the field to the cyanide (sodium hydroxide), nutrient (sulphuric acid), TOC (hydrochloric acid), and total metals (ultra-pure nitric acid) sample containers.

Table 2.4-1. Water Quality Parameters and Method Detection Limits, Back River Project, 2012

Parameter	Detection Limit
Physical Tests	
Conductivity	2 µS/cm
Hardness (as $CaCO_3$)	0.5
pH	0.01 pH
Alkalinity, Bicarbonate (as $CaCO_3$)	2
Alkalinity, Carbonate (as $CaCO_3$)	2
Alkalinity, Hydroxide (as $CaCO_3$)	2
Alkalinity, Total (as $CaCO_3$)	2
Total Suspended Solids	3
Total Dissolved Solids	10
Turbidity	0.1 NTU
Nutrients	
Ammonia (as N)	0.005
Nitrate (as N)	0.005
Nitrite (as N)	0.001
Total Kjeldahl Nitrogen	0.05
Ortho Phosphate (as P)	0.001
Total Phosphorus	0.002
Major Anions	
Bromide (Br)	0.05
Chloride (Cl)	0.5
Fluoride (F)	0.02
Sulphate (SO_4)	0.5
Organic Carbon	
Total Organic Carbon	0.5
Cyanides	
Free Cyanide	0.001
Total Cyanide	0.001
Metals (Total and Dissolved)	
Aluminum (Al)	0.003
Antimony (Sb)	0.00005
Arsenic (As)	0.00003

Parameter	Detection Limit
Metals (Total and Dissolved) (con'd)	
Barium (Ba)	0.00005
Beryllium (Be)	0.0002
Bismuth (Bi)	0.0005
Boron (B)	0.005
Cadmium (Cd)	0.00001
Calcium (Ca)	0.02
Chromium (Cr)	0.0001
Cobalt (Co)	0.0001
Copper (Cu)	0.0005
Iron (Fe)	0.01
Lead (Pb)	0.00005
Lithium (Li)	0.005
Magnesium (Mg)	0.005
Manganese (Mn)	0.00005
Mercury (Hg)	0.00001
Molybdenum (Mo)	0.00005
Nickel (Ni)	0.0001
Phosphorus (P)	0.3
Potassium (K)	0.05
Selenium (Se)	0.0001
Silicon (Si)	0.05
Silver (Ag)	0.00001
Sodium (Na)	0.01
Strontium (Sr)	0.0001
Thallium (Tl)	0.00005
Tin (Sn)	0.0001
Titanium (Ti)	0.01
Uranium (U)	0.00001
Vanadium (V)	0.00005
Zinc (Zn)	0.003

Note: Detection limits are mg/L unless otherwise indicated.

All water samples were kept cold, but above freezing, and sent to ALS in Yellowknife, Northwest Territories (NT) on the first available flight from camp. Samples were then sent to ALS's Burnaby laboratory where the lowest metal detection limits were available. Due to logistical constraints, hold times for some parameters and some samples were exceeded. Dissolved metals samples were filtered by ALS in their Burnaby laboratory to avoid contamination issues related to field filtration.



Plate 2.4-2. Labeled laboratory supplied sample containers (from back to front: routine, cyanides, total metals, dissolved metals, nutrients and total organic carbon).

Detection limits were the lowest achievable by the lab. Detection limits were occasionally higher than the theoretical minimum presented in Table 2.4-1. This occurred when dilution of a sample was required to compensate for other interfering parameters (e.g., turbidity). Realized detection limit ranges are indicated on all relevant figures in this report.

2.4.2 Open-water Field Sample Collection

Open-water water quality samples were collected by boat in August, using an acid-washed 5 L Teflon-lined GO-FLO sampling bottle (Plate 2.4-3). The GO-FLO was lowered on a metred line to a depth 0.5 m lower than the desired sampling depth, before being raised to the sampling depth and closed using a weighted messenger. The water collected was used to fill the laboratory-provided sample containers.

Water quality samples were collected from 1 m below the surface and from mid-depth where lake sites were deep enough (> 6 m). For deeper stratified lakes, samples were collected from the mid point of the bottom layer to avoid collecting water at the thermocline. One sample was collected at each depth with 20% replication for QA/QC.

Water quality samples were taken from the surface (0.1 m) at the shallow Pond 19 and Echo lakes and from 0.5 m below the surface at the shallow George Lake South, Lytle Lake and Sleigh Lake sampling sites to avoid disturbing sediments. At the shallow Pond 19 and Echo Lake water quality samples were taken from a boat, using an anchor and the wind to drift out to the centre of the lake to avoid disturbing sediments.

Water quality samples were preserved, handled, transported and analyzed as described in the April water quality section.

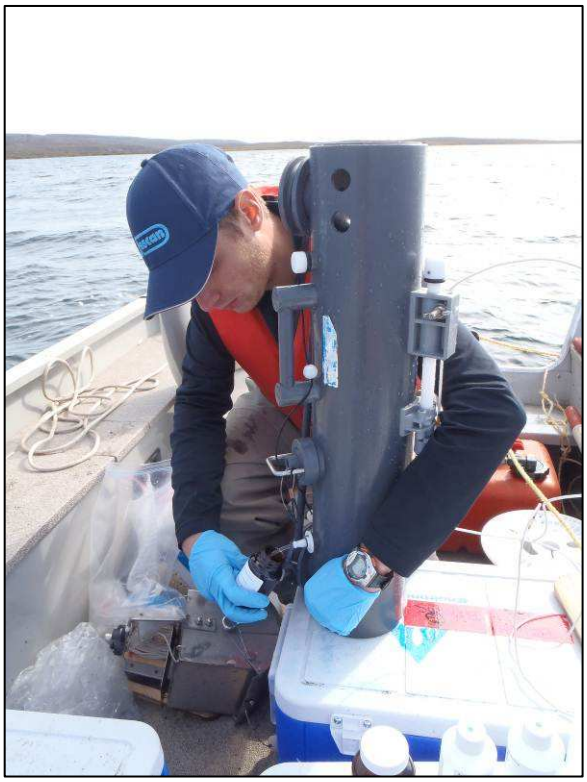


Plate 2.4-3. Laboratory-provided sample containers were filled with water collected using a 5 L GO-FLO bottle.

2.4.3 Quality Assurance/Quality Control (QA/QC)

A quality assurance and quality control program (QA/QC) was incorporated into the design of the freshwater baseline program to account for within-site variability and any contamination that originated from sampling equipment, field sampling, or sample transportation. This included the use of replicates, blanks, and chain of custody forms.

Twenty five percent of the water samples were collected in duplicate to assess the magnitude and potential causes of variability between samples.

Equipment blanks, field blanks, and travel blanks comprised approximately 20% of the total number of lake water quality samples collected. Equipment blanks were designed to detect contamination from the sampling equipment, including the sampling bottle (GO-FLO or Niskin). Field blanks measured potential contamination from sample exposure to air, while travel blanks were designed to detect potential contamination from travel and storage during sampling.

Equipment blanks were collected in the field by first rinsing an acid-washed GO-FLO with double de-ionized water (DDI water; provided by ALS) then filling the GO-FLO bottle with DDI water, allowing the water to sit for approximately one minute (as would occur with a real sample), repeating this, and then drawing sub-samples from the bottle. Equipment blanks were preserved and handled in the same fashion as real samples.

Field blanks were processed in the field by opening the bottles provided by ALS (containing DDI water) and exposing the sample to air for approximately one minute. The bottles were preserved and handled the same as the regular samples.

Travel blanks were provided by ALS and were never opened, but were otherwise handled in the same way as the regular samples.

All samples, including blanks, were recorded on a chain of custody form and sent to ALS Burnaby via ALS Yellowknife. Blanks were tested for general parameters, nutrients, anions, cyanides and total metals.

2.4.4 Data Management

Parameters of interest, including parameters with CCME water quality guidelines for the protection of aquatic life, were graphed unless values were consistently below detection limits (CCME 2012).

Values below analytical detection limits were replaced with half the realized sample detection limit for graphing and analysis. Water quality concentrations at each lake were compared to the CCME guidelines. The factor of exceedance, the factor by which concentrations exceeded CCME guidelines, was calculated for each sample. The average factor of exceedance was calculated for each lake.

The water sample duplicates were assessed for the magnitude of variability between samples using relative percent difference (RPD) as calculated by:

$$RPD = | [(dupeA - dupeB) / ((dupeA + dupeB) / 2)]| \times 100$$

The results of RPD calculations were examined to detect patterns of sampling heterogeneity, sample contamination, or analytical errors. For example, duplicate samples having several water quality parameters with RPDs greater than 20% could suggest one sample had higher particulate matter than the other sample leading elevated concentrations of several parameters; thus, indicating *in situ* sampling variability. On the other hand, duplicate samples having only one or a few parameters with RPDs above 20% could suggest analytical inconsistencies.

Water quality variables where one or both values were less than five times the detection limit were not included in the RPD calculations because analytical results near the detection limit are increasingly unreliable (BC MWLAP 2003). Field duplicates with RPD values exceeding 20% were noted and all duplicates and RPDs are listed in Appendix 3.2-2.

2.5 STREAM WATER QUALITY

The 2012 stream water quality sampling focused on characterizing the potential natural variation both seasonally and geographically. Samples were collected during June (freshet), August (low-flow period, and September (the higher flow period). Seventeen stream sites within the Goose and George areas were sampled, including one reference stream approximately 25 km from George Camp and one reference stream 15 km from Goose Camp. Twelve of these stream sites were in the Goose Property and five were in the George Property.

2.5.1 Field Sample Collection

Duplicate stream water samples were collected from each site using clean techniques. Where reduced flow was present, samples were collected from banks or rocks to prevent contamination from sediments. Samples were always collected where flow was evident. Where flow was high, the field sampler stood facing upstream being careful not to disturb sediments. Where possible, samples were

collected from 10 cm depth. Water quality samples were preserved immediately in the field (as described in lakes water quality section).

In August, water quality samples could not be collected for Echo OF as it was dry, and Reference B OF had to be sampled 600 m upstream near the outflow (Plate 2.5-1).



Plate 2.5-1. August water quality samples could not be collected from Echo OF due to dry stream bed (left), and had to be collected in a new location from Reference B OF due to low water levels at original Reference B OF sampling site (right).

Stream water samples were analyzed for the same parameter list as lake water quality samples, and handled and transported identically to the lake water quality samples.

2.5.2 Quality Assurance/Quality Control (QA/QC)

As with lake water quality component, QA/QC measures were included with stream water quality sampling. The program included the use of duplicates, blanks, and chain of custody forms.

Duplicate samples were collected at all sites to allow identification of natural variability, which tends to be higher in the more turbulent streams compared to lakes due to heterogeneously suspended matter (such as organic debris, small insects, etc.).

Field blanks and travel blanks comprised 9% of the total number of stream water quality samples. Field blanks and travel blanks were collected as described in the lake water quality section above.

2.5.3 Data Management

Streams water quality data was managed identically to the lakes water quality data. RPDs were calculated as described in the lakes water quality data management section.

2.6 LAKE SEDIMENT QUALITY

The 2012 sediment quality sampling focused on characterizing the natural variation in lake sediments with depth and by lake. Samples were collected in August from the same twenty four lake sampling sites sampled for water quality, and included one reference lake located approximately 50 km away from George Camp. Thirteen of these lake sites were in the Goose Property and ten were in the George Property.

2.6.1 Field Sample Collection

Triplicate sediment quality samples were collected using an Ekman grab sampler (surface area: 0.0225 m^2). The Ekman was lowered to the sediment layer, trigged shut with a weighted messenger, and then brought gently to the surface, with care taken to not agitate the collected sediments. At the surface, the sediment was carefully transferred onto a white plastic tray, photographed, and described for colour, texture, and other characteristics. The top 2-3 cm of sediment was collected and homogenized in a plastic bowl before being split into two whirl-pak bags, one for particle size and one for sediment chemistry. Plate 2.6-1 shows the collection of sediment samples.



Plate 2.6-1. Sediment quality samples were collected using an Ekman grab. Left, setting the grab; Centre, ready to release the sediment; Right, the sediment ready for the top layer to be sampled (Gander Lake).

Sediment samples were kept cold and sent to ALS in Yellowknife, NT on the first available flight from camp. Samples were then sent to ALS's Burnaby laboratory where they were analyzed for grain size, moisture, nutrients, cyanide and solid-phase metals.

Table 2.6-1 presents the sediment quality parameters that were analyzed and their detection limits. Note that realized detection limits may differ from these theoretical values. The realized detection limit ranges are indicated on all relevant figures.

Table 2.6-1. Sediment Quality Parameters and Detection Limits, Back River Project, 2012

Parameter	Units	Detection Limit	Parameter	Units	Detection Limit
Physical Tests			***Leachable Nutrients***		
% Moisture	%	0.25	Total Nitrogen	%	0.02
pH	pH	0.1	***Plant Available Nutrients***		
Particle Size			Available Ammonium (as N)	mg/kg	1
% Gravel (>2 mm)	%	0.1	Available Nitrate (as N)	mg/kg	2
% Sand (2.0 mm - 0.063 mm)	%	0.1	Nitrite (as N)	mg/kg	0.4
% Silt (0.063 mm – 4 µm)	%	0.1	Available Phosphate (as P)	mg/kg	2
% Clay (<4 µm)	%	0.1	***Cyanides***		
Organic Carbon			Total Cyanide	mg/kg	3
Total Organic Carbon	%	0.1	Weak-acid dissociable Cyanide	mg/kg	3

(continued)

Table 2.6-1. Sediment Quality Parameters and Detection Limits, Back River Project, 2012 (completed)

Parameter	Units	Detection Limit	Parameter	Units	Detection Limit
Metals			***Metals (continued)***		
Aluminum (Al)	mg/kg	50	Mercury (Hg)	mg/kg	0.005
Antimony (Sb)	mg/kg	0.1	Molybdenum (Mo)	mg/kg	0.5
Arsenic (As)	mg/kg	0.05	Nickel (Ni)	mg/kg	0.5
Barium (Ba)	mg/kg	0.5	Phosphorus (P)	mg/kg	50
Beryllium (Be)	mg/kg	0.2	Potassium (K)	mg/kg	100
Bismuth (Bi)	mg/kg	0.2	Selenium (Se)	mg/kg	0.2
Cadmium (Cd)	mg/kg	0.05	Silver (Ag)	mg/kg	0.1
Calcium (Ca)	mg/kg	50	Sodium (Na)	mg/kg	100
Chromium (Cr)	mg/kg	0.5	Strontium (Sr)	mg/kg	0.5
Cobalt (Co)	mg/kg	0.1	Sulphur (S)	mg/kg	500
Copper (Cu)	mg/kg	0.5	Thallium (Tl)	mg/kg	0.05
Iron (Fe)	mg/kg	50	Tin (Sn)	mg/kg	2
Lead (Pb)	mg/kg	0.5	Titanium (Ti)	mg/kg	1
Lithium (Li)	mg/kg	5	Uranium (U)	mg/kg	0.05
Magnesium (Mg)	mg/kg	20	Vanadium (V)	mg/kg	0.2
Manganese (Mn)	mg/kg	1	Zinc (Zn)	mg/kg	1

2.6.2 Quality Assurance/Quality Control (QA/QC)

All sediment quality samples were recorded on a chain of custody form and sent to ALS in Yellowknife. Samples were then sent to ALS's Burnaby laboratory for analysis, where lower detection limits could be obtained.

2.6.3 Data Management

All parameters for which CCME sediment quality guidelines for the protection of aquatic life exist, as well as other parameters of interest, were graphed.

Values below analytical detection limits were replaced with half the realized detection limit for graphing and analysis. All sediment samples collected were compared to the following CCME guidelines for the protection of aquatic life, including the interim sediment quality guidelines (ISQGs) and the probable effects levels (PELs; CCME 2012). The more conservative ISQGs are levels below which adverse biological effects are rarely observed, whereas the higher PELs correspond to concentrations above which negative effects frequently occur. The factor of exceedance, the factor by which concentrations exceeded CCME guidelines, was calculated for each sample. The average factor of exceedance was calculated for each lake.

2.7 STREAM SEDIMENT QUALITY

The seventeen stream sites were also sampled for sediment quality in August 2012 (Table 2.1-2). Twelve of these stream sites were in the Goose Property and five were in the George Property. Three replicate samples were collected per stream site.

2.7.1 Field Sample Collection

Stream sediments were collected with a plastic spoon. Each replicate sample was a composite of multiple spoonfuls from a single reach, homogenized in a plastic bowl, and collected in a whirl-pak bag (Plate 2.7-1). Depositional zones (where finer sediments accumulate) were preferentially sampled. All sediment quality samples were transported and analyzed as described in the lake sediment section above.



Plate 2.7-1. Three sediment quality samples were collected into labelled whirl-pak bags at each site. Left, samples were first homogenized in a plastic bowl (Komatic IF, replicate 2); right, the three sediment quality replicates from Giraffe Outflow.

2.7.2 Quality Assurance/Quality Control (QA/QC)

As with lake sediment quality samples, stream sediment samples were recorded on a chain of custody form and sent to ALS in Yellowknife. Samples were then sent to ALS's Burnaby laboratory for analysis, as lower detection limits could be obtained there.

Sediment quality samples could not be collected from Llama OF which runs through a boulder garden (Plate 2.7-2) or Echo OF as it was dry during the August sampling period.



Plate 2.7-2. Fine depositional sediments could not be collected from Llama OF as the stream runs through a boulder garden. Fine depositional sediments likely fall through gaps between large rocks.

2.7.3 Quality Assurance/Quality Control (QA/QC)

As with lake sediment quality samples, stream sediment samples were recorded on a chain of custody form and sent to ALS in Yellowknife. Samples were then sent to ALS's Burnaby laboratory for analysis, where lower detection limits could be obtained.

2.7.4 Data Management

Streams sediment quality data was managed identically to the lakes sediment quality data.

2.8 PRIMARY PRODUCERS

2.8.1 Phytoplankton

Phytoplankton are free-floating autotrophic algae that play an important role in many aquatic systems as primary producers and prey for higher trophic levels. Phytoplankton have short generation times and can respond rapidly to environmental change. These characteristics make them useful indicators of water quality and ecosystem health. Phytoplankton biomass, densities, and taxonomy samples were collected from a total of twelve lake sampling sites in the Goose Property and nine lake sampling sites in the George Property during April and/or August 2012.

2.8.2 Phytoplankton Field Sample Collection

In April, a single sample was collected from all lakes sampled for water quality. Under-ice samples were collected from 1 m below the ice water interface using a Niskin bottle. In August, triplicate samples were collected from 1 m below the surface using a 5 L GO-FLO bottle. One litre was collected for each biomass sample in an opaque plastic bottle, to ensure chlorophyll did not degrade and phytoplankton did not multiply before being filtered (Plate 2.8-1). For each density/taxonomy sample, 250 mL was collected.

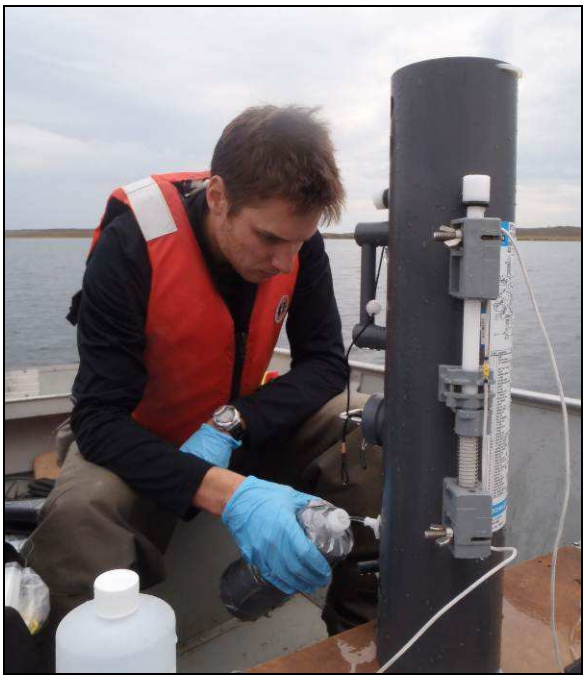


Plate 2.8-1. Phytoplankton samples were collected from 1 m depth using the GO-FLO. Above, biomass samples being collected in an opaque bottle at Fold Lake in August 2012.

Phytoplankton biomass samples were filtered onto 0.45 µm pore size filters back in camp and kept dark and frozen until analysis by ALS in Burnaby. Density/taxonomic samples were preserved with Lugol's iodine solution and were sent to EcoAnalysts, Idaho, USA for enumeration and identification.

2.8.3 Periphyton

Periphyton are algae that grow on the surfaces of rocks or larger plants and are an important food item for many benthic invertebrates, which are in turn the main food source for fish in streams and rivers. Because of their rapid generation rates, periphyton are among the first organisms to respond to environmental stressors or nutrients, and can exhibit taxon-specific changes making them good indicators of current environmental conditions. Three stream periphyton samples were collected from eleven streams in the Goose Property and five streams in the George Property during August 2012.

2.8.4 Periphyton Field Sample Collection

A circular template with a foam base was used to seal a known area of rock from the rest of the rock. Periphyton in this area were collected using tweezers, a modified toothbrush, a syringe, and distilled water. For each replicate, two rocks were selected with flat upper surfaces suitable for periphyton sampling. The periphyton were sampled from three circles on each of the two rocks for each replicate (i.e., a total of six circles; Plate 2.8-2).



Plate 2.8-2. Periphyton were collected from a known area using a circular template. Left, template and a periphyton-covered rock at Propellor OF; Right, after sampling the rocks from one replicate at MN-01 OF, note the six bare circles.

No periphyton samples could be collected at Echo OF as it was dry during August sampling. Substrate at Komatic IF was entirely soft sediments, with no rocks. The periphyton community was collected in a similar fashion to other streams, by holding a template onto the sediment, scraping the periphyton off the sediment, and using a syringe to collect the suspended periphyton.

The volume of periphyton samples were measured back at the lab. For biomass, each sample was homogenized, and a known volume (usually between 5 and 10%) was sampled using a syringe. This subsample was filtered onto 0.45 µm pore size filters back in camp and kept dark and frozen until analysis by ALS in Burnaby. The remaining volume was the density/taxonomy sample and was preserved with Lugol's solution and sent to EcoAnalysts, Idaho, USA for enumeration and identification.

2.8.5 Quality Assurance/Quality Control (QA/QC)

Primary producer samples had triplicate replication at each site, and used chain of custody forms. EcoAnalysts have their own internal QA/QC protocols including creating a digital image library of every taxon encountered in the project for future reference, and having an independent phycologist analyze 10% of samples to ensure taxonomic accuracy and reproducibility in the analysis methods.

2.8.6 Data Management and Analysis

The number of organisms per sample was converted to density, either cells/L for phytoplankton and cells/cm^2 for periphyton, by dividing each sample by the volume/area sampled.

Density, genus richness, and diversity were calculated from the taxonomic analysis. Richness is the simplest measure of biodiversity and is simply a count of the number of taxa (in this case genera) in a given area or volume. Diversity indices are quantitative measures of how evenly the taxon richness is distributed within a known area or volume.

For the calculation of richness and diversity, taxa were grouped by genera. Plankton and periphyton not identifiable to the genus level were excluded from the richness and diversity analysis (for phytoplankton an unknown Chlorophyte coccoid, for periphyton an unknown centric diatom and an unknown pennate diatom). The Simpson's diversity index (D) was used as the measure of diversity, and takes into account dominance, the number of taxa present, and relative abundance of each taxa (evenness). This was calculated by:

$$\textit{Simpson's Diversity Index (}D\textit{)} = 1 - \sum_{i=1}^{G} p_i^2$$

where G is the number of genera present, and p_i is the relative density of each genus calculated as n_i/N, where n_i is the number of individuals in genus i, and N is the total number of all individuals. Note that this formula for the Simpson's diversity index produces values that range from 0 (lowest diversity) to 1 (maximum diversity), and represents the probability that two genera taken randomly from a sample are from two different genera.

2.9 AQUATIC INVERTEBRATES

2.9.1 Zooplankton

Zooplankton are the heterotrophic component of aquatic plankton, and serve as an important link in the aquatic food web, acting as consumers of phytoplankton and prey to many fish species. Zooplankton samples were collected from seven lake sites in the Goose Property and nine lakes sites in the George Property during August 2012 (Table 2.1-1).

Field Collection

Three samples were collected using a 30 cm diameter, 118 µm mesh size zooplankton net fitted with an internally mounted flowmeter (General Oceanics, model 2030R). At locations deeper than 6 m, vertical hauls were used. At these sites, the net was lowered to within 1.5 m of the lake bottom and brought to the surface at a speed of 0.5 m/s. At sites between 2 m and 6 m depth, oblique tows were conducted by lowering the net to within 1.5 m of the lake bottom and hauling the net vertically while the boat was moved along the anchor line. Horizontal tows were conducted at the shallower sites less than 2 m by pulling the zooplankton net through the surface water (0.5 m depth) for approximately 10 s at a rate of 0.5 m/s.

The samples were preserved with 5% buffered formalin and sent to EcoAnalysts, Idaho, USA, for enumeration and identification (Plate 2.9-1).



Plate 2.9-1. Zooplankton collected at Rabbit Lake, August 2012.

Quality Assurance/Quality Control (QA/QC)

Zooplankton samples had triplicate replication at each site, and used chain of custody forms. EcoAnalysts have their own internal QA/QC protocols including creating a digital image library of every taxon encountered in the project for future reference, and having an independent taxonomist analyze 10% of samples to ensure taxonomic accuracy and reproducibility in the analysis methods.

Data Management

The internally-mounted flowmeter was used to allow the calculation of the volume of water passing through the net during all hauls. The volume sampled for zooplankton was calculated, as outlined in the General Oceanics instruction manual (General Oceanics Inc., accessed 2012), and shown by the following equation:

$$\textit{Volume in } m^3 = (\textit{number of flowmeter counts} \times 26{,}873/999{,}999) \times (\textit{diameter of net opening}^2/4) \times \pi$$

Zooplankton densities were calculated by dividing the number of individuals per sample by the volume of water filtered (in cubic metres).

Genus richness and diversity were calculated as outlined in the primary production section, with organisms unidentified to genus level excluded from analyses. Additionally, nauplii were excluded from all analyses, and copepodites were excluded from composition, richness, and diversity analyses.

2.9.2 Benthic Macroinvertebrates

Benthic macroinvertebrates (benthos) are organisms greater than 500 µm in size that inhabit lake and stream bottoms. Benthos are important indicators of environmental change as these organisms are in close contact with the sediments and feed on algae, bacteria, and detritus. Benthic invertebrates also less mobile than fish, making them good indicators of local conditions. Benthic organisms are also important food sources for fish, particularly in streams.

Lake Benthos Field Collection

Lake benthos samples were collected from eleven lake sites in the Goose Property and ten lake sites in the George Property during August 2012. Five replicate samples, each a composite of three Ekman grab

samples, were collected at each lake site. Samples were gently sieved in the field using a 500 µm sieve bucket (Plate 2.9-2). Samples were preserved in 10% buffered formalin and then sent to EcoAnalysts, Idaho, USA, for enumeration and identification.



Plate 2.9-2. Sediment was gently sieved out of the benthos samples.

Stream Benthos Field Collection

Benthos samples were collected from seventeen stream sites during August 2012. A 500 µm mesh size Hess sampler, with a sampling surface area of 0.096 m^2, was used to collect stream benthos samples (Plate 2.9-3). Five replicate samples, each a composite of three Hess samples were collected from each stream station. Most streams had limited flow during August. Consequently, replicate samples were collected where depth and substrate allowed. Notes were taken on depth and flow in the area. When required, flow was created by the sampler to ensure all benthic invertebrates were swept into the Hess sampler's cod end.



Plate 2.9-3. Benthos samples were collected using a Hess Sampler. Left, at Gander US, one of the streams with higher flow and volume; Right, a small benthos sample at bottom of plastic sample jar from Gander US.

Samples were preserved in 10% buffered formalin and sent to EcoAnalysts, Idaho, USA for enumeration and identification.

Quality Assurance/Quality Control (QA/QC)

Each lake and stream benthos sample was a composite of three subsamples. Five benthos replicate samples were collected at each site, and all samples were recorded on chain of custody forms. EcoAnalysts have their own internal QA/QC protocols including having an independent taxonomist analyze 10% of samples to ensure taxonomic accuracy and reproducibility in the analytical methods, and assessing their sorting efficiency.

To ensure consistent and accurate sorting of benthos samples (sorting efficacy), a quality assurance (QA) sort of benthic sample residues was conducted on a randomly selected 10% of the benthos samples. The criterion for an acceptable sort was that more than 90% of the total number of organisms found in both the initial and QA sort were recovered during the initial sort, as required by Environment Canada for invertebrate community surveys (Environment Canada 2002). Any sample not meeting the 90% removal criterion was re-sorted a third time.

This was calculated by the following equation:

$$\text{SortingEfficacy} = \frac{\text{OriginalCount}}{\text{OriginalCount} + \left(\frac{\text{QACount} * \text{QASquares}}{\text{QTSquares}} \right)} * 100$$

where OriginalCount = the number of organisms picked up by the first sorter; QACount = the number of organisms found in the Quality Assurance sort; QASquares = the number of grids sorted during the QA process; QTSquares = the total number of grids in the QA Caton sampling tray.

2.9.3 Data Management

The number of individuals per sample was converted to density (individuals/m^2) by dividing each sample by the volume/area sampled.

Richness and diversity were calculated as outlined in the primary producer section, but at the family level instead of the genus level. Organisms unidentified to genus level were excluded from analyses. Nematodes are meiofauna and samples collected using 500 µm mesh will not be representative, copepods are pelagic and cladocera (water fleas) are mobile and were not considered permanent members of the benthos (Environment Canada 2011).

3. Results and Discussion

3. Results and Discussion

3.1 TEMPERATURE AND DISSOLVED OXYGEN

3.1.1 Under-ice Physical Limnology

Ice thickness, temperature, and dissolved oxygen concentrations were measured in April 2012 (Figures 3.1-1a to 3.1-1c; Appendix 3.1-1).

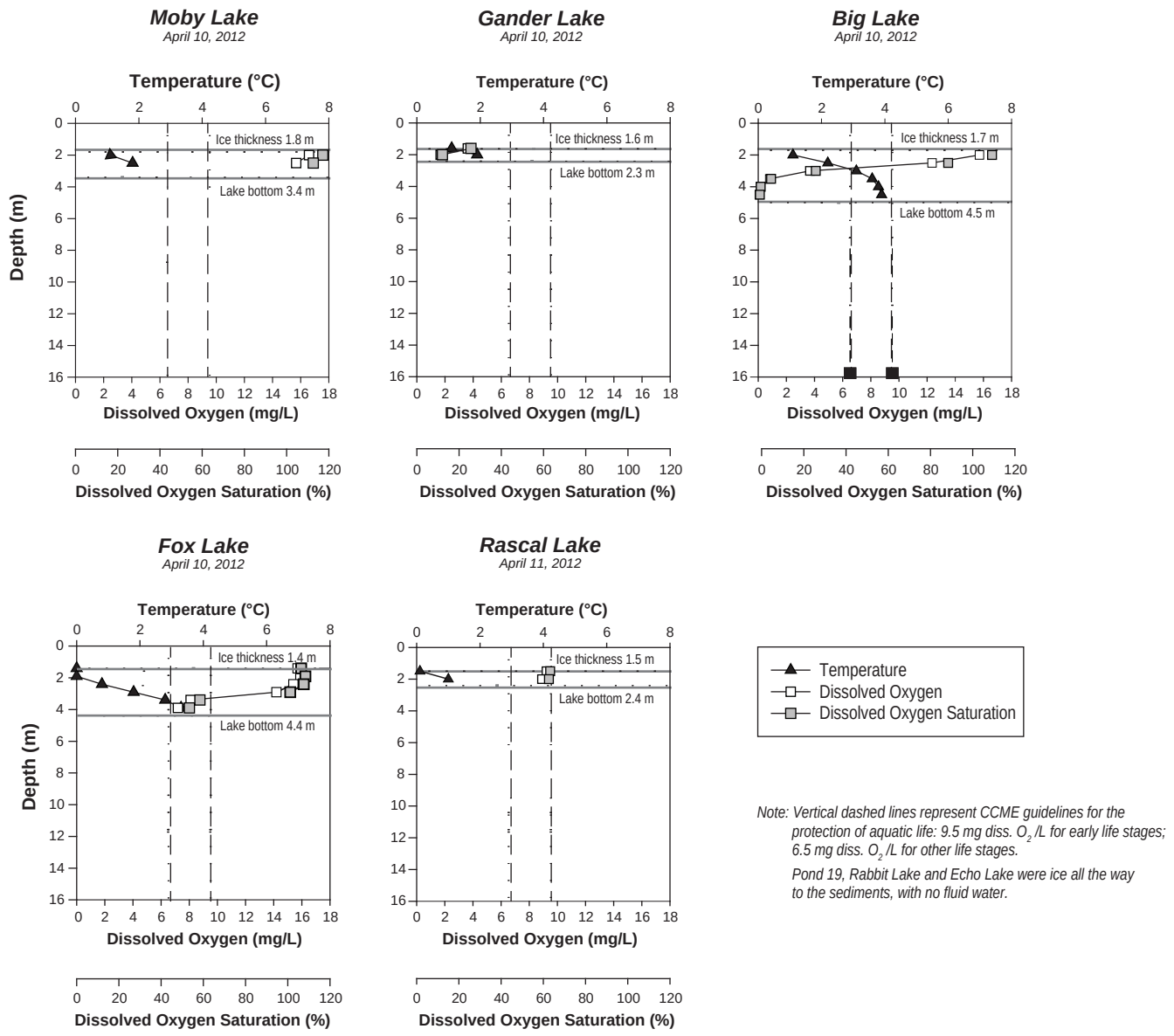
All lakes were isothermal. Temperatures near the ice-water interface were close to 1°C, and warmed to approximately 3°C to 4°C near the sediments of lakes deeper than 4 m. Temperatures in the deeper Reference Lake C, with a maximum lake depth of 35 m, were cooler ranging from 0.6°C at the ice-water interface to 1.1°C close to the bottom.

April temperature and dissolved oxygen profiles at sampling sites generally had lower temperatures and higher dissolved oxygen concentrations at the ice-water interface than near the sediments. Reference Lake C had more consistent temperatures and dissolved oxygen concentrations through the water column than the other lake sites. There was no clear difference in profiles between lakes in the Goose and George areas.

Dissolved oxygen concentrations tended to be highest near the water-ice interface: between 13.0 mg/L and 17.7 mg/L in most lakes. The water near the water-ice interface was at over 90% oxygen saturation at most lakes. Well-oxygenated water suggests there was higher primary productivity at the surface, with the actively photosynthesizing algae as the main oxygen source during the under-ice period since no atmospheric exchange was possible.

The two lakes that were not well oxygenated in April were the shallow Gander Lake (2.3 m) and Rascal Lake (2.4 m), both within the Goose Property. These lakes had dissolved oxygen concentrations that were below CCME guidelines for freshwater aquatic life. Established CCME guideline oxygen concentrations for the protection of cold-water aquatic life are 9.5 mg/L for early life stages and 6.5 mg/L for other life stages (CCME 2012). The maximum dissolved oxygen concentration at Gander Lake was 3.6 mg/L, well below the CCME guidelines for early and all other life stages. Rascal Lake had dissolved oxygen concentrations slightly below the CCME guideline for early life stages (9.22 mg/L and 8.9 mg/L). The highest dissolved oxygen concentrations were measured at the shallowest lake George Lake South (15.2 mg/L) (George Property). However there was only 0.4 m of fluid water, and results could be an artifact of the augering process in extremely low water conditions or a reflection of ice algae or periphyton photosynthesis.

Generally, dissolved oxygen concentrations declined gradually throughout the water column to minimum concentrations at the water-sediment interface. Many lakes had minimum dissolved oxygen concentrations below the CCME guidelines in their deeper waters; exceptions tended to be the shallow lakes (Moby, Giraffe North, Goose Neck, Goose Central, and George South) and the deeper lakes (Fold, George Central, and Reference C). Low levels of dissolved oxygen near the water-sediment interface are common in Arctic lakes over April, and are a result of oxygen depletion from decomposition and respiration in the water-sediment interface and a lack of atmospheric exchange due to ice cover (CCME 2012).



Note: Vertical dashed lines represent CCME guidelines for the protection of aquatic life: 9.5 mg diss. O_2 /L for early life stages; 6.5 mg diss. O_2 /L for other life stages.

Pond 19, Rabbit Lake and Echo Lake were ice all the way to the sediments, with no fluid water.

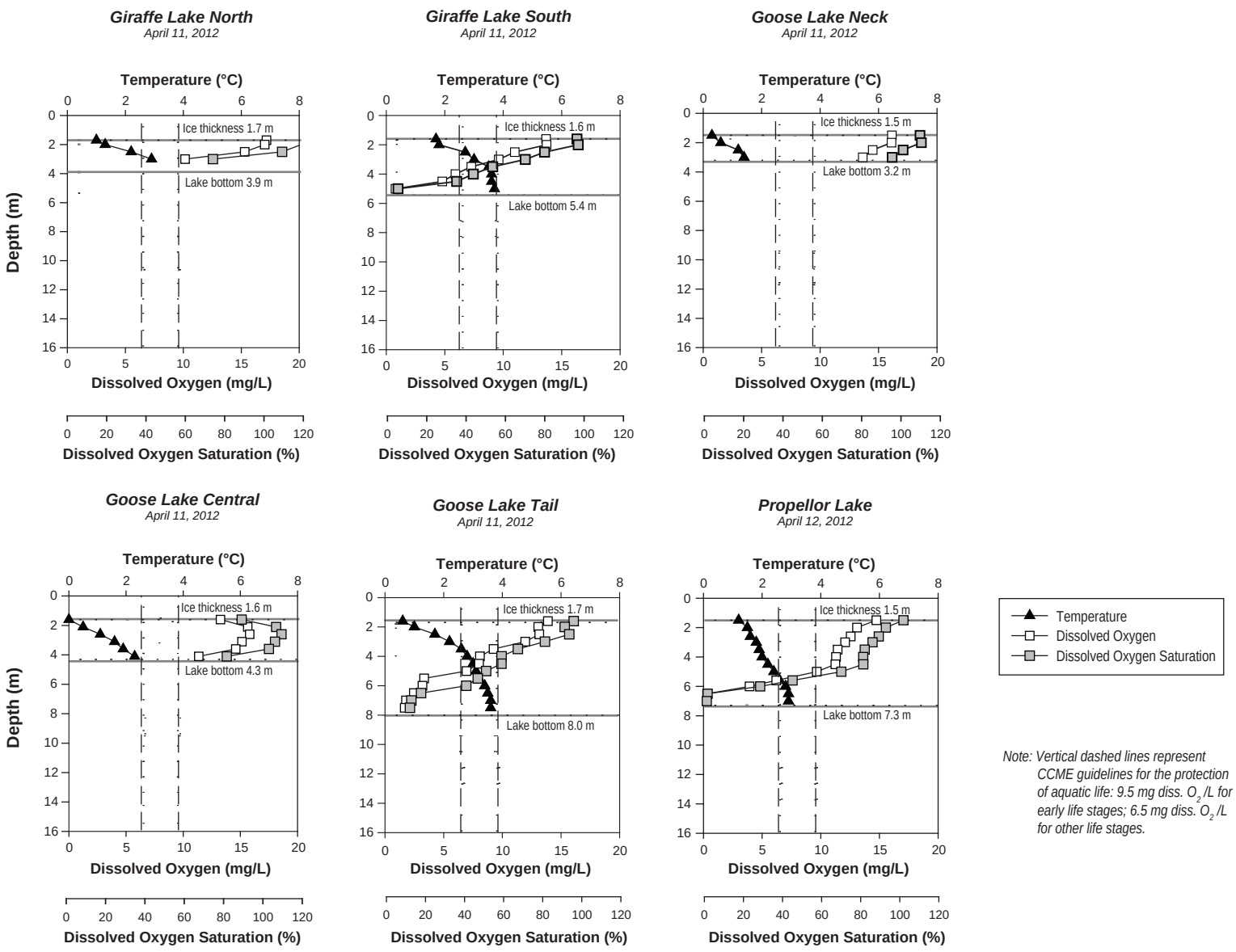
Figure 3.1-1a

Sabina GOLD & SILVER CORP.

Under-ice Temperature and Dissolved Oxygen Profiles in Goose Area Lakes, Back River Project, April 2012

Figure 3.1-1a

Rescan™ Engineers & Scientists



Note: Vertical dashed lines represent CCME guidelines for the protection of aquatic life: 9.5 mg diss. O_2 /L for early life stages; 6.5 mg diss. O_2 /L for other life stages.

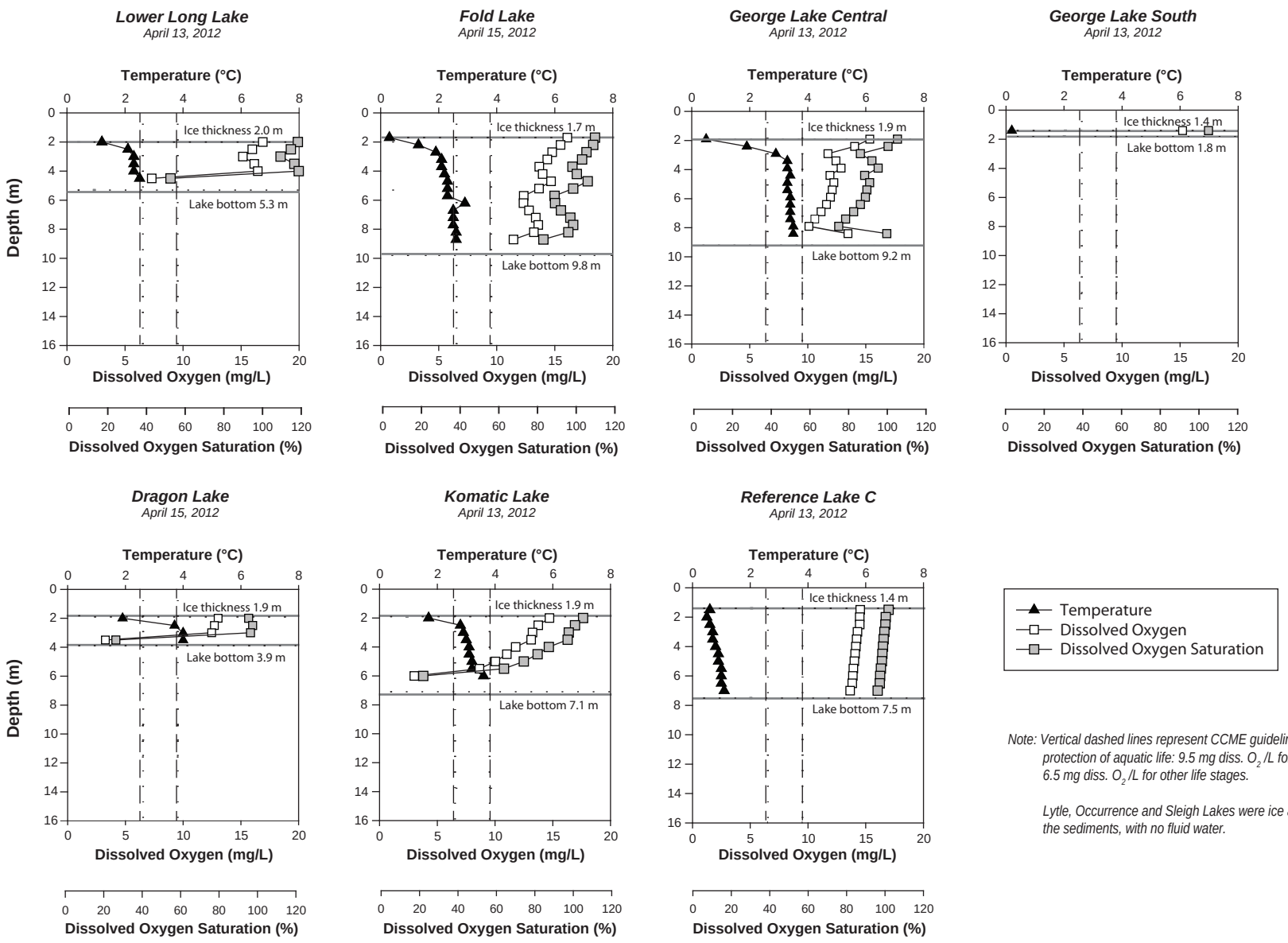
Figure 3.1-1b

Sabina GOLD & SILVER CORP.

Under-ice Temperature and Dissolved Oxygen Profiles in Goose Area Lakes, Back River Project, April 2012

Figure 3.1-1b

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Note: Vertical dashed lines represent CCME guidelines for the protection of aquatic life: 9.5 mg diss. O_2 /L for early life stages; 6.5 mg diss. O_2 /L for other life stages.

Lytle, Occurrence and Sleigh Lakes were ice all the way to the sediments, with no fluid water.

Figure 3.1-1c

Sabina GOLD & SILVER CORP.

Under-ice Temperature and Dissolved Oxygen Profiles in George Area Lakes, Back River Project, April 2012

Figure 3.1-1c

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3.1.2 Open-water Physical Limnology

Limnological characteristics were measured during the open-water season in August 2012, and included temperature and dissolved oxygen profiles (Figures 3.1-2a to 3.1-2d) and Secchi depths. Surface temperatures tended to be higher, and dissolved oxygen concentrations and saturations lower, in August than in April. Lake temperature and dissolved oxygen profiles were also more stable down the water column in August than in April.

Depth profiles showed most lakes were well mixed in the August, with uniform temperatures and dissolved oxygen concentrations through the water column. The exception to this was Reference Lake C, a lake over twice as deep as the others sampled, which was stratified with a distinct thermocline at 19 m. Waters above the thermocline were warmer, with lower dissolved oxygen concentrations, although dissolved oxygen saturation was fairly constant throughout the water column.

Overall, surface temperatures varied between lakes from 8.5°C to 13°C, with the warmest lakes being Moby Lake, Fox Lake, Goose Lake Neck and Propellor Lake, all in the Goose area. Water temperatures below the thermocline at Reference Lake C were cooler, ranging from 6°C to 8.5°C (Figure 3.1-2d).

August dissolved oxygen concentrations and saturations were greater in the Goose area lakes than in the George area lakes. Dissolved oxygen concentrations ranged between 9.5 mg/L and 11.5 mg/L in Goose area lakes, and between 8 mg/L and 9.5 mg/L in the George area lakes (with the highest concentrations below the thermocline in Reference Lake C). Dissolved oxygen saturations followed a similar trend, ranging from 85% to 100% in Goose area lakes compared with 75% to 80% in George area lakes.

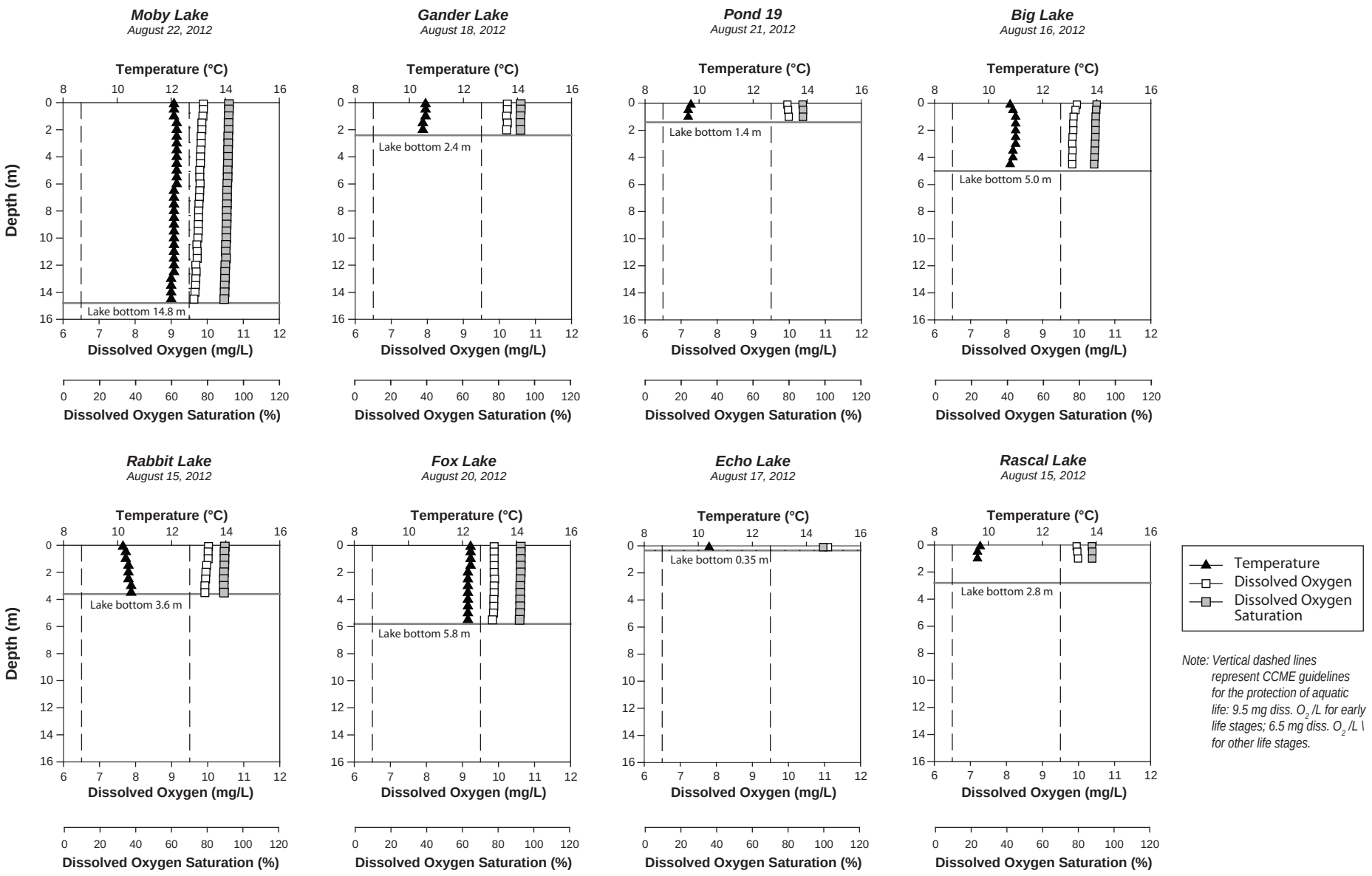
Dissolved oxygen concentrations were above the CCME guideline for the protection of aquatic life for early life stages (9.5 mg/L) at all Goose area lake sites at all depths. For lakes within the George Property, dissolved oxygen concentrations tended to be below the CCME guideline with the exception of Reference Lake C. All lakes at all depths were above the CCME guidelines for early life stages (6.5 mg/L; CCME 2012).

Secchi depth, a measure of water clarity, was deeper than the bottom in shallower lakes (i.e., light reached sediment layer), and ranged from 4.8 m to 8.4 m in the deeper lakes (Table 3.1-1). The euphotic depth, the depth with sufficient sunlight for net photosynthesis, extended throughout the water column in all lakes, except the deep Reference Lake C. This indicates that net photosynthesis could occur throughout the entire water column as well as in the benthic habitat. Reference Lake C had a euphotic depth 17 m, slightly above the observed August thermocline (19 m). This indicates this lake would be less favourable for phytoplankton growth during this period due to the algae being mixed into deeper, more poorly lit waters. Benthic primary production would be increasingly possible as the waters became shallower than 17 m.

3.1.3 Stream Temperature and Dissolved Oxygen

Stream temps and DO measurements were collected in June 2012, shortly after ice thaw, and in the lower flow August and September months. Streams had higher water levels and flow in June, and lower levels and flow in August, with moderate water levels and flow in September. Sections of many streams were either dry or flowed underground or through boulder fields during August sampling. Echo OF was dry during August sampling, and both Reference B OF and Reference C OF sampling sites had to be moved upstream to allow sampling. Plate 3.1-1 shows the stream flow and water level during the three sampling sessions; many streams also had hydrometric stations with quantitative data available in the 2012 hydrology report (Rescan 2012b).

Temperatures were measured in June, August, and September 2012, and dissolved oxygen concentrations were measured during the lower flow sampling surveys in August and September 2012.



Note: Vertical dashed lines represent CCME guidelines for the protection of aquatic life: 9.5 mg diss. O_2 /L for early life stages; 6.5 mg diss. O_2 /L \ for other life stages.

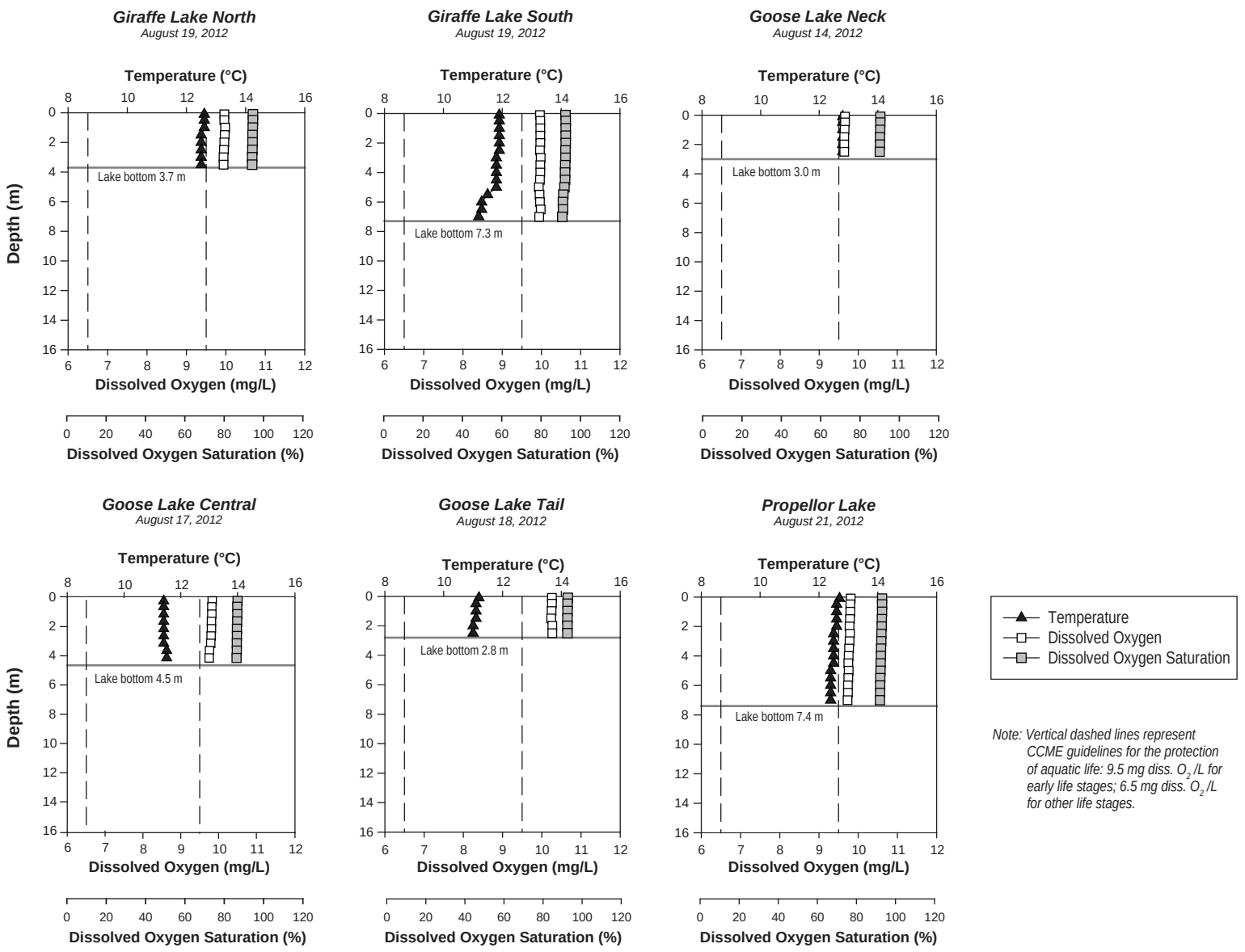
Figure 3.1-2a

Sabina GOLD & SILVER CORP.

Open-water Temperature and Dissolved Oxygen Profiles in Goose Area Lakes, Back River Project, August 2012

Figure 3.1-2a

Rescan™ Engineers & Scientists



Note: Vertical dashed lines represent CCME guidelines for the protection of aquatic life: 9.5 mg diss. O_2 /L for early life stages; 6.5 mg diss. O_2 /L for other life stages.

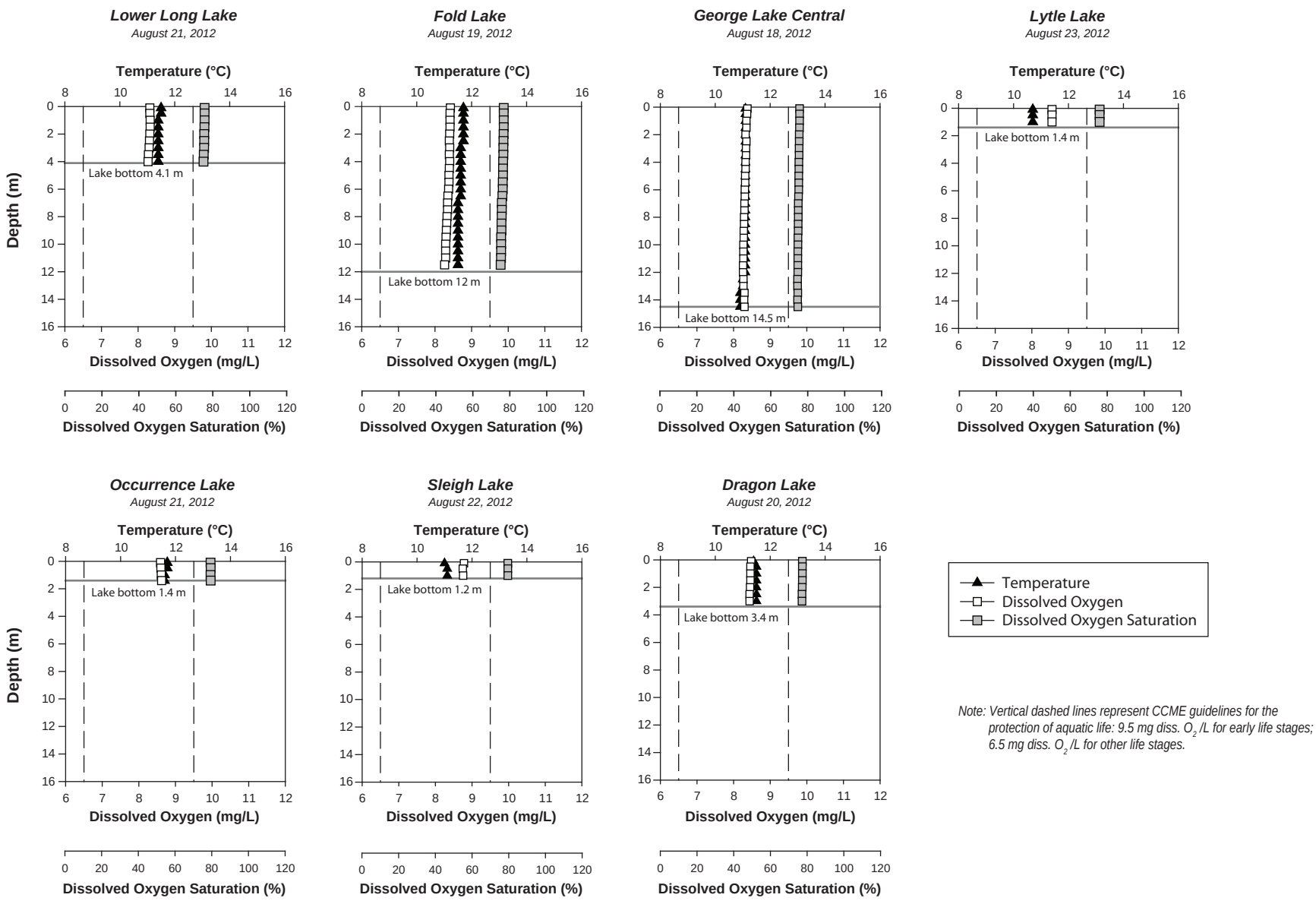
Figure 3.1-2b

Sabina GOLD & SILVER CORP.

Open-water Temperature and Dissolved Oxygen Profiles in Goose Area Lakes, Back River Project, August 2012

Figure 3.1-2b

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Note: Vertical dashed lines represent CCME guidelines for the protection of aquatic life: 9.5 mg diss. O_2 /L for early life stages; 6.5 mg diss. O_2 /L for other life stages.

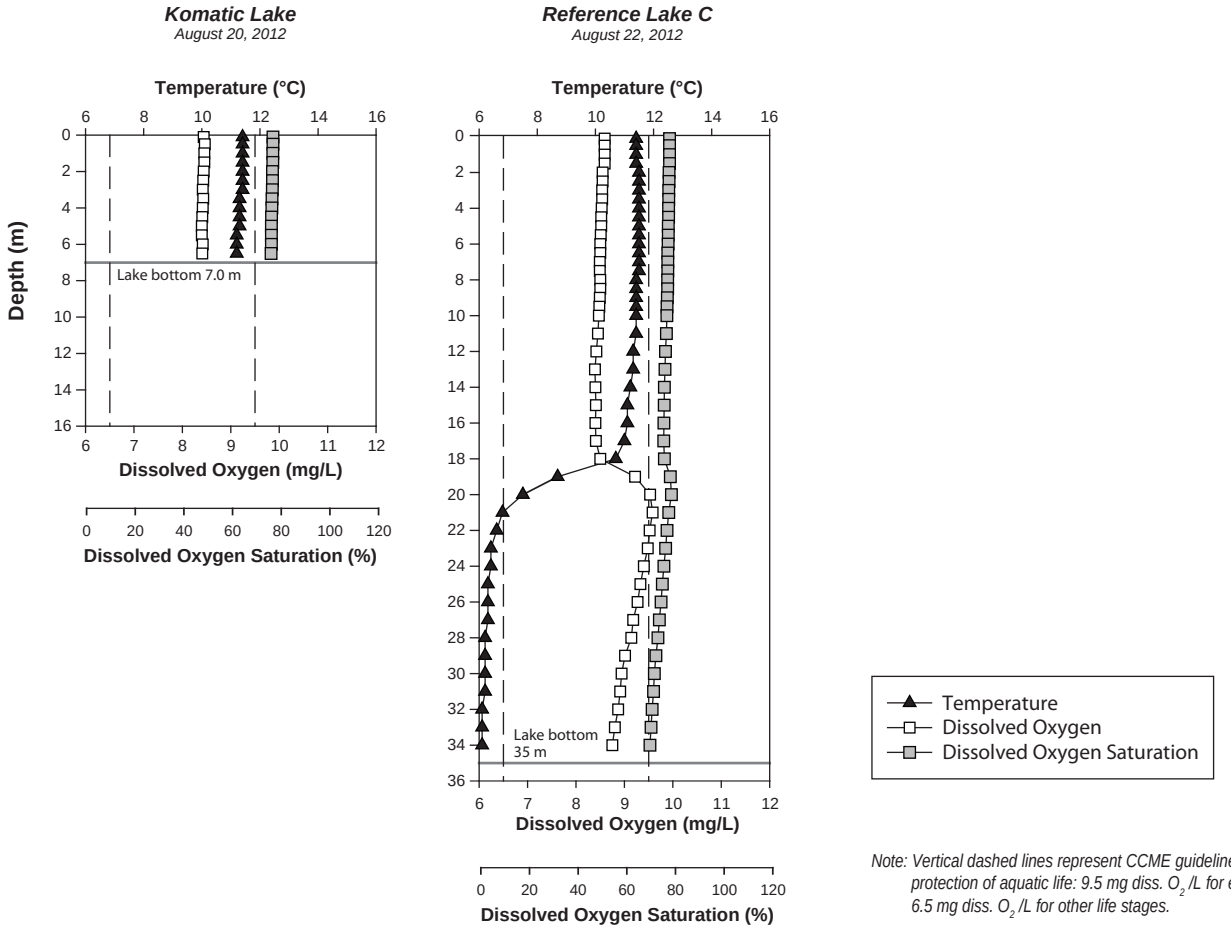
Figure 3.1-2c

Sabina GOLD & SILVER CORP.

Open-water Temperature and Dissolved Oxygen Profiles in George Area Lakes, Back River Project, August 2012

Figure 3.1-2c

Rescan™ Engineers & Scientists



Note: Vertical dashed lines represent CCME guidelines for the protection of aquatic life: 9.5 mg diss. O_2 /L for early life stages; 6.5 mg diss. O_2 /L for other life stages.

Figure 3.1-2d

Sabina GOLD & SILVER CORP.

Open-water Temperature and Dissolved Oxygen Profiles in George Area Lakes, Back River Project, August 2012

Figure 3.1-2d

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Table 3.1-1. Secchi and Euphotic Zone Depths for the Back River Lakes, August 2012

Lake	Sampling Site Depth (m)	Secchi Depth D_s (m)	Euphotic Zone Depth EZD (m)
Goose Area			
Moby Lake	14.8	6.7	bottom (18.1)
Gander Lake	2.4	bottom	
Pond 19	1.4	bottom	
Big Lake	5.0	bottom	
Rabbit Lake	3.6	bottom	
Fox Lake	5.8	5.0	bottom (13.5)
Echo Lake	0.4	bottom	
Rascal Lake	2.8	bottom	
Giraffe Lake North	3.7	bottom	
Giraffe Lake South	7.3	5.5	bottom (14.9)
Goose Lake Neck	3.0	bottom	
Goose Lake Central	4.5	bottom	
Goose Lake Tail	2.8	bottom	
Propellor Lake	7.4	6.5	bottom (17.6)
George Area			
Lower Long Lake	4.1	bottom	
Fold Lake	12	6.7	bottom (18.1)
George Lake Central	14.5	8.4	bottom (22.7)
George Lake South	1.6	bottom	
Lytle Lake	1.4	bottom	
Occurrence Lake	1.4	bottom	
Sleigh Lake	1.2	bottom	
Dragon Lake	3.4	bottom	
Komatic Lake	7.0	4.8	bottom (13.0)
Reference Lake C	35.0	6.3	17.0

Note: Euphotic Zone Depth is the depth at which light penetration is 1% of the surface irradiance.

Temperatures varied seasonally in the Project streams, with the highest temperatures during the low-flow August period. Streams ranged from 3°C to 11°C in June, 8°C to 19°C in August, 3°C to 11°C in September. George area streams tended to be colder in June and warmer in August, with no clear trend in September (Table 3.1-2).

Dissolved oxygen concentrations in streams were lower in August than in September, with Llama OF having consistently lower concentrations than all other streams (Table 3.1-2). Streams in August had dissolved oxygen concentrations below 10.5 mg/L, with nine sampling sites below the CCME guideline for the protection of freshwater aquatic life for early life stages (9.5 mg/L; CCME 2012). Llama OF had dissolved oxygen concentrations below the CCME guideline for the protection of freshwater aquatic life for other life stages (6.5 mg/L) in both August and September. All other stream sampling sites had dissolved oxygen concentrations above CCME guidelines in September, with the maximum 11.7 mg/L at Wolf OF.

Goose Area Streams

Moby OF:



Gander IF:



Gander US:



Pond 19 OF:



Chair OF:



Llama OF:



(continued)

Plate 3.1-1. Stream water levels and flow varied between sampling events. From left to right, June (brown vegetation), August (green vegetation) and September (orange vegetation).

Echo OF:



Giraffe OF:



Wolf OF:



Goose OF:



Propellor OF:



Reference B OF (third from left is summer sampling location further upstream):



(continued)

Plate 3.1-1. Stream water levels and flow varied between sampling events. From left to right, June (brown vegetation), August (green vegetation) and September (orange vegetation) (continued).

George Area Streams

George OF:



Sleigh OF:



Dragon OF:



Komatic IF:



Reference C OF:



Plate 3.1-1. Stream water levels and flow varied between sampling events. From left to right, June (brown vegetation), August (green vegetation) and September (orange vegetation) (completed).

3.2 LAKE WATER QUALITY

Lake water quality samples were collected in April (under-ice) and August (open-water) 2012. Lake water quality data collected in 2012 are presented graphically in Figures 3.2-1a to 3.2-6. Raw water quality data for lakes are presented in Appendices 3.2-1 to 3.2-3.

Table 3.1-2. Temperature and Dissolved Oxygen in Streams, Back River Project, 2012

Stream	June	August			September		
	Temp (°C)	Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)	Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Saturation (%)
Goose Area							
Moby OF	4.6	10.6	9.59	86.1	4.2	10.91	83.7
Gander IF	3.5	11.8	9.56	88.3	4.1	11.25	86.0
Gander US	3.6	11.7	9.93	91.5	4.2	11.12	85.3
Pond 19 OF	5.6	8.5	7.92	67.5	3.3	10.47	78.4
Chair OF	6.4	12.0	9.86	91.5	4.6	10.79	83.6
Llama OF	5.0	9.9	4.55	40.1	5.9	5.75	46.1
Echo OF	8.5	nc	nc	nc	4.3	10.63	81.7
Giraffe OF	5.6	15.0	8.90	88.4	4.4	10.88	83.9
Wolf OF	9.2	11.9	9.99	92.5	2.2	11.72	85.2
Goose OF	6.2	18.9	9.64	101.7	4.5	10.99	84.9
Propellor OF	5.2	14.4	7.10	69.5	5.7	9.90	79.0
Reference B OF	10.5	13.1	8.57	81.5	6.0	10.93	87.6
George Area							
George OF	3.4	15.43	9.47	98.0	4.2	11.05	84.7
Sleigh OF	3.8	18.42	8.91	95.1	4.3	11.10	85.1
Dragon OF	3.7	17.34	8.96	93.5	5.2	11.01	86.7
Komatic IF	5.5	12.83	9.26	87.7	4.2	11.04	84.5
Reference C OF	3.3	13.77	10.24	99.1	7.3	10.62	88.2

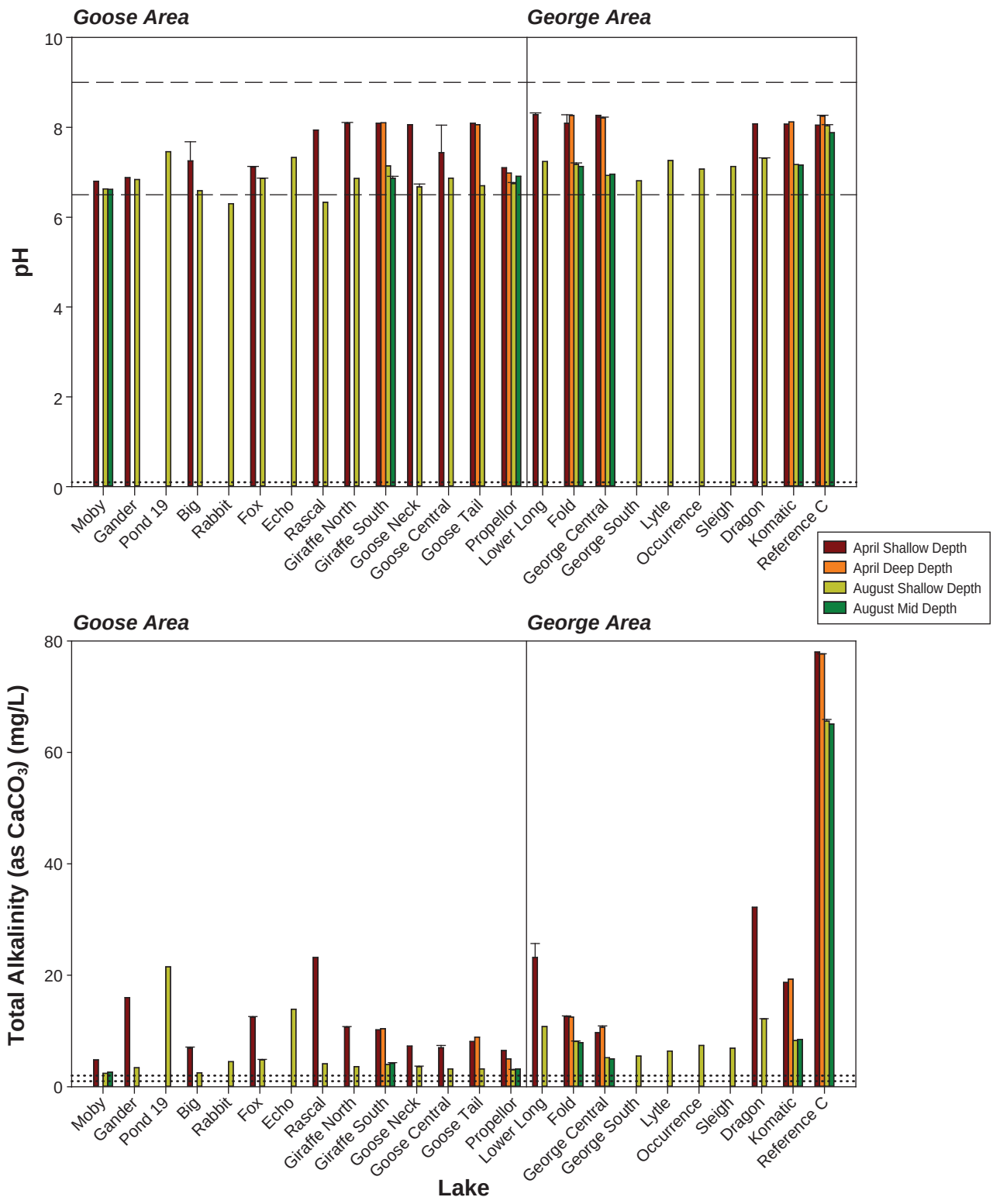
Note: Shaded values show concentrations below the CCME guidelines for freshwater aquatic life; light grey for early life stages (9.5 mg/L) and dark grey for all life stages (6.5 mg/L).

3.2.1 Physical Parameters

The lakes had slightly acidic to alkaline pH values ranging from 6.3 at Rabbit Lake in August to 8.32 at Lower Long Lake in April (Figure 3.2-1a). Lake water tended to be more acidic in August (average of 7.0) than in April (average of 7.8), and more acidic in Goose area lakes (average of 7.1) than in George area lakes (average of 7.7). Only Rabbit Lake and Rascal Lake during August had pH levels outside the CCME guideline range of 6.5 to 9.0 (CCME 2012), each with pH levels of 6.3.

Alkalinity measures the buffering capacity (i.e., ability to neutralize acids) of a lake, with greater alkalinities having greater buffering abilities and a more stable pH. Total alkalinities varied across seasons and spatially between George and Goose area lakes, with higher alkalinity observed in April than in August, and in George area lakes than in Goose area lakes. Overall, the Project lakes were poorly buffered with total alkalinity below 35 mg $CaCO_3$/L and as low as 2.4 mg $CaCO_3$/L at Moby Lake in August. The exception to this was Reference Lake C, which ranged from 65 to 78 mg $CaCO_3$/L.

Hardness, conductivity and total dissolved solids (TDS) followed similar patterns to total alkalinity, with higher concentrations of each in April than in August, and in George area lakes than in Goose area lakes (Figure 3.2-1b). The sampled lakes generally had soft water (< 60 mg $CaCO_3$/L), with hardness less than 40 mg $CaCO_3$/L, low conductivity (< 100 µS/cm), and low levels of total dissolved solids, below 80 mg/L. The exceptions were Dragon and Komatic lakes in April, and Reference Lake C in both April and August, which had higher concentrations for all three parameters.



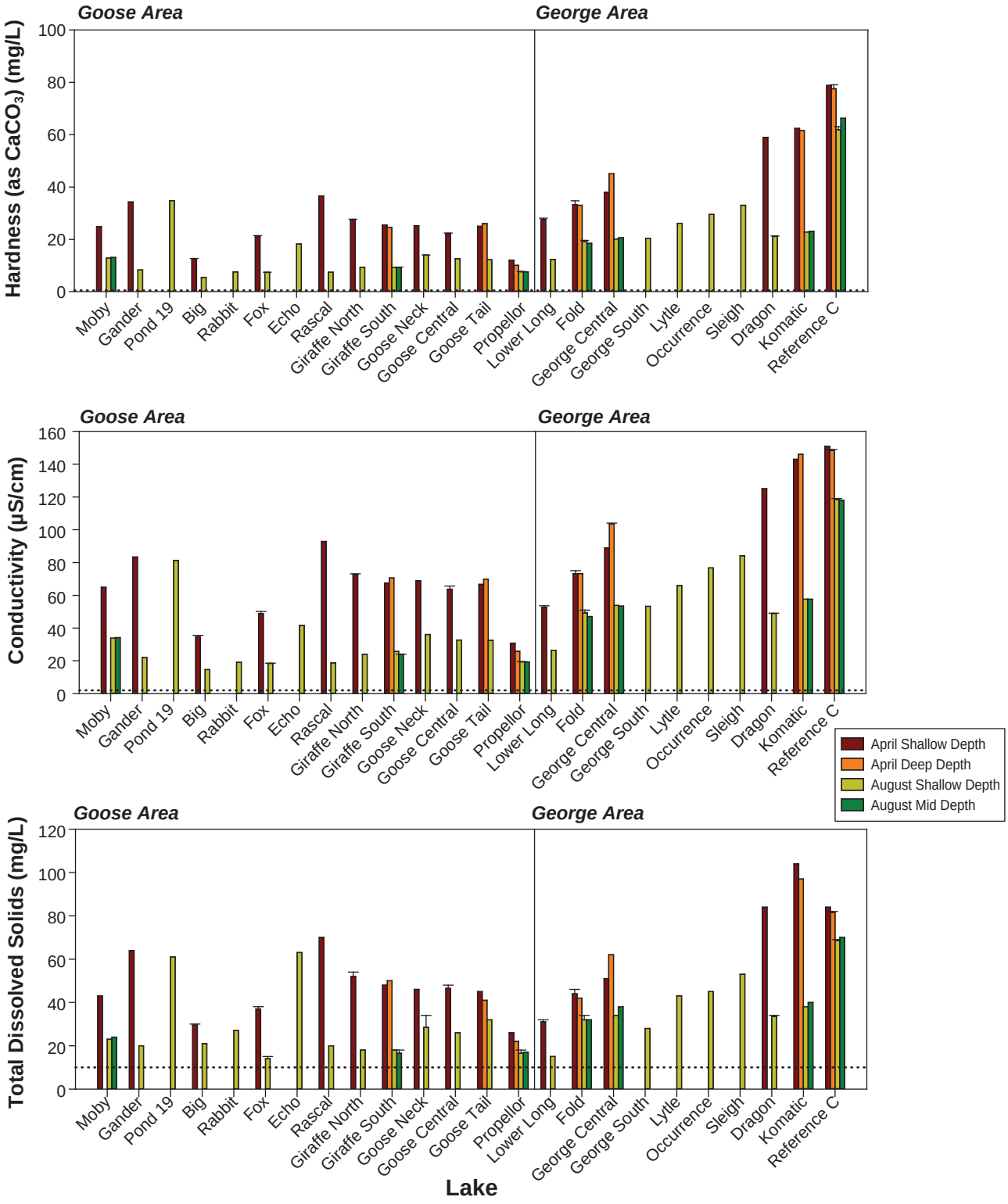
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (pH 0.1; alkalinity 1 or 2 mg/L).
Dashed lines represent CCME guideline for pH (6.5 - 9).

Sabina GOLD & SILVER CORP.

pH and Total Alkalinity in Lakes, Back River Project, 2012

Figure 3.2-1a

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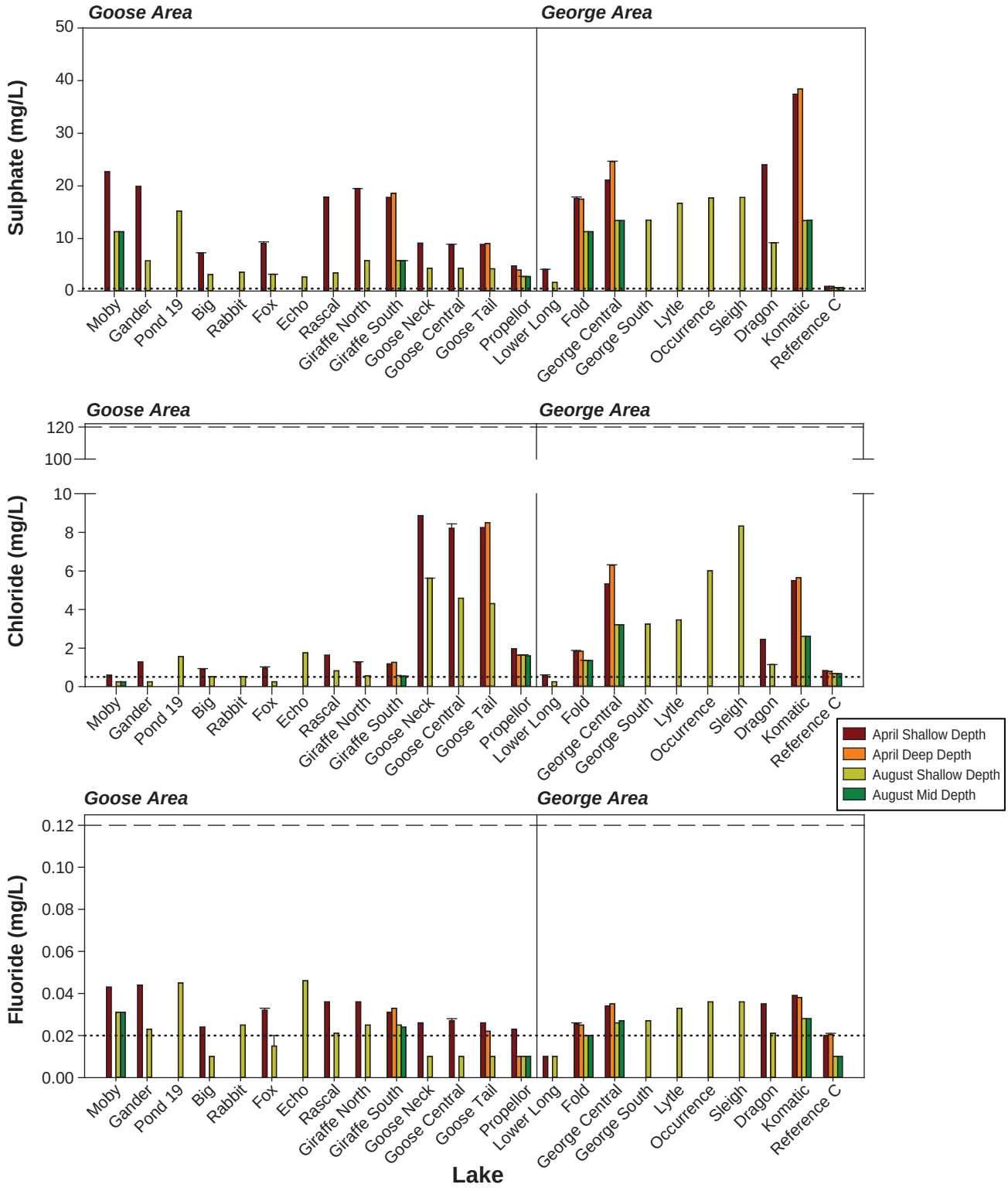
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (hardness 0.5 mg/L; conductivity 2.0 µS/cm; total dissolved solids 10 mg/L).

Sabina GOLD & SILVER CORP.

Hardness, Conductivity and Total Dissolved Solid Concentrations in Lakes, Back River Project, 2012

Figure 3.2-1b

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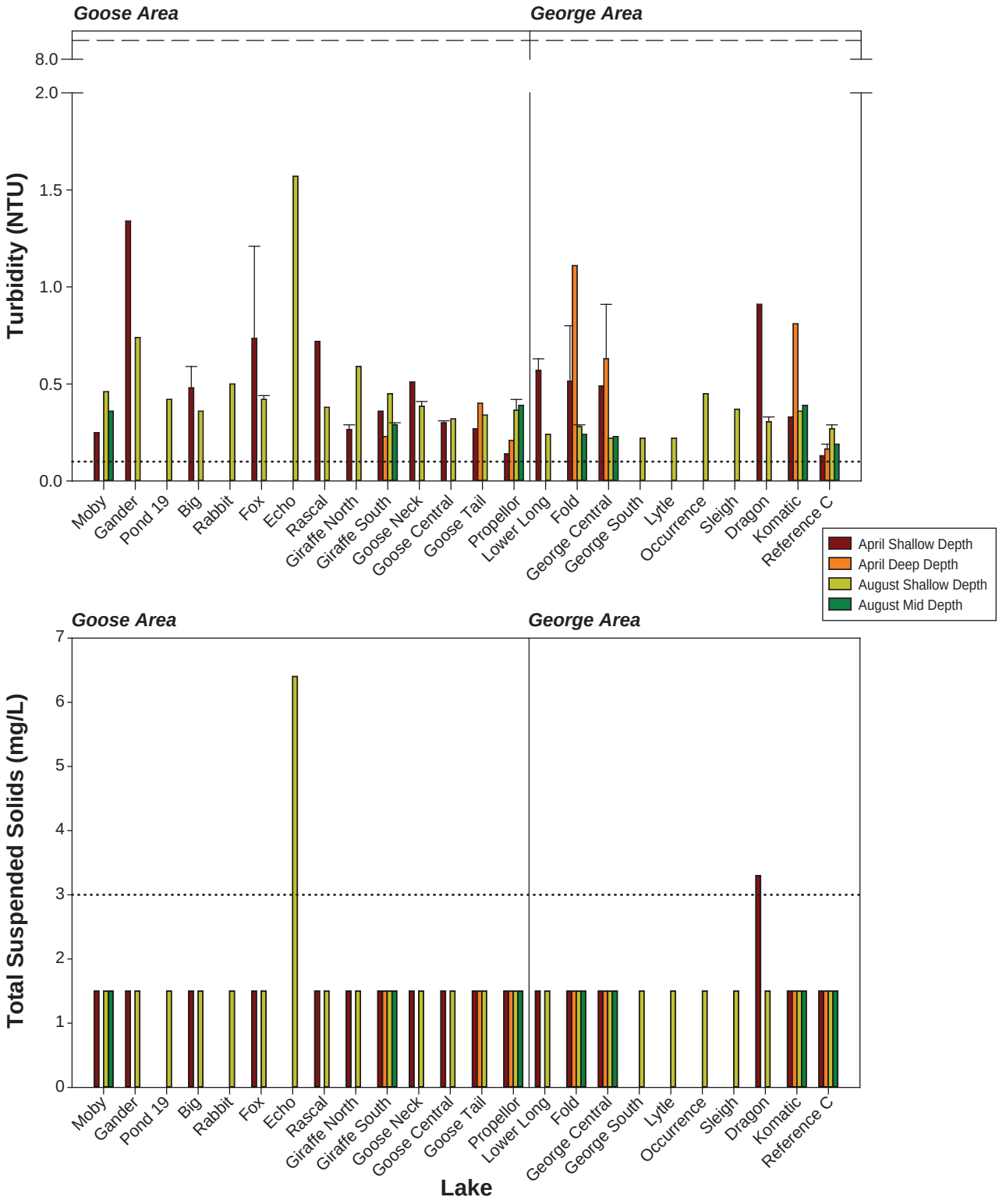
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (sulphate 0.5 mg/L; chloride 0.5 mg/L; fluoride 0.02 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed red lines represent the CCME long-term guideline for chloride (120 mg/L) and the CCME interim guideline for fluoride (0.12 mg/L).
The CCME short-term guideline for chloride is 640 mg/L (not shown).

Sabina GOLD & SILVER CORP.

Sulphate, Chloride and Fluoride Concentrations in Lakes, Back River Project, 2012

Figure 3.2-2

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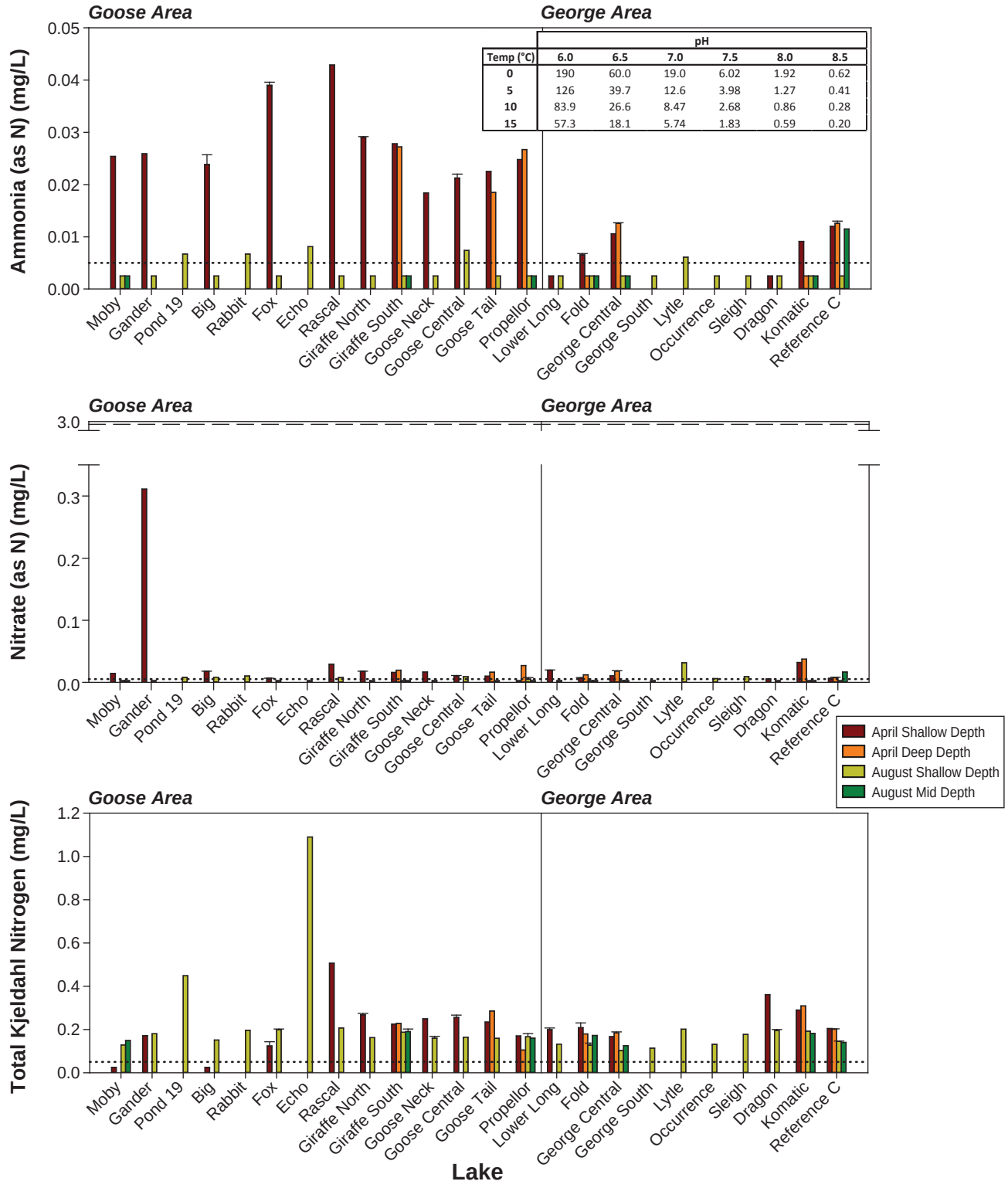
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (turbidity 0.1 mg/L; total suspended solids 3 mg/L).
Values below the detection limit are plotted at half the detection limit.
CCME guidelines for turbidity and total suspended solids are dependent upon background levels.

Sabina GOLD & SILVER CORP.

Turbidity and Total Suspended Solids Concentrations in Lakes, Back River Project, 2012

Figure 3.2-3

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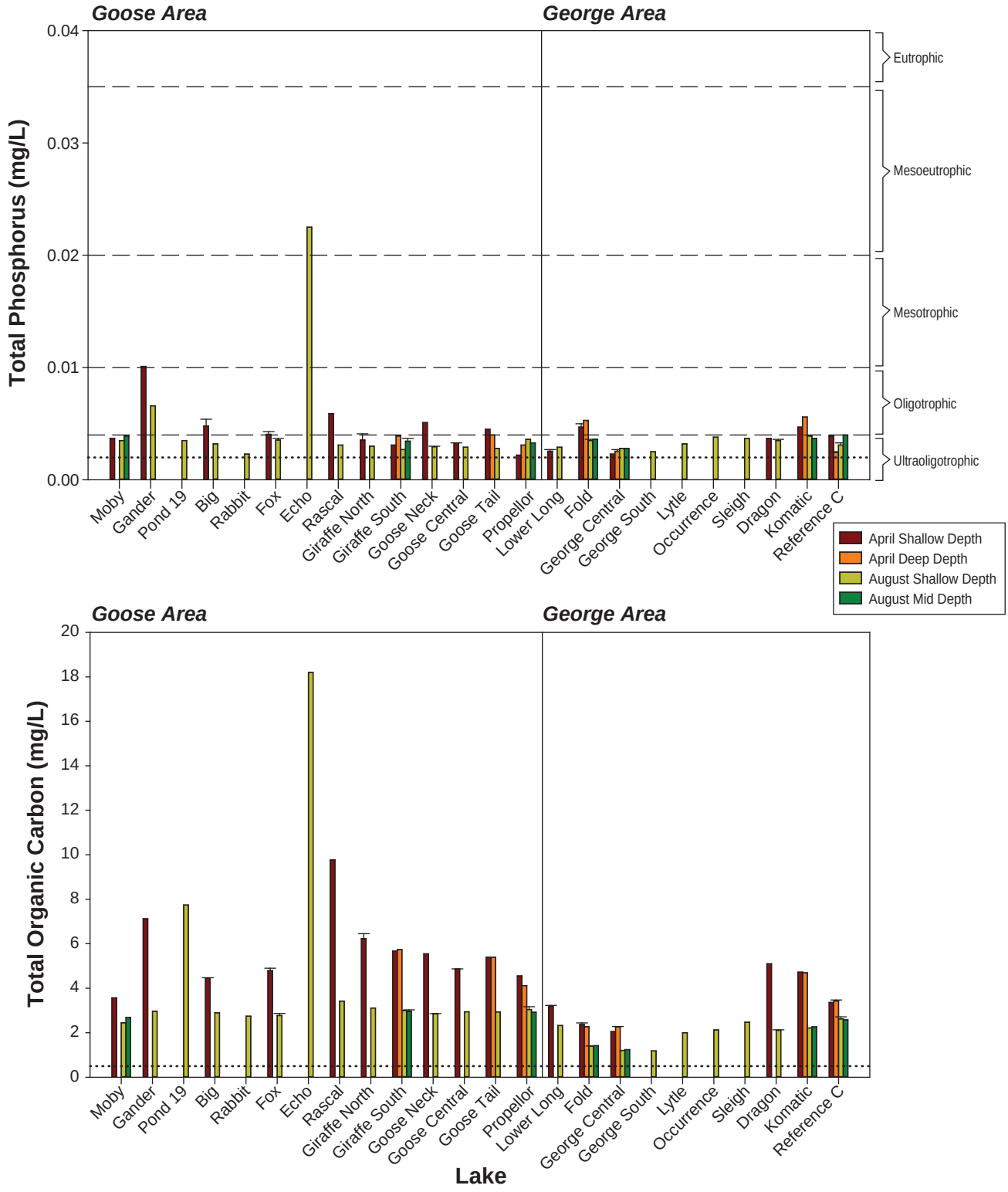
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (ammonia 0.005 mg/L; nitrate 0.005 mg/L; TKN 0.05 mg/L).
Values below the detection limit are plotted at half detection limit.Inset table shows temperature- and pH-dependent CCME guideline for ammonia.
Dashed lines represent CCME long-term guideline for nitrate (3 mg/L).
CCME short-term guideline for nitrate is 124 mg/L (not shown).Nitrite concentrations were always below detection limit (0.001 mg/L) so were not plotted.

Sabina GOLD & SILVER CORP.

Ammonia, Nitrate, and Total Kjeldahl Nitrogen Concentrations in Lakes, Back River Project, 2012

Figure 3.2-4a

Rescan™ Engineers & Scientists



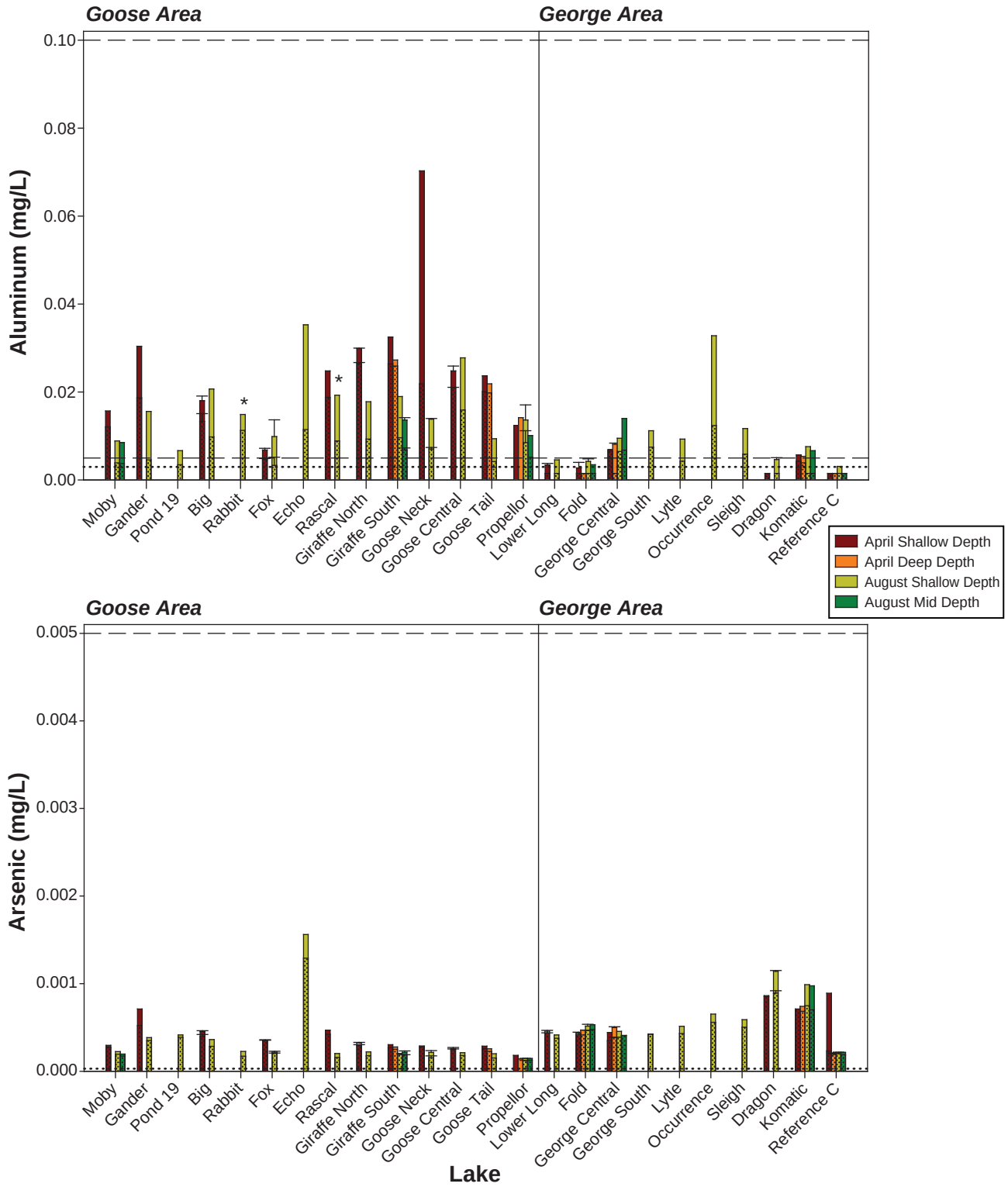
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (total phosphorus 0.002 mg/L; total organic carbon 0.5 mg/L).
Dashed lines represent CCME trigger ranges for total phosphorus(<0.004 mg/L = ultraoligotrophic; 0.004–0.010 mg/L = oligotrophic; 0.01–0.02 mg/L = mesotrophic; 0.02–0.035 mg/L = mesoeutrophic; 0.035–0.1 mg/L = eutrophic; >0.1 mg/L = hypereutrophic)

Sabina GOLD & SILVER CORP.

Total Phosphorus and Total Organic Carbon Concentrations in Lakes, Back River Project, 2012

Figure 3.2-4b

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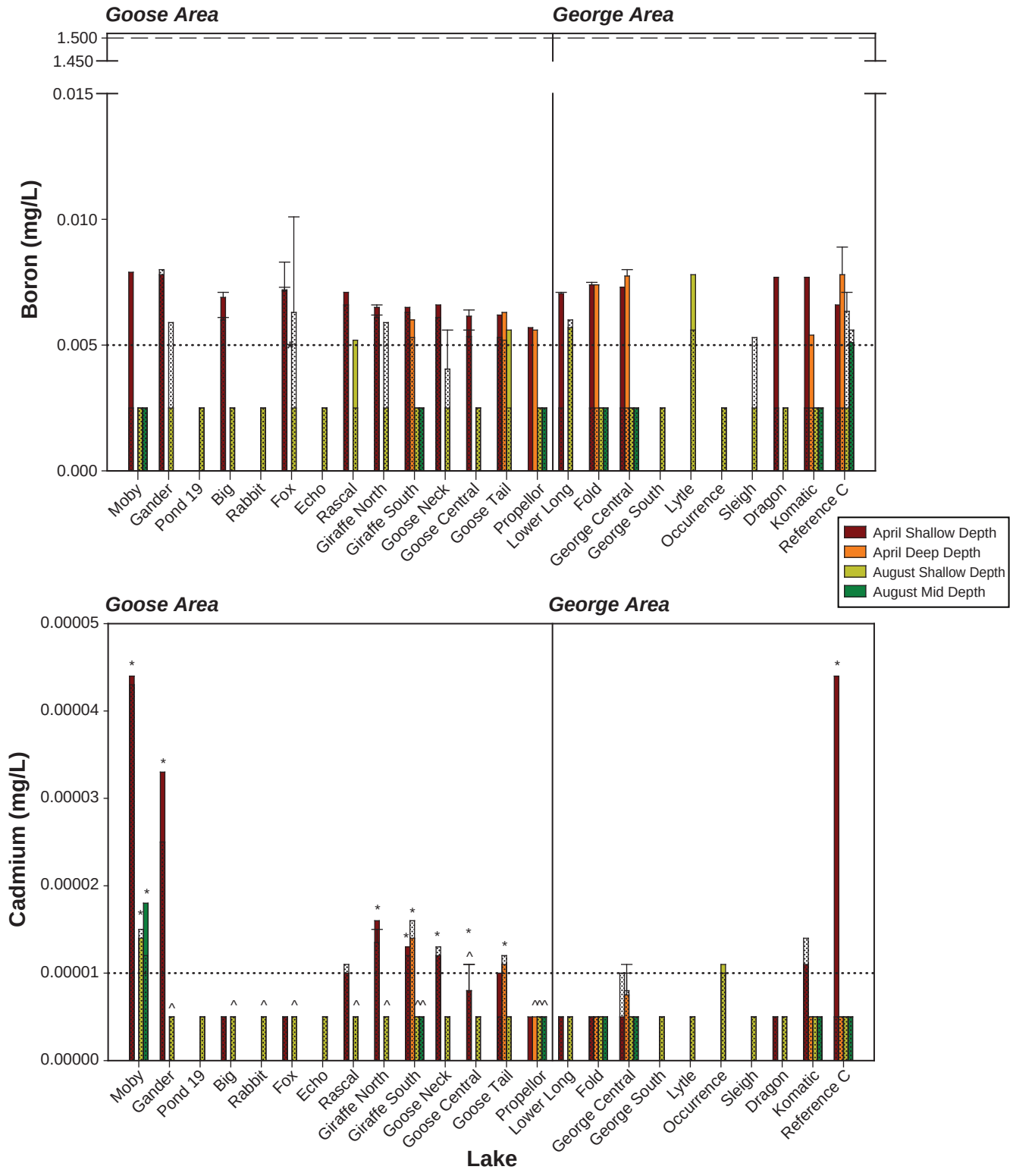
Notes: *Error bars represent standard error of the mean of replicates.*
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limit (aluminum 0.003 mg/L; arsenic 0.00003 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
The CCME guideline for arsenic is 0.005 mg/L.
CCME guidelines for aluminum are pH-dependent (0.005 mg/L at pH less than 6.5; 0.1 mg/L at pH greater than or equal to 6.5).
pH was above 6.5 at all sites except Rabbit and Rascal Lakes in shallow depths in August (6.3 and 6.33, respectively).
The CCME interim guideline for arsenic is 0.005 mg/L.
** Indicates mean total aluminum values that were higher than CCME guidelines.*

Sabina GOLD & SILVER CORP.

Aluminum and Arsenic Concentrations in Lakes, Back River Project, 2012

Figure 3.2-5a

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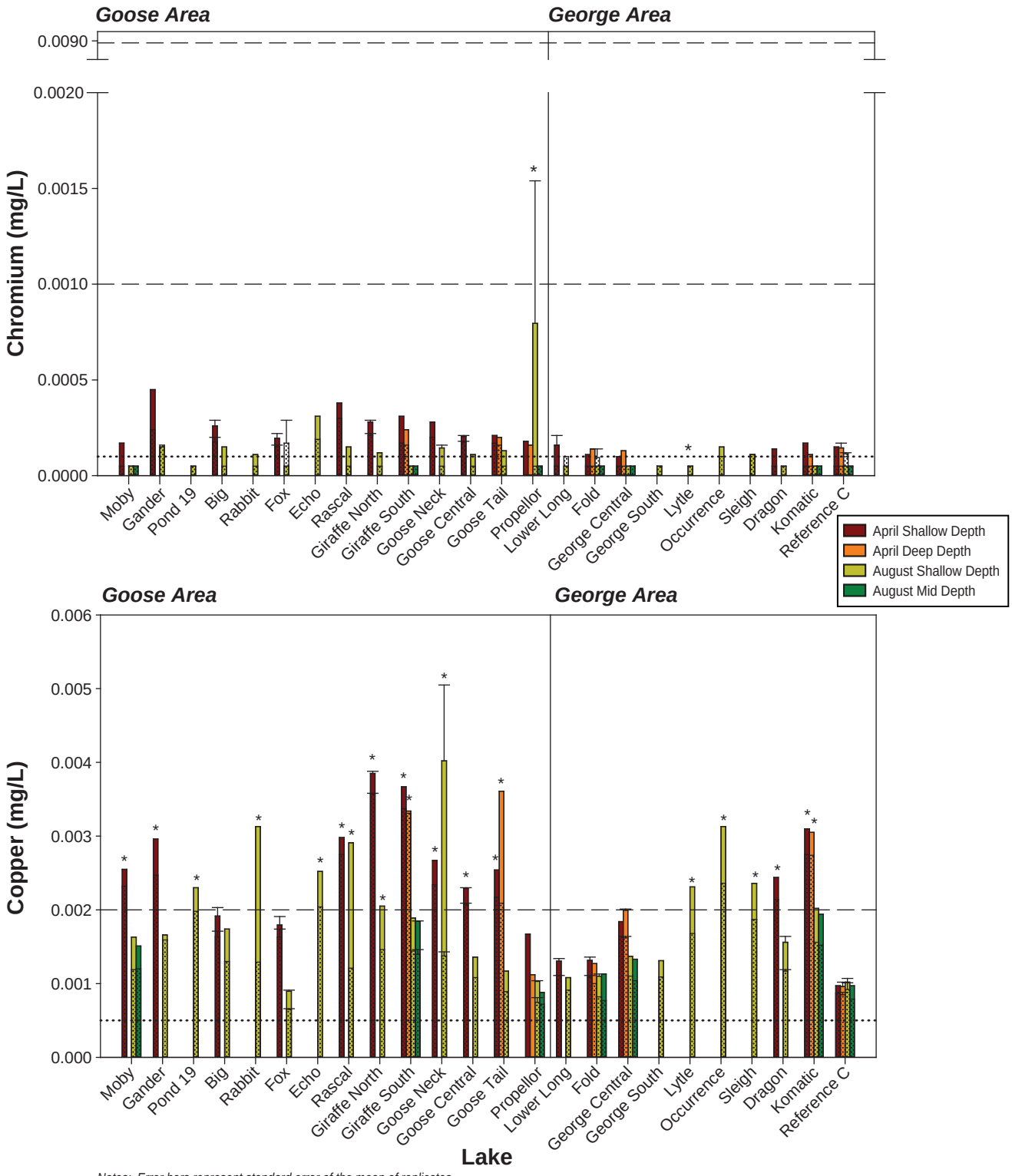
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limit (boron 0.005; cadmium 0.00001 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines (boron 1.5 mg/L long term and 29 mg/L short-term [not shown]).
The interim CCME guideline for cadmium (in mg/L) is calculated using the equation $10^{(0.86[\log(\text{hardness})]-3.2)}/1000$.
** Indicates mean total cadmium values that are higher than CCME guidelines (hardness corrected in the case of cadmium).*
^ Indicates cadmium values below detection limits where 0.5 x the detection limit was above hardness-dependent guidelines.

Sabina GOLD & SILVER CORP.

Boron and Cadmium Concentrations in Lakes, Back River Project, 2012

Figure 3.2-5b

Rescan™ Engineers & Scientists



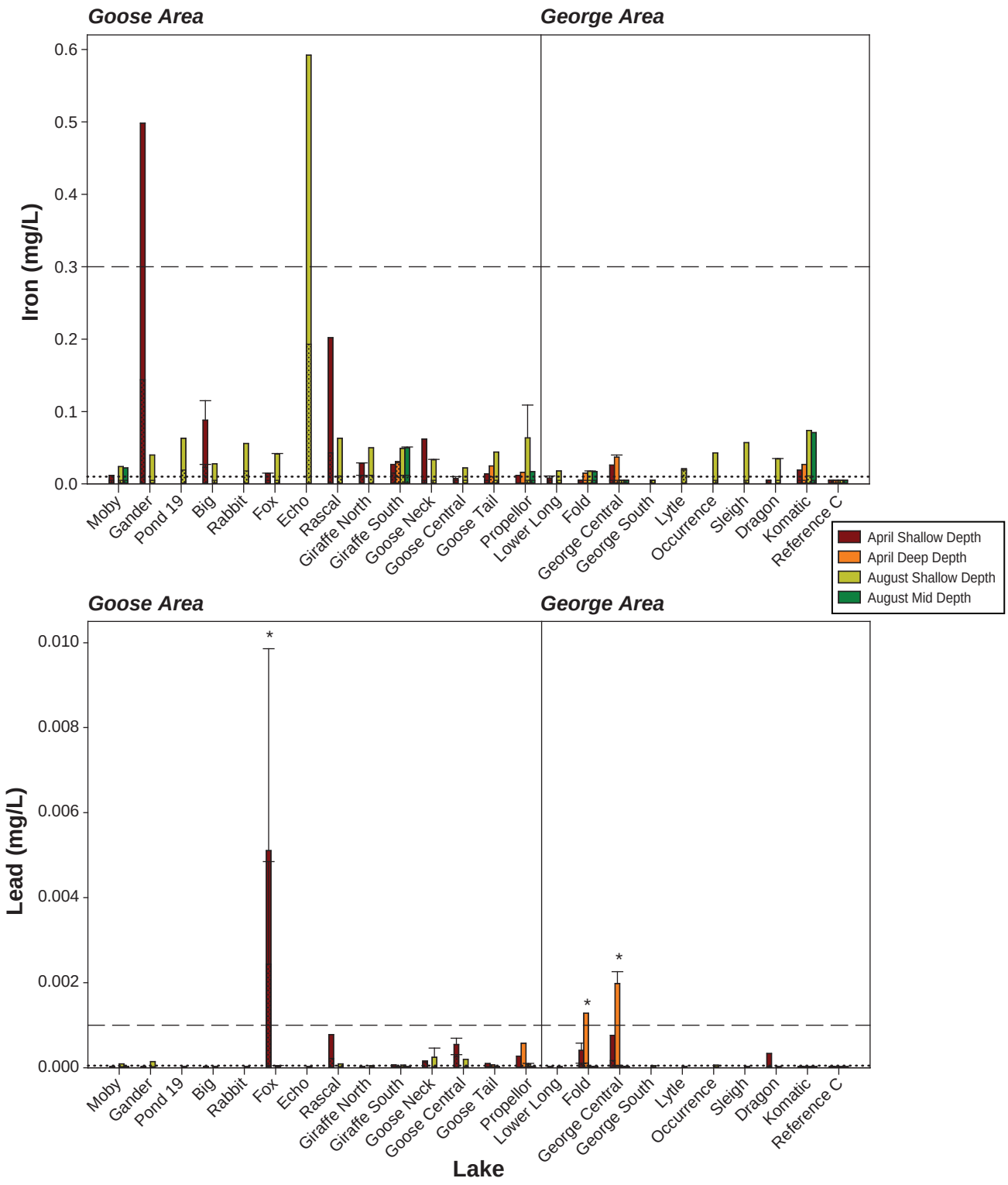
Notes: *Error bars represent standard error of the mean of replicates.*
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limit (chromium 0.0001; copper 0.0005 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
The CCME guideline for hexavalent chromium (0.001 mg/L) and interim guideline for trivalent chromium (0.0089 mg/L).
The CCME guideline for copper (in mg/L) is calculated using the equation: $e^{(0.8545[\ln(\text{hardness})]-1.465)} \times 0.0002$.
Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.
** Indicates mean total chromium and copper values that were higher than CCME guidelines (hardness corrected in the case of copper).*

Sabina GOLD & SILVER CORP.

Chromium and Copper Concentrations in Lakes, Back River Project, 2012

Figure 3.2-5c

Rescan™ Engineers & Scientists



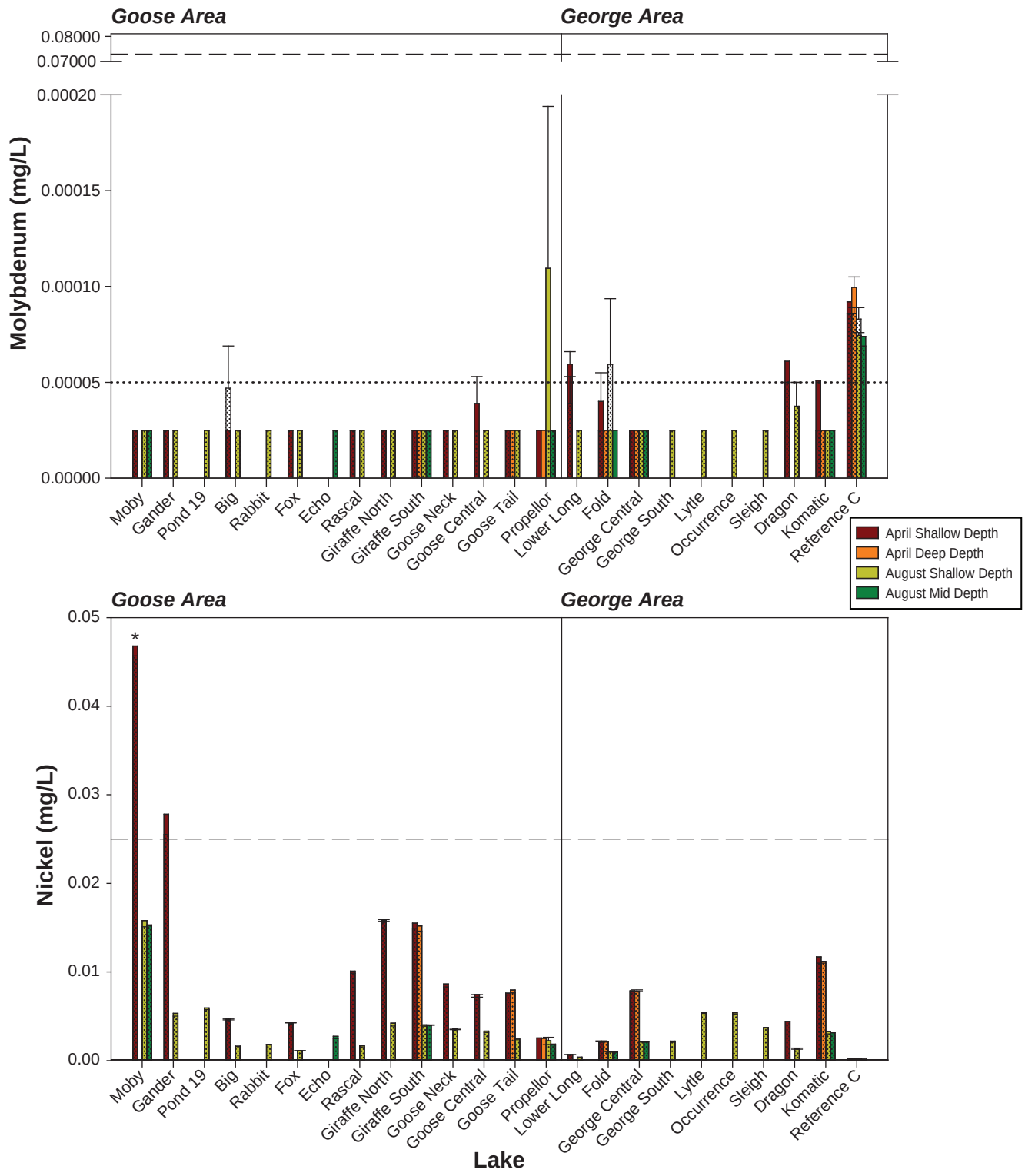
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limit (iron 0.01 mg/L; lead 0.00005 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
The CCME guideline for iron is 0.3 mg/L.
The CCME guideline for lead (in mg/L) is calculated using the equation $e^{(1.273[\ln(\text{hardness})]-4705)}/1000$, and is a minimum of 0.001 mg/L regardless of hardness.
** Indicates mean total lead values that are higher than CCME guidelines.*

Sabina GOLD & SILVER CORP.

Iron and Lead Concentrations in Lakes, Back River Project, 2012

Figure 3.2-5d

Rescan™ Engineers & Scientists



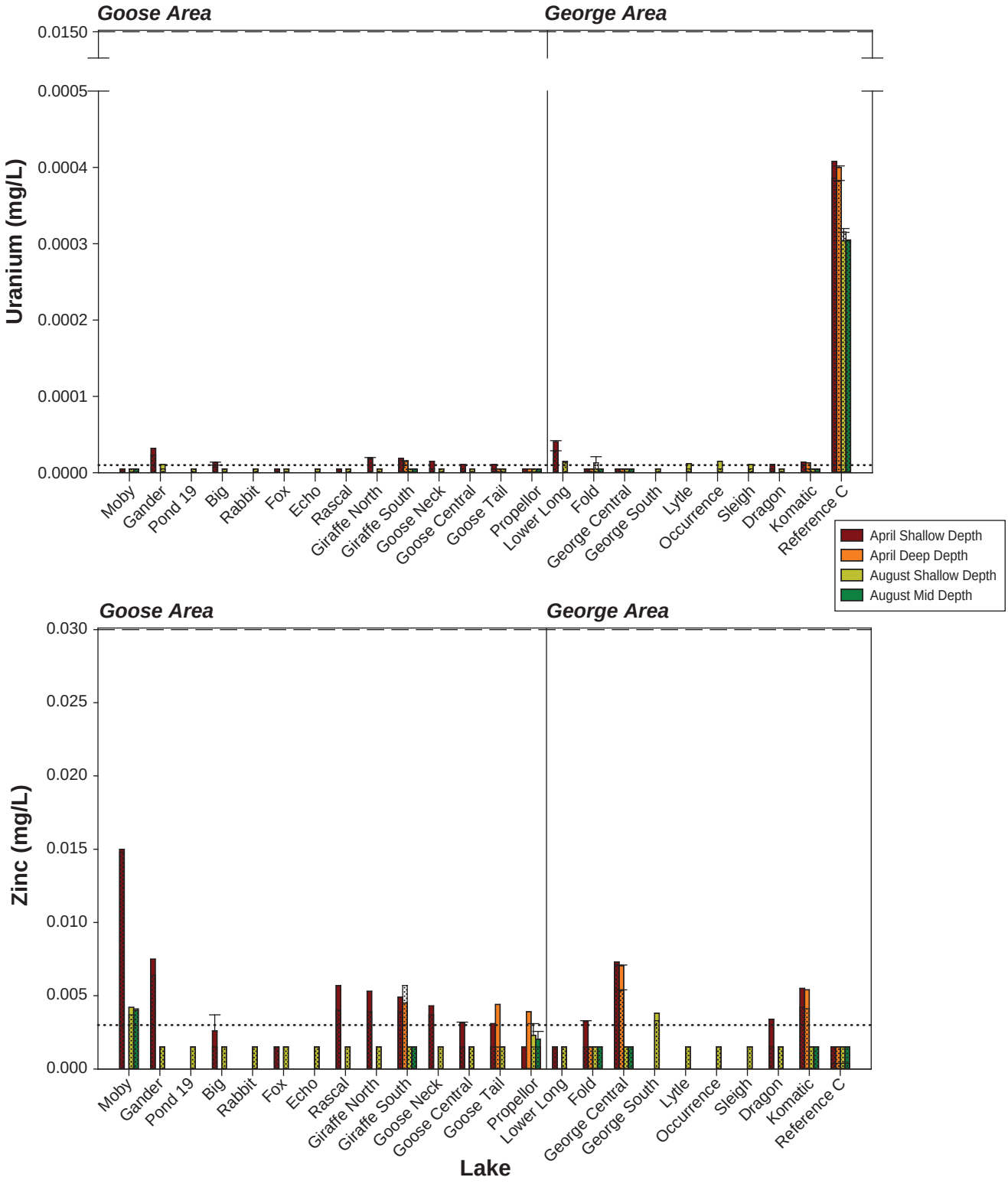
Notes: *Error bars represent standard error of the mean of replicates.*
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limit (molybdenum 0.00005 mg/L; nickel 0.0001 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
The interim CCME guideline for molybdenum is 0.073 mg/L.
The CCME guideline for nickel (in mg/L) can be calculated using the equation $e^{[1.273[\ln(\text{hardness})]-4.705]}/1000$.
Nickel guideline is a minimum of 0.025 mg/L regardless of hardness.
** Indicates mean total nickel values that were higher than CCME guidelines.*

Sabina GOLD & SILVER CORP.

Molybdenum and Nickel Concentrations in Lakes, Back River Project, 2012

Figure 3.2-5e

Rescan™ Engineers & Scientists



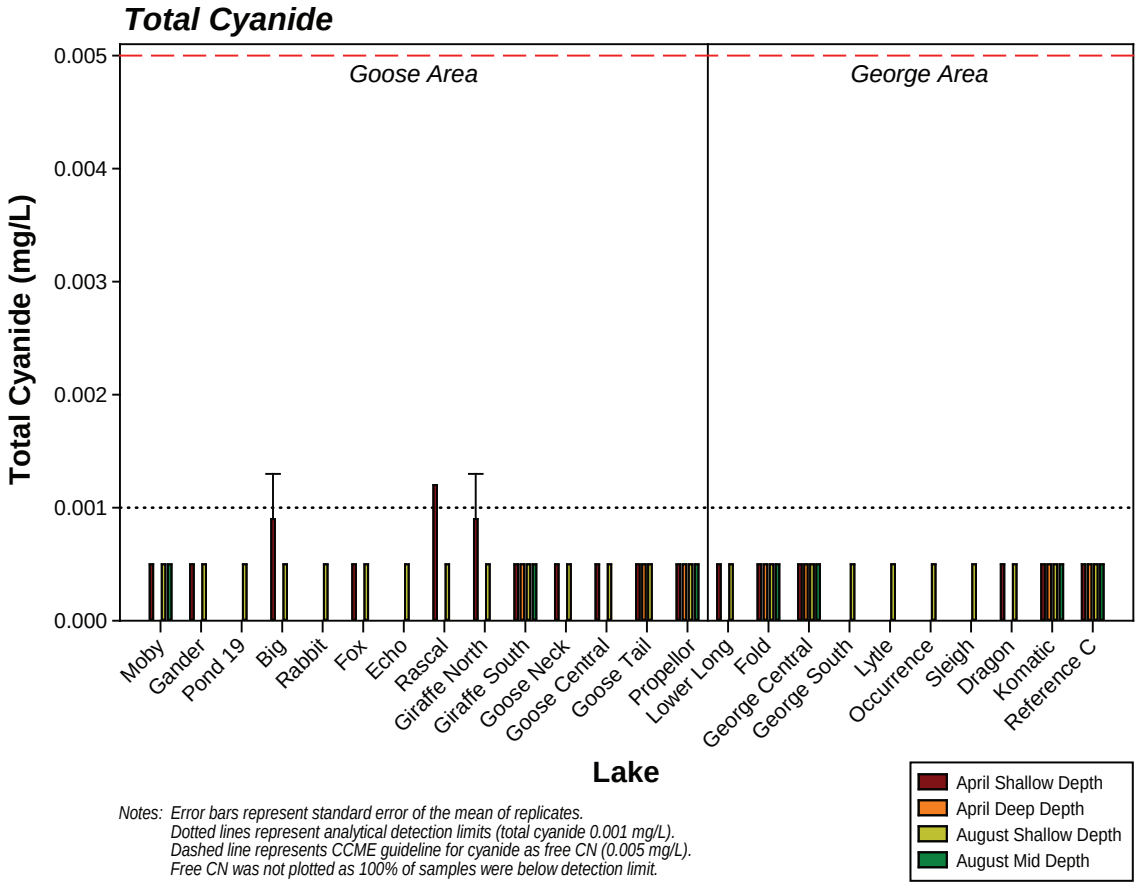
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed spotted columns represent dissolved metals.
Dotted lines represent analytical detection limits (uranium 0.00001 mg/L; zinc 0.003 mg/L).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines (uranium long-term 0.015 mg/L and short-term 0.033 mg/L [not shown]; zinc 0.03 mg/L).

Sabina GOLD & SILVER CORP.

Uranium and Zinc Concentrations in Lakes, Back River Project, 2012

Figure 3.2-5f

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Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (total cyanide 0.001 mg/L).
Dashed line represents CCME guideline for cyanide as free CN (0.005 mg/L).
Free CN was not plotted as 100% of samples were below detection limit.

Sabina GOLD & SILVER CORP.

Total Cyanide Concentrations in Lakes, Back River Project, 2012

Figure 3.2-6

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Water hardness can influence the toxicity of some metals (e.g. cadmium, copper, lead and nickel), most lakes are sensitive to these metals due to their soft waters and have low hardness-dependent CCME guidelines. Lakes with harder water, such as Reference Lake C, are less sensitive to metals and have higher hardness-dependent CCME guidelines.

3.2.2 Major Anions

Sulphate, the dominant measured major anion, concentrations tended to be higher in April than in August and in the George area lakes than in the Goose area lakes (Figure 3.2-2). Sulphate concentrations were less than 25 mg/L, with the exception of Komatic Lake in April which had an average concentration of 37.9 mg/L. Sulphate concentrations were lowest in Reference Lake C, ranging from 0.65 mg/L to 0.9 mg/L.

Chloride concentrations ranged from below detection limit (0.5 mg/L) to 8.9 mg/L, with highest concentrations at the Goose Lake sampling sites in April, and in Sleigh Lake in August (Figure 3.2-2). Chloride concentrations were well below the short term and long term CCME guidelines (120 mg/L and 620 mg/L; CCME 2012).

Lake fluoride concentrations tended to be higher in April than in August, but were similar across Goose and George areas (Figure 3.2-2). Fluoride concentrations ranged from below detection limit (0.02 mg/L) to 0.046 in Echo Lake in August, well below the CCME interim guideline of 0.12 mg/L (CCME 2012).

3.2.3 Suspended Material

Turbidity levels were low in all lakes, with most below 0.9 NTU and all below 1.6 NTU (Figure 3.2-3). Lake turbidities varied between April and August with no clear overall seasonal trend. Lakes had low levels of total suspended solids (TSS), with concentrations below detection limits (3 mg/L) or less at all lakes, except Echo Lake (6.5 mg/L) and Dragon Lake (3.3 mg/L) in April. The highest turbidities and TSS concentrations were observed in the shallow Echo Lake (0.4 m), and may be an artifact of sampling in shallow waters or the ease of wind-driven re-suspension in shallow waters.

The low turbidity and TSS allowed greater light penetration in the water column, creating the high water clarity observed with the Secchi depths.

3.2.4 Nutrients

Nutrient concentrations were low, sometimes below detection limits, and the lakes can be considered nutrient-poor (Figures 3.2-4a and 3.2-4b). The shallow Echo Lake had relatively high total Kjeldahl nitrogen (TKN) concentrations, high total phosphorus, and high TOC concentrations, consistent with its higher turbidity and total suspended solid concentrations than other lakes.

Ammonia and nitrate concentrations tended to be higher in April than in August, and in the Goose area lakes than in George area lakes (Figure 3.2-4a). Ammonia concentrations were all below 0.05 mg/L, and well below relevant pH- and temperature-dependent CCME guidelines (CCME 2012). Nitrate concentrations were all below 0.04 mg/L, except Gander Lake, which was an order of magnitude higher at 0.31 mg/L in April only. Nitrite concentrations were all below detection limits. TKN concentrations ranged from below detection limits (0.05 mg/L) to 1.1 mg/L, with all but the shallow Echo Lake having concentrations under 0.5 mg/L.

Ortho-phosphate concentrations were at or below detection limits for all lakes and total phosphorus concentrations were generally low (Figure 3.2-4b). Most lakes sampled can be classified as ultra-oligotrophic (< 0.004 mg/L) to oligotrophic (0.004 to 0.01 mg/L) based on the CCME trigger ranges

for phosphorus in freshwater systems (CCME 2012). The exceptions were Gander Lake in April that had a total concentration of 0.0101 mg/L, just above the CCME trigger range for mesotrophic lakes (0.01 to 0.02 mg/L), and the shallow Echo Lake which would be defined as mesoeutrophic (0.02 to 0.035 mg/L).

Much of the nutrients in the lakes were in forms not as readily available to plant life. The vast majority of both nitrogen and phosphorus were tied up in the organic fraction, with TKN generally a magnitude greater than nitrate and ammonia concentrations, and phosphate was only detectable in the total phase.

TOC concentrations in lakes were higher in April than in August, and in Goose area lakes than in George area lakes (Figure 3.2-4b). Lake TOC concentrations were below 10 mg/L at all lakes, except the shallow Echo Lake with TOC concentrations of 18 mg/L in August.

3.2.5 Metals

Overall, lakes generally had low metal concentrations, with concentrations tending to be higher in April. Metals concentrations can be higher during the April due to natural processes, including solute exclusion during ice formation, changes in redox chemistry, increased remineralization, and decreased biological uptake. There was no clear spatial trend in metal concentrations, with no sites having consistently high or low metal concentrations. Graphs for all metals with CCME guidelines are presented in Figures 3.2-5a to 3.2-5f.

Total aluminum concentrations tended to be higher in Goose area lakes. All lakes had less than 0.04 mg/L aluminum, except Goose Lake Neck in April (Figure 3.2-5a), and all concentrations were below the pH-dependent CCME guideline, except Rabbit and Rascal lakes where the lower pH resulted in a lower guideline level (0.005 mg/L for pH < 6.5; 0.1 mg/L mg/L for pH ≥ 6.5; CCME 2012).

Lakes had total arsenic concentrations well below the CCME guideline (0.005 mg/L; CCME 2012), with George area lakes tending to have higher concentrations than Goose area lakes (Figure 3.2-5a). The highest arsenic concentrations were observed at the shallow Echo Lake (0.00156 mg/L).

Lake total boron and cadmium concentrations were higher in April than in August, with most samples over the detection limits in April and below in August (boron 0.005 mg/L; cadmium 0.00001 mg/L) (Figure 3.2-5b). All total boron concentrations were well below CCME guidelines, with the highest concentration still two orders of magnitude below the CCME guideline (1.5 mg/L; CCME 2012). Cadmium concentrations were highest in Moby, Gander and Reference Lake C. Moby, Gander, Rascal, Giraffe, Goose and Reference Lake C all had detectable cadmium concentrations above CCME guidelines in April. Only Moby Lake had detectable cadmium concentrations above the CCME guideline in August. The cadmium CCME guideline is hardness dependent, resulting in many of the soft-water Goose area lakes having cadmium guidelines below the detection limit (indicated with ^ in Figure 3.2-5b).

Total chromium concentrations in lakes were generally higher in April than in August (Figure 3.2-5c). In April, all lakes except George Lake had chromium concentrations above the detection limit (0.0001 mg/L), while approximately two thirds of samples in August were below detection limits. All total chromium concentrations were below 0.0005 mg/L, and below the CCME guideline for hexavalent chromium (0.001 mg/L; CCME 2012), with the exception of Propellor Lake at 1 m depth in August. The Propellor Lake sample measured 0.00154 mg/L in the regular sample and below detection limits in the field duplicate. Note both of these replicates had dissolved chromium below detection limits. It is possible that the high concentrations observed in replicate one are the result of a fleck of particulate material in the sample, or a reflection of an analytical error.

Lakes had naturally elevated total copper concentrations, with more than half of the lakes having concentrations above the CCME hardness-dependent guidelines (Figure 3.2-5c). Hardness-dependent guidelines tended to be low in most lakes. Exceedances were more common in April than in August, and in the Goose area lakes than the George area lakes. Concentrations ranged from 0.0009 mg/L in Fox Lake in August to 0.0040 mg/L in Goose Lake Neck in August, with the minimum copper hardness-dependent guideline being 0.002 mg/L (CCME 2012).

Total iron concentrations were below the CCME guideline of 0.3 mg/L at all lakes, expect Gander Lake in April (0.5 mg/L) and Echo Lake (0.6 mg/L) in August (Figure 3.2-5d). Most lakes had lead concentrations far below the CCME guideline of 0.001 mg/L (CCME 2012). Exceptions were Fox Lake shallow water, and Fold and Goose Lake Central deep water quality samples in April. The highest concentrations were in Fox Lake in April, which had an average lead concentration of 0.005 mg/L, but showed considerable variation between the two replicates (0.00035 mg/L and 0.009 mg/L).

Lake water quality samples mostly had total molybdenum concentrations below detection limits (Figure 3.2-5e). Dragon Lake and Reference Lake C were the only lakes with detectable total molybdenum concentrations in both April and August. CCME guidelines for molybdenum were two orders of magnitude higher than the maximum concentration observed in lake samples (CCME 2012).

Total nickel concentrations in lakes were below 0.02 mg/L, except in Moby and Gander lakes in April (0.047 mg/L and 0.028 mg/L; Figure 3.2-5e). Only Moby Lake in April exceeded the hardness-dependent CCME guideline for nickel (CCME 2012).

Lakes had low total uranium concentrations, with most below or near the 0.00001 mg/L detection limit (Figure 3.2-5e). The exception was Reference Lake C, which had considerably higher total uranium concentrations in both shallow and deep samples from April and August, ranging from 0.0003 mg/L to 0.0004 mg/L. All lakes had uranium concentrations below the CCME long-term guideline (0.015 mg/L; CCME 2012).

Generally, total zinc concentrations were above detection limits (0.003 mg/L) in April and below in August (Figure 3.2-5f). The highest zinc concentrations were observed in Moby Lake in April (0.015 mg/L), but were still below half the CCME guideline level (0.030 mg/L; CCME 2012).

Total mercury, selenium, silver and thallium concentrations were consistently below analytical detection limits in all samples so were not graphed.

3.2.6 Cyanides

Total cyanide concentrations in lakes were below the detection limit (0.001 mg/L) for all samples except Big Lake, Rascal Lake, and Giraffe Lake North in April (0.0012 to 0.0013 mg/L; Figure 3.2-6). All lakes had free cyanide concentrations below detection limits and all were below the CCME guideline for free cyanide (0.005 mg/L; CCME 2012).

3.2.7 Comparison with CCME Guidelines

Table 3.2-1 gives the percentage of lake water quality samples that were above their respective parameter CCME guideline level, and Table 3.2-2 provides the average factor by which the concentrations were higher than CCME guidelines.

Table 3.2-1. Lake Water Quality, Percent of Samples in which Concentrations were Higher than CCME Guidelines, Back River Project, 2012

			pH	Fluoride	Chloride	Ammonia (as N)	Nitrate	Nitrite	Total Phosphorus	Aluminum (Al)	Arsenic (As)	Boron (B)	Cadmium (Cd)	
													Hardness-based Equation[be]	
CCME Guideline Values[a]			6.5 - 9.0	0.12[b] mg/L	Short-term 640 mg/L; Long-term 120 mg/L	Temperature- and pH-dependent	Short-term 124 mg/L; Long-term 2.935 mg/L	0.06 mg/L	Trophic Status[c] Range	0.005 - 0.1[d] mg/L	0.005 mg/L	Short-term 29 mg/L; Long term 1.5 mg/L	Samples above Detection Limits	Samples below Detection Limits (using half the detection limit)
Lake	Total Number of Samples Collected	Number of Parameters with Exceedances												
Goose Area														
Moby Lake	3	3	0	0	0	0	0	0	ultraoligotrophic	0	0	0	100	0
Gander Lake	2	3	0	0	0	0	0	0	oligotrophic - mesotrophic	0	0	0	50	50
Pond 19	1	1	0	0	0	0	0	0	ultraoligotrophic	0	0	0	0	0
Big Lake	3	2	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	0	33.3
Rabbit Lake	1	4	100	0	0	0	0	0	ultraoligotrophic	100	0	0	0	100
Fox Lake	4	2	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	0	50
Echo Lake	1	2	0	0	0	0	0	0	mesoeutrophic	0	0	0	0	0
Rascal Lake	2	1	50	0	0	0	0	0	ultraoligotrophic - oligotrophic	50	0	0	0	50
Giraffe Lake North	3	2	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	33.3	67.7
Giraffe Lake South	5	2	0	0	0	0	0	0	ultraoligotrophic	0	0	0	40	60
Goose Lake Neck	3	2	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	33.3	0
Goose Lake Central	3	2	0	0	0	0	0	0	ultraoligotrophic	0	0	0	33.3	0
Goose Lake Tail	3	2	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	66.7	0
Propellor Lake	5	2	0	0	0	0	0	0	ultraoligotrophic	0	0	0	0	80
George Area														
Lower Long Lake	3	0	0	0	0	0	0	0	ultraoligotrophic	0	0	0	0	0
Fold Lake	6	1	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	0	0
George Lake Central	5	2	0	0	0	0	0	0	ultraoligotrophic	0	0	0	0	0
George Lake South	1	0	0	0	0	0	0	0	ultraoligotrophic	0	0	0	0	0
Lytle Lake	1	1	0	0	0	0	0	0	ultraoligotrophic	0	0	0	0	0
Occurrence Lake	1	1	0	0	0	0	0	0	ultraoligotrophic	0	0	0	0	0
Sleigh Lake	1	1	0	0	0	0	0	0	ultraoligotrophic	0	0	0	0	0
Dragon Lake	3	1	0	0	0	0	0	0	ultraoligotrophic	0	0	0	0	0
Komatic Lake	4	1	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	0	0
Reference C Lake	6	1	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	16.7	0

Notes: *(continued)*

a) Canadian water quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) Interim guideline.

c) < 0.004 mg/L = ultraoligotrophic; 0.004 - 0.01 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; > 0.1 mg/L = hypereutrophic.

d) 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000. There is no minimum guideline. Samples from sites where hardness was low may have guideline concentrations below analytical detection limits. Samples where half the detection limit was above their hardness-dependent guideline are shown in a separate column in the table.

f) Guideline concentration of hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L).

g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ x 0.0002. Copper guideline is a minium of 0.002 mg/L regardless of hardness.

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minimum of 0.001 mg/L regardless of hardness.

i) Guideline concentration for inorganic mercury.

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

Table 3.2-1. Lake Water Quality, Percent of Samples in which Concentrations were Higher than CCME Guidelines, Back River Project, 2012 (completed)

		Chromium (Cr)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Uranium (U)	Zinc (Zn)	Free Cyanide
CCME Guideline Values[a]		Cr (VI) 0.001[bf] mg/L	Hardness-dependent ≥ 0.002[g] mg/L	0.3 mg/L	Hardness-dependent ≥ 0.001[h] mg/L	0.000026[i] mg/L	0.073[b] mg/L	Hardness-dependent ≥ 0.025[j] mg/L	0.001 mg/L	0.0001 mg/L	0.0005 mg/L	Short-term 0.033 mg/L; Long-term 0.015 mg/L	0.03 mg/L	0.005 as Free CN
Lake	Total Number of Samples Collected													
Goose Area														
Moby Lake	3	0	33.3	0	0	0	0	33.3	0	0	0	0	0	0
Gander Lake	2	0	50	50	0	0	0	0	0	0	0	0	0	0
Pond 19	1	0	100	0	0	0	0	0	0	0	0	0	0	0
Big Lake	3	0	33.3	0	0	0	0	0	0	0	0	0	0	0
Rabbit Lake	1	0	100	0	0	0	0	0	0	0	0	0	0	0
Fox Lake	4	0	0	0	25	0	0	0	0	0	0	0	0	0
Echo Lake	1	0	100	100	0	0	0	0	0	0	0	0	0	0
Rascal Lake	2	0	100	0	0	0	0	0	0	0	0	0	0	0
Giraffe Lake North	3	0	100	0	0	0	0	0	0	0	0	0	0	0
Giraffe Lake South	5	0	40	0	0	0	0	0	0	0	0	0	0	0
Goose Lake Neck	3	0	100	0	0	0	0	0	0	0	0	0	0	0
Goose Lake Central	3	0	66.7	0	0	0	0	0	0	0	0	0	0	0
Goose Lake Tail	3	0	66.7	0	0	0	0	0	0	0	0	0	0	0
Propellor Lake	5	20	0	0	0	0	0	0	0	0	0	0	0	0
George Area														
Lower Long Lake	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Fold Lake	6	0	0	0	16.7	0	0	0	0	0	0	0	0	0
George Lake Central	5	0	20	0	40	0	0	0	0	0	0	0	0	0
George Lake South	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Lytle Lake	1	0	100	0	0	0	0	0	0	0	0	0	0	0
Occurrence Lake	1	0	100	0	0	0	0	0	0	0	0	0	0	0
Sleigh Lake	1	0	100	0	0	0	0	0	0	0	0	0	0	0
Dragon Lake	3	0	33.3	0	0	0	0	0	0	0	0	0	0	0
Komatic Lake	4	0	75	0	0	0	0	0	0	0	0	0	0	0
Reference C Lake	6	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:

a) Canadian water quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) Interim guideline.

c) < 0.004 mg/L = ultraoligotrophic; 0.004 - 0.01 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; > 0.1 mg/L = hypereutrophic.

d) 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000. There is no minimum guideline. Samples from sites where hardness was low may have guideline concentrations below analytical detection limits. Samples where half the detection limit was above their hardness-dependent guideline are shown in a separate column in the table.

f) Guideline concentration of hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L).

g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ x 0.0002. Copper guideline is a minium of 0.002 mg/L regardless of hardness.

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minimum of 0.001 mg/L regardless of hardness.

i) Guideline concentration for inorganic mercury.

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

Table 3.2-2. Lake Water Quality, Average Factor by which Concentrations were Higher than CCME Guidelines, Back River Project, 2012

			pH*	Fluoride	Chloride	Ammonia (as N)	Nitrate	Nitrite	Total Phosphorus	Aluminum (Al)	Arsenic (As)	Boron (B)	Cadmium (Cd)	Chromium (Cr)
CCME Guideline Values[a]			6.5 - 9.0	0.12[b] mg/L	Short-term 640 mg/L; Long-term 120 mg/L	Temperature- and pH-dependent	Short-term 124 mg/L; Long-term 2.935 mg/L	0.06 mg/L	Trophic Status[c] Range	0.005 - 0.1[d] mg/L	0.005 mg/L	Short-term 29 mg/L; Long-term 1.5 mg/L	Hardness-based Equation[be]	Cr (VI) 0.001[bf] mg/L
Lake	Total Number of Samples Collected	Number of Parameters with Exceedances												
Goose Area														
Moby Lake	3	1	-	-	-	-	-	-	ultraoligotrophic	-	-	-	3.33	-
Gander Lake	2	2	-	-	-	-	-	-	oligotrophic - mesotrophic	-	-	-	1.89	-
Pond 19	1	1	-	-	-	-	-	-	ultraoligotrophic	-	-	-	-	-
Big Lake	3	1	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	1.21	-
Rabbit Lake	1	3	below	-	-	-	-	-	ultraoligotrophic	2.98	-	-	1.39	-
Fox Lake	4	2	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	1.00	-
Echo Lake	1	2	-	-	-	-	-	-	mesoeutrophic	-	-	-	-	-
Rascal Lake	2	3	below	-	-	-	-	-	ultraoligotrophic - oligotrophic	2.05	-	-	1.07	-
Giraffe Lake North	3	2	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	1.36	-
Giraffe Lake South	5	2	-	-	-	-	-	-	ultraoligotrophic	-	-	-	1.23	-
Goose Lake Neck	3	1	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	-	-
Goose Lake Central	3	0	-	-	-	-	-	-	ultraoligotrophic	-	-	-	-	-
Goose Lake Tail	3	1	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	-	-
Propellor Lake	5	1	-	-	-	-	-	-	ultraoligotrophic	-	-	-	1.23	-
George Area														
Lower Long Lake	3	0	-	-	-	-	-	-	ultraoligotrophic	-	-	-	-	-
Fold Lake	6	0	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	-	-
George Lake Central	5	0	-	-	-	-	-	-	ultraoligotrophic	-	-	-	-	-
George Lake South	1	0	-	-	-	-	-	-	ultraoligotrophic	-	-	-	-	-
Lytle Lake	1	1	-	-	-	-	-	-	ultraoligotrophic	-	-	-	-	-
Occurrence Lake	1	1	-	-	-	-	-	-	ultraoligotrophic	-	-	-	-	-
Sleigh Lake	1	1	-	-	-	-	-	-	ultraoligotrophic	-	-	-	-	-
Dragon Lake	3	0	-	-	-	-	-	-	ultraoligotrophic	-	-	-	-	-
Komatic Lake	4	1	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	-	-
Reference C Lake	6	0	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	-	-

Notes: *(continued)*

Values represent the average factor by which 2012 samples were higher than CCME guidelines.

Half the detection limit was substituted for values that were below the detection limit for the calculation of exceedance factors. Shaded cells show sites where all samples that exceeded a particular parameter guideline were below the detection limit.

The average concentration of a particular parameter may be below the CCME guideline concentration even if a percentage of samples is higher than this guideline concentration.

** Note factor by which average concentrations exceeded pH guidelines was not calculated as pH guidelines are a range. Exceedances are shown for reference only.*

a) Canadian water quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) Interim guideline.

c) < 0.004 mg/L = ultraoligotrophic; 0.004 - 0.01 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; > 0.1 mg/L = hypereutrophic.

d) 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5.

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000. There is no minimum guideline.

f) Guideline concentration of hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L).

g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ x 0.0002. Copper guideline is a minium of 0.002 mg/L regardless of hardness.

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minimum of 0.001 mg/L regardless of hardness.

i) Guideline concentration for inorganic mercury.

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

Table 3.2-2. Lake Water Quality, Average Factor by which Concentrations were Higher than CCME Guidelines, Back River Project, 2012 (completed)

Lake	Total Number of Samples Collected	Copper (Cu)	Iron (Fe)	Lead (Pb)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Uranium (U)	Zinc (Zn)	Free Cyanide
CCME Guideline Values[a]		Hardness-dependent ≥ 0.002[g] mg/L	0.3 mg/L	Hardness-dependent ≥ 0.001[h] mg/L	0.000026[i] mg/L	0.073[b] mg/L	Hardness-dependent ≥ 0.025[j] mg/L	0.001 mg/L	0.0001 mg/L	0.0005 mg/L	Short-term 0.033 mg/L; Long-term 0.015 mg/L	0.03 mg/L	0.005 as Free CN
Goose Area													
Moby Lake	3	-	-	-	-	-	-	-	-	-	-	-	-
Gander Lake	2	1.16	-	-	-	-	-	-	-	-	-	-	-
Pond 19	1	1.15	-	-	-	-	-	-	-	-	-	-	-
Big Lake	3	-	-	-	-	-	-	-	-	-	-	-	-
Rabbit Lake	1	1.57	-	-	-	-	-	-	-	-	-	-	-
Fox Lake	4	-	-	2.57	-	-	-	-	-	-	-	-	-
Echo Lake	1	1.26	1.97	-	-	-	-	-	-	-	-	-	-
Rascal Lake	2	1.47	-	-	-	-	-	-	-	-	-	-	-
Giraffe Lake North	3	1.63	-	-	-	-	-	-	-	-	-	-	-
Giraffe Lake South	5	1.26	-	-	-	-	-	-	-	-	-	-	-
Goose Lake Neck	3	1.79	-	-	-	-	-	-	-	-	-	-	-
Goose Lake Central	3	-	-	-	-	-	-	-	-	-	-	-	-
Goose Lake Tail	3	1.22	-	-	-	-	-	-	-	-	-	-	-
Propellor Lake	5	-	-	-	-	-	-	-	-	-	-	-	-
George Area													
Lower Long Lake	3	-	-	-	-	-	-	-	-	-	-	-	-
Fold Lake	6	-	-	-	-	-	-	-	-	-	-	-	-
George Lake Central	5	-	-	-	-	-	-	-	-	-	-	-	-
George Lake South	1	-	-	-	-	-	-	-	-	-	-	-	-
Lytle Lake	1	1.16	-	-	-	-	-	-	-	-	-	-	-
Occurrence Lake	1	1.57	-	-	-	-	-	-	-	-	-	-	-
Sleigh Lake	1	1.18	-	-	-	-	-	-	-	-	-	-	-
Dragon Lake	3	-	-	-	-	-	-	-	-	-	-	-	-
Komatic Lake	4	1.26	-	-	-	-	-	-	-	-	-	-	-
Reference C Lake	6	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

Values represent the average factor by which 2012 samples were higher than CCME guidelines.

Half the detection limit was substituted for values that were below the detection limit for the calculation of exceedance factors. Shaded cells show sites where all samples that exceeded a particular parameter guideline were below the detection limit.

The average concentration of a particular parameter may be below the CCME guideline concentration even if a percentage of samples is higher than this guideline concentration.

** Note factor by which average concentrations exceeded pH guidelines was not calculated as pH guidelines are a range. Exceedances are shown for reference only.*

a) Canadian water quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) Interim guideline.

c) < 0.004 mg/L = ultraoligotrophic; 0.004 - 0.01 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; > 0.1 mg/L = hypereutrophic.

d) 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5.

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000. There is no minimum guideline.

f) Guideline concentration of hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L).

g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ x 0.0002. Copper guideline is a minium of 0.002 mg/L regardless of hardness.

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minimum of 0.001 mg/L regardless of hardness.

i) Guideline concentration for inorganic mercury.

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

All lakes had water quality within the CCME guidelines for pH (6.5 to 9), except Rabbit Lake and Rascal Lake in August (pH: 6.3). All lakes had water quality below CCME guidelines for chloride, fluoride, ammonia, nitrate, nitrite and free cyanide. All lakes except Lower Long exceeded CCME guidelines in at least one sample for at least one of the following metals: total aluminum, total cadmium, total chromium, total copper, total iron, total lead, and total nickel.

Average concentrations exceeded CCME guidelines for at least one parameter at over two thirds of lakes. Parameters where average lake concentrations exceeded guidelines included total aluminum, total cadmium, total copper, total iron, and total lead. Over a third of sites had average concentrations that exceeded cadmium guidelines, and over half had average concentrations that exceeded copper guidelines. Rabbit and Rascal lakes had the greatest number of parameters with average concentrations that exceeded CCME guidelines at three.

More average concentrations exceeded CCME guidelines in lakes in the Goose area than in the George area. Moby Lake had the greatest exceedance, with average cadmium concentrations 3.33 times greater than its hardness-dependent CCME guideline. Most other average exceedances were between one and two times greater than their respective CCME guidelines.

George area lakes, in particular Dragon, Komatic and Reference C, tended to have higher hardness levels than Goose area lakes, and this resulted in higher hardness-dependent CCME guideline concentrations for parameters that are hardness-dependent (total cadmium, copper, lead, and nickel). All other lakes had much lower hardness levels (i.e., were softer), meaning the hardness-dependent CCME guidelines were lower, and in the case of cadmium, sometimes below the analytical detection limit.

3.2.8 Lake Water Quality Assurance/Quality Control

In total, four equipment blanks, four field blanks, and four travel blanks were processed for 56 parameters as part of the 2012 lake water quality program.

Blanks were below detection limits for the vast majority of parameters (Appendix 3.2-2). A few parameters were either at or close to detection limits for some blanks; total selenium in the April Goose area field blank; total barium in the April George area equipment blank; conductivity, ammonia, chloride, total barium, total lead, total nickel and total sodium in the August Goose area equipment blank; and total lead in the August George equipment blank.

Concentrations of some parameters were clearly above detection levels, including nitrate, aluminum and manganese in the August Goose equipment blank, and barium in the August George equipment blank. Nitrate concentrations were 0.0463 mg/L in the August Goose area equipment blank, higher than all regular samples, with the exception of Gander Lake in April. Note the sampler bottles were acid washed with nitric acid, to prevent metal contamination. Aluminum concentrations were 0.0941 mg/L in the August Goose area equipment blank, higher than all other regular samples. Total manganese in the August Goose area equipment blank and total barium in the August George area equipment blank were above detection levels, but below all concentrations observed in regular samples.

There were 12 samples (four of each blank type) measured for 56 for a total of 452 potential hits. Fourteen were above detection limits (3%), but only four were clearly above the DL (0.9%). Based on these calculations, and the absence of consistent trends in the blanks, the lake water quality data was considered robust.

Fifteen pairs of field duplicates for sampled lakes were compared for each water quality parameter (Appendix 3.2-3). A total of 29% (386/1335) of the duplicate concentrations were at least five times greater than their detection limits and so used in RPD calculations. Of these RPD calculations, only 7% (26/386) had an RPD above 20%, only 2.6% (10/386) had an RPD equal or greater than 50%, and only 0.26% (1/386) had an RPD above 100%. The cause of the elevated RPDs is not known, but likely reflects

the environmental heterogeneity at lakes, although could also result from lab analysis errors or sampler handling. The low proportion of high RPDs suggests the lake water quality data is robust.

3.3 STREAM WATER QUALITY

Stream water quality samples were collected in June (freshet), August (summer), and September 2012. Stream water quality data collected in 2012 are presented graphically in Figures 3.3-1a to 3.3-5g. Raw water quality data for streams are presented in Appendices 3.3-1 to 3.3-3.

3.3.1 Physical Parameters

The streams in the Goose and George Properties were largely circumneutral, poorly buffered, with soft water'. The surveyed streams ranged in pH from an average of 6.0 (Echo OF) to 8.0 (Reference C OF), with streams tending to have their lowest pH in June and highest pH in August (Figure 3.3-1a). Streams in the Goose area streams tended to be more acidic than those in the George area, consistent with trends in lake pH. The highest pH levels in each season were observed in Reference C OF, with a pH ranging from 7.7 to 8.1. The lowest pH levels were below the lower CCME guideline limit for freshwater aquatic health (pH 6.5) at Chair OF in June (6.1) and Echo OF in June and Sept (6.0). Echo OF was outside of CCME guideline ranges in 2011 also with an average pH of 5.87 (Rescan 2012a).

Streams were poorly buffered, with low total alkalinity levels (Figure 3.3-1a). Total alkalinities were less than 16 mg/L at all streams, except at Reference C OF, which was higher in June (average of 26 mg/L) and considerably higher in August and September (averages of 68.3 mg/L and 66.8 mg/L).

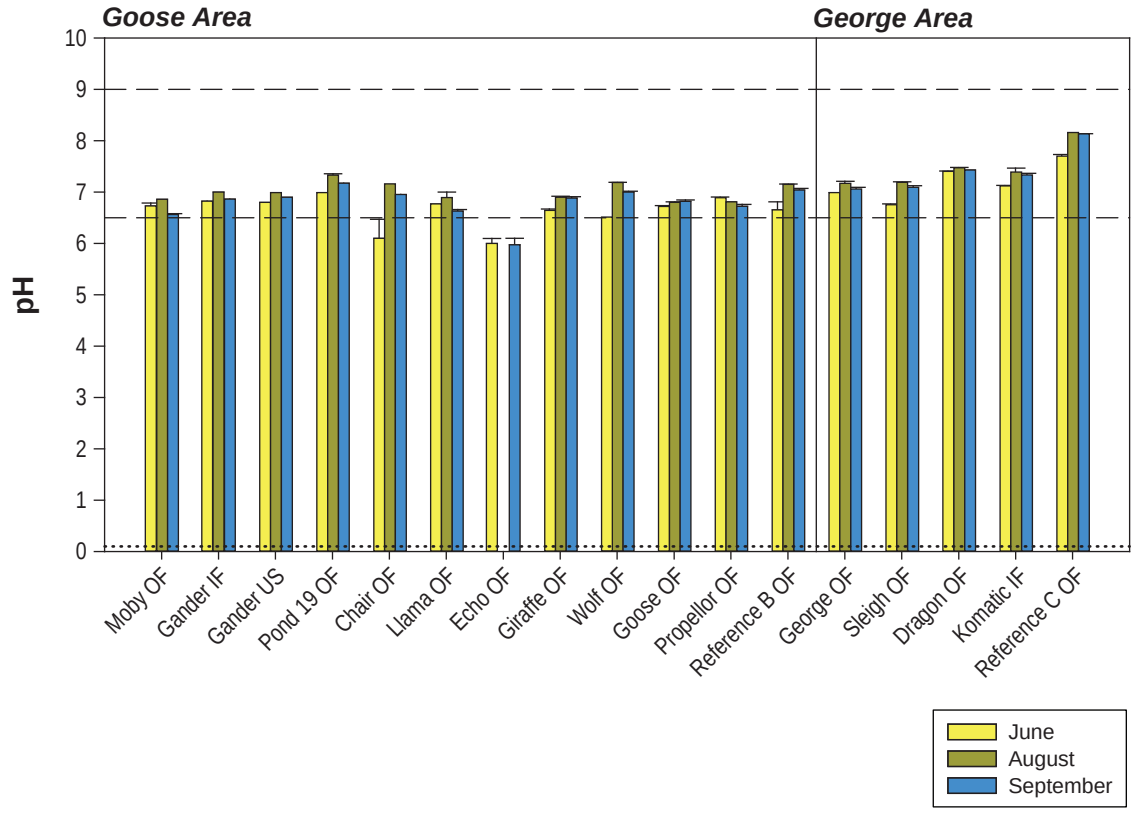
Overall streams tended to be soft (<60 mg $CaCO_3$/L), with softest water measured in June when freshet resulted in stream water diluted by ice and snowmelt, and harder water in August when streams had lower volumes and more surface contact (Figure 3.3-1b). Streams in the Goose area tended to be softer than those in the George area. Exceptions were Llama OF, which had moderately hard water (67 mg $CaCO_3$/L) in August, and had hard water in September (132 mg $CaCO_3$/L). This was considerably harder than all other streams sampled. This continued the trend observed in 2011 of Llama OF having considerably higher hardness than other streams in the area (Rescan 2012a). Reference C OF in August and September also had moderately hard water (63 mg/L).

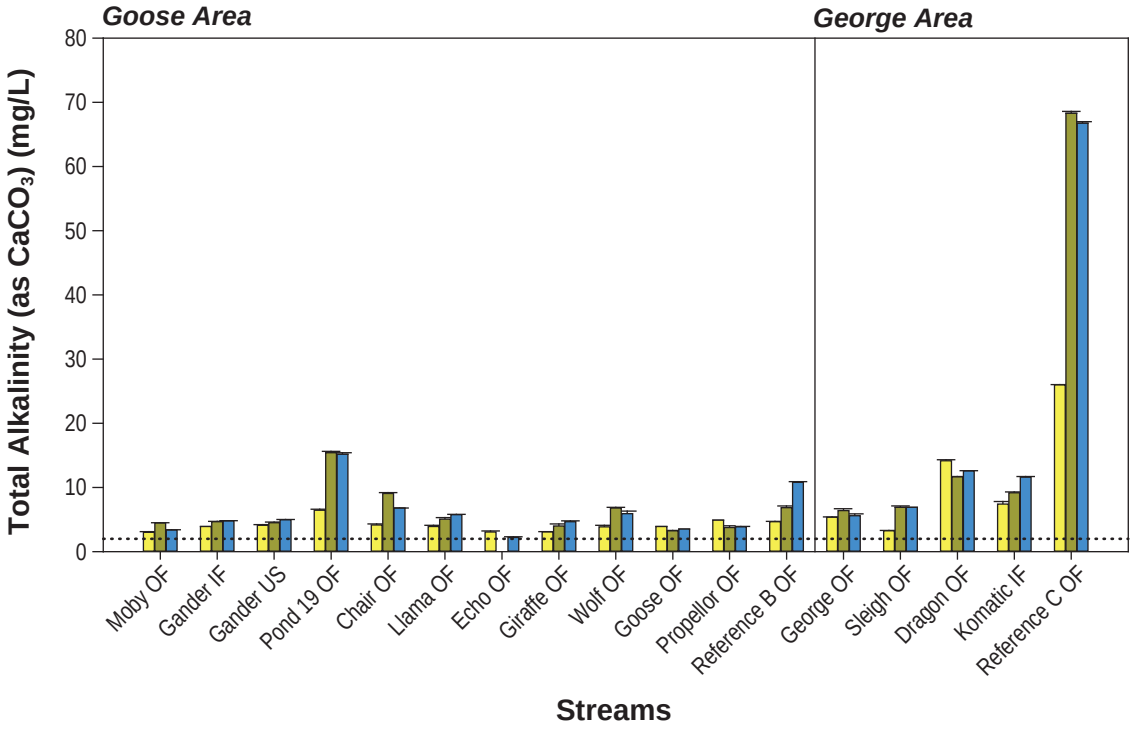
Patterns in conductivity and TDS followed those of hardness, with low conductivity (less than 125 µS/cm) and TDS (less than 100 mg/L) in all streams, except Llama OF, and generally lower concentrations in Goose area lakes than in George area lakes (Figure 3.3-1b). Llama OF had higher conductivities and TDS concentrations than all other stream in August (conductivity 175 µS/cm; TDS 121 mg/L) and September (conductivity 336 µS/cm; TDS 299 mg/L). Chloride and calcium concentrations were also higher at Llama OF in August and September than the other stream sites.

3.3.2 Major Anions

Sulphate was usually the dominant anion at stream sites, except for at Llama OF (chloride). Concentrations varied seasonally tending to be highest in September, and geographically tending to be highest in the George area streams (Figure 3.3-2). All streams had sulphate concentrations below 40 mg/L, with lowest concentrations in Reference C OF near detection limits in all seasons (0.5 mg/L).

Overall, streams had low chloride and fluoride concentrations with most streams being near detection limits (Figure 3.3-2). The exception was Llama OF, spiking above the detection limit for chloride (0.5 mg/L) in August (41 mg/L) and September (88 mg/L). Note Llama OF is downstream of exploration drilling sites, where drilling salts containing chlorides are used, elevated chloride levels may be a result of drilling salt influence. Fluoride ranged between 0.04 mg/L and the detection limit (0.02 mg/L) for all sites. All streams were below CCME guidelines for chloride and fluoride (CCME 2012).





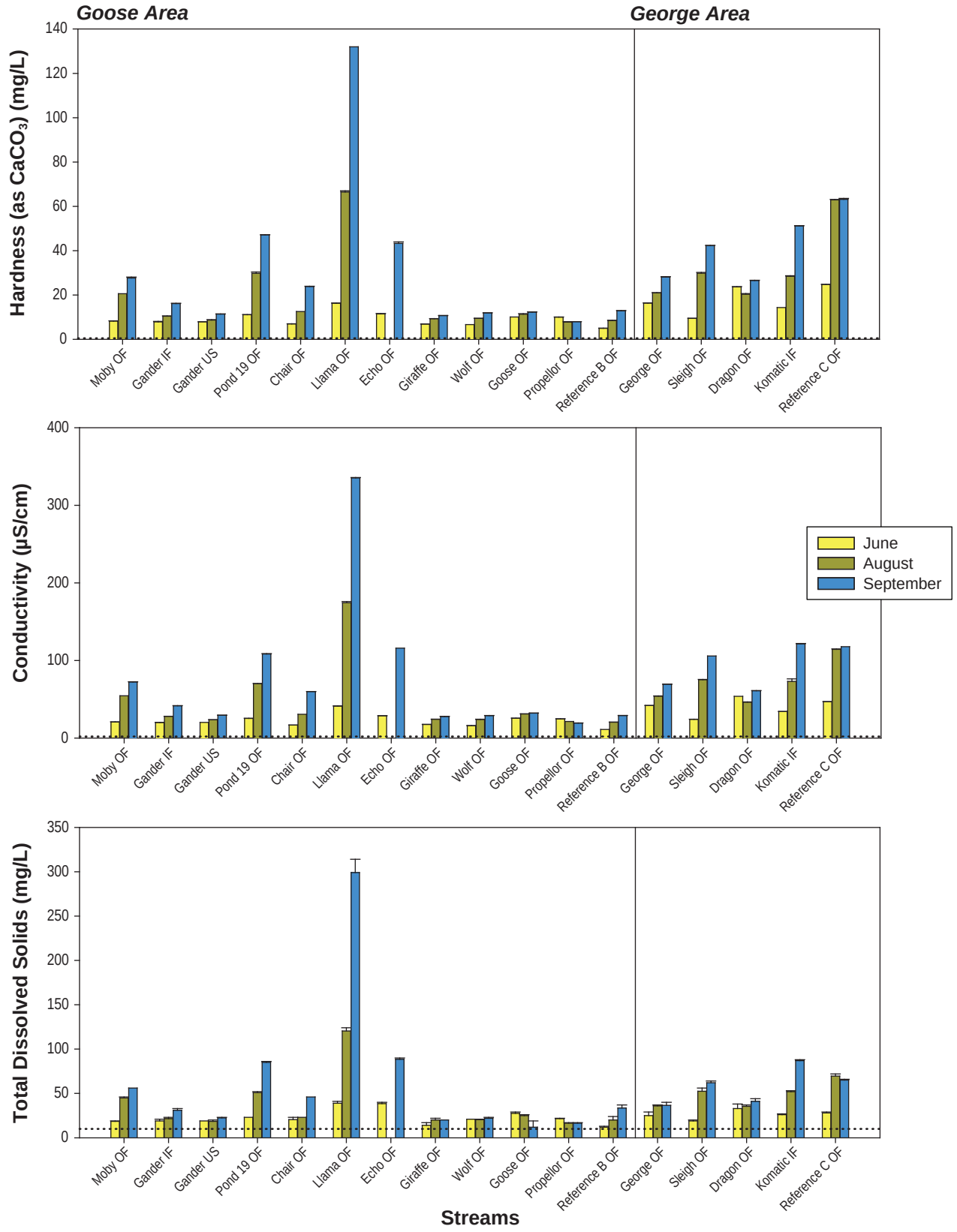
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (pH 0.1; total alkalinity 2 mg/L).
Dashed lines represent CCME guideline for pH 6.5-9.

Sabina GOLD & SILVER CORP.

pH and Total Alkalinity in Streams, Back River Project, 2012

Figure 3.3-1a

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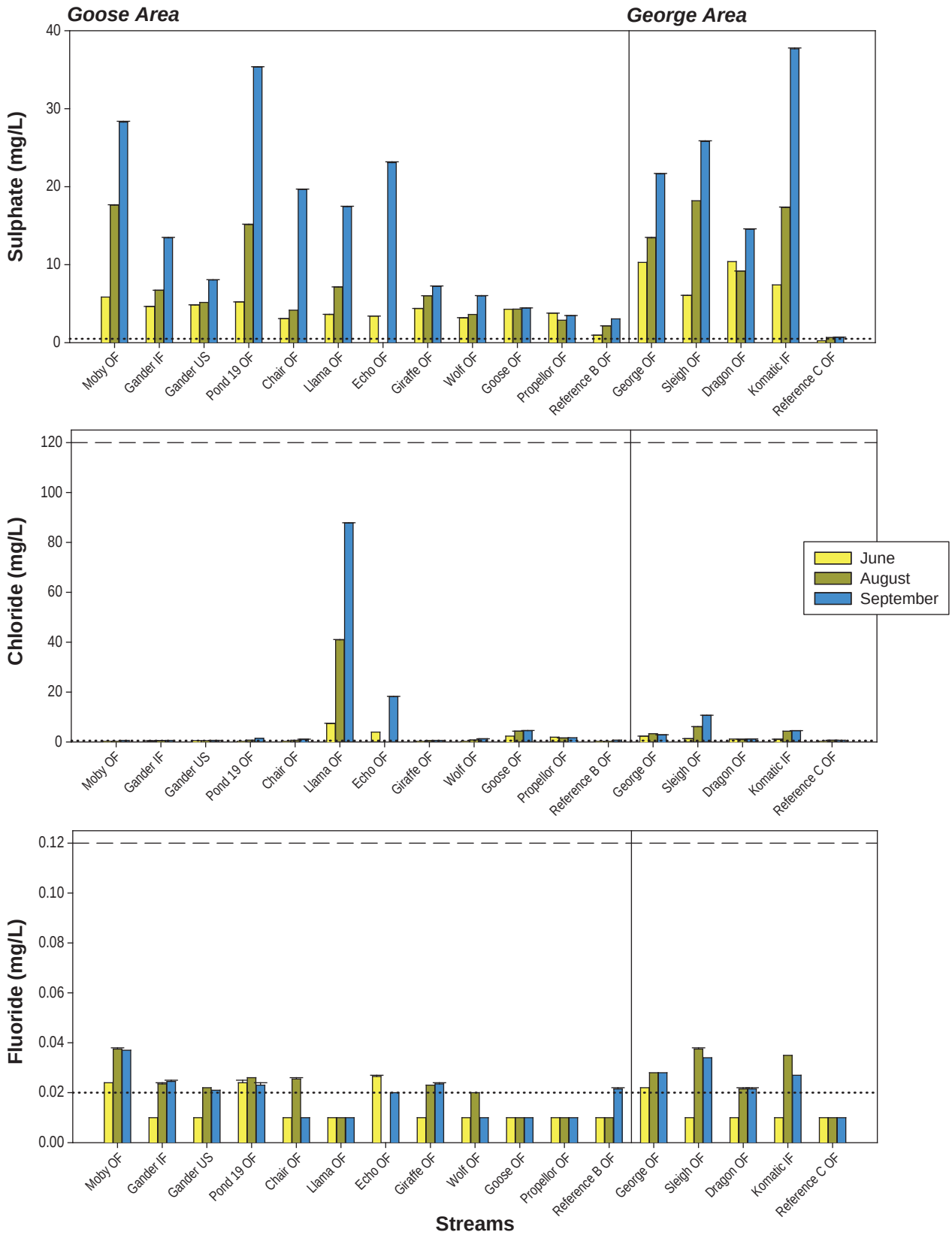
Notes: Error bars represent standard error of the mean of replicates.
Dotted black lines represent analytical detection limits (hardness 0.5 mg/L; conductivity 2 µs/cm; total dissolved solids 10 mg/L).
There are no CCME guidelines for hardness, conductivity, and total dissolved solids.

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Hardness, Conductivity and Total Dissolved Solids in Streams, Back River Project, 2012

Figure 3.3-1b

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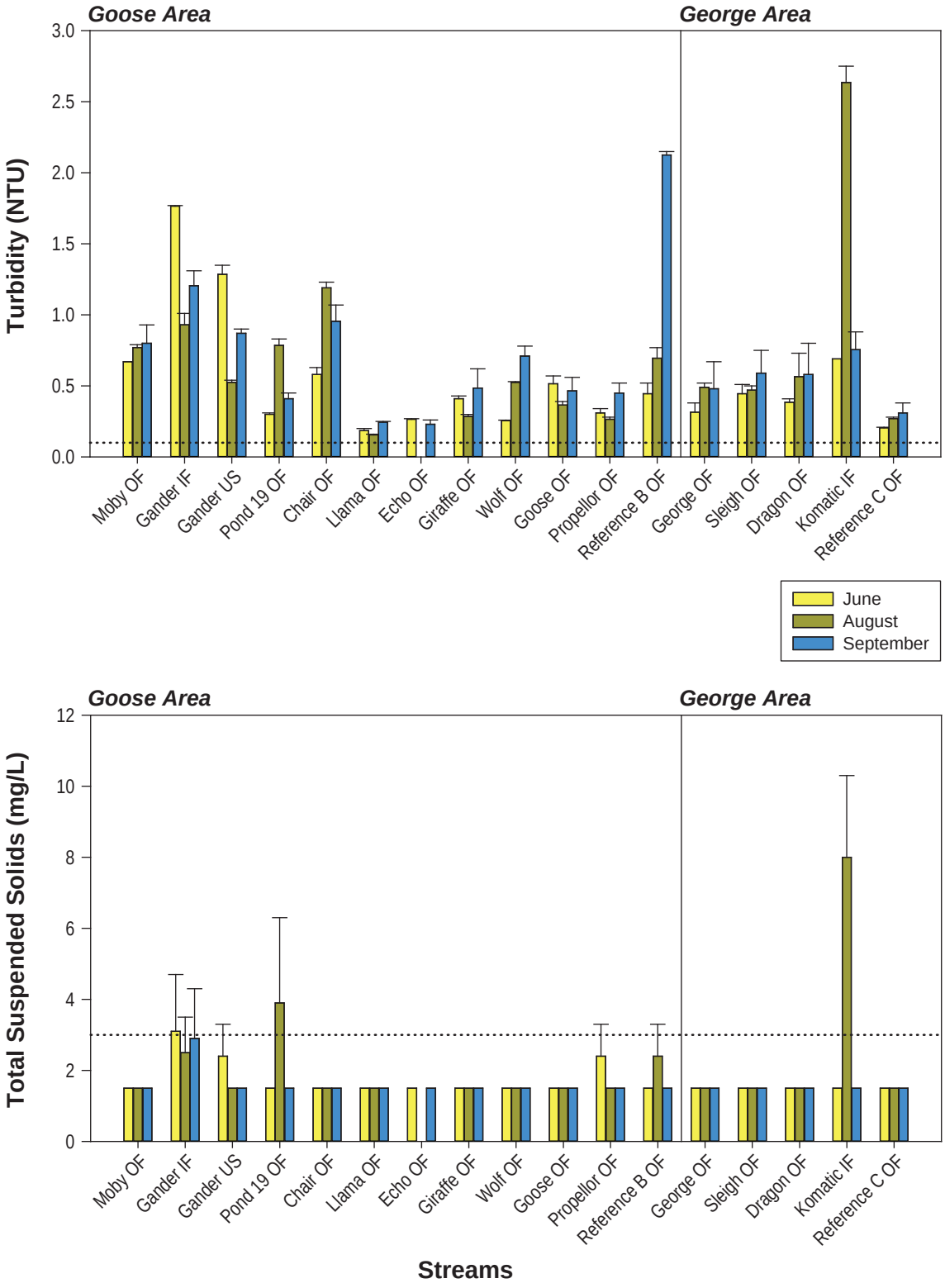
Notes: Error bars represent standard error of the mean of replicates.
Dotted black lines represent analytical detection limits (sulphate 0.5 mg/L; chloride 0.5 mg/L; fluoride 0.02 mg/L).
Values below detection limit were plotted as half of the detection limit.
Dashed lines represent the CCME long-term guideline for chloride (120 mg/L) and the CCME guideline for fluoride (0.12 mg/L).
The CCME short-term guideline for chloride is 640 mg/L (not shown).

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Sulphate, Chloride and Fluoride Concentrations in Streams, Back River Project, 2012

Figure 3.3-2

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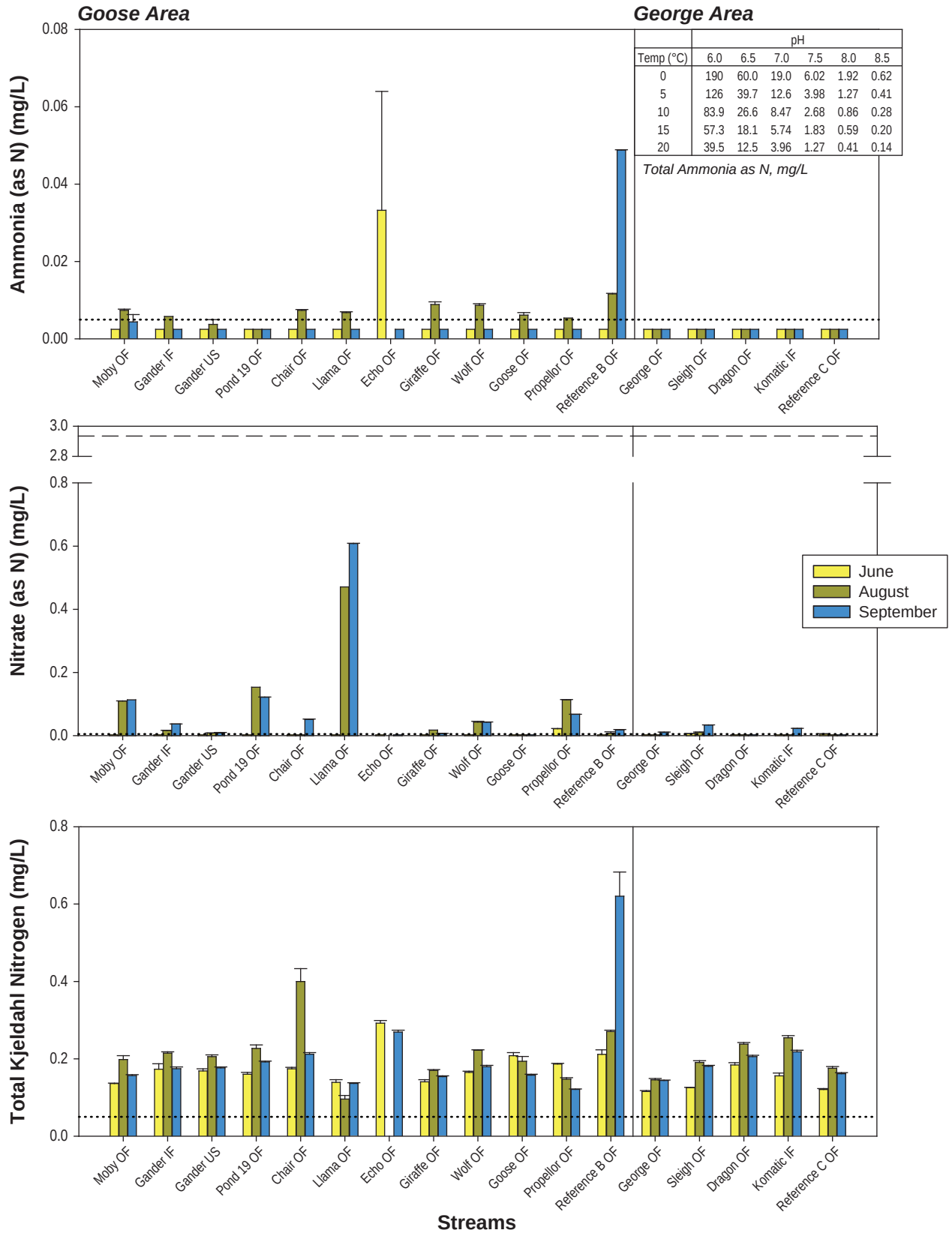
Notes: Error bars represent standard error of the mean of replicates.
Dotted black lines represent analytical detection limits (turbidity 0.1 NTU; total suspended solids 3 mg/L).
Values below detection limit were plotted as half of the detection limit.
CCME guidelines for turbidity and total suspended solids are dependent on background levels.

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Turbidity and Total Suspended Solids in Streams, Back River Project, 2012

Figure 3.3-3

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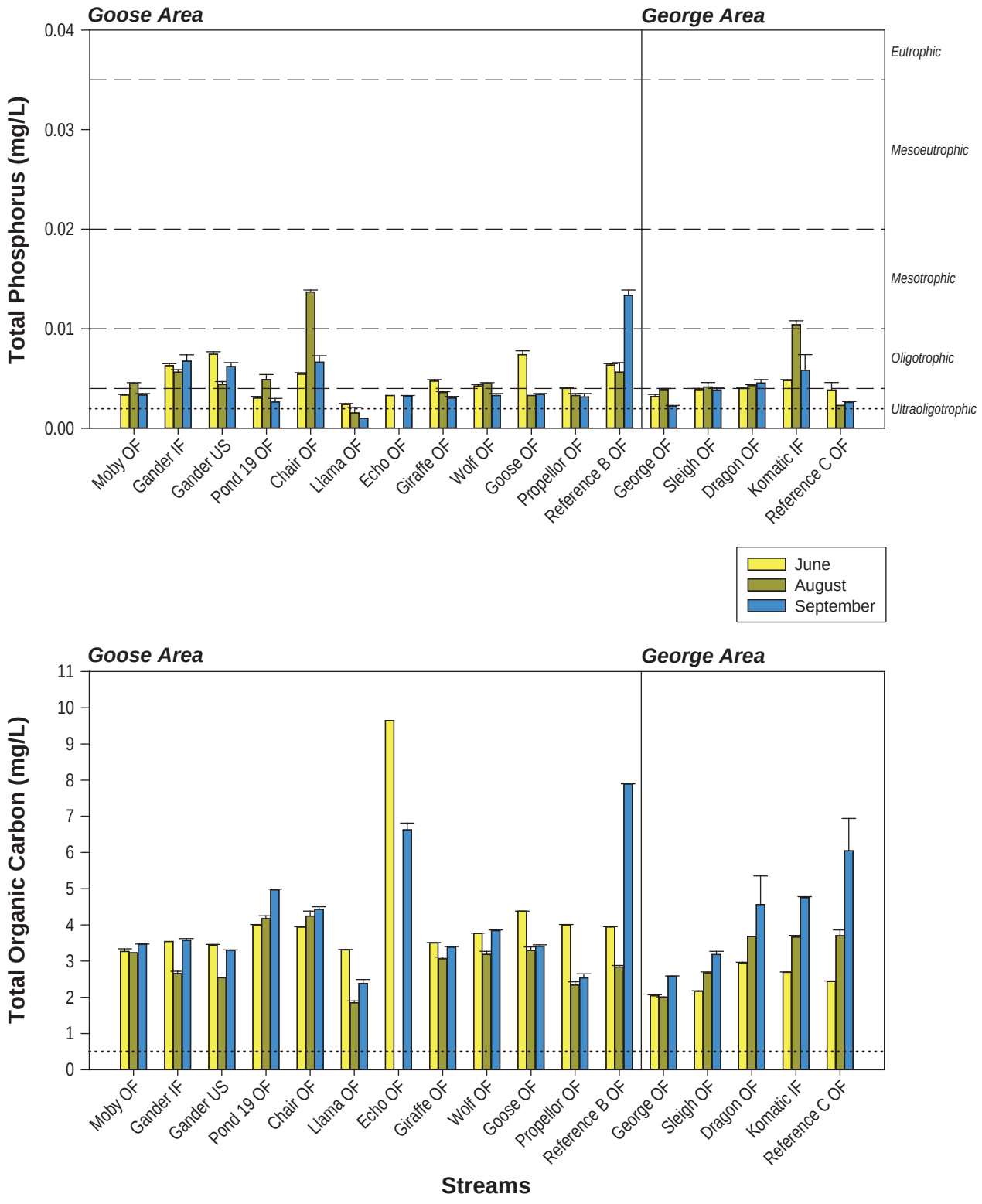
Notes: Error bars represent standard error of the mean of replicates.
Dotted black lines represent analytical detection limits (ammonia 0.005 mg/L; nitrate 0.005 mg/L; TKN 0.05 mg/L).
Values below the detection limit are plotted at half of the detection limit.
Inset table shows temperature- and pH-dependent CCME guidelines for ammonia.
Dashed red lines represent the CCME long-term guideline for nitrate (2.935 mg/L).
CCME short-term guideline for nitrate is 124 mg/L (not shown).
Nitrite concentrations were always below detection limit (0.001 mg/L) so were not plotted.

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Ammonia, Nitrate and Total Kjeldahl Nitrogen Concentrations in Streams, Back River Project, 2012

Figure 3.3-4a

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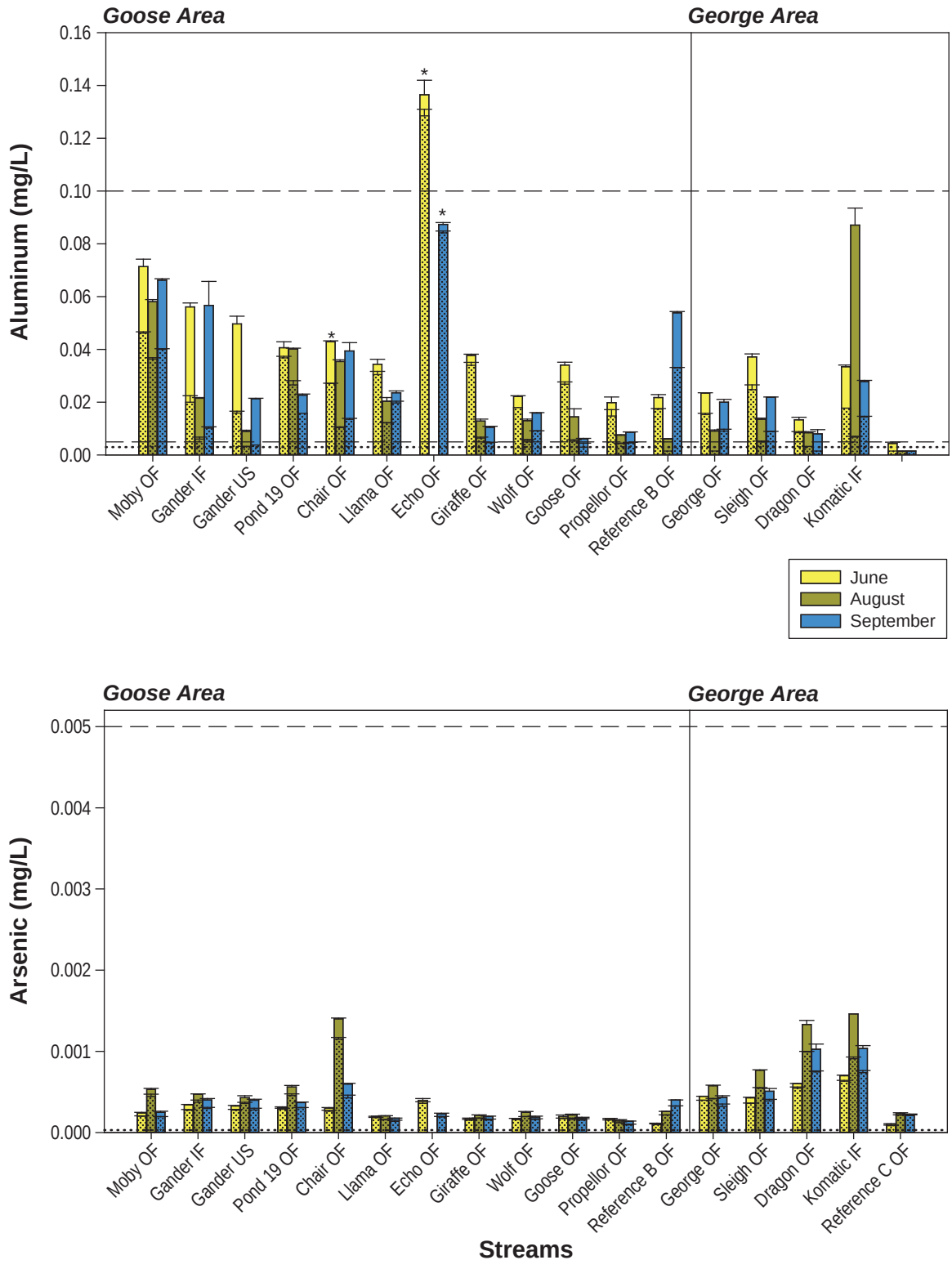
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limits (total phosphorus 0.002 mg/L; total organic carbon 0.5 mg/L).
Values below detection limit were plotted as half of the detection limit.
Dashed lines represent CCME trigger ranges for total phosphorus (<0.004 mg/L = ultraoligotrophic; 0.004-0.01 mg/L = oligotrophic; 0.01-0.02 = mesotrophic; 0.02-0.035 mg/L = mesoeutrophic; 0.035-0.1 mg/L = eutrophic; >0.1 mg/L = hypereutrophic).
There is no CCME guideline for total organic carbon.

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Total Phosphorus and Total Organic Carbon Concentrations in Streams, Back River Project, 2012

Figure 3.3-4b

Rescan™ Engineers & Scientists



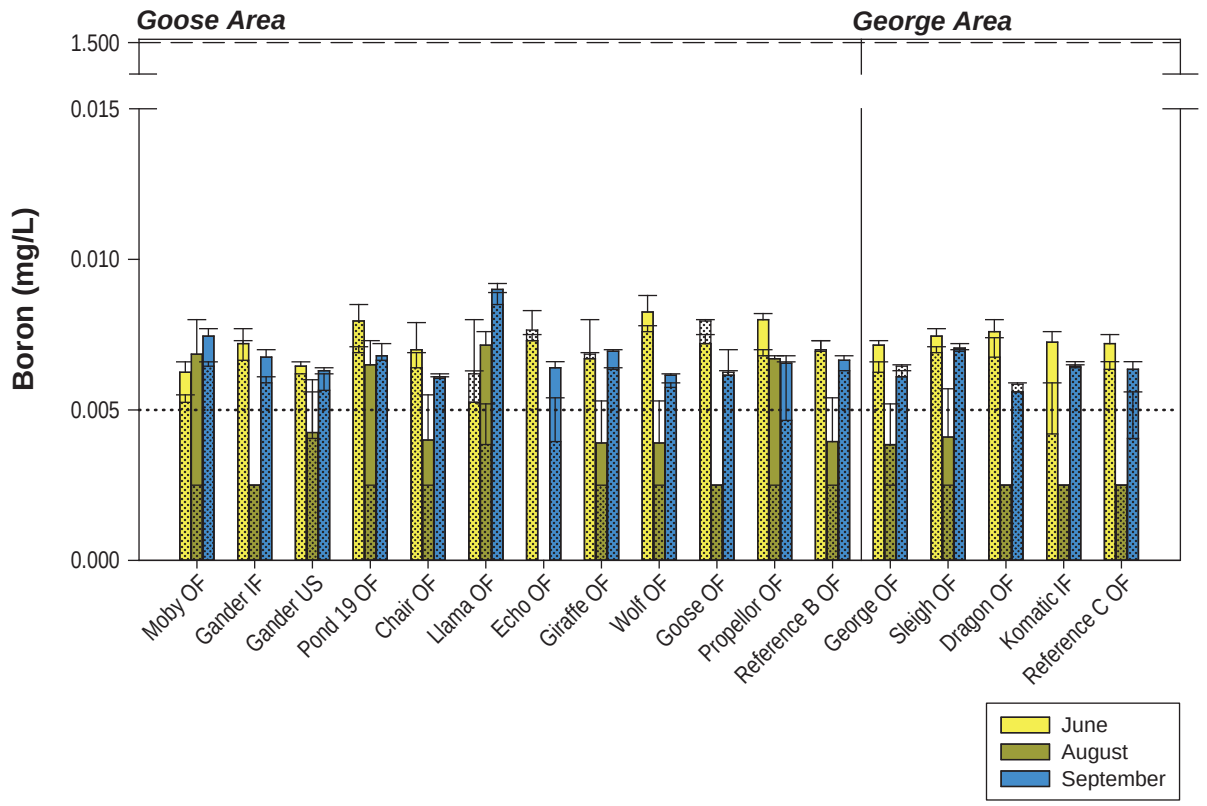
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limits (aluminum 0.003 mg/L; arsenic 0.00003 mg/L).
Values below detection limit were plotted as half of the detection limit.
Dashed lines represent CCME guidelines. The CCME guideline for arsenic is 0.005 mg/L.
CCME guidelines for aluminum are pH-dependent (0.005 mg/L at pH less than 6.5; 0.1 mg/L at pH greater than or equal to 6.5).
pH was above 6.5 at all sites except Echo OF (June and September) and Chair OF (June).
**Indicates mean total metal values that were higher than CCME guidelines.*

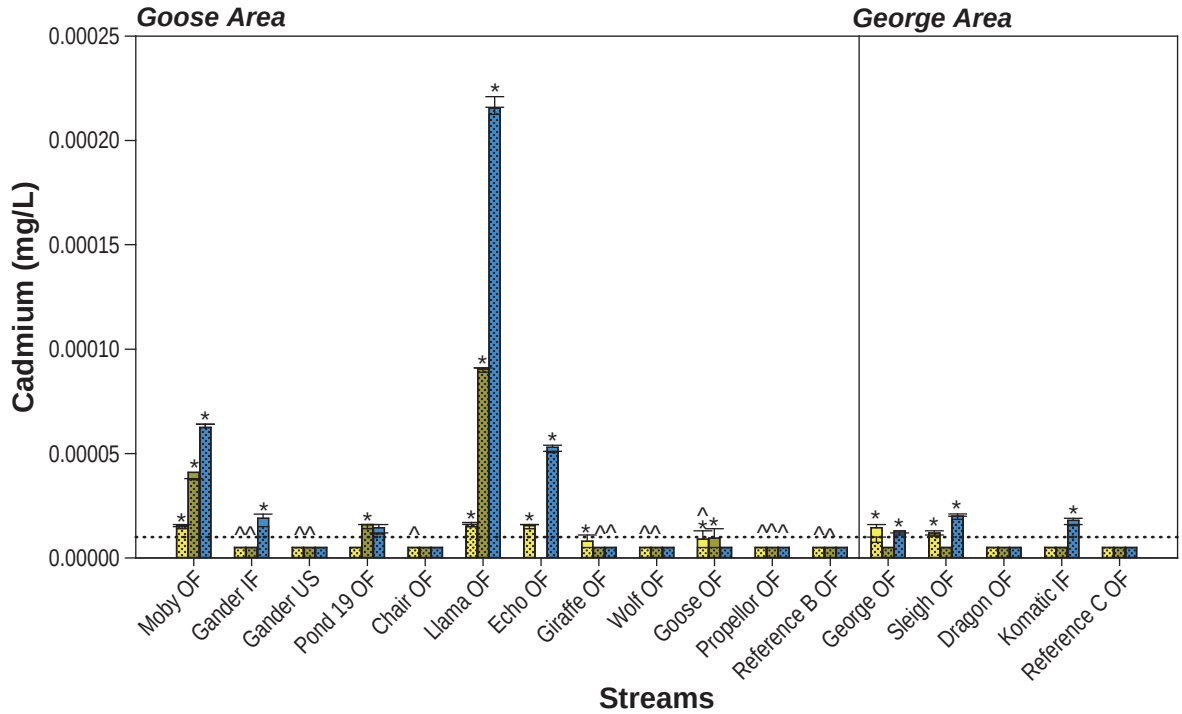
Sabina GOLD & SILVER CORP.

Aluminum and Arsenic Concentrations in Streams, Back River Project, 2012

Figure 3.3-5a

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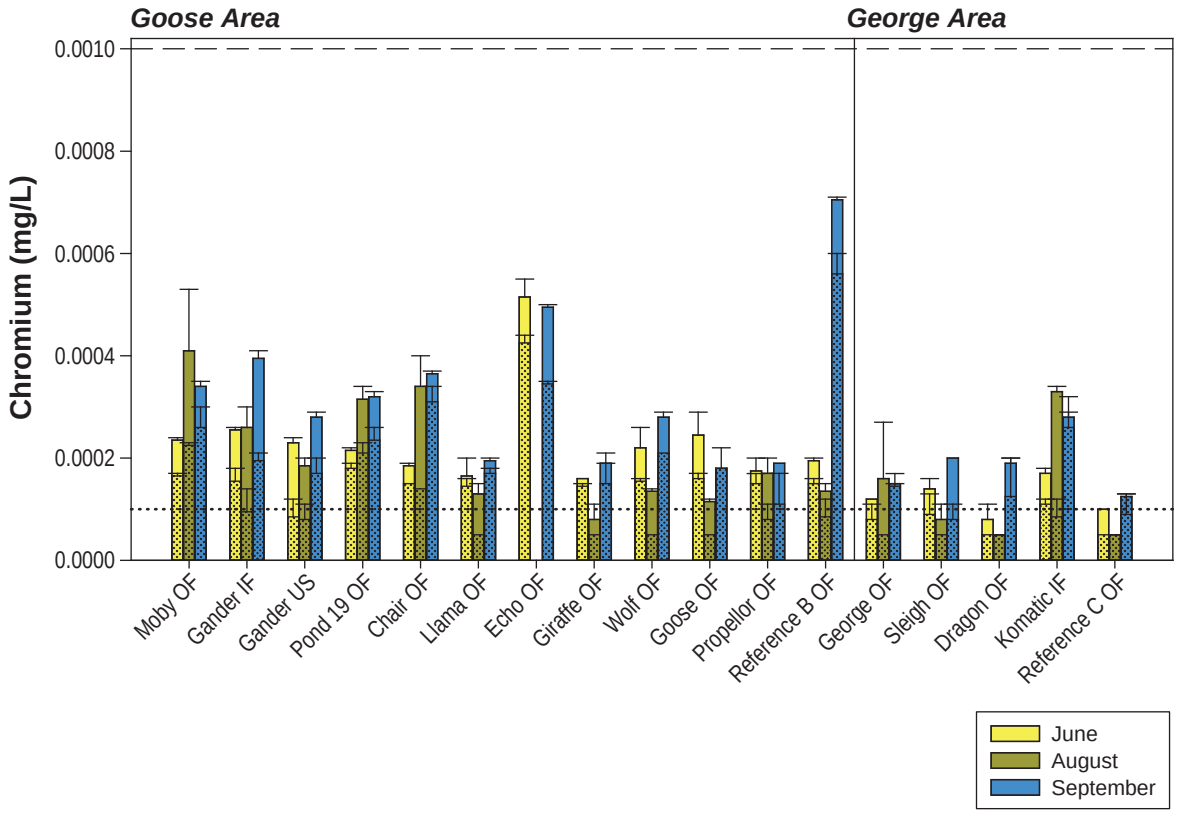
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limits (boron 0.005 mg/L; cadmium 0.00001 mg/L).
Values below detection limit were plotted as half of the detection limit.
Dashed lines represent CCME guidelines. The CCME guidelines for boron are 1.5 mg/L long term and 29 mg/L short term [not shown]).
The CCME guideline for cadmium (in mg/L) can be calculated using the equation: $10^{(0.86[\log(\text{hardness})]-3.2)}/1000$.
** Indicates mean total metal values that were higher than CCME guidelines.*
^ Indicates cadmium values below detection limnts where 0.5 x the detection limit was above hardness-dependent guidelines.

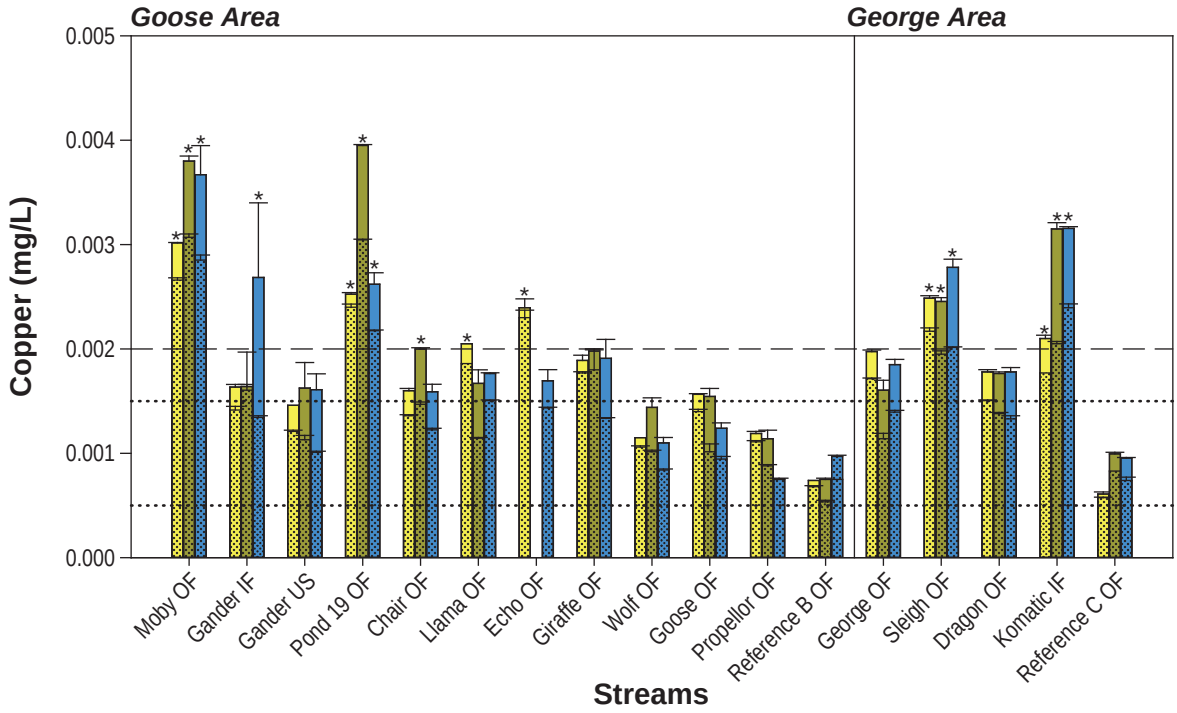
Sabina GOLD & SILVER CORP.

Boron and Cadmium Concentrations in Streams, Back River Project, 2012

Figure 3.3-5b

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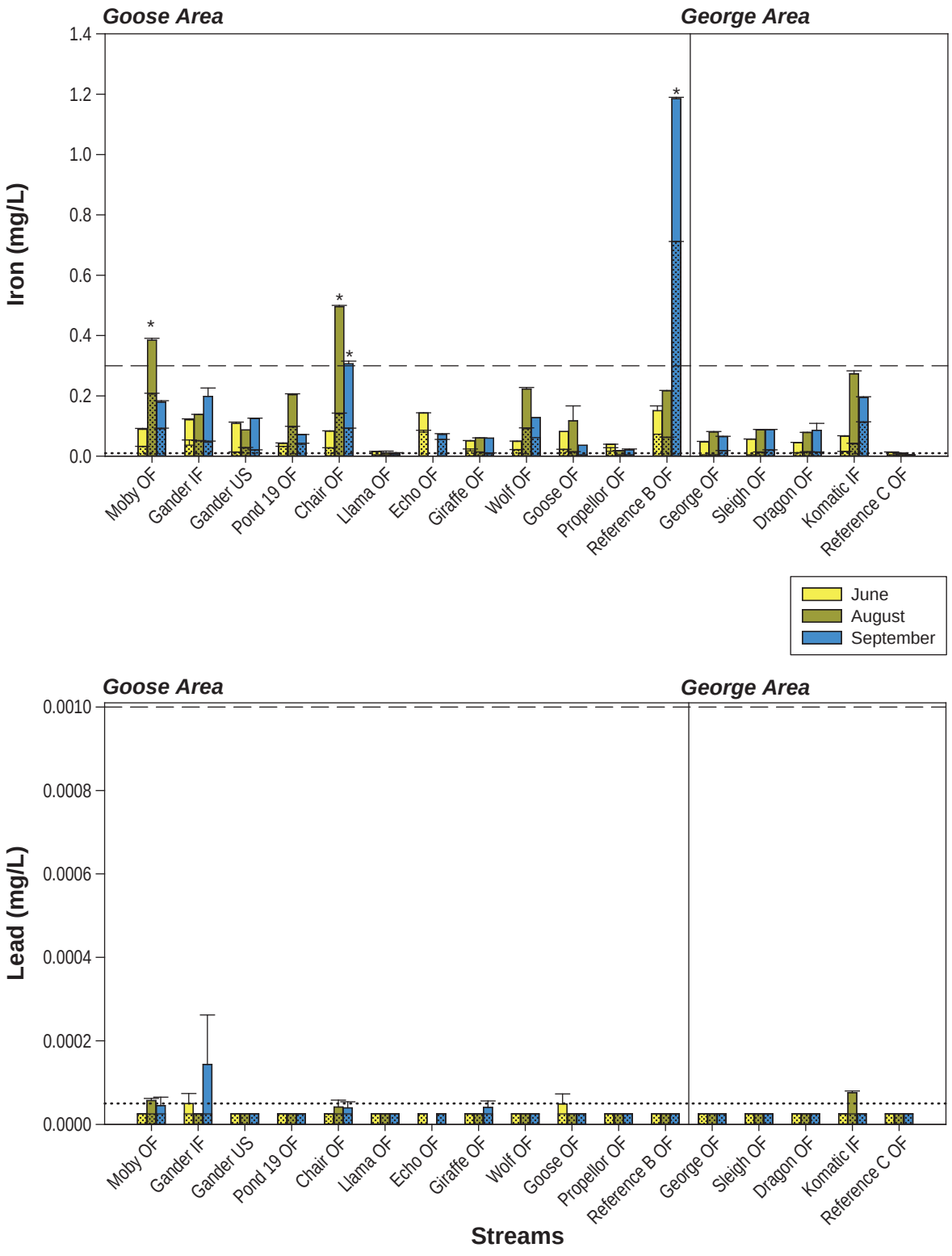
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed diagonal lined columns represent dissolved metals.
Dotted lines represent analytical detection limits (chromium 0.0001 mg/L; copper 0.0005 or 0.0015 mg/L).
Values below detection limit were plotted as half of the detection limit.
** Indicates mean total metal values that were higher than CCME guidelines.*

Sabina GOLD & SILVER CORP.

Chromium and Copper Concentrations in Streams, Back River Project, 2012

Figure 3.3-5c

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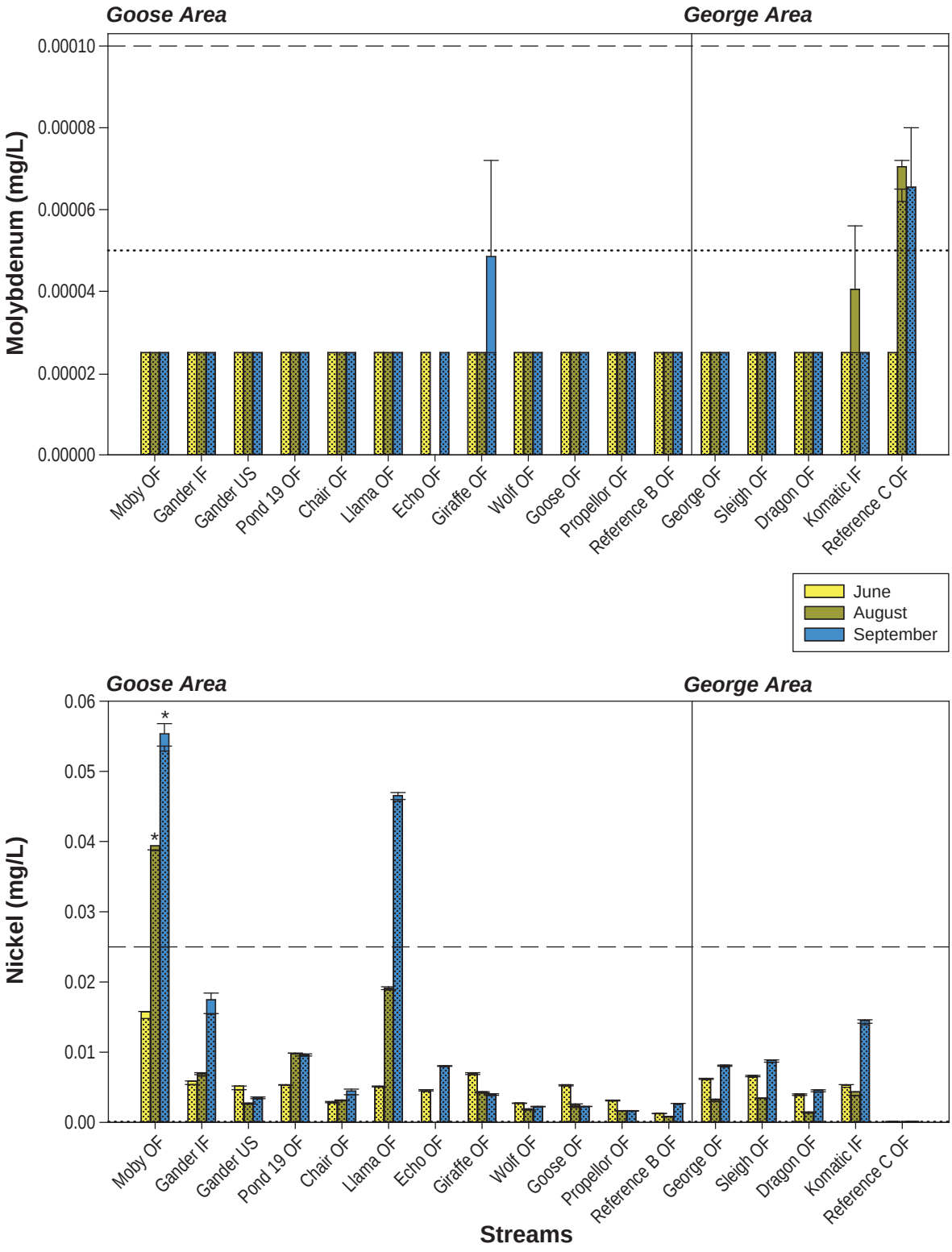
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limits (iron 0.01 mg/L; lead 0.00005 mg/L).
Values below detection limit were plotted as half of the detection limit.
Dashed lines represent CCME guidelines. The CCME guideline for iron is 0.3 mg/L.
The CCME guideline for lead (in mg/L) can be calculated using the equation: $e^{(1.273[\ln(\text{hardness})]-4.705)}/1{,}000$.
Lead guideline is a minimum of 0.001 mg/L regardless of hardness.
** Indicates mean total metal values that were higher than CCME guidelines.*

Sabina GOLD & SILVER CORP.

Iron and Lead Concentrations in Streams, Back River Project, 2012

Figure 3.3-5d

Rescan™ Engineers & Scientists



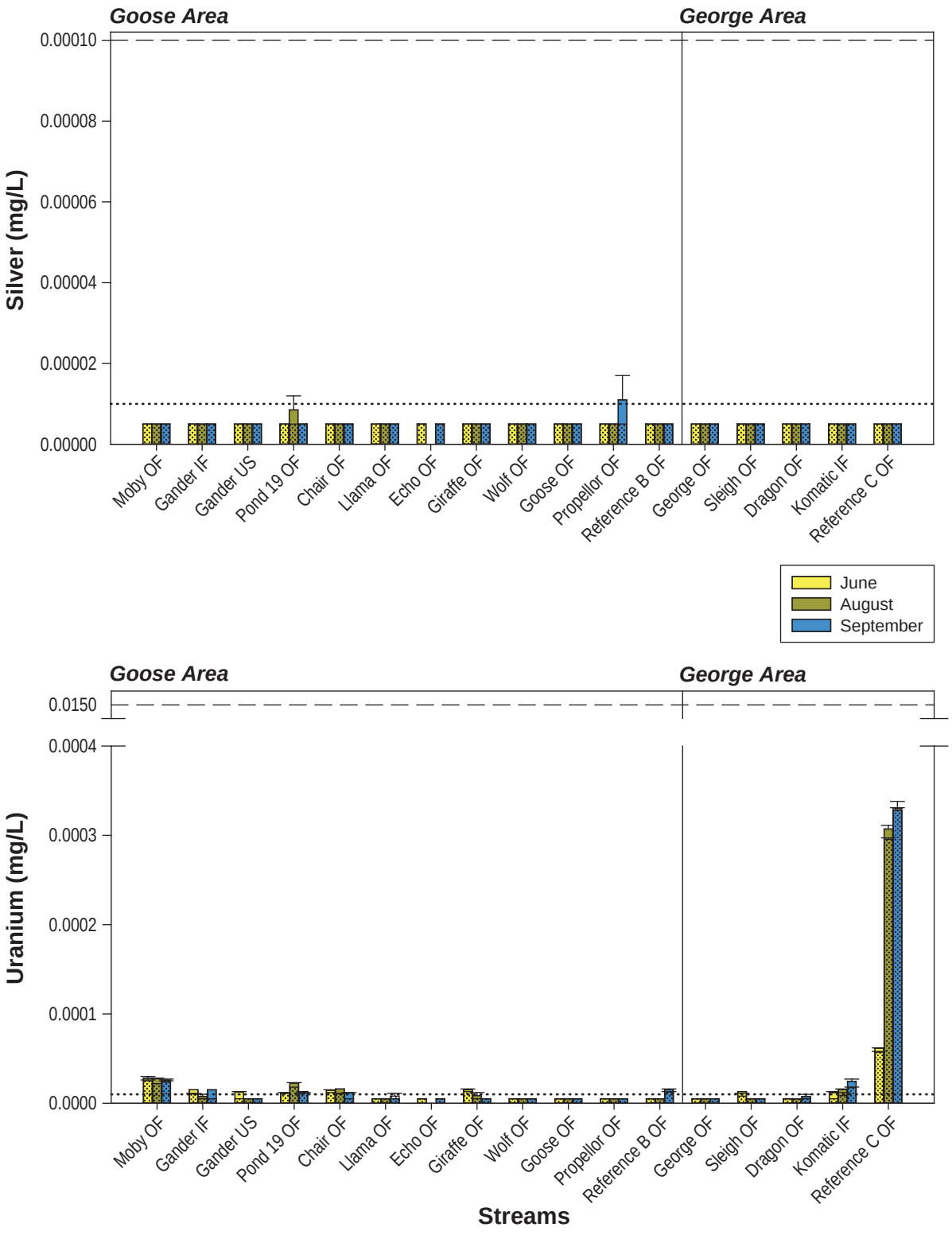
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limits (molybdenum 0.00005 mg/L; nickel 0.0001 mg/L).
Values below detection limit were plotted as half of the detection limit.
Dashed lines represent CCME guidelines.The CCME guideline for nickel (in mg/L) can be calculated using the equation $e^{\{0.76[\ln(\text{hardness})]+1.06\}/1000}$.
Nickel guideline is a minimum of 0.025 mg/L regardless of hardness.
The interim CCME guideline for molybdenum is 0.073 mg/L.
** Indicates total mean nickel values that were higher than CCME guidelines.*

Sabina GOLD & SILVER CORP.

Molybdenum and Nickel Concentrations in Streams, Back River Project, 2012

Figure 3.3-5e

Rescan™ Engineers & Scientists



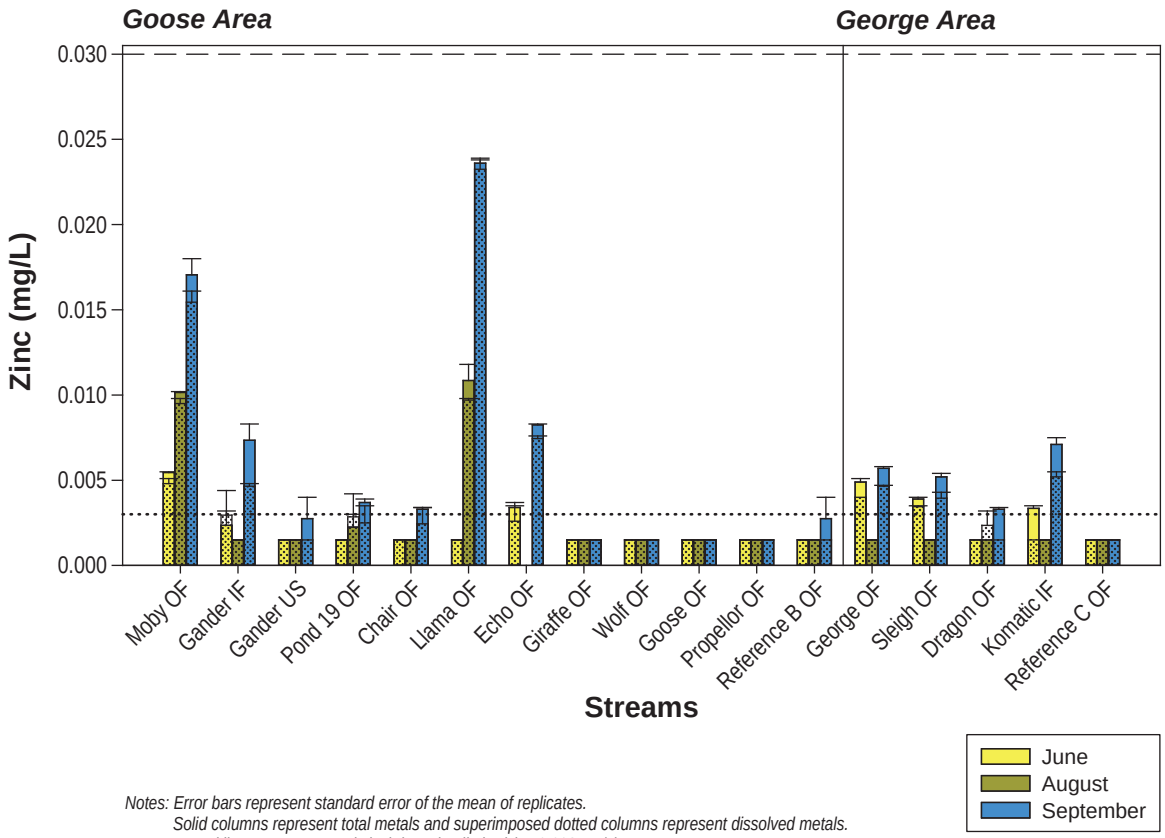
Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limits (silver 0.00001 mg/L; uranium 0.00001 mg/L).
Values below detection limit were plotted as half of the detection limit.
Dashed lines represent CCME guidelines (silver 0.0001 mg/L; uranium long-term 0.015 mg/L).
The short-term CCME guideline for uranium is not shown (0.033 mg/L).

Sabina GOLD & SILVER CORP.

Silver and Uranium Concentrations in Streams, Back River Project, 2012

Figure 3.3-5f

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Notes: Error bars represent standard error of the mean of replicates.
Solid columns represent total metals and superimposed dotted columns represent dissolved metals.
Dotted lines represent analytical detection limits (zinc 0.003 mg/L).
Values below detection limit were plotted as half of the detection limit
Dashed lines represent CCME guidelines (zinc 0.03 mg/L).

Sabina GOLD & SILVER CORP.

Zinc Concentrations in Streams, Back River Project, 2012

Figure 3.3-5g

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3.3.3 Suspended Material

In general, Project streams had clear water with no apparent trend between Goose and George area streams. Turbidity levels were low at most streams, ranging from 0.15 to 1.3 NTU (Figure 3.3-3). The exceptions were Gander IF in June (1.8 NTU), Reference B OF in September (2.1 NTU) and Komatic IF in August (2.6 NTU). Most streams had TSS concentrations below the detection limit (3 mg/L), and only Gander IF had detectable levels in all seasons. The highest TSS concentration (8 mg/L) was measured in Komatic IF in August.

3.3.4 Nutrients

Streams surveyed had low nutrient concentrations overall, with no clear trend between Goose and George area streams.

Like the surveyed lakes, streams in the study area tended to have low concentrations of inorganic nitrogen (ammonia, nitrate, and nitrite; Figure 3.3-4a). Most stream sites had ammonia concentrations near the analytical detection limit (0.005 mg/L) in all seasons. The two exceptions were Echo OF with 0.033 mg/L ammonia in June and Reference B OF with 0.049 mg/L ammonia in September. Nitrate levels were lowest in June, with most streams below detection limits (0.005 mg/L). Higher nitrate levels were observed in August and September with most streams below 0.16 mg/L. The exception to this was Llama OF in August, which had nitrate concentrations approximately three to four times higher in August and September (0.47 mg/L and 0.61 mg/L). Nitrite levels were below detection limits (0.001 mg/L) at all stream sites in all seasons. TKN concentrations were similar across streams, generally less than 0.30 mg/L, with the exceptions of Chair OF in August (0.40 mg/L) and Reference B OF in September (0.62 mg/L). All streams had ammonia, nitrate and nitrite concentrations well below the CCME guidelines (CCME 2012).

All streams sampled had total phosphorus concentrations below 0.02 mg/L (Figure 3.3-4b), and most would be considered either ultraoligotrophic (< 0.004 mg/L) or oligotrophic (0.004 to 0.01 mg/L) based on the CCME trigger ranges for total phosphorus (CCME 2012). Chair OF in August, Reference B in September, and Komatic IF were mesotrophic (0.01 to 0.02 mg/L) in August.

TOC was similar across all streams, with most concentrations between 1.8 and 5.0 mg/L (Figure 3.3-4b). Exceptions to this were Echo OF in June and August and Reference B OF in September, which had concentrations between 6.6 and 9.7 mg/L and were similarly elevated in 2011 (Rescan 2012a), and Reference C OF which had August concentrations of 6.0 mg/L. Note these three streams also had the lowest water levels.

3.3.5 Metals

Overall, metal concentrations varied both spatially and temporally (Figures 3.3-5a to 3.3-5g). Aluminum, chromium and iron tended to be higher in several Goose area streams, while arsenic concentrations tended to be higher in the George area streams. Giraffe OF, Wolf OF, Goose OF, Propellor OF, Reference B OF, and Reference C OF often had lower concentrations of arsenic, cadmium, copper, nickel, uranium and zinc than other sites. Reference C OF had relatively high molybdenum and uranium concentrations. Metal concentrations were often higher in the low flow August and September sampling sessions.

Aluminum concentrations ranged from below detection limits (0.003 mg/L) at Reference C OF in August and September to 0.14 mg/L at Echo OF in June, with most being below 0.07 mg/L (Figure 3.3-5a). The CCME guideline for aluminum is pH-dependent, with a lower guideline for water with pH less than 6.5 (0.005 mg/L; CCME 2012). All three of the samples with pH below 6.5 exceeded the guidelines

(Chair OF in June, and Echo OF in August and September). Echo OF had the highest total aluminum concentrations of all streams, a trend also observed in 2011.

Overall, streams had low total arsenic levels, with all concentrations below 0.0015 mg/L and the CCME guideline of 0.005 mg/L (Figure 3.3-5a). Average concentrations tended to be highest in August, and higher in George area streams than in Goose area streams, similar to trends observed in lake water quality. Boron concentrations were similar across stream sites, ranging from below detection limits (0.005 mg/L) to 0.009 mg/L, and tended to be lowest in August (Figure 3.3-5b). All streams were well below the CCME guidelines for boron (1.5 mg/L).

Cadmium concentrations in most stream samples were below or near detection limits (0.00001 mg/L) (Figure 3.3-5b). Moby OF, Llama OF, and Echo OF had cadmium concentrations close to detection limits in June, but cadmium concentrations more than doubled in August and September. In particular, cadmium concentrations in Llama OF were 14 times greater in September than in June. CCME guidelines for cadmium are hardness-dependent, which resulted in some particularly soft streams having guideline concentrations below detection limits (0.00001 mg/L). Most streams exceeded CCME guidelines in at least one sampling session (including those where half the detection limit was above the hardness-dependent CCME guideline), the two exceptions were Dragon OF and Reference C OF.

Average total chromium concentrations ranged from below detection limits (0.0001 mg/L) to 0.0007 mg/L, and tended to be lowest in the George area streams (Figure 3.3-5c). The highest concentrations were observed in Echo OF (0.0005 mg/L) and in Reference B OF in September (0.0007 mg/L), and were below the CCME guideline for the protection of freshwater aquatic life (0.001 mg/L for hexavalent chromium).

Streams sampled had high total copper concentrations, with over a third of streams exceeding CCME guidelines in at least one sampling session (Figure 3.3-5c). The lowest copper concentrations were observed at Wolf OF, Goose OF, Propellor OF, Reference B OF and Reference C OF, all consistently below the 0.002 mg/L minimum CCME guideline for copper.

Most streams had total iron concentrations were below the CCME guideline for freshwater aquatic life of 0.3 mg/L (Figure 3.3-5d). Exceptions were Moby OF in August, Chair OF in August and September, and Reference B OF in September. Reference B OF had the highest recorded iron levels (average of 0.52 mg/L), with September concentrations three times greater than the CCME guideline (1.185 mg/L compared to CCME guideline 0.3 mg/L). High iron concentrations were also observed for Reference B OF in 2011 (Rescan 2012a). Llama OF, Propellor OF, and Reference C OF had the lowest iron concentrations, all below or near the detection limit (0.01 mg/L).

Total lead and molybdenum concentrations were below or near detection limits in all streams during all seasons (lead 0.00005 mg/L; molybdenum 0.00005 mg/L). All concentrations were below the CCME guidelines for the protection of freshwater aquatic life (lead 0.001 mg/L; molybdenum 0.0001 mg/L; Figures 3.3-5d and 3.3-5e).

Total nickel concentrations were below 0.02 mg/L at most streams (Figure 3.3-5e). Moby OF had higher average nickel concentrations in August (0.04 mg/L) and September (0.06 mg/L), which exceeded the CCME hardness-dependent guideline. Llama OF also had higher nickel concentrations in September (0.05 mg/L), but did not exceed the hardness-dependent CCME guideline due to high hardness levels. Nickel concentrations were lowest at Reference C OF, being near or below detection limits (0.0001 mg/L) in all sampling sessions.

Streams mostly had total silver and uranium concentrations below or near the detection limits (silver 0.00001 mg/L; uranium 0.00001 mg/L; Figure 3.3-5f). The exception to this was Reference C OF, which

had average uranium concentrations an order of magnitude greater than all other sites, with August and September concentrations averaging 0.000307 mg/L and 0.000328 mg/L while all other sites averaged below 0.00003 mg/L.

Zinc concentrations were often below the detection limit (0.003 mg/L), consistently so for Giraffe OF, Wolf OF, Goose OF, Propellor OF, and Reference C OF. Zinc concentrations followed a similar pattern to nickel, with September concentrations at Moby OF and Llama OF being relatively high (0.017 mg/L and 0.024 mg/L; Figure 3.3-5f). All streams were below the CCME guideline for zinc (0.03 mg/L).

All streams in all seasons had total mercury, selenium, and thallium concentrations below their respective detection limit.

3.3.6 Cyanides

Total and free cyanide concentrations were all below the detection limit of 0.001 mg/L, and therefore below the CCME guideline of 0.005 mg/L (CCME 2012).

3.3.7 Comparison with CCME Guidelines

The percentage of stream water quality samples where parameter concentrations were above CCME guidelines is presented in Table 3.3-1. Table 3.3-2 shows the average factor that concentrations at each stream were higher than CCME guidelines.

All streams had water quality within the CCME guidelines for pH, (6.5 to 9), except Chair OF in June (6.1), and Echo OF in June and Sept (6.0). All streams had water quality below CCME guidelines for chloride, fluoride, ammonia, nitrate, nitrite and free cyanide. All streams, except Dragon OF and Reference C OF, exceeded CCME guidelines in at least one sample for at least one of the following metals: total aluminum, total cadmium, total copper, total iron, and total nickel (Table 3.3-1).

Average concentrations exceeded CCME guidelines for at least one parameter at most streams. Parameters where average stream concentrations exceeded guidelines included aluminum, cadmium, copper, iron and nickel (Table 3.3-2). Thirteen of the seventeen of streams had average cadmium concentrations that exceeded the CCME guidelines (including all but one of the Goose area streams), although four of these streams had hardness-dependent guidelines and cadmium concentrations consistently below detection limits. Five streams had average copper concentrations that exceeded CCME guidelines. Echo OF exceeded CCME guidelines for the greatest number of parameters (aluminum, cadmium and copper) and had the highest exceedances with average aluminum concentrations 22 times higher and average cadmium concentrations 18 times higher than the CCME guidelines.

As observed with lake water quality, more average concentrations exceeded CCME guidelines in streams in the Goose area than in the George area.

CCME guidelines for total aluminum are pH dependent, with a lower total aluminum guideline for waters with a pH of less than 6.5. Only the two streams with average pH values below 6.5, Chair OF (June) and Echo OF (June and September), had average aluminum concentrations that exceeded the guideline concentration (by a factor of 3.1 and 22.4). Streams with higher hardness concentrations including Pond 19 OF, Llama OF, Sleigh OF, Dragon OF, Komatic IF and Reference C OF had higher hardness-dependent CCME guideline concentrations for total cadmium, copper, lead, and nickel. Softer streams had lower hardness-dependent CCME guidelines, and in the case of cadmium, sometimes the calculated guideline concentration was below the actual analytical detection limit.

Table 3.3-1. Stream Water Quality, Percent of Samples in which Concentrations were Higher than CCME Guidelines, Back River Project, 2012

			pH	Fluoride	Chloride	Ammonia (as N)	Nitrate	Nitrite	Total Phosphorus	Aluminum (Al)	Arsenic (As)	Boron (B)	Cadmium (Cd)	
													Hardness-based Equation[be]	
CCME Guideline Values[a]			6.5 - 9.0	0.12[b] mg/L	Short-term 640 mg/L; Long-term 120 mg/L	Temperature- and pH-dependent	Short-term 124 mg/L; Long-term 2.935 mg/L	0.06 mg/L	Trophic Status[c] Range	0.005 - 0.1[d] mg/L	0.005 mg/L	Short-term 29 mg/L; Long-term 1.5 mg/L	Samples above Detection Limits	Samples below Detection Limits (using half the detection limit)
Stream	Total Number of Samples Collected	Number of Parameters with Exceedances												
Goose Area														
Moby OF	6	4	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	100	0
Gander IF	6	2	0	0	0	0	0	0	oligotrophic	0	0	0	33.3	66.7
Gander US	6	1	0	0	0	0	0	0	oligotrophic	0	0	0	0	66.7
Pond 19 OF	6	2	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	33.3	0
Chair OF	6	5	33.3	0	0	0	0	0	oligotrophic - mestrophic	33.3	0	0	0	33.3
Llama OF	6	2	0	0	0	0	0	0	ultraoligotrophic	0	0	0	100	0
Echo OF	4	4	100	0	0	0	0	0	ultraoligotrophic	100	0	0	100	0
Giraffe OF	6	2	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	16.7	83.3
Wolf OF	6	1	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	0	66.7
Goose OF	6	1	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	33.3	16.7
Propellor OF	6	1	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	0	100
Reference B OF	6	2	0	0	0	0	0	0	oligotrophic - mestrophic	0	0	0	0	66.7
George Area														
George OF	6	1	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	66.7	0
Sleigh OF	6	2	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	66.7	0
Dragon OF	6	0	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	0	0
Komatic IF	6	2	0	0	0	0	0	0	oligotrophic - mestrophic	0	0	0	16.7	0
Reference C OF	6	0	0	0	0	0	0	0	ultraoligotrophic - oligotrophic	0	0	0	0	0

Notes: *(continued)*

a) Canadian water quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) Interim guideline.

c) < 0.004 mg/L = ultraoligotrophic; 0.004 - 0.01 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; > 0.1 mg/L = hypereutrophic.

d) 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5.

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000. There is no minimum guideline. Samples from sites where hardness was low may have guideline concentrations below analytical detection limits. Samples where half the detection limit was above their hardness-dependent guideline are shown in a separate column in the table.

f) Guideline concentration of hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L).

g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ x 0.0002. Copper guideline is a minium of 0.002 mg/L regardless of hardness.

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minimum of 0.001 mg/L regardless of hardness.

i) Guideline concentration for inorganic mercury.

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

Table 3.3-1. Stream Water Quality, Percent of Samples in which Concentrations were Higher than CCME Guidelines, Back River Project, 2012 (completed)

		Chromium (Cr)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Uranium (U)	Zinc (Zn)	Free Cyanide
CCME Guideline Values[a]		Cr (VI) 0.001[bf] mg/L	Hardness-dependent ≥ 0.002[g] mg/L	0.3 mg/L	Hardness-dependent ≥ 0.001[h] mg/L	0.000026[i] mg/L	0.073[b] mg/L	Hardness-dependent ≥ 0.025[j] mg/L	0.001 mg/L	0.0001 mg/L	0.0005 mg/L	Short-term 0.033 mg/L; Long-term 0.015 mg/L	0.03 mg/L	0.005 as Free CN
Stream	**Total Number of Samples Collected**													
Goose Area														
Moby OF	6	0	100	33.3	0	0	0	66.7	0	0	0	0	0	0
Gander IF	6	0	16.7	0	0	0	0	0	0	0	0	0	0	0
Gander US	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Pond 19 OF	6	0	100	0	0	0	0	0	0	0	0	0	0	0
Chair OF	6	0	16.7	50	0	0	0	0	0	0	0	0	0	0
Llama OF	6	0	33.3	0	0	0	0	0	0	0	0	0	0	0
Echo OF	4	0	50	0	0	0	0	0	0	0	0	0	0	0
Giraffe OF	6	0	33.3	0	0	0	0	0	0	0	0	0	0	0
Wolf OF	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Goose OF	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Propellor OF	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Reference B OF	6	0	0	33.3	0	0	0	0	0	0	0	0	0	0
George Area														
George OF	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Sleigh OF	6	0	100	0	0	0	0	0	0	0	0	0	0	0
Dragon OF	6	0	0	0	0	0	0	0	0	0	0	0	0	0
Komatic IF	6	0	100	0	0	0	0	0	0	0	0	0	0	0
Reference C OF	6	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:

a) Canadian water quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) Interim guideline.

c) < 0.004 mg/L = ultraoligotrophic; 0.004 - 0.01 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; > 0.1 mg/L = hypereutrophic.

d) 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5.

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000. There is no minimum guideline. Samples from sites where hardness was low may have guideline concentrations below analytical detection limits. Samples where half the detection limit was above their hardness-dependent guideline are shown in a separate column in the table.

f) Guideline concentration of hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L).

g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ x 0.0002. Copper guideline is a minium of 0.002 mg/L regardless of hardness.

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minimum of 0.001 mg/L regardless of hardness.

i) Guideline concentration for inorganic mercury.

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

Table 3.3-2. Stream Water Quality, Average Factor by which Concentrations were Higher than CCME Guidelines, Back River Project, 2012

Stream	Total Number of Samples Collected	Number of Parameters with Exceedances	pH*	Fluoride	Chloride	Ammonia (as N)	Nitrate	Nitrite	Total Phosphorus	Aluminum (Al)	Arsenic (As)	Boron (B)	Cadmium (Cd)	Chromium (Cr)
CCME Guideline Values[a]			6.5 - 9.0	0.12[b] mg/L	Short-term 640 mg/L; Long-term 120 mg/L	Temperature- and pH-dependent	Short-term 124 mg/L; Long-term 2.935 mg/L	0.06 mg/L	Trophic Status[c] Range	0.005 - 0.1[d] mg/L	0.005 mg/L	Short term 29 mg/L; Long-term 1.5 mg/L	Hardness-based Equation[be]	Cr (VI) 0.001[bf] mg/L
Goose Area														
Moby OF	6	4	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	4.71	-
Gander IF	6	2	-	-	-	-	-	-	oligotrophic	-	-	-	1.71	-
Gander US	6	2	-	-	-	-	-	-	oligotrophic	-	-	-	1.18	-
Pond 19 OF	6	3	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	1.07	-
Chair OF	6	2	exceed	-	-	-	-	-	oligotrophic - mestrophic	3.11	-	-	-	-
Llama OF	6	2	-	-	-	-	-	-	ultraoligotrophic	-	-	-	8.38	-
Echo OF	4	4	exceed	-	-	-	-	-	ultraoligotrophic	22.39	-	-	18.25	-
Giraffe OF	6	2	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	4.12	-
Wolf OF	6	2	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	1.21	-
Goose OF	6	2	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	1.57	-
Propellor OF	6	2	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	1.26	-
Reference B OF	6	3	-	-	-	-	-	-	Oligotrophic - mestrophic	-	-	-	1.37	-
George Area														
George OF	6	2	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	1.28	-
Sleigh OF	6	3	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	1.36	-
Dragon OF	6	1	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	-	-
Komatic IF	6	2	-	-	-	-	-	-	oligotrophic - mestrophic	-	-	-	-	-
Reference C OF	6	1	-	-	-	-	-	-	ultraoligotrophic - oligotrophic	-	-	-	-	-

Notes: *(continued)*

Values represent the average factor by which 2012 samples are higher than CCME guidelines.

Half the detection limit was substituted for values that were below the detection limit for the calculation of exceedance factors. Shaded cells show sites where all samples that exceeded a particular parameters guideline were below the detection limit.

The average concentration of a particular parameter may be below the CCME guideline concentration even if a percentage of samples is higher than this guideline concentration.

** Note factor by which average concentrations exceeded pH guidelines was not calculated as pH guidelines are a range. Exceedances are shown for reference only.*

a) Canadian water quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) Interim guideline.

c) < 0.004 mg/L = ultraoligotrophic; 0.004 - 0.01 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; > 0.1 mg/L = hypereutrophic.

d) 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5.

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000. There is no minimum guideline.

f) Guideline concentration of hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L).

g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ x 0.0002. Copper guideline is a minium of 0.002 mg/L regardless of hardness.

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minimum of 0.001 mg/L regardless of hardness.

i) Guideline concentration for inorganic mercury.

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

Table 3.3-2. Stream Water Quality, Average Factor by which Concentrations were Higher than CCME Guidelines, Back River Project, 2012 (completed)

		Copper (Cu)	Iron (Fe)	Lead (Pb)	Mercury (Hg)	Molybdenum (Mo)	Nickel (Ni)	Selenium (Se)	Silver (Ag)	Thallium (Tl)	Uranium (U)	Zinc (Zn)	Free Cyanide
CCME Guideline Values[a]		Hardness-dependent ≥ 0.002[g] mg/L	0.3 mg/L	Hardness-dependent ≥ 0.001[h] mg/L	0.000026[i] mg/L	0.073[b] mg/L	Hardness-dependent ≥ 0.025[j] mg/L	0.001 mg/L	0.0001 mg/L	0.0005 mg/L	Short-term 0.033 mg/L; Long-term 0.015 mg/L	0.03 mg/L	0.005 as Free CN
Stream	Total Number of Samples Collected												
Goose Area													
Moby OF	6	1.75	-	-	-	-	1.18	-	-	-	-	-	-
Gander IF	6	-	-	-	-	-	-	-	-	-	-	-	-
Gander US	6	-	-	-	-	-	-	-	-	-	-	-	-
Pond 19 OF	6	1.52	-	-	-	-	-	-	-	-	-	-	-
Chair OF	6	-	-	-	-	-	-	-	-	-	-	-	-
Llama OF	6	-	-	-	-	-	-	-	-	-	-	-	-
Echo OF	4	1.02	-	-	-	-	-	-	-	-	-	-	-
Giraffe OF	6	-	-	-	-	-	-	-	-	-	-	-	-
Wolf OF	6	-	-	-	-	-	-	-	-	-	-	-	-
Goose OF	6	-	-	-	-	-	-	-	-	-	-	-	-
Propellor OF	6	-	-	-	-	-	-	-	-	-	-	-	-
Reference B OF	6	-	1.73	-	-	-	-	-	-	-	-	-	-
George Area													
George OF	6	-	-	-	-	-	-	-	-	-	-	-	-
Sleigh OF	6	1.29	-	-	-	-	-	-	-	-	-	-	-
Dragon OF	6	-	-	-	-	-	-	-	-	-	-	-	-
Komatic IF	6	1.40	-	-	-	-	-	-	-	-	-	-	-
Reference C OF	6	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

Values represent the average factor by which 2012 samples are higher than CCME guidelines.

Half the detection limit was substituted for values that were below the detection limit for the calculation of exceedance factors. Shaded cells show sites where all samples that exceeded a particular parameters guideline were below the detection limit.

The average concentration of a particular parameter may be below the CCME guideline concentration even if a percentage of samples is higher than this guideline concentration.

** Note factor by which average concentrations exceeded pH guidelines was not calculated as pH guidelines are a range. Exceedances are shown for reference only.*

a) Canadian water quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) Interim guideline.

c) < 0.004 mg/L = ultraoligotrophic; 0.004 - 0.01 mg/L = oligotrophic; 0.01 - 0.02 mg/L = mesotrophic; 0.02 - 0.035 mg/L = mesoeutrophic; 0.035 - 0.1 mg/L = eutrophic; > 0.1 mg/L = hypereutrophic.

d) 0.005 mg/L at pH < 6.5; 0.1 mg/L at pH ≥ 6.5.

e) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000. There is no minimum guideline.

f) Guideline concentration of hexavalent chromium. No concentrations were higher than the CCME guideline for trivalent chromium (0.0089 mg/L).

g) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ x 0.0002. Copper guideline is a minium of 0.002 mg/L regardless of hardness.

h) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minimum of 0.001 mg/L regardless of hardness.

i) Guideline concentration for inorganic mercury.

j) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

3.3.8 Stream Water Quality Assurance/Quality Control

Five field and five travel blanks were collected during stream sampling, representing 10% of the regular stream samples collected (Appendix 3.3-1). All blanks for all parameters were below detection limits, with two exceptions. In the June Goose area travel blank, TKN was slightly above the TKN detection limit, and in the September George area travel blank, ammonia was above the detection limit. In both cases, the other set of travel blanks collected during the same sampling period was below detection limits for all parameters.

Fifty pairs of field duplicates for sampled streams were compared for each water quality variable. The RPD value was used as a measure of the variability inherent in field sampling (Appendix 3.3-2). A total of 29% (1,303/4,450) of the duplicate concentrations were at least five times greater than their detection limits and so were used in the RPD calculations. Of these, only 0.5% (21/1,303) had an RPD above 20%, only 0.1% (4/1,303) had an RPD equal or greater than 50%, and none had an RPD above 100%.

These QA/QC samples show that the WQ samples collected were of high quality, and sampling heterogeneity was minimal during the stream sampling.

3.4 LAKE SEDIMENT QUALITY

Lake sediment quality samples were collected in August 2012, and the data are presented graphically in Figures 3.4-1 to 3.4-3d. Raw sediment quality data for lakes are presented in Appendix 3.4-1. The variability in sediment colour, texture, and sample volume of the samples is shown in Plate 3.4-1. Nutrient data for some lakes was unable to be analyzed due to the insufficient volume in the sample.

3.4.1 Particle Size

Most lake sediments were composed of over 50% sand, with lesser amounts of clay and silt (Figure 3.4-1). Exceptions were Pond 19, Rascal, Giraffe South, and Goose Lake Tail in the Goose area, which had a more even split between sand and silt. In the George area, George Central, George South and Sleigh lakes were composed of over 50% silt. Gravel composed over 1% of sediments only at Pond 19 (18.5%), Giraffe South (5.1%), and Dragon lakes(13.5%).

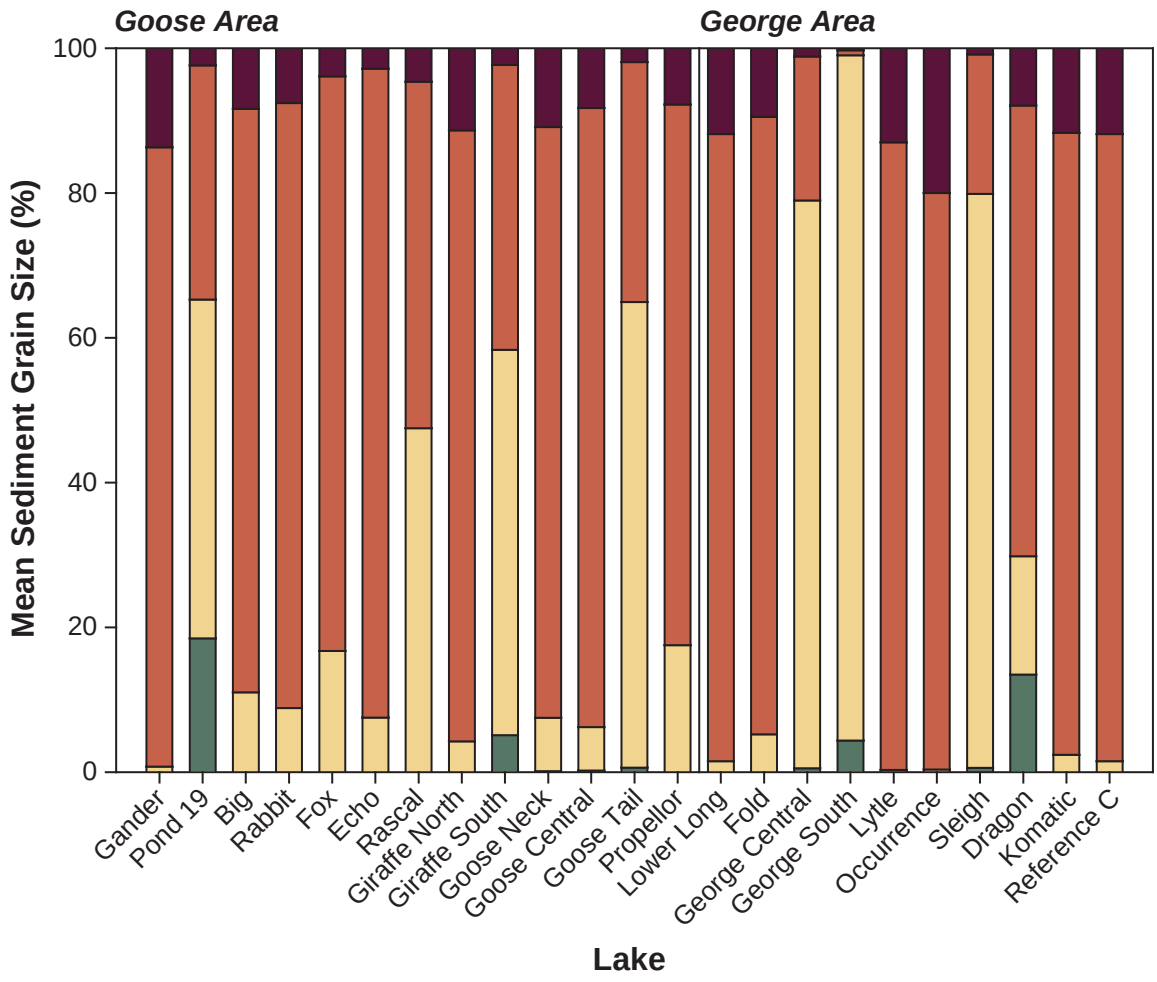
3.4.2 Nutrients

Overall, nutrient concentrations tended to be higher in sediments from Goose area lakes compared to George area lakes (Figures 3.4-2a and 3.4-2b). Nutrient concentrations were related to sediment composition with the three lakes sites with the lowest proportion of silt, such as in George Lake Central (deep), George Lake South and Sleigh Lake, having lower nutrient concentrations.

Available ammonium ranged from below detection limits (1 mg/L) at Sleigh Lake to 32.3 mg/kg at Goose Lake Neck. Total nitrogen was similarly variable, ranging from very close to detection limits (0.02%) to 0.91% at Echo OF. Available phosphate (as P) was less than 15 mg/kg for most lakes. Fold Lake and Reference Lake C had higher phosphate concentrations at 19.9 mg/kg and 23.5 mg/kg, and the highest were observed at Propellor Lake, which had 48 mg/kg phosphate similar to concentrations measured in August 2011 (Rescan 2012a). Lake sediments contained between 0.2% and 15% TOC, following very closely the patterns observed for total nitrogen.

3.4.3 Metals

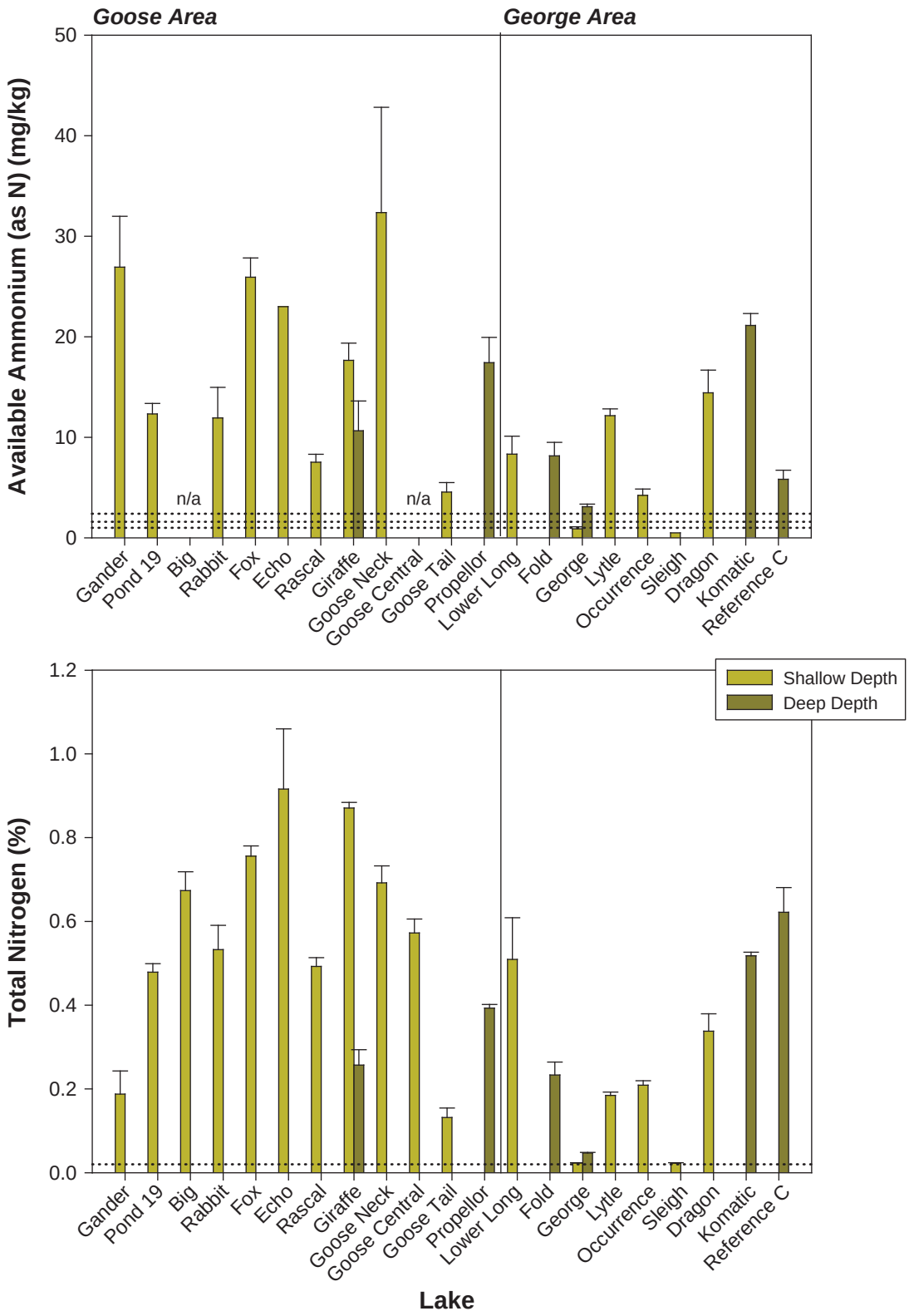
Metal concentrations varied considerably among lake sites. Komatic Lake tended to have the highest concentrations of metals, while Goose Lake Tail and Sleigh Lake tended to have the lowest concentrations.



Note: Stacked bars are means of triplicate samples.

Figure 3.4-1

Sediment Grain Size Composition in Lakes, Back River Project, 2012



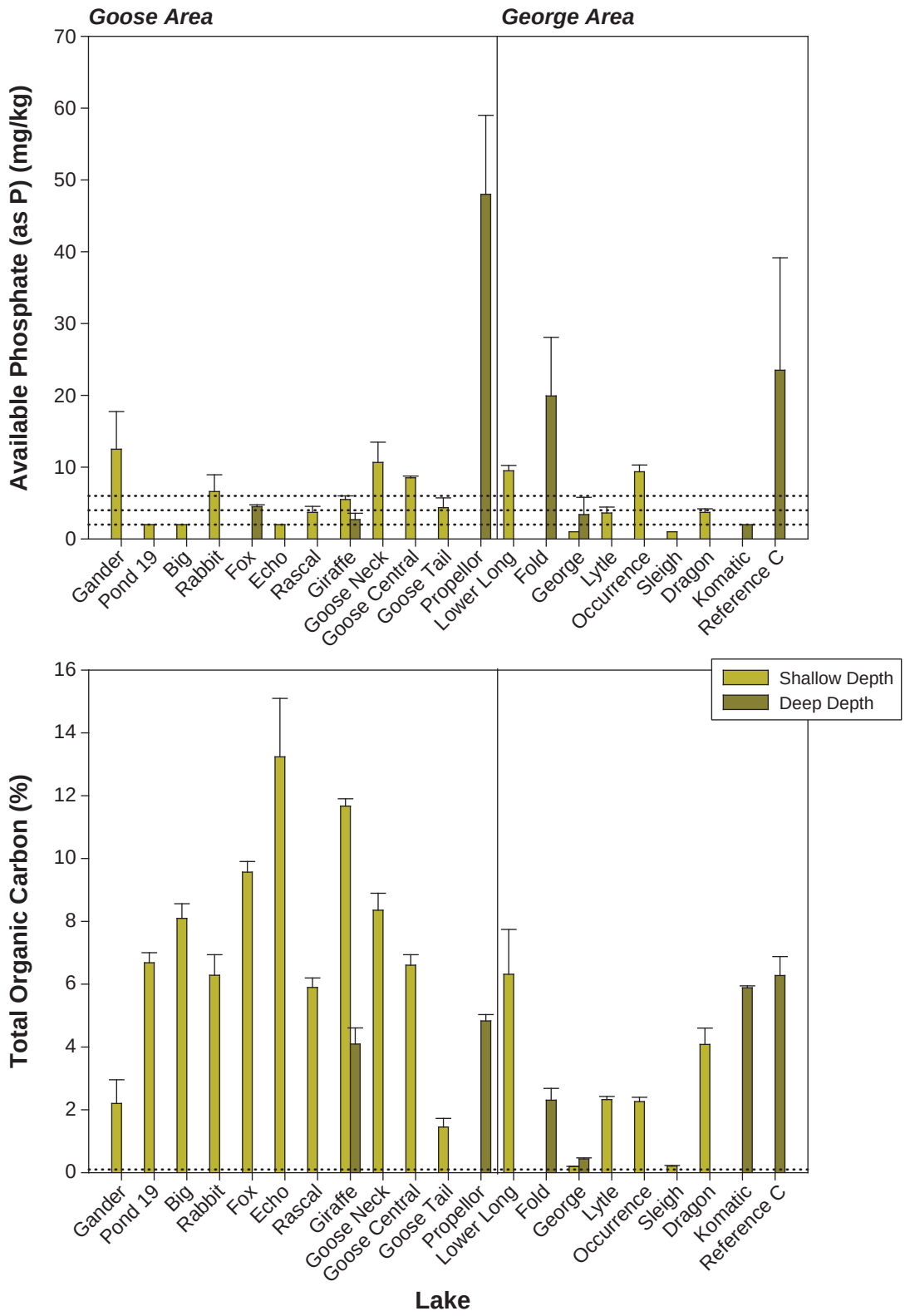
Notes: n/a = available ammonium could not be analyzed for some samples due to insufficient sample volume.
Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (available ammonia 1 - 2.4 mg/kg; total nitrogen 0.02%).
Values below the detection limit are plotted at half the detection limit.

Sabina GOLD & SILVER CORP.

Available Ammonium and Total Nitrogen Concentrations in Lake Sediments, Back River Project, 2012

Figure 3.4-2a

Rescan™ Engineers & Scientists



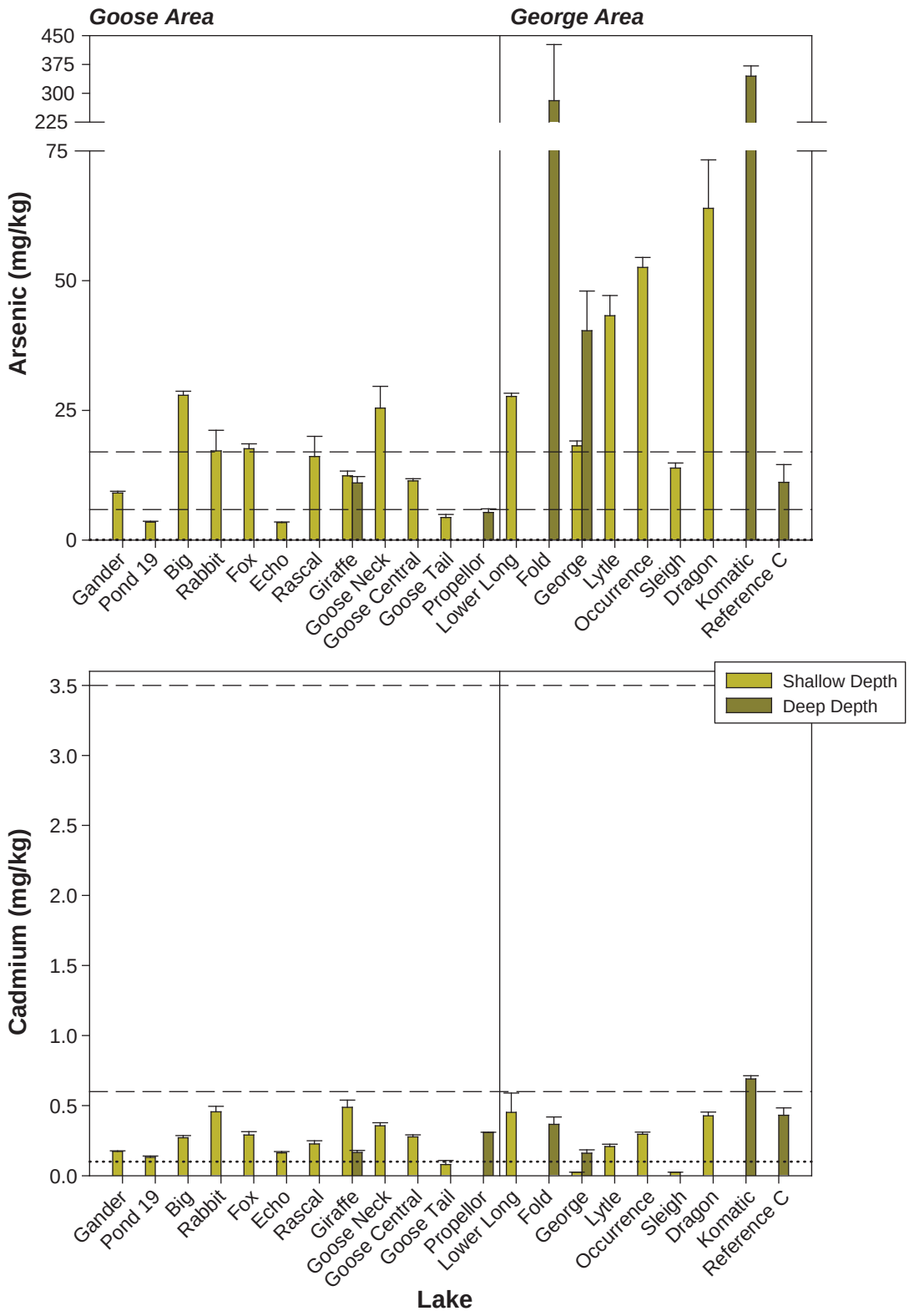
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (available phosphate 2.0 - 6.0 mg/kg; total organic carbon 0.1%).
Values below the detection limit are plotted at half the detection limit.

Sabina GOLD & SILVER CORP.

Available Phosphate and Total Organic Carbon Concentrations in Lake Sediments, Back River Project, 2012

Figure 3.4-2b

Rescan™ Engineers & Scientists



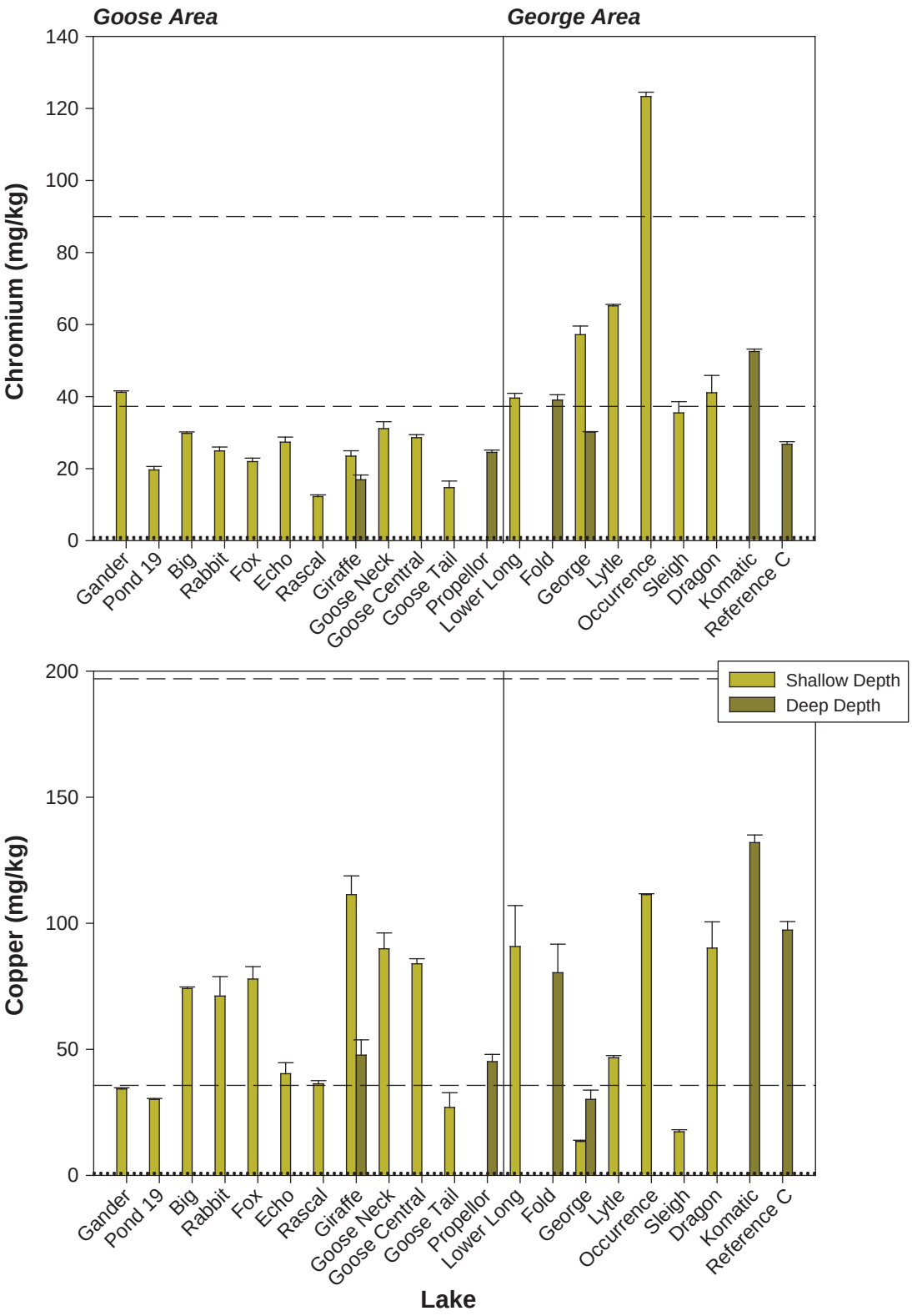
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (arsenic 0.05 - 0.10 mg/kg; cadmium 0.05 - 0.10 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
For arsenic, the ISQG is 5.9 mg/kg and the PEL is 17 mg/kg.
For cadmium, the ISQG is 0.6 mg/kg and the PEL is 3.5 mg/kg.

Sabina GOLD & SILVER CORP.

Arsenic and Cadmium Concentrations in Lake Sediments, Back River Project, 2012

Figure 3.4-3a

Rescan™ Engineers & Scientists



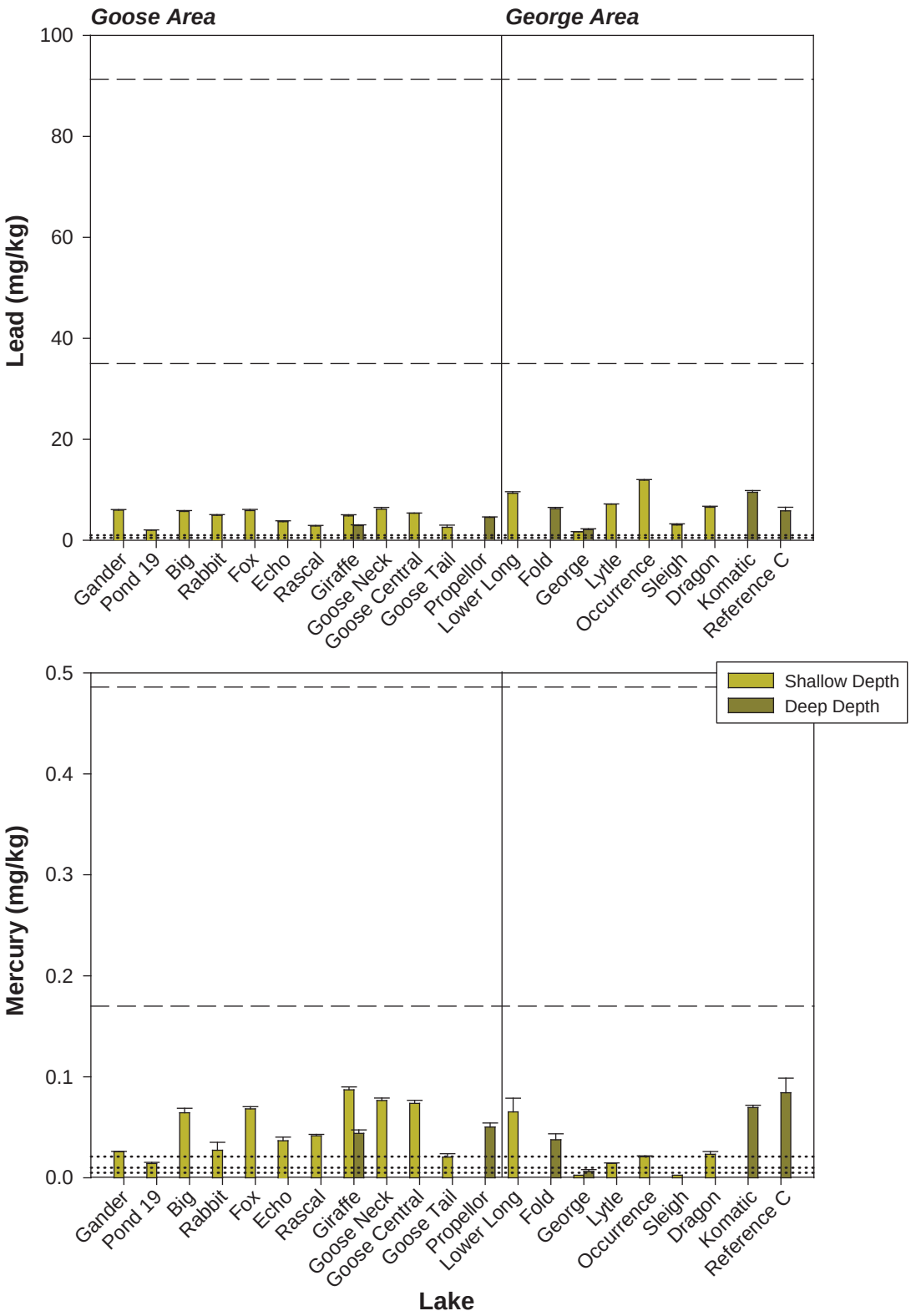
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (chromium 0.05 - 1.0 mg/kg; copper 0.50 - 1.0 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
For chromium, the ISQG is 37.3 mg/kg and the PEL is 90 mg/kg.
For copper, the interim sediment quality guideline is 35.7 mg/kg and the probable effect level is 197 mg/kg.

Sabina GOLD & SILVER CORP.

Chromium and Copper Concentrations in Lake Sediments, Back River Project, 2012

Figure 3.4-3b

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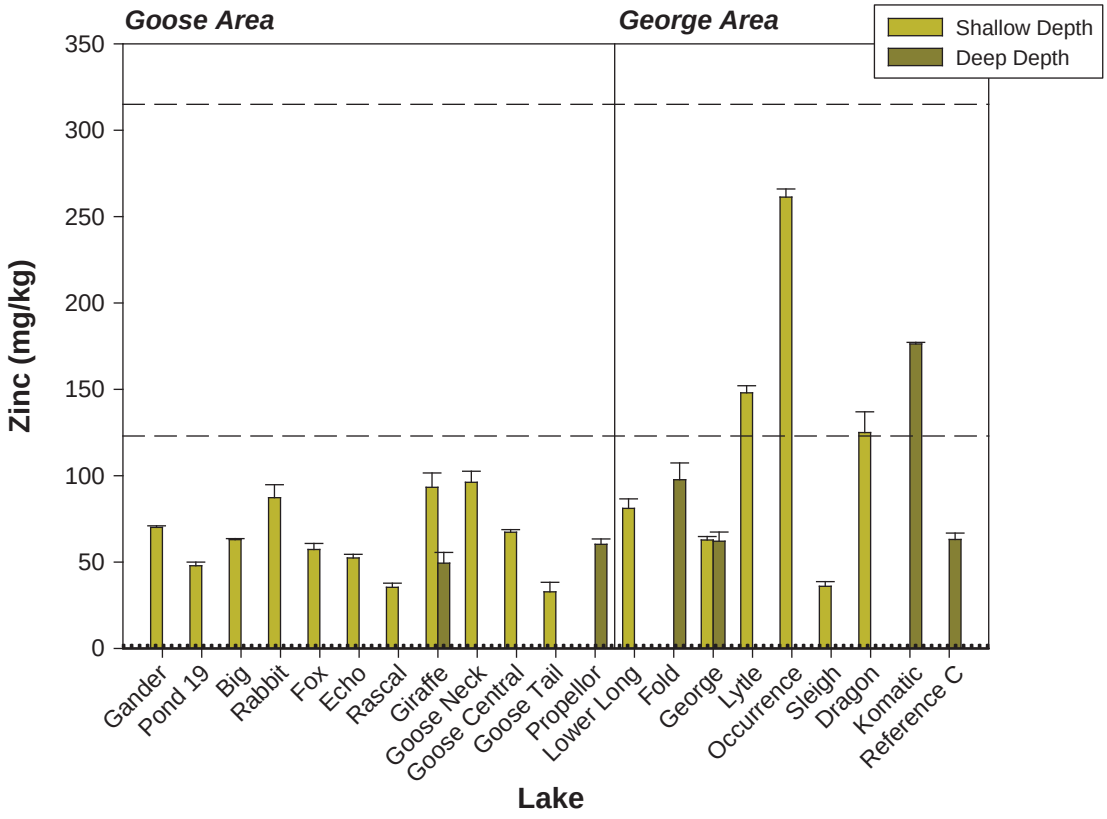
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (lead 0.50 - 1.0 mg/kg; mercury 0.0050 - 0.0210 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
For lead, the ISQG is 35 mg/kg and the PEL is 91.3 mg/kg.
For mercury, the ISQG is 0.17 mg/kg and the PEL is 0.486 mg/kg.

Sabina GOLD & SILVER CORP.

Lead and Mercury Concentrations in Lake Sediments, Back River Project, 2012

Figure 3.4-3c

Rescan™ Engineers & Scientists



Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (zinc 1.0 - 2.0 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guidelines.
For zinc, the ISQG is 123 mg/kg and the PEL is 315 mg/kg.

Sabina GOLD & SILVER CORP.

Zinc Concentrations in Lake Sediments, Back River Project, 2012

Figure 3.4-3d

Rescan™ Engineers & Scientists

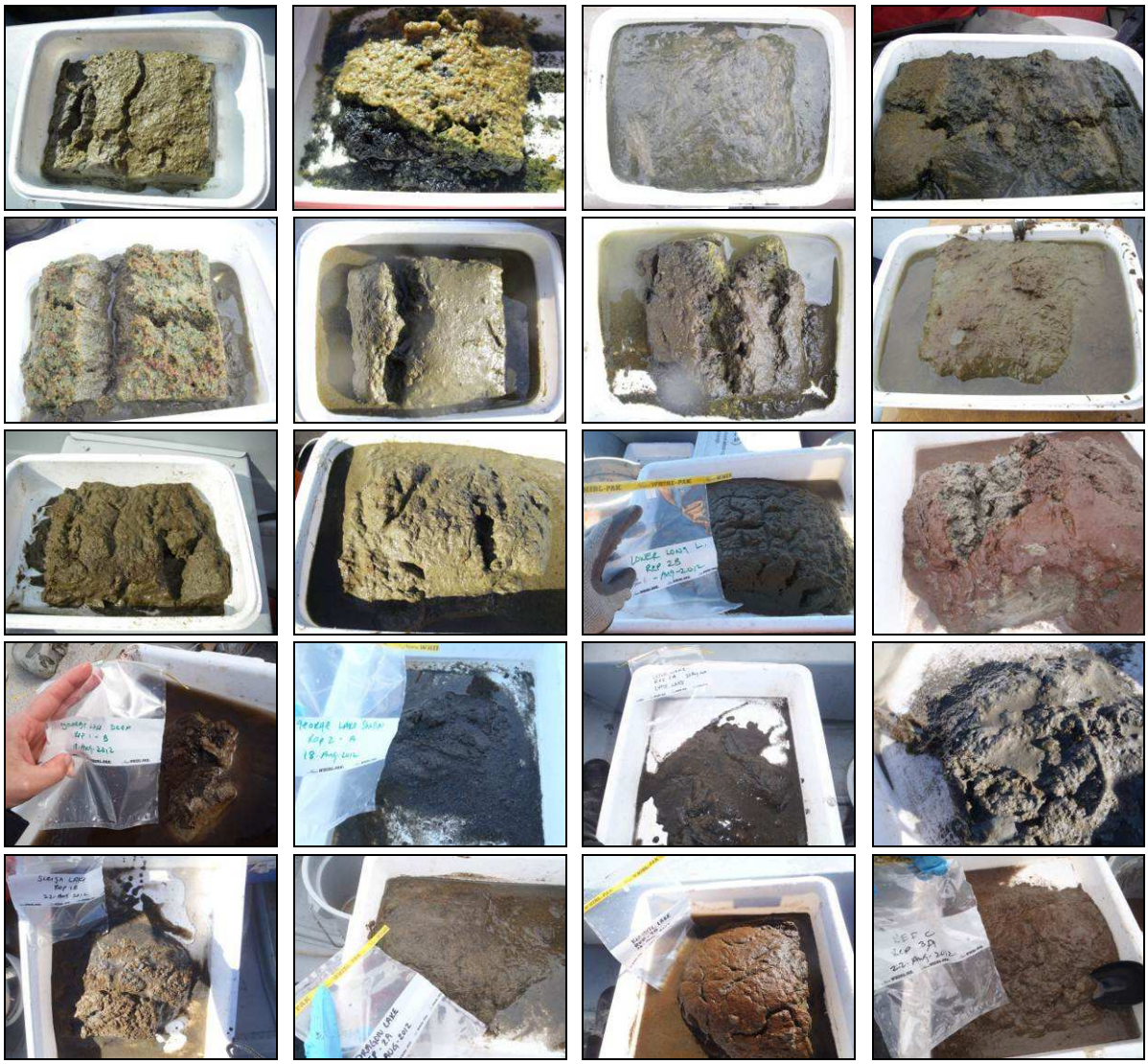


Plate 3.4-1. Some of the sediment samples collected in August. From top left to bottom; Gander Lake, Pond 19, Rabbit Lake, Fox Lake, Rascal Lake, Giraffe Lake North, Giraffe Lake South, Goose Lake Central, Goose Lake Tail, Propellor Lake, Lower Long Lake, Fold Lake, George Lake Central, George Lake South, Lytle Lake, Occurrence Lake, Sleigh Lake, Dragon Lake, Komatic Lake, Reference Lake C.

Average arsenic concentrations were naturally elevated in sediments and were extremely variable among lakes, ranging from 3.3 mg/kg to 64 mg/kg at most lakes. George area lakes tended to have higher arsenic concentrations, with very high concentrations observed at Fold Lake (281 mg/kg) and Komatic Lake (354 mg/kg; Figure 3.4-3a). The majority of lakes had sediment arsenic concentrations that exceeded the CCME ISQG of 5.9 mg/kg, and over half exceeded the CCME PEL (17 mg/kg).

Cadmium sediment concentrations ranged from below detection limits at the shallow George Lake South site and Sleigh Lake to 0.69 mg/kg at Komatic Lake, which exceeded the CCME ISQG of 0.6 mg/kg (Figure 3.4-3a).

Goose area lakes tended to have lower concentrations of chromium in their sediments (Figure 3.4-3b). Chromium concentrations were high in lake sediments, with over a third exceeding the CCME ISQG concentration (37.3 mg/kg) and Occurrence Lake exceeding the CCME PEL of 90 mg/kg by a factor of 1.4.

Overall, lake sediments had naturally high concentrations of copper, as almost three quarters of sites were above CCME ISQGs, with the highest concentration in Occurrence Lake (132 mg/kg), exceeding the CCME PEL also (90 mg/kg; Figure 3.4-3b). Lead concentrations followed a similar spatial patterns to copper, but were at naturally low levels, with all concentrations less than half the CCME ISQG (35 mg/kg; Figure 3.4-3c).

Mercury levels were generally low (Figure 3.4-3c), and followed similar spatial patterns to cadmium. Patterns of zinc concentrations in lake sediments were very similar to those seen in chromium, with highest concentrations in the George area lakes. Lytle, Occurrence, Dragon and Komatic lakes all exceeded the CCME ISQG for zinc (123 mg/kg; Figure 3.4-3d).

3.4.4 Cyanides

Total cyanide concentrations ranged from below detection limits (0.05 mg/kg) in George Lake Central, George Lake South, and Sleigh Lake to 0.38 mg/kg in Fox Lake and Goose Lake Neck. Weak acid dissociable (WAD) cyanide concentrations followed a similar trend but were lower, with a third below detection limits and the maximum concentration at 0.125 mg/kg in Fox Lake.

3.4.5 Comparison with CCME Guidelines

Table 3.4-1 summarizes the percentage of sediment sample that metal concentrations were higher than CCME guidelines, and Table 3.4-2 presents the average factor that the sediment metal concentrations at each site were higher than their respective CCME guideline.

Lake sediments had high concentrations of arsenic, chromium, copper and zinc that often exceeded at CCME ISQGs. George area lakes had higher sediment metal concentrations than Goose area lakes. All lakes, except Pond 19, had at least one sample that exceeded the CCME ISQG for at least one metal, with most lakes exceeding for arsenic and copper. Exceedance of chromium guidelines was common in George area lakes (seven out of ten lakes exceeded), and only observed in Gander Lake out of the thirteen Goose area lakes. Thirteen of the twenty three lakes sampled had at least one sample that exceeded CCME PELs for arsenic, and all samples at Occurrence Lake exceeded the chromium CCME PEL.

Lakes had average concentrations for arsenic that often exceeded CCME ISQGs and PELs, and average cadmium, copper and zinc concentrations that in many cases exceeded CCME ISQGs. Cadmium and zinc ISQGs were only exceeded in George area lakes, where in general exceedances tended to be more frequent and greater in magnitude than those in Goose area lakes. Komatic Lake had the greatest number of exceedances (four), and the greatest magnitude of exceedance with arsenic concentrations almost sixty times the CCME ISQG.

The majority of lake sediments had average arsenic concentrations greater than the CCME ISQG (5.9 mg/kg), and almost half also exceeded the higher CCME PELs (17 mg/kg). Fold and Komatic lakes had particularly high arsenic concentration, exceeding the higher CCME PELs by an average factor of 16.5 and 20.3 respectively. Almost three quarters of streams had average copper concentrations that exceeded CCME ISQGs, with the maximum average exceedance being 3.1 at Giraffe Lake North.

3.5 STREAM SEDIMENT QUALITY

Stream sediment samples were collected in August 2012, and Figures 3.5-1 to 3.5-3d present the stream sediment quality results. All raw sediment quality data for streams are presented in Appendix 3.5-1.

Table 3.4-1. Lake Sediment Quality, Percent of Samples in which Concentrations were Higher than CCME Guidelines, Back River Project, 2012

			Percent of Samples that Exceeded the ISQG[b] Guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
CCME Guideline Value[a] (mg/kg)			5.9	0.6	37.3	35.7	35	0.17	123
Lake	Total Number of Samples Collected	Number of Parameters with Exceedances							
Goose Area									
Gander	3	2	100	0	100	0	0	0	0
Pond 19	3	0	0	0	0	0	0	0	0
Big	3	2	100	0	0	100	0	0	0
Rabbit	3	2	100	0	0	100	0	0	0
Fox	3	2	100	0	0	100	0	0	0
Echo	3	2	100	0	0	66.7	0	0	0
Rascal	3	1	0	0	0	66.7	0	0	0
Giraffe North	3	2	100	0	0	100	0	0	0
Giraffe South	3	2	100	0	0	100	0	0	0
Goose Neck	3	2	100	0	0	100	0	0	0
Goose Central	3	2	100	0	0	100	0	0	0
Goose Tail	3	1	0	0	0	33.3	0	0	0
Propellor	3	2	33.3	0	0	100	0	0	0
George Area									
Lower Long	3	3	100	0	100	100	0	0	0
Fold	3	3	100	0	66.7	100	0	0	0
George Central	3	1	100	0	0	0	0	0	0
George South	3	2	100	0	100	0	0	0	0
Lytle	3	4	100	0	100	100	0	0	100
Occurrence	3	4	100	0	100	100	0	0	100
Sleigh	3	2	100	0	33.3	0	0	0	0
Dragon	3	4	100	0	33.3	100	0	0	67.7
Komatic	3	5	100	100	100	100	0	0	100
Reference C	3	2	66.7	0	0	100	0	0	0

(continued)

Table 3.4-1. Lake Sediment Quality, Percent of Samples in which Concentrations were Higher than CCME Guidelines, Back River Project, 2012 (completed)

			Percent of Samples that Exceeded the PEL[c] Guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
CCME Guideline Value[a] (mg/kg)			17	3.5	90	197	91.3	0.486	315
Lake	Total Number of Samples Collected	Number of Parameters with Exceedances							
Goose Area									
Gander	3	0	0	0	0	0	0	0	0
Pond 19	3	0	0	0	0	0	0	0	0
Big	3	1	100	0	0	0	0	0	0
Rabbit	3	1	33.3	0	0	0	0	0	0
Fox	3	1	33.3	0	0	0	0	0	0
Echo	3	1	33.3	0	0	0	0	0	0
Rascal	3	0	0	0	0	0	0	0	0
Giraffe North	3	0	0	0	0	0	0	0	0
Giraffe South	3	0	0	0	0	0	0	0	0
Goose Neck	3	1	100	0	0	0	0	0	0
Goose Central	3	0	0	0	0	0	0	0	0
Goose Tail	3	0	0	0	0	0	0	0	0
Propellor	3	0	0	0	0	0	0	0	0
George Area									
Lower Long	3	1	100	0	0	0	0	0	0
Fold	3	1	100	0	0	0	0	0	0
George Central	3	1	100	0	0	0	0	0	0
George South	3	1	66.7	0	0	0	0	0	0
Lytle	3	1	100	0	0	0	0	0	0
Occurrence	3	2	100	0	100	0	0	0	0
Sleigh	3	0	0	0	0	0	0	0	0
Dragon	3	1	100	0	0	0	0	0	0
Komatic	3	1	100	0	0	0	0	0	0
Reference C	3	0	0	0	0	0	0	0	0

All values represent the percent of samples that were higher than CCME guidelines.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) ISQG = Interim sediment quality guideline.

c) PEL = Probable Effects Level.

Table 3.4-2. Lake Sediment Quality, Average Factor by which Concentrations were Higher than CCME Guidelines, Back River Project, 2012

			Average Factor by which Samples Exceeded the ISQG[b] Guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
CCME Guideline Value[a] (mg/kg)			5.9	0.6	37.3	35.7	35	0.17	123
Lake	Total Number of Samples Collected	Parameters with Exceedances							
Goose Area									
Gander	3	2	1.5	-	1.1	-	-	-	-
Pond 19	3	0	-	-	-	-	-	-	-
Big	3	2	4.7	-	-	2.1	-	-	-
Rabbit	3	2	2.9	-	-	2.0	-	-	-
Fox	3	2	3.0	-	-	2.2	-	-	-
Echo	3	2	2.7	-	-	1.1	-	-	-
Rascal	3	1	-	-	-	1.0	-	-	-
Giraffe North	3	2	2.1	-	-	3.1	-	-	-
Giraffe South	3	2	1.9	-	-	1.3	-	-	-
Goose Neck	3	2	4.3	-	-	2.5	-	-	-
Goose Central	3	2	1.9	-	-	2.4	-	-	-
Goose Tail	3	0	-	-	-	-	-	-	-
Propellor	3	1	-	-	-	1.3	-	-	-
George Area									
Lower Long	3	3	4.7	-	1.1	2.5	-	-	-
Fold	3	3	47.7	-	1.0	2.3	-	-	-
George Central	3	1	6.8	-	-	-	-	-	-
George South	3	2	3.1	-	1.5	-	-	-	-
Lytle	3	4	7.3	-	1.7	1.3	-	-	1.2
Occurrence	3	4	8.9	-	3.3	3.1	-	-	2.1
Sleigh	3	1	2.4	-	-	-	-	-	-
Dragon	3	4	11.4	-	1.1	2.3	-	-	1.0
Komatic	3	5	58.4	1.2	1.4	3.7	-	-	1.4
Reference C	3	2	1.9	-	-	2.7	-	-	-

(continued)

Table 3.4-2. Lake Sediment Quality, Average Factor by which Concentrations were Higher than CCME Guidelines, Back River Project, 2012 (completed)

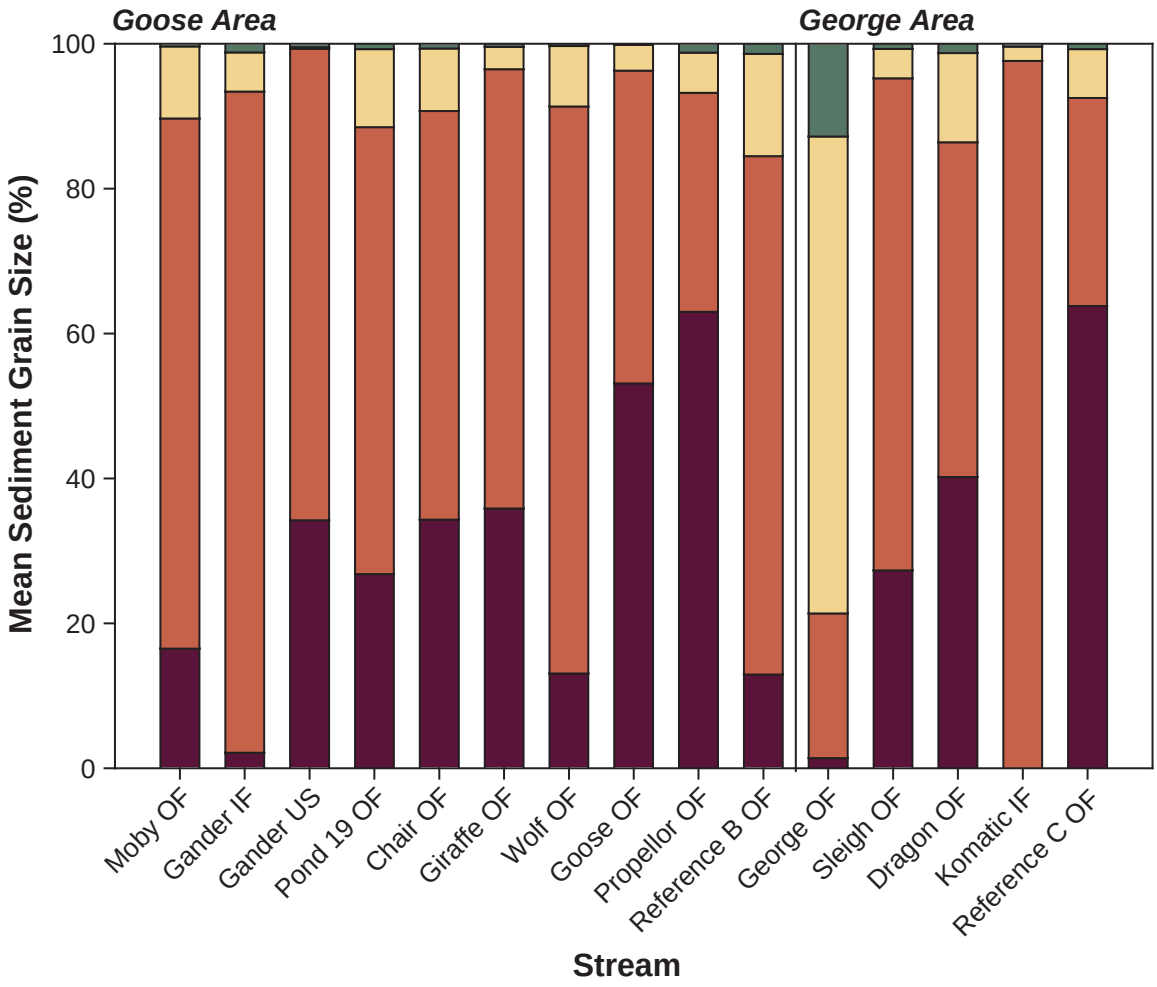
			Average Factor by which Samples Exceeded the PEL[c] Guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
CCME Guideline Value[a] (mg/kg)			17	3.5	90	197	91.3	0.486	315
Lake	Total Number of Samples Collected	Parameters with Exceedances							
Goose Area									
Gander	3	0	-	-	-	-	-	-	-
Pond 19	3	0	-	-	-	-	-	-	-
Big	3	1	1.6	-	-	-	-	-	-
Rabbit	3	1	1.0	-	-	-	-	-	-
Fox	3	1	1.0	-	-	-	-	-	-
Echo	3	0	-	-	-	-	-	-	-
Rascal	3	0	-	-	-	-	-	-	-
Giraffe North	3	0	-	-	-	-	-	-	-
Giraffe South	3	0	-	-	-	-	-	-	-
Goose Neck	3	1	1.5	-	-	-	-	-	-
Goose Central	3	0	-	-	-	-	-	-	-
Goose Tail	3	0	-	-	-	-	-	-	-
Propellor	3	0	-	-	-	-	-	-	-
George Area									
Lower Long	3	1	1.6	-	-	-	-	-	-
Fold	3	1	16.5	-	-	-	-	-	-
George Central	3	1	2.4	-	-	-	-	-	-
George South	3	1	1.1	-	-	-	-	-	-
Lytle	3	1	2.5	-	-	-	-	-	-
Occurrence	3	2	3.1	-	1.4	-	-	-	-
Sleigh	3	0	-	-	-	-	-	-	-
Dragon	3	1	3.8	-	-	-	-	-	-
Komatic	3	1	20.3	-	-	-	-	-	-
Reference C	3	0	-	-	-	-	-	-	-

Values represent the average factor by which 2012 samples were higher than CCME guidelines.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) ISQG = Interim sediment quality guideline.

c) PEL = Probable Effects Level.



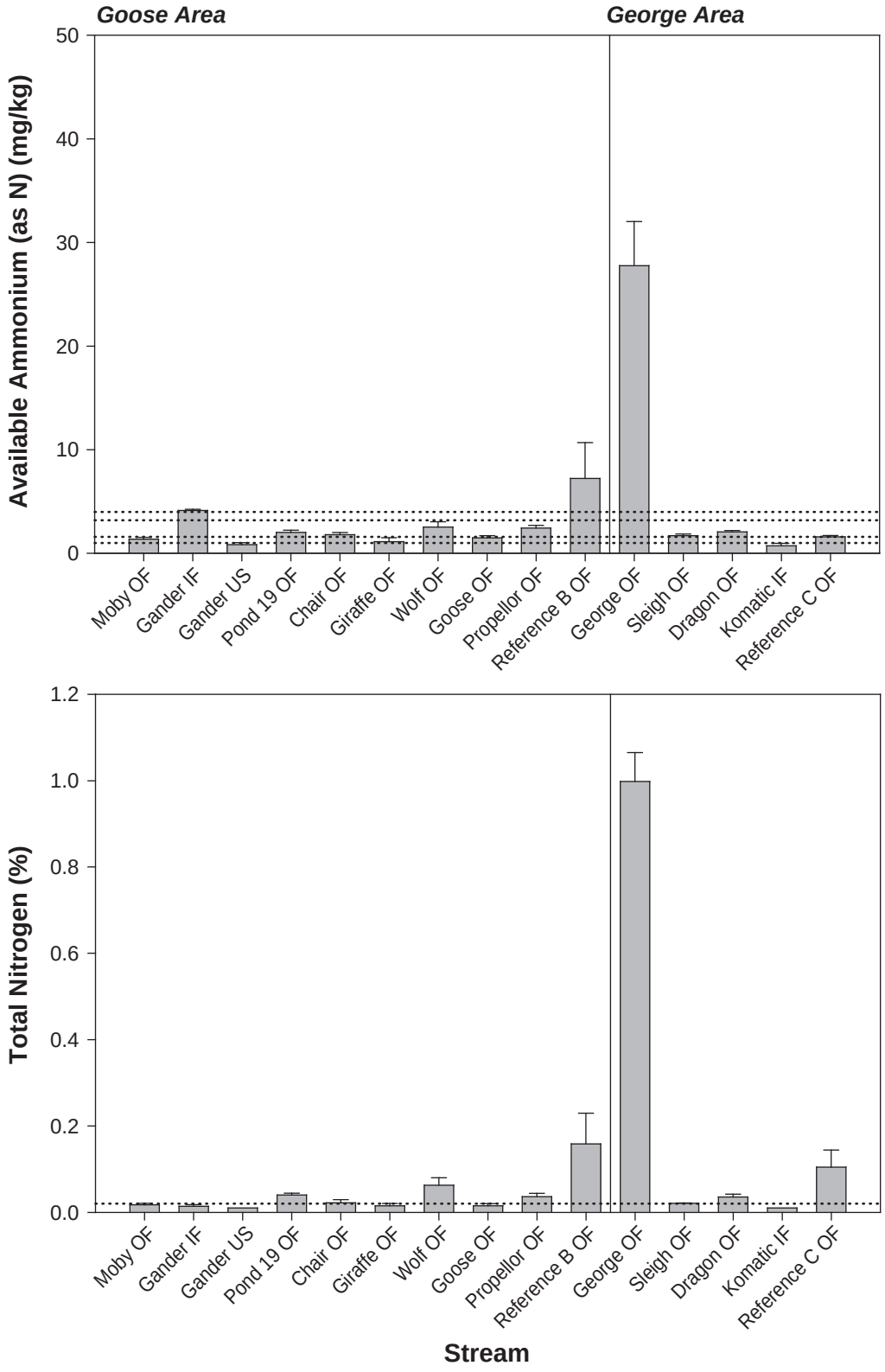
Note: Stacked bars are means of triplicate samples.

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Sediment Grain Size Composition in Streams, Back River Project, 2012

Figure 3.5-1

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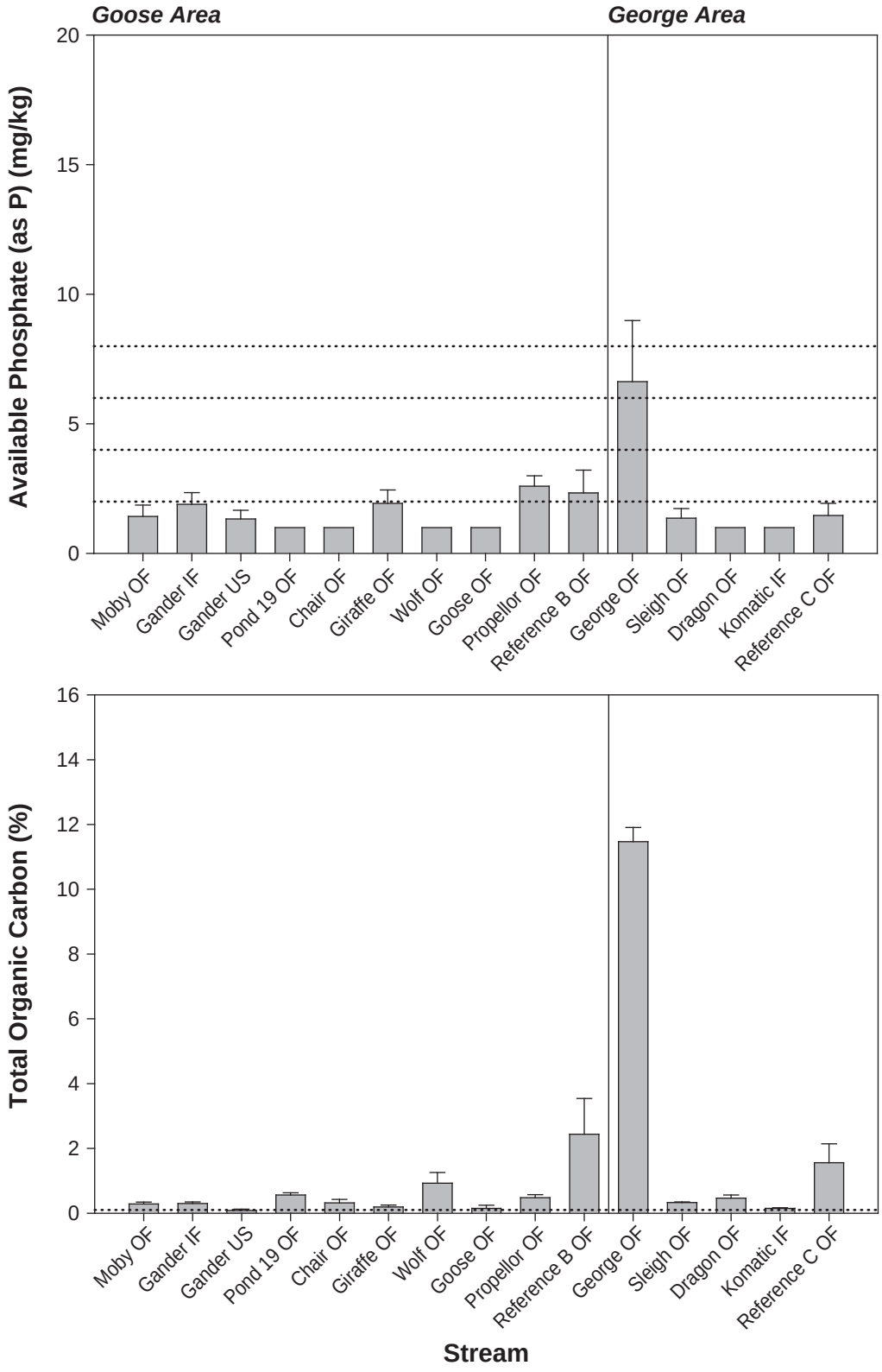
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (available ammonium 1 - 4.0 mg/kg; total nitrogen 0.02%)
Values below the detection limit are plotted at half the detection limit.

Sabina GOLD & SILVER CORP.

Available Ammonium and Total Nitrogen Concentrations in Stream Sediments, Back River Project, 2012

Figure 3.5-2a

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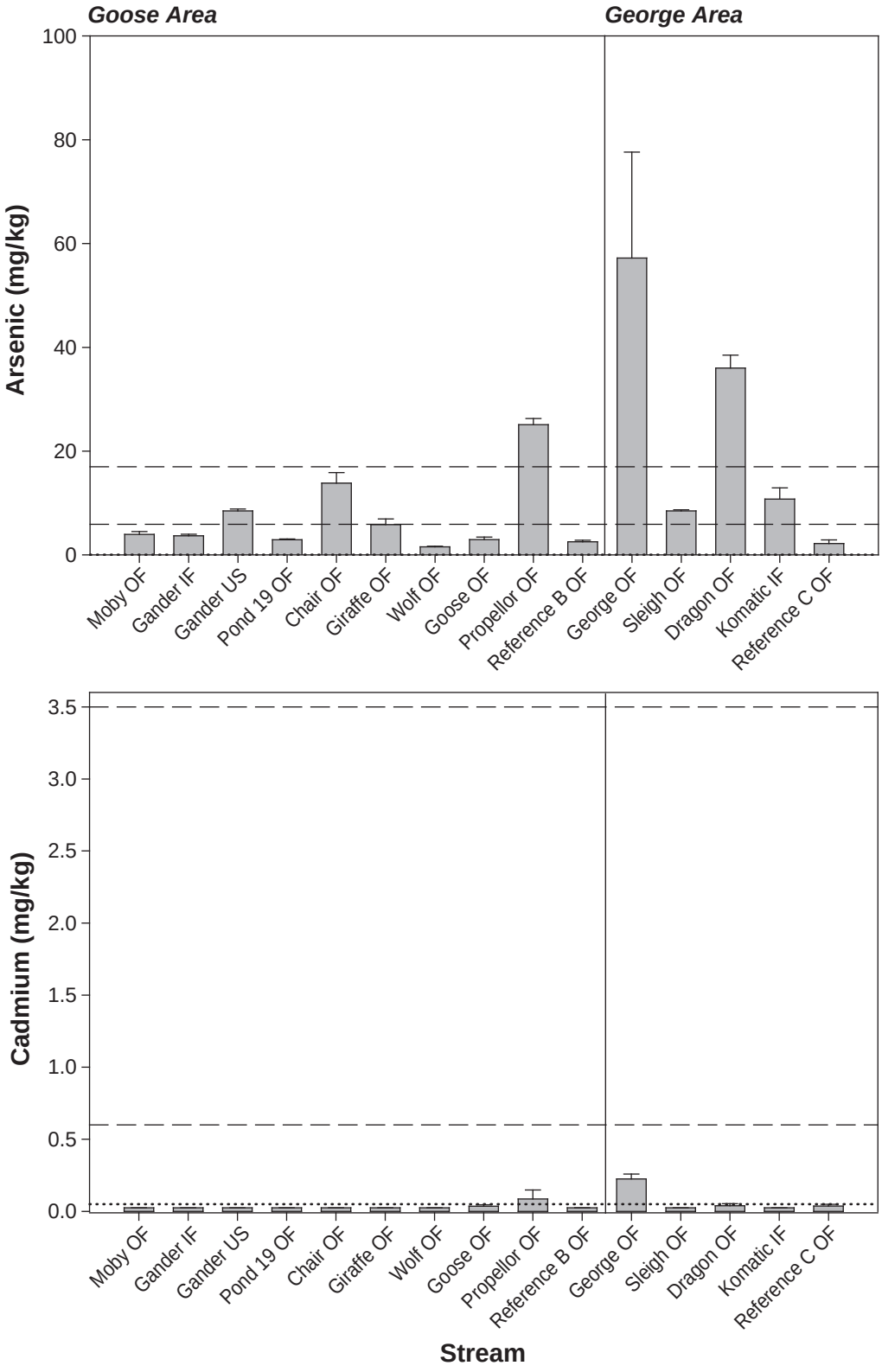
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (available phosphate 2.0 - 8.0 mg/kg; total organic carbon 0.1%)
Values below the detection limit are plotted at half the detection limit.

Sabina GOLD & SILVER CORP.

Available Phosphate and Total Organic Carbon Concentrations in Stream Sediments, Back River Project, 2012

Figure 3.5-2b

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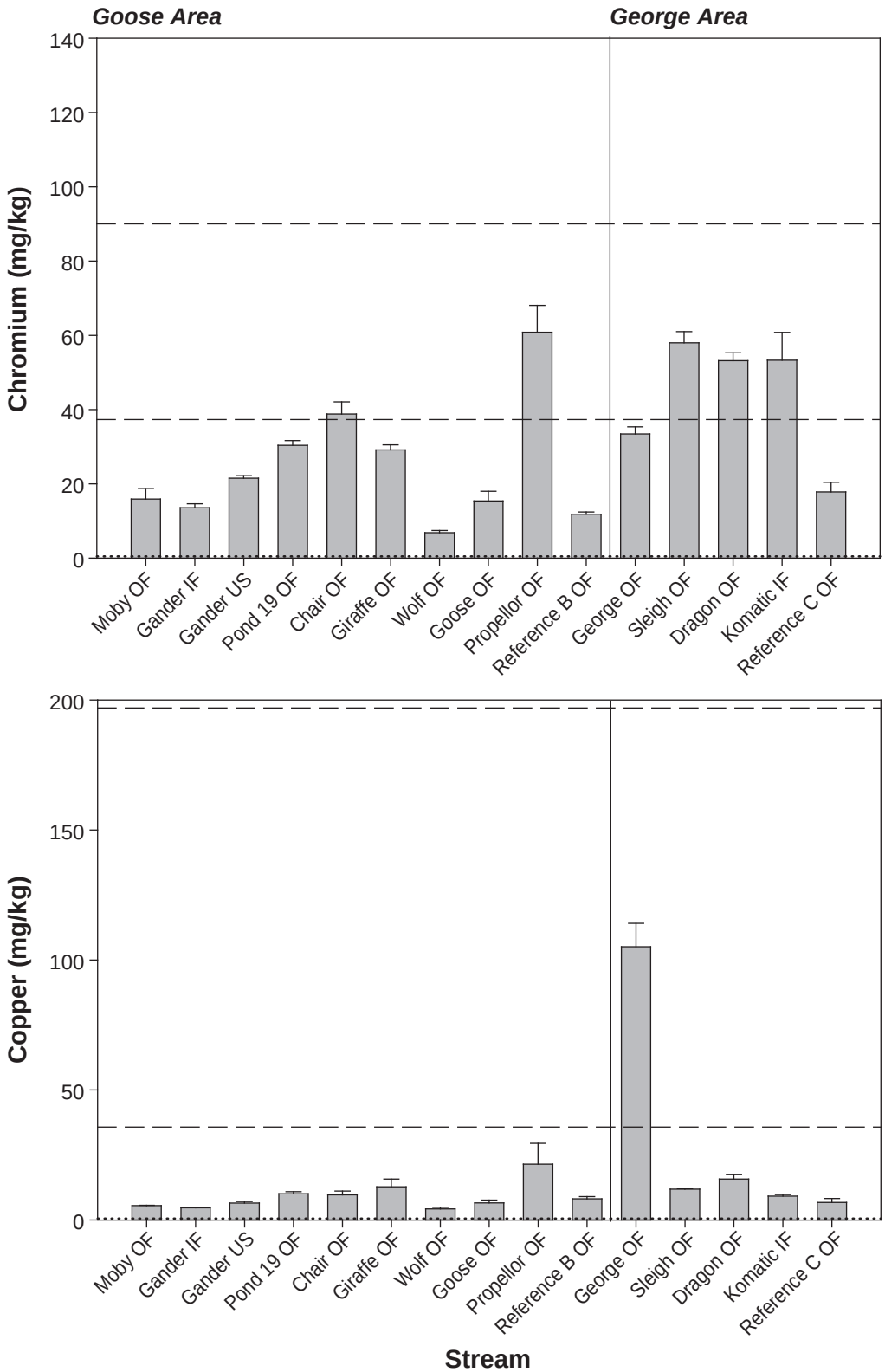
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (arsenic 0.05 mg/kg; cadmium 0.05 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guideline.
For arsenic, the ISQG is 5.9 mg/kg and the PEL is 17 mg/kg.
For cadmium, the ISQG is 0.6 mg/kg and the PEL is 3.5 mg/kg.

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Arsenic and Cadmium Concentrations in Stream Sediments, Back River Project, 2012

Figure 3.5-3a

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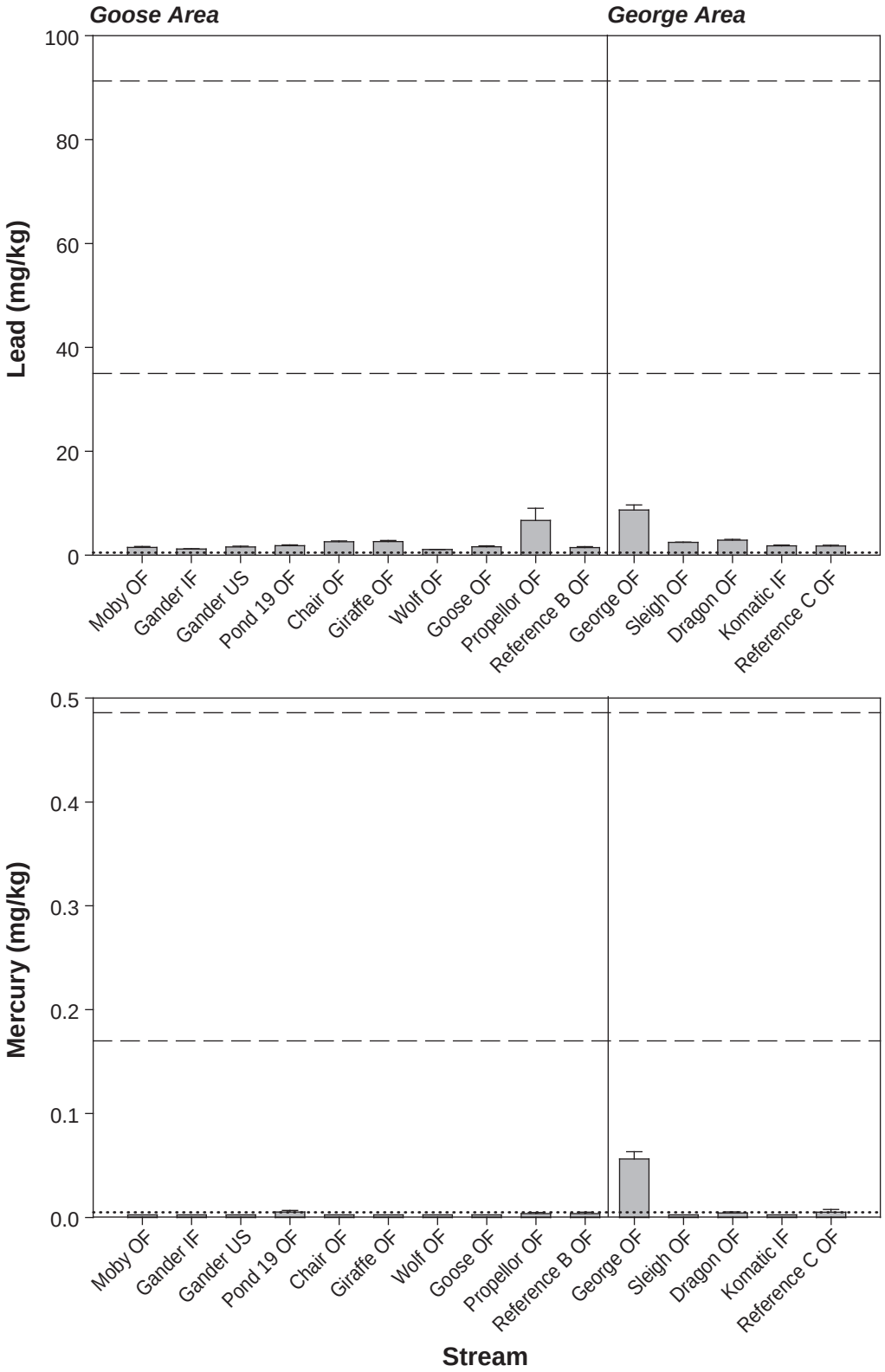
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (chromium 0.5 mg/kg; copper 0.5 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guideline.
For chromium, the ISQG is 37.3 mg/kg and the PEL is 90 mg/kg.
For copper, the ISQG is 35.7 mg/kg and the PEL is 197 mg/kg.

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Chromium and Copper Concentrations in Stream Sediments, Back River Project, 2012

Figure 3.5-3b

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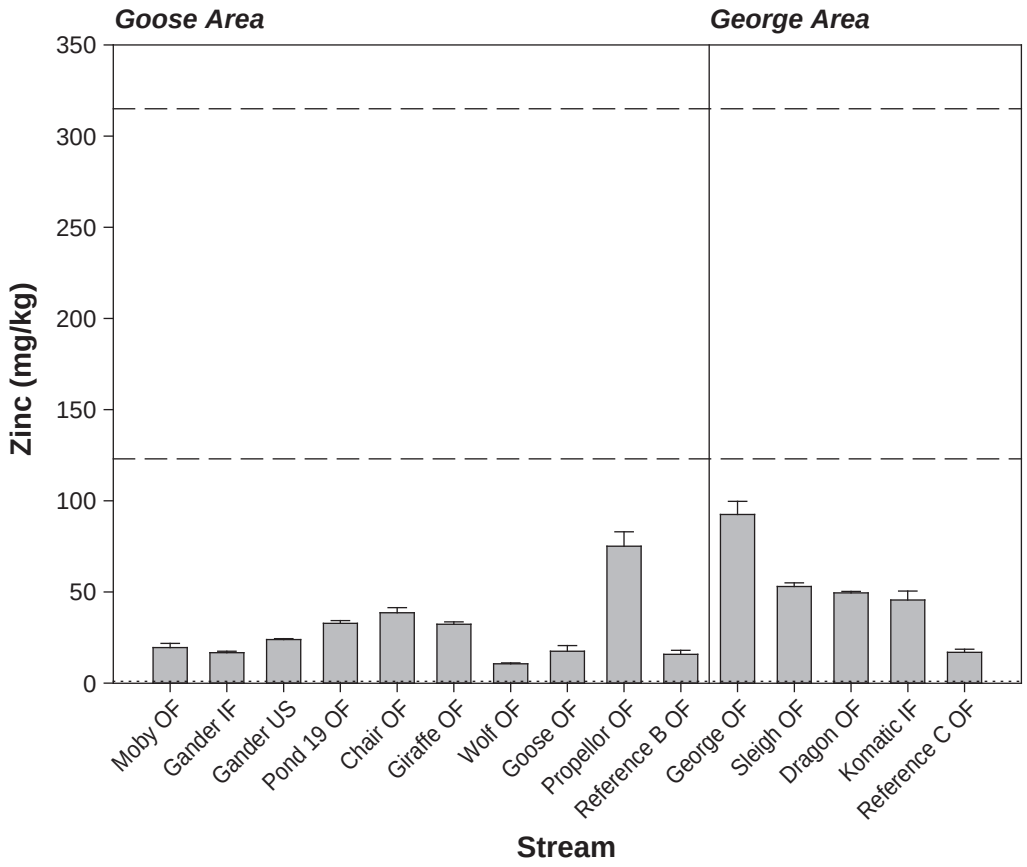
Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (lead 0.5 mg/kg; mercury 0.005 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guideline.
For lead, the ISQG is 35 mg/kg and the PEL is 91.3 mg/kg.
For mercury, the ISQG is 0.17 mg/kg and the PEL is 0.486 mg/kg.

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Lead and Mercury Concentrations in Stream Sediments, Back River Project, 2012

Figure 3.5-3c

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Notes: Error bars represent standard error of the mean of replicates.
Dotted lines represent analytical detection limit (zinc 1.0 mg/kg).
Values below the detection limit are plotted at half the detection limit.
Dashed lines represent CCME guideline.
For zinc, the ISQG is 123 mg/kg and the PEL is 315 mg/kg.

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Zinc Concentrations in Stream Sediments, Back River Project, 2012

Figure 3.5-3d

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3.5.1 Particle Size

Stream sediments were a mixture of gravel, sand, silt and clay (Figure 3.5-1). Sand made up over half the sediments at most sites, except in Goose OF, Propellor OF, and Reference B OF where gravel was dominant, George OF where silt was dominant, and Dragon OF having an even split between gravel and sand. Clay made up 15% of George OF sediments, the only site where clay was a significant (> 2%) component.

3.5.2 Nutrients

Nutrients were low in sediments, tending to be below or close to detection limits, with the exception of George OF. George OF had much higher nutrient concentrations than other stream sites, mirroring the much higher proportions of fine sediments present there. Reference B OF and Reference C OF tended to have slightly higher nutrient concentrations than other stream sites.

Average available ammonium ranged between 0.8 mg/kg to 7.3 mg/kg in most stream sediments, the exception being George OF which had ammonium concentrations of 27.8 mg/kg (Figure 3.5-2a). Ammonium values in stream sediments sampled in 2011 were higher, with all streams averaging above 10.2 mg/kg (Rescan 2012a).

Total nitrogen followed the same pattern as ammonium, with considerably higher values observed at George OF (average 1.0%) than in all other streams (average of 0.04%; Figure 3.5-2a). Nitrate and nitrite were consistently below detection limits. Available phosphate concentrations were either near or below detection limits for all samples, except George OF, which again had higher concentrations (6.6 mg/kg; Figure 3.5-2b).

Total organic carbon (TOC) content followed the same trend observed for ammonium and nitrogen, averaging less than 2.5% in all stream sediments, except George OF, which averaged over four times higher at 11.5% (Figure 3.5-2b).

3.5.3 Metals

Stream sediments had metal concentrations that were similar or lower than those in lake sediments (Figures 3.5-3a to 3.5-3d). Metal concentrations tended to be lower in Goose area streams than in George area streams. George OF often had the highest metal concentrations in sediments, corresponding with the high proportion of fine silts and clays. As observed in 2011, Wolf OF often had the lowest metal concentrations in sediments (Rescan 2012a).

Arsenic concentrations were high in stream sediments, with almost half the sites having average concentrations that exceeded CCME ISQGs (5.9 mg/kg). Propellor OF, George OF, and Dragon OF had the highest arsenic concentrations in sediments with all samples above the CCME PEL of 17 mg/kg (Figure 3.5-3a).

Stream sediments had low cadmium levels, with most sites near or below the detection limit (0.05 mg/L). The exception was George OF, which had average cadmium concentrations of 0.23 mg/kg, below the CCME ISQG of 0.6 mg/kg (Figure 3.5-3a).

Chromium concentrations in stream sediments varied from 6.9 mg/kg at Wolf OF to above the CCME ISQG (37.3 mg/kg) for Chair OF, Propellor OF, Sleigh OF, Dragon OF and Komatic IF (Figure 3.5-3b). Copper concentrations followed similar patterns to arsenic, with considerably higher concentrations observed at George OF, exceeding the CCME ISQG (35.7 mg/kg), than in all other stream sediments (Figure 3.5-3b).

Lead and zinc showed similar patterns, with George OF and Propellor OF having higher concentrations in their sediments than other streams (Figure 3.5-3c and 3.5-3d). All stream sediments were below the CCME ISQGs for lead (35 mg/kg) and zinc (123 mg/kg).

Mercury concentrations were near or below detection limits (0.005 mg/kg) for in sediments at all streams, with the exception of George OF (0.056 mg/kg; Figure 3.5-3c).

3.5.4 Cyanides

Total and WAD cyanides were near or below their analytical detection limits (0.05 mg/kg) at most streams (0.05 mg/kg), with the exceptions of Reference B OF (0.086 mg/kg total cyanide) and George OF, which had concentrations an order of magnitude greater than detection limits (0.20 mg/kg for WAD cyanide; 0.47 mg/kg for total cyanide).

3.5.5 Comparison with CCME Guidelines

The percentage of sediment samples that metal concentrations were higher than CCME guidelines is summarized in Table 3.5-1. Table 3.5-2 presents the average factor by which sediment concentrations were higher than CCME guidelines.

Stream sediments had concentrations of arsenic, chromium, and copper that sometimes exceeded CCME ISQGs. Over half of the streams had at least one sample that exceeded the CCME ISQG for at least one metal, with arsenic being the most commonly exceeded metal (with almost half of streams sampled having average concentrations exceed ISQGs). Almost half the sites sampled had average concentrations that exceeded CCME ISQGs for arsenic, and over a quarter for chromium. George OF was the only site where average copper concentrations in sediments exceeded ISQGs. The CCME PELs were only exceeded for arsenic, and only at Propellor OF, George OF and Dragon OF.

In streams where average metal exceeded CCME ISQGs, concentrations tended to exceed by a factor of less than three. Exceptions were Propellor OF (4.3), George OF (9.7) and Dragon OF (6.1) for arsenic, which also exceeded the arsenic CCME .

3.6 PRIMARY PRODUCERS

3.6.1 Phytoplankton

Lake phytoplankton samples were collected in August 2012. Figures 3.6-1 to 3.6-3 present 2012 phytoplankton results, and all raw phytoplankton data are presented in Appendices 3.6-1 to 3.6-5. A variety of phytoplankton were observed, with some of the more abundant taxa shown in Plate 3.6-1.

3.6.1.1 Biomass, Density and Community Composition

Lakes had low phytoplankton biomass (as chlorophyll *a*), with concentrations consistently below 2 µg chl *a*/L. This can be considered ultra-oligotrophic (Vollenweider and Kerekes 1982; Figure 3.6-1). Chlorophyll *a* levels were highest in Fold, Dragon, and Komatic lakes during the under-ice period in April, ranging from 1.15 µg chl *a*/L to 1.71 µg chl *a*/L. All other lakes had concentrations below 1 µg chl *a*/L. Phytoplankton densities were also low in lakes, generally less than 2,000 cells/mL, with the exceptions of Fold, George Central, and Komatic lakes during August, which ranged from 3,900 to 5,600 cells/mL.

Differences in the patterns observed for biomass and density (peaks in April vs August, and in different lakes) may reflect varying levels of intracellular chlorophyll *a* in different phytoplankton cells.

Lakes in the study area contained a diverse assemblage of phytoplankton taxa, which differed between April and August and between lakes (Figure 3.6-2). Major phytoplankton groups observed were Myxophyceae (cyanobacteria), Cryptophyceae (a class of flagellated algae) and Chlorophyceae (green algae), which made up an average of 82% of all phytoplankton collected. Other important groups were Chrysophyceae (golden algae) and Bacillariophyceae (diatoms), averaging 9% and 8%, respectively. All other groups generally made up less than 1% of phytoplankton communities at lakes.

Table 3.5-1. Stream Sediment Quality, Percent of Samples in which Concentrations were Higher than CCME Guidelines, Back River Project, 2012

			Percent of Samples that Exceeded the ISQG[b] Guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
CCME Guideline Value[a] (mg/kg)			5.9	0.6	37.3	35.7	35	0.17	123
Stream	Total Number of Samples Collected	Parameters with Exceedances							
Goose Area									
Moby OF	3	0	0	0	0	0	0	0	0
Gander IF	3	0	0	0	0	0	0	0	0
Gander US	3	1	100	0	0	0	0	0	0
Pond 19 OF	3	0	0	0	0	0	0	0	0
Chair OF	3	2	100	0	66.7	0	0	0	0
Giraffe OF	3	1	66.7	0	0	0	0	0	0
Wolf OF	3	0	0	0	0	0	0	0	0
Goose OF	3	0	0	0	0	0	0	0	0
Propellor OF	3	3	100	0	100	33.3	0	0	0
Reference B OF	3	0	0	0	0	0	0	0	0
George Area									
George OF	3	2	100	0	0	100	0	0	0
Sleigh OF	3	2	100	0	100	0	0	0	0
Dragon OF	3	2	100	0	100	0	0	0	0
Komatic IF	3	2	100	0	100	0	0	0	0
Reference C OF	3	0	0	0	0	0	0	0	0

(continued)

Table 3.5-1. Stream Sediment Quality, Percent of Samples in which Concentrations were Higher than CCME Guidelines, Back River Project, 2012 (completed)

			Percent of Samples that Exceeded the PEL[c] Guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
CCME Guideline Value[a] (mg/kg)			17	3.5	90	197	91.3	0.486	315
Stream	Total Number of Samples Collected	Parameters with Exceedances							
Goose Area									
Moby OF	3	0	0	0	0	0	0	0	0
Gander IF	3	0	0	0	0	0	0	0	0
Gander US	3	0	0	0	0	0	0	0	0
Pond 19 OF	3	0	0	0	0	0	0	0	0
Chair OF	3	0	0	0	0	0	0	0	0
Giraffe OF	3	0	0	0	0	0	0	0	0
Wolf OF	3	0	0	0	0	0	0	0	0
Goose OF	3	0	0	0	0	0	0	0	0
Propellor OF	3	1	100	0	0	0	0	0	0
Reference B OF	3	0	0	0	0	0	0	0	0
George Area									
George OF	3	1	100	0	0	0	0	0	0
Sleigh OF	3	0	0	0	0	0	0	0	0
Dragon OF	3	1	100	0	0	0	0	0	0
Komatic IF	3	0	0	0	0	0	0	0	0
Reference C OF	3	0	0	0	0	0	0	0	0

All values represent the percent of samples that were higher than CCME guidelines.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) ISQG = Interim sediment quality guideline.

c) PEL = Probable Effects Level.

Table 3.5-2. Stream Sediment Quality, Average Factor by which Concentrations were Higher than CCME Guidelines, Back River Project, 2012

			Average Factor by which Samples Exceeded the ISQG[b] Guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
CCME Guideline Value[a] (mg/kg)			5.9	0.6	37.3	35.7	35	0.17	123
Stream	Total Number of Samples Collected	Parameters with Exceedances							
Goose Area									
Moby OF	3	0	-	-	-	-	-	-	-
Gander IF	3	0	-	-	-	-	-	-	-
Gander US	3	1	1.4	-	-	-	-	-	-
Pond 19 OF	3	0	-	-	-	-	-	-	-
Chair OF	3	2	2.3	-	1.0	-	-	-	-
Giraffe OF	3	0	-	-	-	-	-	-	-
Wolf OF	3	0	-	-	-	-	-	-	-
Goose OF	3	0	-	-	-	-	-	-	-
Propellor OF	3	2	4.3	-	1.6	-	-	-	-
Reference B OF	3	0	-	-	-	-	-	-	-
George Area									
George OF	3	2	9.7	-	-	2.9	-	-	-
Sleigh OF	3	2	1.4	-	1.6	-	-	-	-
Dragon OF	3	2	6.1	-	1.4	-	-	-	-
Komatic IF	3	2	1.8	-	1.4	-	-	-	-
Reference C OF	3	0	-	-	-	-	-	-	-

(continued)

Table 3.5-2. Stream Sediment Quality, Average Factor by which Concentrations were Higher than CCME Guidelines, Back River Project, 2012 (completed)

			Average Factor by which Samples Exceeded the PEL[c] Guidelines						
			Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Copper (Cu)	Lead (Pb)	Mercury (Hg)	Zinc (Zn)
CCME Guideline Value[a] (mg/kg)			17	3.5	90	197	91.3	0.486	315
Stream	Total Number of Samples Collected	Parameters with Exceedances							
Goose Area									
Moby OF	3	0	-	-	-	-	-	-	-
Gander IF	3	0	-	-	-	-	-	-	-
Gander US	3	0	-	-	-	-	-	-	-
Pond 19 OF	3	0	-	-	-	-	-	-	-
Chair OF	3	0	-	-	-	-	-	-	-
Giraffe OF	3	0	-	-	-	-	-	-	-
Wolf OF	3	0	-	-	-	-	-	-	-
Goose OF	3	0	-	-	-	-	-	-	-
Propellor OF	3	1	1.5	-	-	-	-	-	-
Reference B OF	3	0	-	-	-	-	-	-	-
George Area									
George OF	3	1	3.4	-	-	-	-	-	-
Sleigh OF	3	0	-	-	-	-	-	-	-
Dragon OF	3	1	2.1	-	-	-	-	-	-
Komatic IF	3	0	-	-	-	-	-	-	-
Reference C OF	3	0	-	-	-	-	-	-	-

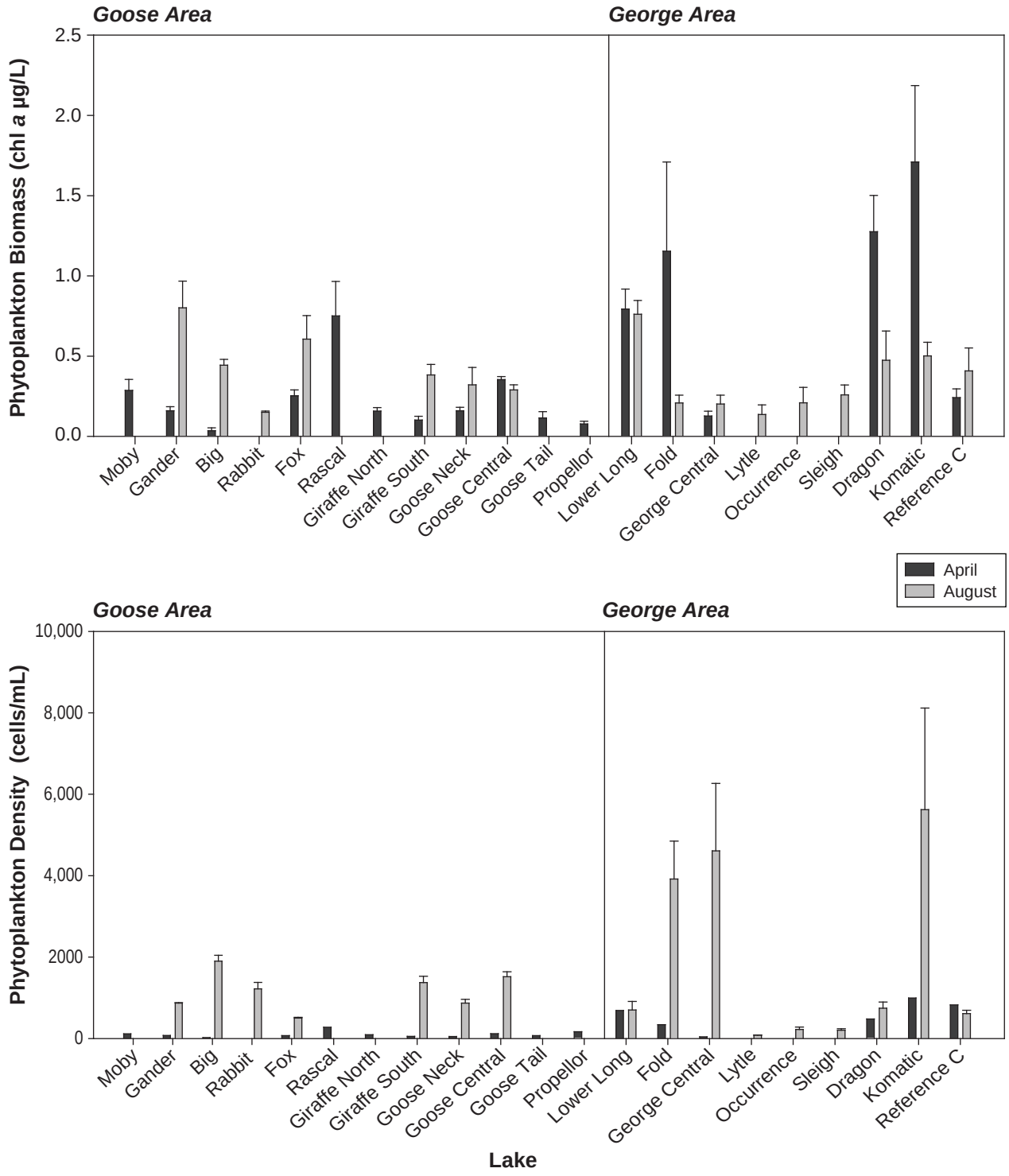
Values represent the average factor by which 2012 samples were higher than CCME guidelines.

Even though a percentage of samples may be higher than a guideline amount, the calculated stream average may not be higher than a guideline amount.

a) Canadian sediment quality guidelines for the protection of aquatic life (CCME, accessed 2012).

b) ISQG = Interim sediment quality guideline.

c) PEL = Probable Effects Level.



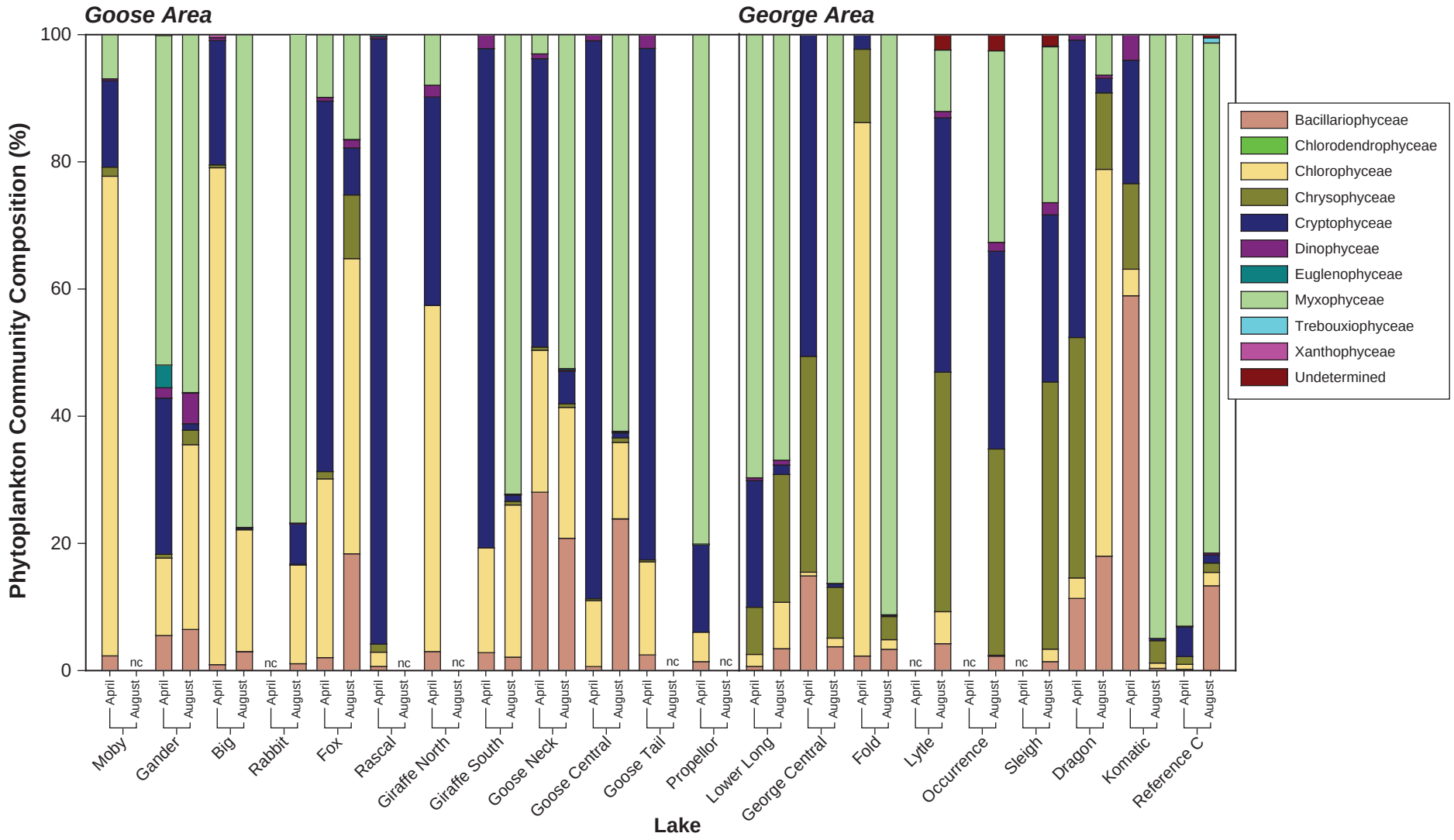
Note: Error bars represent standard error of the mean (except for density in April, where a single replicate was collected).

Sabina GOLD & SILVER CORP.

Phytoplankton Biomass and Density in Lakes, Back River Project, 2012

Figure 3.6-1

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Note: Community composition values represent a single replicate in April, and the mean of replicates in August.
nc = Not Collected.

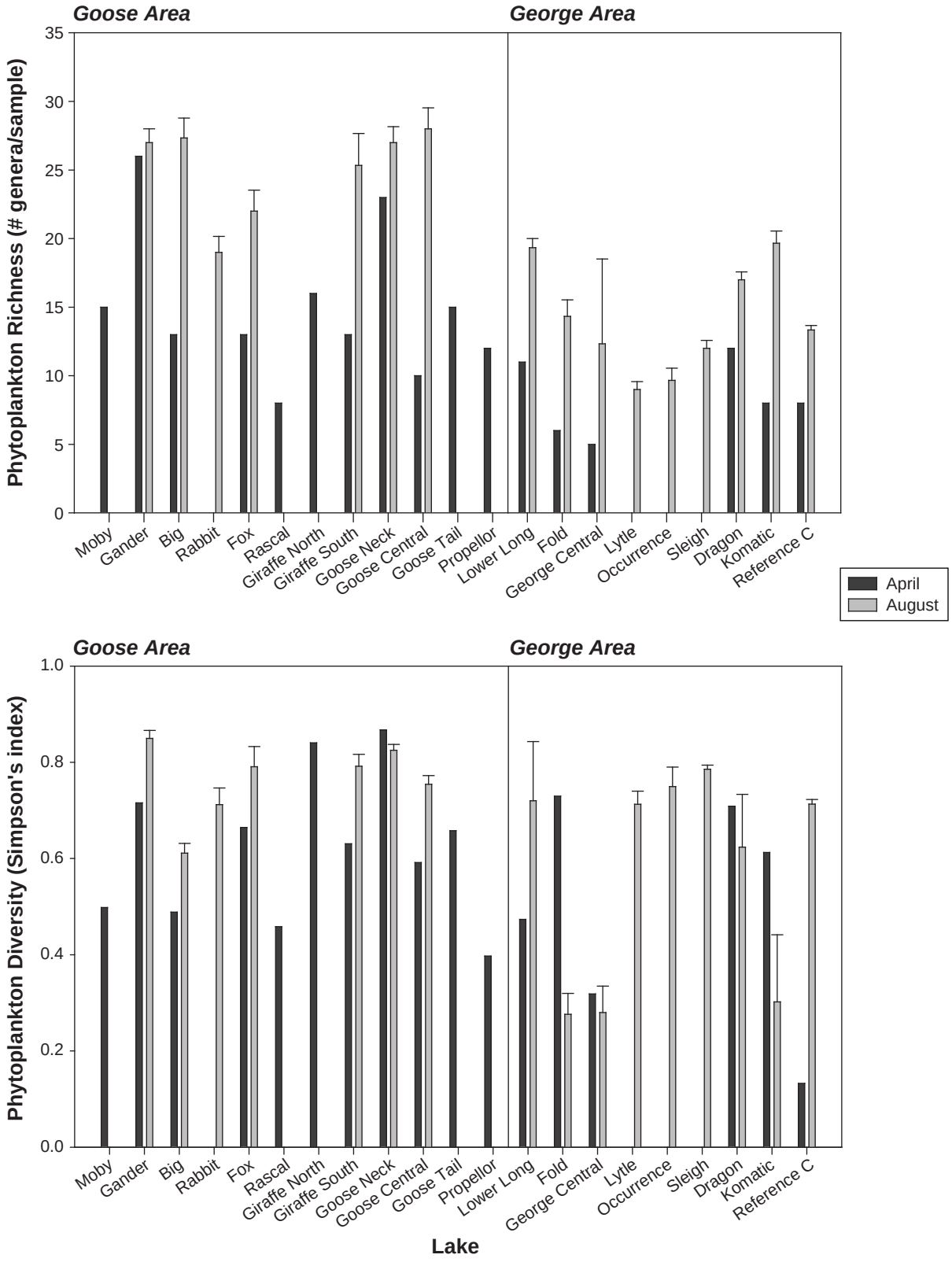
Figure 3.6-2

Sabina GOLD & SILVER CORP.

Phytoplankton Community Composition in Lakes, Back River Project, 2012

Figure 3.6-2

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Notes: Data represent a single replicate in April, and the standard error of the mean in August.
Diversity was analysed at the genus level.

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Phytoplankton Richness and Diversity in Lakes, Back River Project, 2012

Figure 3.6-3

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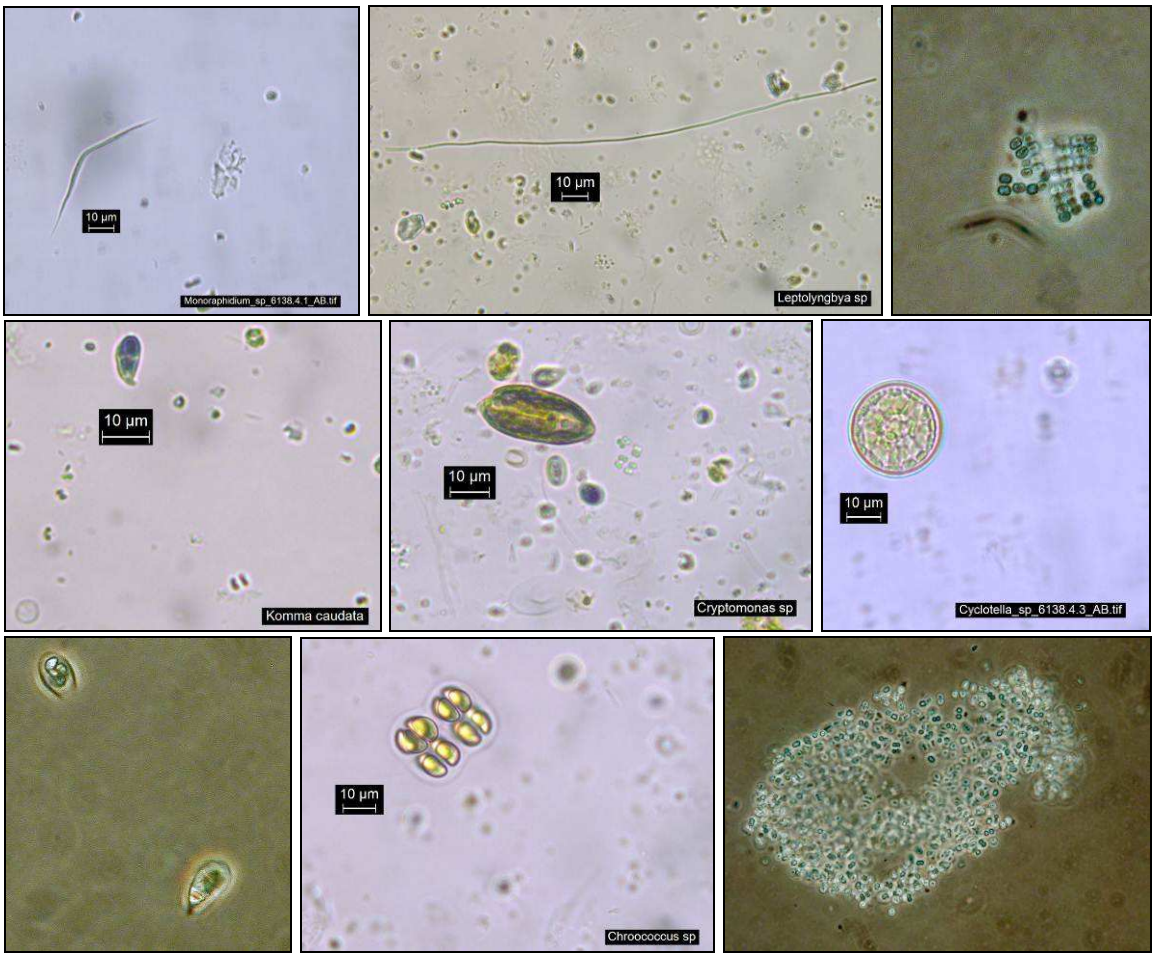


Plate 3.6-1. Some of the most abundant phytoplankton taxa observed in Goose and George area lakes. From top left to bottom right; most abundant in Goose area lakes, Monoraphidium sp.*, Leptolyngbya* sp.*, Merismopedia* sp.*, Komma caudata, Cryptomonas* sp.*; most abundant in George area lakes, Cyclotella* sp.*, Kephyrion* sp.*, Chroococcus* sp. *and Aphanocapsa* sp.

Cryptophytes were more dominant in April than in August, while cyanobacteria were more dominant in August than in April. Lakes had highly variable proportions of green algae, ranging from 84% to less than 1%, with dramatic seasonal (April vs August) differences seen in Big Lake, George Lake Central, and Dragon Lake. George area lakes tended to have greater proportions of chrysophytes than Goose area lakes. Cyanobacteria made up more than 90% of the phytoplankton communities in George Central in August, Komatic in August, and Reference C in April.

Phytoplankton communities were dominated by the three most abundant genera, which comprised between 50% and 96% of phytoplankton sampled (Table 3.6-1). The most abundant genera tended to be in either the myxophycean, chlorophycean or cryptophycean classes. Goose area and George area lakes had different genera dominate the phytoplankton communities. Only one genus was observed in the three most abundant genera in both Goose and George area lakes, the chryosphyte *Dinobryon,* the third most abundant phytoplankton genus at Fox (9.4%), Rascal (1.3%), and Fold (4.8%) lakes.

Table 3.6-1. Most Abundant Phytoplankton Genera in Lakes, Back River Project, 2012

Lake	Most Abundant Phytoplankton Genera		
	Major Taxonomic Group	Genus	% of Sample
Goose Area			
Moby	Chlorophyceae	*Monoraphidium*	69.4
	Cryptophyceae	*Cryptomonas*	11.8
	Myxophyceae	*Anabaena*	6.9
Gander	Myxophyceae	*Anabaena*	29.2
	Chlorophyceae	*Monoraphidium*	12.1
	Myxophyceae	*Merismopedia*	10.5
Big	Myxophyceae	*Leptolyngbya*	60.3
	Chlorophyceae	*Elakatothrix*	11.2
	Myxophyceae	*Coelosphaerium*	5.8
Rabbit	Myxophyceae	*Leptolyngbya*	44.4
	Myxophyceae	*Microcystis*	20.5
	Chlorophyceae	*Monoraphidium*	8.3
Fox	Chlorophyceae	*Monoraphidium*	34.5
	Bacillariophyceae	*Tabellaria*	16.1
	Chrysophyceae	*Dinobryon*	9.4
Rascal	Cryptophyceae	*Komma*	68.6
	Cryptophyceae	*Cryptomonas*	26.6
	Chlorophyceae and Chrysophyceae	*Carteria* and *Dinobryon*	1.3
Giraffe North	Cryptophyceae	*Komma*	25.2
	Chlorophyceae	*Pediastrum*	23.2
	Chlorophyceae	*Sphaerocystis*	14.4
Giraffe South	Myxophyceae	*Merismopedia*	27.3
	Myxophyceae	*Leptolyngbya*	24.7
	Myxophyceae	*Coelosphaerium*	16.8
Goose Neck	Myxophyceae	*Leptolyngbya*	27.1
	Bacillariophyceae	*Tabellaria*	18.3
	Myxophyceae	*Merismopedia*	15.2
Goose Central	Myxophyceae	*Leptolyngbya*	40.2
	Bacillariophyceae	*Tabellaria*	21.7
	Myxophyceae	*Merismopedia*	10.2
Goose Tail	Cryptophyceae	*Cryptomonas*	48.0
	Cryptophyceae	*Komma*	32.4
	Chlorophyceae	*Monoraphidium*	3.7
Propellor	Myxophyceae	*Aphanothece*	76.7
	Cryptophyceae	*Komma*	9.4
	Cryptophyceae	*Cryptomonas*	4.4
George Area			
Lower Long	Myxophyceae	*Aphanocapsa*	38.8
	Myxophyceae	*Planktolyngbya*	17.2
	Chrysophyceae	*Chrysocapsa*	7.0

(continued)

Table 3.6-1. Most Abundant Phytoplankton Genera in Lakes, Back River Project, 2012 (completed)

Lake	Most Abundant Phytoplankton Genera		
	Major Taxonomic Group	Genus	% of Sample
George Area *(cont'd)*			
Fold	Myxophyceae	*Aphanocapsa*	47.5
	Myxophyceae	*Cyanodictyon*	36.4
	Chrysophyceae	*Dinobryon*	4.8
George Central	Myxophyceae	*Aphanothece*	59.4
	Myxophyceae	*Aphanocapsa*	29.8
	Bacillariophyceae	*Cyclotella*	3.1
Lytle	Chrysophyceae	*Kephyrion*	34.9
	Cryptophyceae	*Rhodomonas*	31.8
	Myxophyceae	*Chroococcus*	9.7
Occurrence	Cryptophyceae	*Rhodomonas*	26.0
	Chrysophyceae	*Kephyrion*	18.2
	Myxophyceae	*Chroococcus*	17.5
Sleigh	Chrysophyceae	*Kephyrion*	31.8
	Cryptophyceae	*Rhodomonas*	15.3
	Myxophyceae	*Chroococcus*	12.7
Dragon	Chlorophyceae	*Coenococcus*	48.0
	Bacillariophyceae	*Cyclotella*	15.9
	Chrysophyceae	*Chrysochromulina*	8.7
Komatic	Myxophyceae	*Aphanocapsa*	83.4
	Myxophyceae	*Chroococcus*	5.5
	Bacillariophyceae	*Cyclotella*	3.5
Reference C	Myxophyceae	*Planktolyngbya*	47.7
	Myxophyceae	*Aphanocapsa*	16.8
	Myxophyceae	*Pseudanabaena*	13.6

Note: Individuals not identified to genus level were used only to calculate relative abundance. April and August data was pooled for these calculations.

At the lakes with the highest phytoplankton densities, a few cyanobacteria (*Aphanocapsa*, *Aphanothece* and *Cyanodicton*), made up over 45% of the community during the august sampling. Cyanobacteria genera have small cell sizes relative to other phytoplankton, allowing larger densities to exist than other phytoplankton. Other dominant genera at lakes included the green algae *Monoraphidium*, the cyanobacteria Chroococcus, *Leptolyngbya* and *Mersmopedia*, the cryptophytes *Cryptomonas*, Kephyrion and *Komma* and the diatom *Cyclotella*.

There was visual evidence of benthic primary producers in Pond 19, Rascal Lake, Goose Lake, Occurrence Lake, Sleigh Lake and Reference Lake C during sediment and benthos sample collection (Plate 3.6-2). The most interesting find was the presence of algae in Reference Lake C on top of sediments at 35 m deep, far below both the thermocline (19 m) and the calculated euphotic zone depth (17 m). The algae are thought to be *Nostoc* balls, but were not formally identified, and may have sank out of the euphotic zone (Plate 3.6-3).



Plate 3.6-2. Benthic primary producers were found in some lakes during sediment and benthos sample collection. Top row; left, Pond 19 biofilm in situ*, biofilm on sediment sample and biofilm covered macrophytes; right biofilm on Rascal Lake. Bottom row left Goose Central Lake sediment grabs collected green algae shown in field, and pressed; algal balls observed at Occurrence Lake and Reference Lake C.*



Plate 3.6-3. Algal balls, thought to be Nostoc, were found in Reference Lake C sediment grabs from 35 m depth in August 2012.

3.6.1.2 Richness and Diversity

Genera richness tended to be lower in April than in August, and lower in George area lakes than in Goose area lakes (Figure 3.6-3). Richness averaged between five genera per sample (George Central in April) to 28 genera per sample (Goose Central in August), and tended to be highest at the Gander, Big, Giraffe South, Goose Neck and George Central sites.

Phytoplankton diversity followed a similar trend to richness at most lakes, tending to be lower in George area lakes (Figure 3.6-3). Diversity was highly variable, with most lakes ranging from 0.32 to 0.87. The lowest diversity was measured in Reference Lake C in April, with a Simpson's diversity index of 0.13. Reference C was dominated the cyanobacteria *Planktolyngbya limnetica* (93%) in April, with only eight other taxa present.

3.6.2 Periphyton

Stream periphyton samples were collected in August 2012. Figures 3.6-4 to 3.6-6 present 2012 periphyton results, and all raw periphyton biomass and taxonomic data are presented in Appendices 3.6-4 to 3.6-6. A variety of primary producers were observed in streams during field sampling, with selected examples shown in Plate 3.6-4.



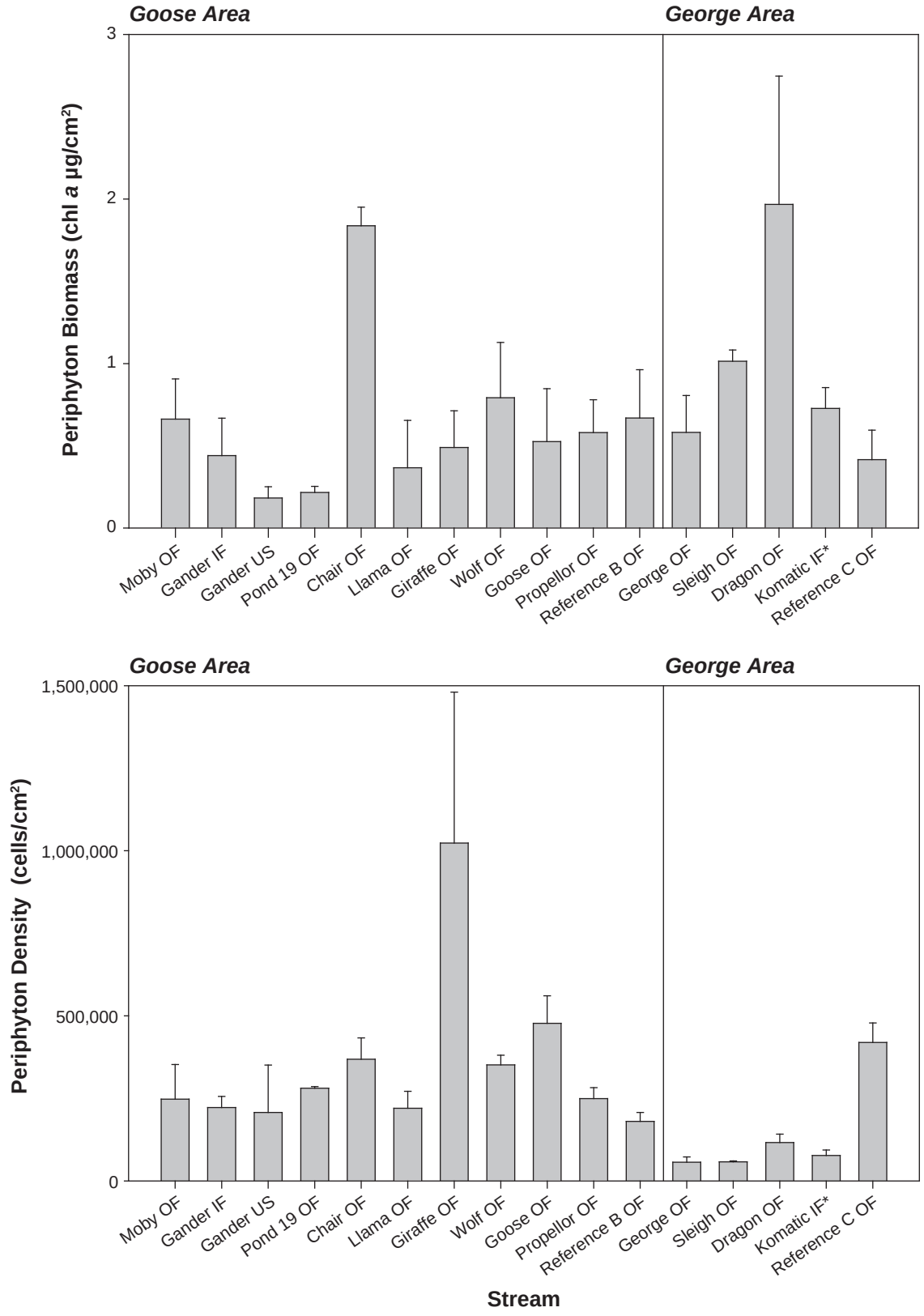
Plate 3.6-4. Examples of benthic primary producers observed in streams. From top left to bottom right, typical periphyton cover observed at most sites (Wolf OF), macrophyte Hippuris vulgaris *growing in Moby OF (*in situ *and* ex situ*), small turfing liverwort growing on rocks at Gander IF (*Jungermannia *sp.); filamentous algae growing on rocks at Propellor OF, and an aquatic moss (Polytrichaceae, likely* Polytrichum *sp.) from Propellor OF.*

3.6.2.1 Biomass, Density and Community Composition

Average periphyton biomass (as chlorophyll *a*) largely ranged from 0.18 µg chl *a*/cm^2 at Gander US to 1.0 chl *a*/cm^2 at Sleigh OF, although biomass levels were much higher in Chair OF (1.83 chl *a*/cm^2) and Dragon OF (1.97 µg chl *a*/cm^2) (Figure 3.6-3). Spatial patterns in biomass did not closely follow densities, which may have reflected variation in the size of the dominant algae and the chlorophyll *a* content in different taxa.

Streams differed in periphyton density with Goose area streams tending to have higher average diversities, with most averaging between 180,000 cells/cm^2 and 478,000 cells/cm^2, and George area streams tending to have lower average diversities, averaging between 56,000 cells/cm^2 and 420,000 cells/cm^2. Periphyton densities were highest and most variable at Giraffe OF, averaging 1,000,000 cells/cm^2. Giraffe OF also had the lowest densities of benthic invertebrates, so the high periphyton densities may have reflected reduced benthic grazing pressure.

Periphyton communities were dominated by Myxophyceae (cyanobacteria) and Bacillariophyceae (diatoms), which averaged over 70% of the community (Figure 3.6-2). Chlorophyceae (green algae) were also a considerable component of stream periphyton communities, averaging up to 30% at some sites. Goose area streams tended to have smaller proportions of diatoms and greater proportions of cyanobacteria than George area lakes, with a few exceptions.



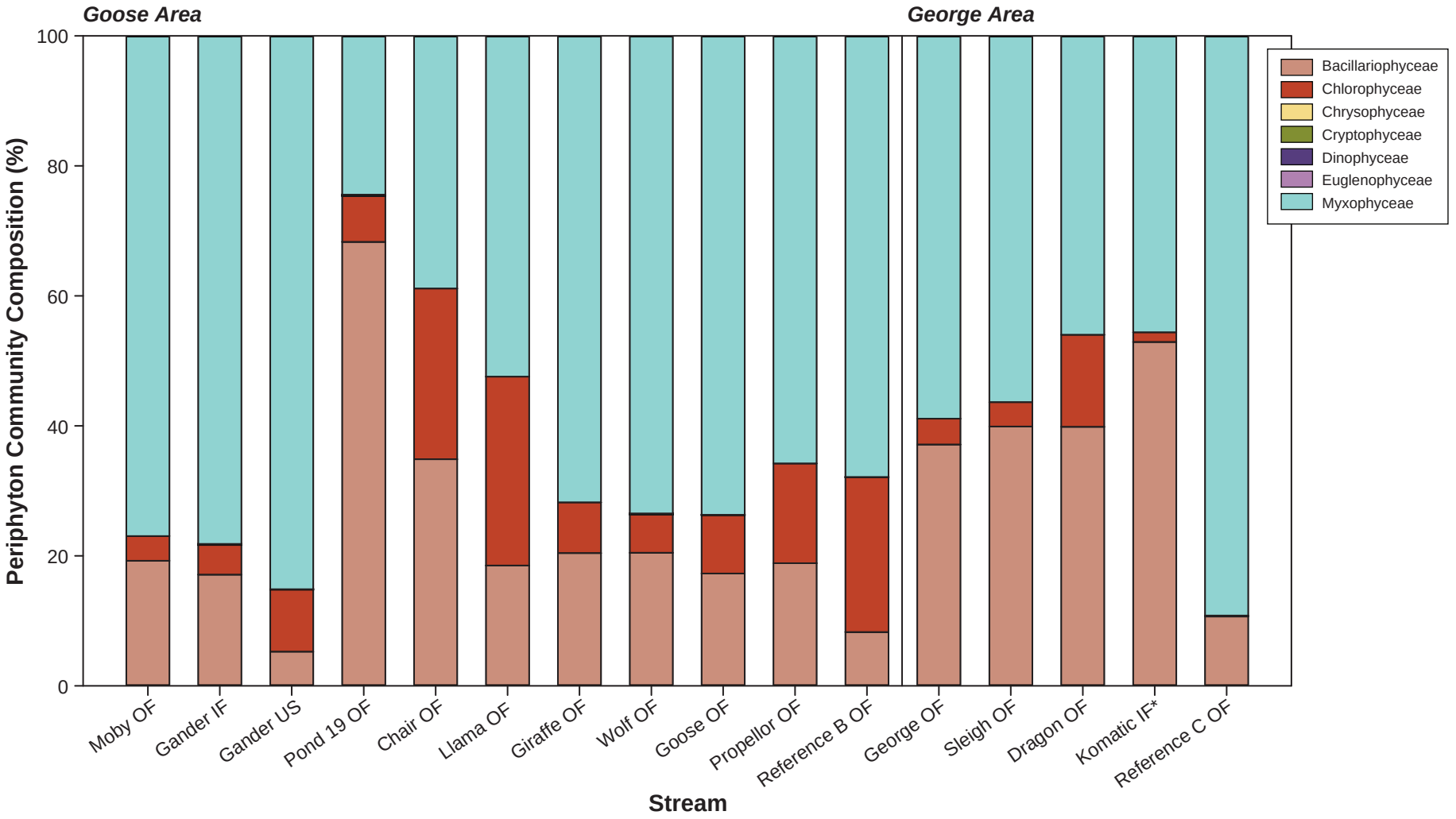
Notes: Error bars represent standard error of the mean.
**Komatic IF had no rocks so periphyton was collected from sediment surface using modified methods.*

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Periphyton Biomass and Density in Streams, Back River Project, 2012

Figure 3.6-4

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Notes: Community composition values represent the mean of replicates.
**Komatic IF had no rocks so periphyton was collected from sediment surface using modified methods.*

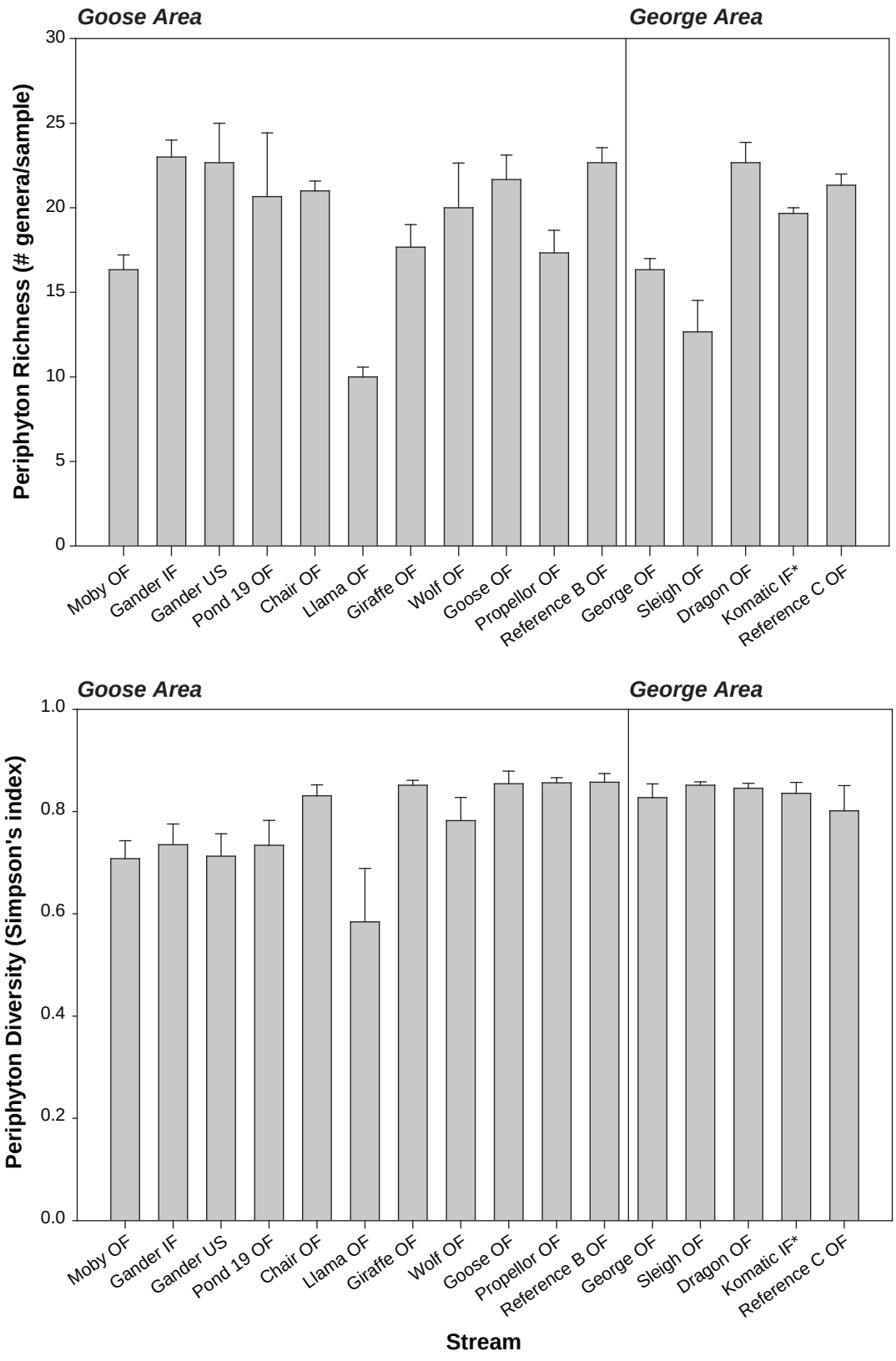
Figure 3.6-5

Sabina GOLD & SILVER CORP.

Periphyton Community Composition in Streams, Back River Project, 2012

Figure 3.6-5

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Notes: Error bars represent standard error of the mean.
**Komatic IF had no rocks so periphyton was collected from sediment surface using modified methods.*

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Periphyton Richness and Diversity in Streams, Back River Project, 2012

Figure 3.6-6

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The three most abundant genera averaged between 45% and 80% of stream periphyton communities, and showed some spatial differentiation (Table 3.6-2). *Tabellaria* (large pennate diatom) and *Woronchinia* (small colonial cyanobacteria) were in the top three genera for a third of streams in the Goose area, but no George area streams. Conversely, *Achnanthidium* (small pennate diatom) and *Leptolyngbya* (filamentous cyanobacteria) were in the top three most abundant taxa in most George area streams, but never for Goose area streams (Plate 3.6-5). The two most abundant periphyton genera at Reference C OF were the cynobacteria *Nostoc* (colonial) and *Scytonema* (filamentous). These were not abundant in any other stream.

Table 3.6-2. Most Abundant Periphyton Genera in Streams, Back River Project, 2012

Stream	Most Abundant Periphyton Genera		
	Major Taxonomic Group	Genus	% of Relative Abundance
Goose Area			
Moby OF	Myxophyceae	*Woronichinia*	40.6
	Myxophyceae	*Oscillatoria*	26.0
	Bacillariophyceae	*Tabellaria*	12.6
Gander IF	Myxophyceae	*Merismopedia*	36.2
	Myxophyceae	*Woronichinia*	30.0
	Myxophyceae	*Microcystis*	7.3
Gander US	Myxophyceae	*Gloeotrichia*	41.7
	Myxophyceae	*Woronichinia*	11.5
	Myxophyceae	*Stigonema*	10.8
Pond 19 OF	Bacillariophyceae	*Tabellaria*	39.5
	Bacillariophyceae	*Navicula*	19.3
	Myxophyceae	*Calothrix*	11.5
Chair OF	Bacillariophyceae	*Tabellaria*	25.5
	Chlorophyceae	*Scenedesmus*	17.2
	Myxophyceae	*Woronichinia*	13.8
Llama OF	Myxophyceae	*Homoeothrix*	50.6
	Chlorophyceae	*Bulbochaete*	13.5
	Bacillariophyceae	*Tabellaria*	9.5
Giraffe OF	Myxophyceae	*Woronichinia*	18.6
	Myxophyceae	*Stigonema*	14.2
	Bacillariophyceae	*Tabellaria*	13.4
Wolf OF	Myxophyceae	*Woronichinia*	24.1
	Myxophyceae	*Gloeotrichia*	16.3
	Bacillariophyceae	*Tabellaria*	11.7
Goose OF	Myxophyceae	*Aphanocapsa*	23.1
	Myxophyceae	*Woronichinia*	13.6
	Myxophyceae	*Dichothrix*	12.0
Propellor OF	Bacillariophyceae	*Tabellaria*	19.9
	Myxophyceae	*Dichothrix*	15.2
	Myxophyceae	*Calothrix*	12.0
Reference B OF	Myxophyceae	*Woronichinia*	20.2
	Myxophyceae	*Calothrix*	19.3
	Myxophyceae	*Merismopedia*	9.0

(continued)

Table 3.6-2. Most Abundant Periphyton Genera in Streams, Back River Project, 2012 (completed)

Stream	Most Abundant Periphyton Genera		
	Major Taxonomic Group	Genus	% of Relative Abundance
George Area			
George OF	Myxophyceae	*Leptolyngbya*	19.2
	Myxophyceae	*Stigonema*	15.7
	Bacillariophyceae	*Achnanthidium*	14.8
Sleigh OF	Myxophyceae	*Leptolyngbya*	22.4
	Bacillariophyceae	*Achnanthidium*	14.6
	Myxophyceae	*Calothrix*	12.5
Dragon OF	Bacillariophyceae	*Achnanthidium*	21.6
	Myxophyceae	*Dichothrix*	14.5
	Myxophyceae	*Leptolyngbya*	9.8
Komatic IF*	Bacillariophyceae	*Achnanthidium*	24.5
	Myxophyceae	*Merismopedia*	19.9
	Myxophyceae	*Leptolyngbya*	12.0
Reference C OF	Myxophyceae	*Nostoc*	25.5
	Myxophyceae	*Scytonema*	16.5
	Myxophyceae	*Aphanocapsa*	11.8

Note: Individuals not identified to genus level were used only to calculate relative abundance.

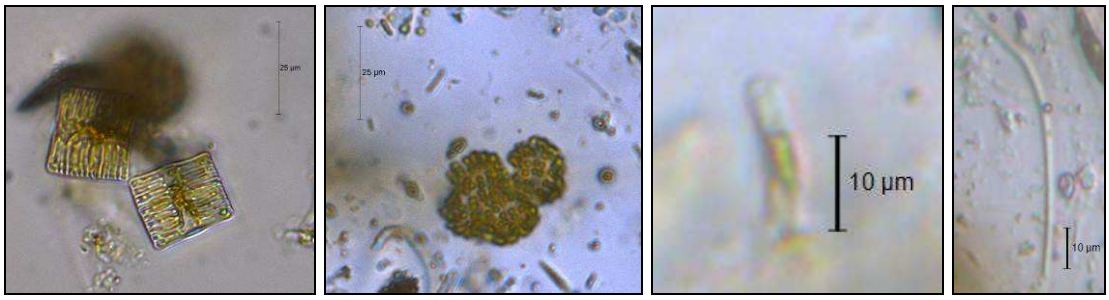


Plate 3.6-5. Tabellaria flocculosa *and* Woronichinia naegeliana *were highly abundant in Goose area streams;* Achnanthidium *sp. and* Leptolyngbya *sp. were highly abundant in George area streams.*

3.6.2.2 Richness and Diversity

Periphyton genera richness averaged from 10 to 23 genera/sample, with most streams over16 genera/sample (Figure 3.6-3). Llama OF had the lowest average periphyton richness in all streams measured in both 2012 (10 genera/sample) and 2011 (18 genera/sample; Rescan 2012a). This stream had quite different substrate from all other streams sampled, running through a boulder field.

Periphyton diversity was high and very similar among all stream sites, averaging between 0.71 and 0.86 (Simpson's index). The exception was Llama OF, which had the lowest and most variable diversity, averaging at 0.58 on the Simpson's diversity index.

3.7 AQUATIC INVERTEBRATES

3.7.1 Zooplankton

Lake zooplankton samples were collected in August 2012. Figures 3.7-1 and 3.7-2 present 2012 zooplankton results, and all raw zooplankton data are presented in Appendices 3.7-1 to 3.7-4. A variety of zooplankton were observed, with some of the more abundant taxa shown in Plate 3.7-1.

3.7.1.1 Density and Community Composition

Zooplankton densities, excluding nauplii, tended to be higher at Goose area lakes than at George area lakes (Figure 3.7-1). Twelve out of the sixteen of lakes had densities below 30,000 individuals/m^3, and all were below 58,000 individuals/m^3, except Gander Lake with 83,000 individuals/m^3. The lowest densities were observed at Occurrence Lake, with approximately 680 individuals/m^3. Patterns in copepodite densities did not match with zooplankton densities, and varied between lakes. Copepodites were absent in over a quarter of lakes (Rabbit, Lower Long, Occurrence, Sleigh, Dragon, and Reference Lake C) and were highest in Fold Lake (15,000 individuals/m^3).

Rotifers and crustaceans dominated the zooplankton communities in all lakes (Figure 3.7-2). Rotifers tended to be more dominant in Goose area lakes and made up almost all of the zooplankton community in Gander Lake. Crustaceans were more dominant in George area lakes and made up almost all of the communities in Lytle, Occurrence, and Sleigh lakes. The most dominant crustacean families were Diaptomidae, a family of calanoid copepods, and Daphniidae, a family of water fleas. The most dominant rotifer families were Brachionidae and Conochilidae.

Lakes were dominated by a few highly abundant genera. The three most abundant genera comprised between 60% and 100% of zooplankton communities at all lakes, with the exception of Reference Lake C where unidentified cyclopoid copepods made up 77% of the community (Table 3.7-1). Common zooplankton genera included the rotifers *Kellicottia* and *Conochilus,* and the crustaceans *Leptodiaptomus*, *Daphnia,* and *Holopedium*.

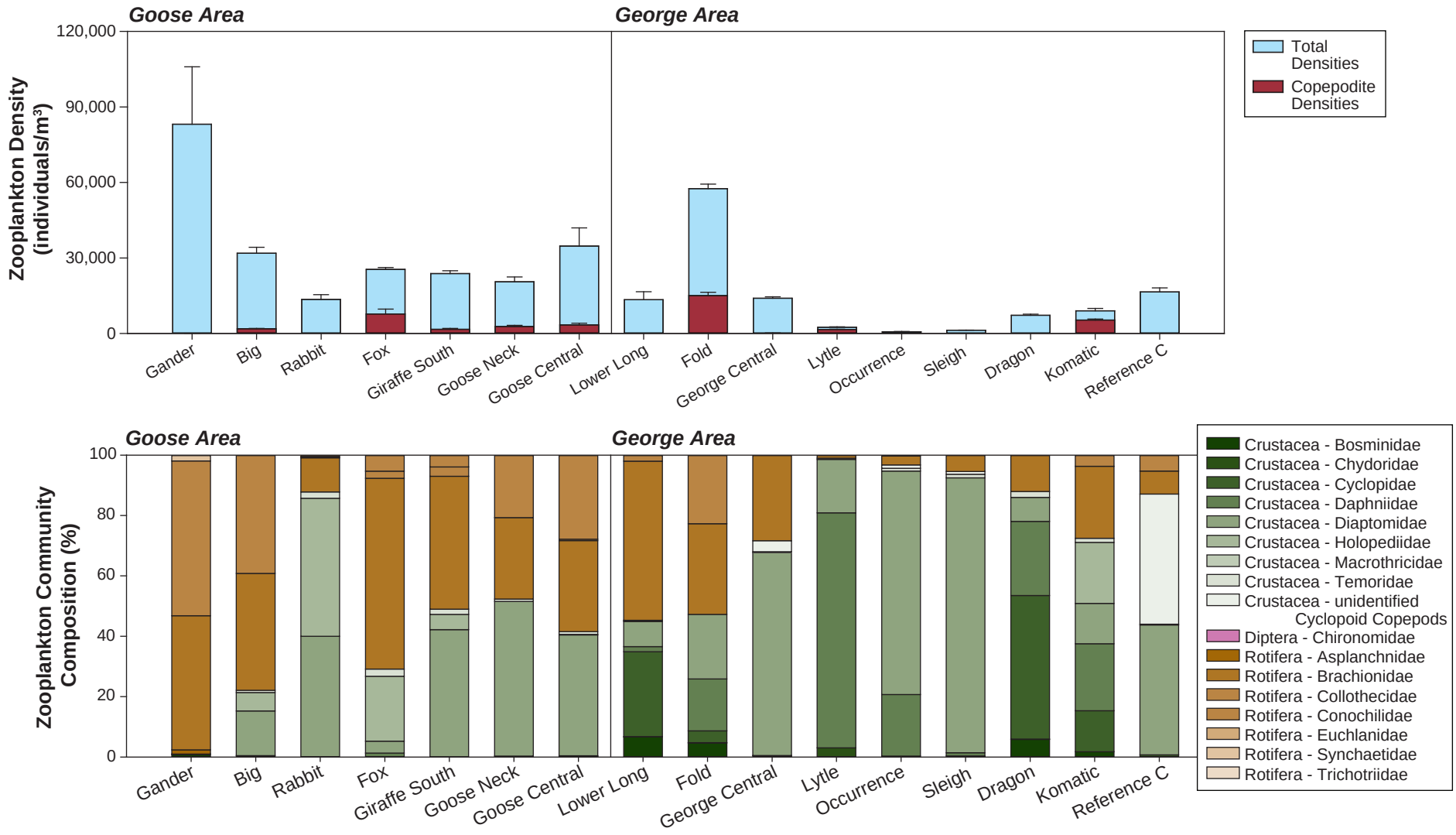
Note over two thirds of zooplankton individuals at George Lake Central were not able to be identified to genus level, with most of these being copepods from the Diaptomidae family.

3.7.1.2 Richness and Diversity

Note, due to differences in depth and sampling, the volume of water sampled for zooplankton varied between sites from an average of 0.54 m^3 to 0.98 m^3 at most lakes, with the much deeper Reference Lake C having sampled 1.57 m^3. Additionally, taxonomists analyzed a subsample of each sample, which differed between replicates. This could affect diversity and richness calculations, which were done per sample and do not linearly correlate with sampling volume or effort.

Average zooplankton genera richness varied between lakes, with Goose area lakes tending to having higher richness than George area lakes (Figure 3.7-2). The average genera richness ranged from 5.0 to 10.3 genera/sample, with the exception of George Lake Central which had a particularly low richness of just 2.7 genera/sample.

Diversity was also variable between lakes, ranging between 0.3 and 0.8 on the Simpson's diversity index. The exceptions were two George area lakes, George Lake Central and Sleigh, which had much lower diversity averaging 0.05 and 0.14, respectively (Figure 3.7-2). George Central was dominated mainly by individuals unidentified to the genus level (mostly copepods from the Diaptomidae family), while Sleigh Lake was 88% *Leptodiaptomus*.



Notes: Error bars represent the standard error of the mean of the total density.
Community composition values represent the mean of triplicate replicates.
Density data does not include nauplii, composition data does not include nauplii or copepodites.

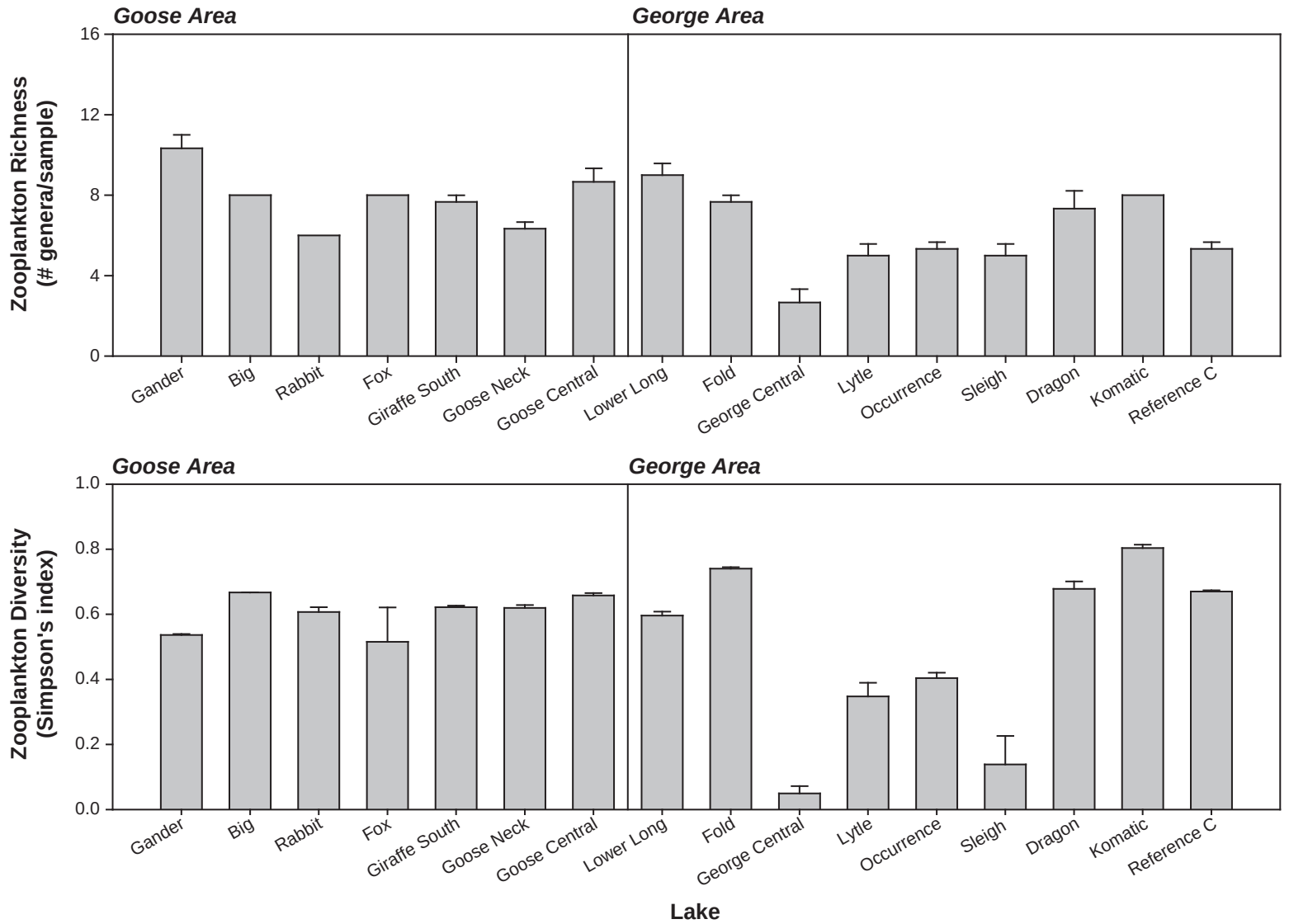
Figure 3.7-1

Sabina GOLD & SILVER CORP.

Zooplankton Density and Community Composition in Lakes, Back River Project, 2012

Figure 3.7-1

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Notes: Error bars represent standard error of the mean.
Diversity and richness data does not include nauplii or copepodites or organisms not identified to the genus level.

Figure 3.7-2

Sabina GOLD & SILVER CORP.

Zooplankton Richness and Diversity in Lakes, Back River Project, 2012

Figure 3.7-2

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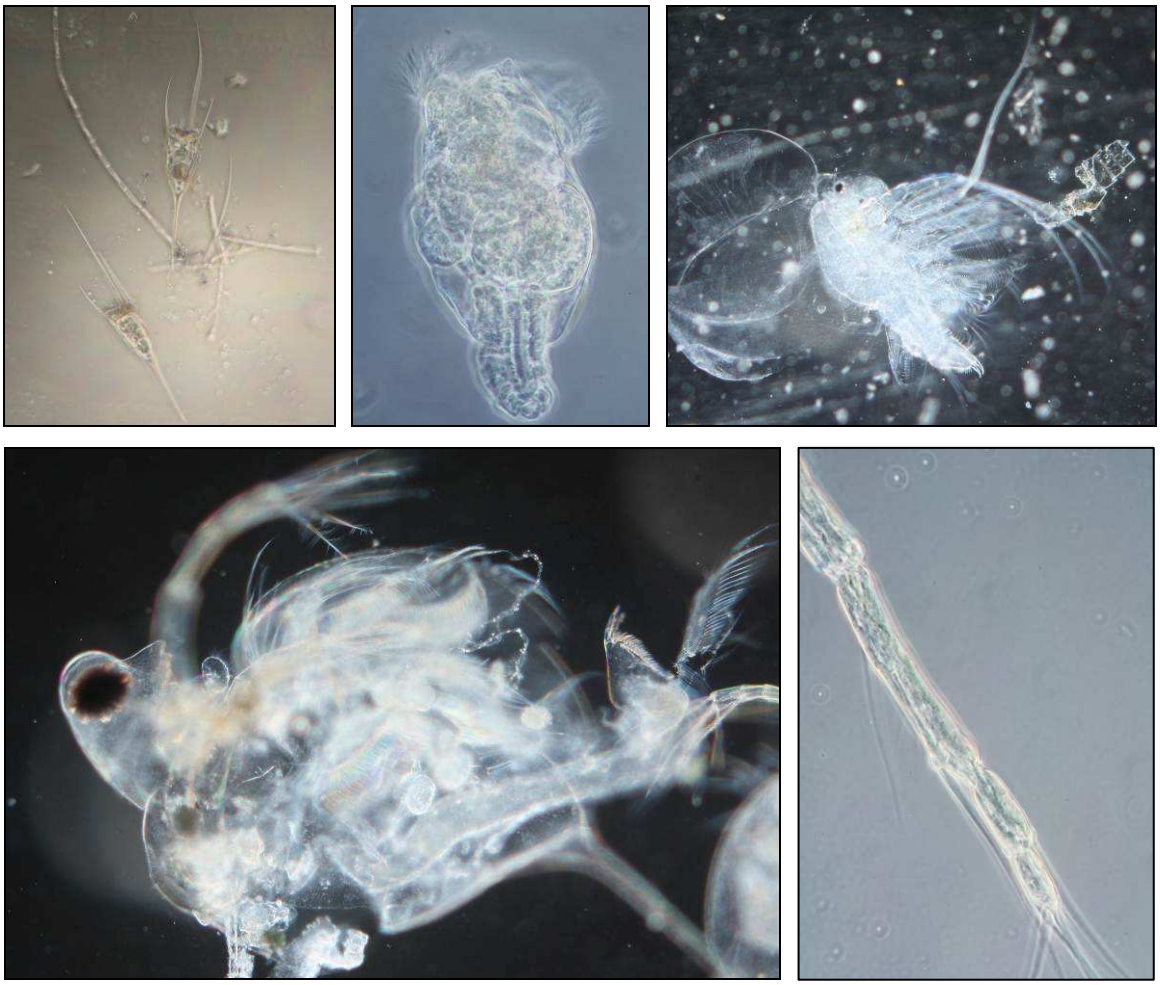


Plate 3.7-1. Some of the most abundant zooplankton taxa observed. From top left to bottom right, Kellicottia longispina, Conochilus unicornis, Holopedium gibberum, Daphnia middenorffiana *and the antennae of a* Leptodiaptomus pribilofensis *used in taxonomic identification.*

Table 3.7-1. Most Abundant Zooplankton Genera in Lakes, Back River Project, 2012

Lake	Most Abundant Zooplankton Genera		
	Major Taxonomic Group	Genus	% Relative Abundance
Goose Area			
Gander	Rotifera - Conochilidae	*Conochilus*	51.3
	Rotifera - Brachionidae	*Kellicottia*	44.3
	Rotifera - Synchaetidae	*Synchaeta*	1.9
Big	Rotifera - Conochilidae	*Conochilus*	39.2
	Rotifera - Brachionidae	*Kellicottia*	38.7
	Crustacea - Diaptomidae	*Leptodiaptomus*	14.8
Rabbit	Crustacea - Holopedidae	*Holpedium*	45.7
	Crustacea - Diaptomidae	*Leptodiaptomus*	40.0
	Rotifera - Brachionidae	*Kellicottia*	11.4
Fox	Rotifera - Brachionidae	*Kellicottia*	63.2

(continued)

Table 3.7-1. Most Abundant Zooplankton Genera in Lakes, Back River Project, 2012 (completed)

Lake	Most Abundant Zooplankton Genera		
	Major Taxonomic Group	Genus	% Relative Abundance
Goose Area *(cont'd)*			
	Crustacea - Holopedidae	*Holpedium*	21.5
	Rotifera - Conochilidae	*Conochilus*	5.3
Giraffe South	Rotifera - Brachionidae	*Kellicottia*	44.0
	Crustacea - Diaptomidae	*Leptodiaptomus*	42.1
	Crustacea - Holopedidae	*Holpedium*	5.1
Goose Neck	Crustacea - Diaptomidae	*Leptodiaptomus*	51.2
	Rotifera - Brachionidae	*Kellicottia*	27.0
	Rotifera - Conochilidae	*Conochilus*	20.6
Goose Central	Crustacea - Diaptomidae	*Leptodiaptomus*	40.0
	Rotifera - Brachionidae	*Kellicottia*	30.1
	Rotifera - Conochilidae	*Conochilus*	27.8
George Area			
Lower Long	Rotifera - Brachionidae	*Kellicottia*	52.6
	Crustacea - Cyclopidae	*Cyclops*	28.1
	Crustacea - Bosminidae	*Eubosmina*	6.7
Fold	Rotifera - Brachionidae	*Kellicottia*	29.6
	Rotifera - Conochilidae	*Conochilus*	22.7
	Crustacea - Daphniidae	*Daphnia*	17.2
George Central	Rotifera - Brachionidae	*Kellicottia*	28.4
	Crustacea - Cyclopidae	*Cyclops*	0.4
	Crustacea - Temoridae	*Heterocope*	0.3
Lytle	Crustacea - Daphniidae	*Daphnia*	77.9
	Crustacea - Diaptomidae	*Leptodiaptomus*	17.7
	Crustacea - Chydoridae	*Eurycercus*	1.3
Occurrence	Crustacea - Diaptomidae	*Leptodiaptomus*	70.5
	Crustacea - Daphniidae	*Daphnia*	20.4
	Rotifera - Brachionidae	*Kellicottia*	3.1
Sleigh	Crustacea - Diaptomidae	*Leptodiaptomus*	88.4
	Rotifera - Brachionidae	*Kellicottia*	5.4
	Crustacea - Temoridae	*Heterocope*	1.2
Dragon	Crustacea - Cyclopidae	*Cyclops*	47.5
	Crustacea - Daphniidae	*Daphnia*	24.5
	Rotifera - Brachionidae	*Kellicottia*	12.0
Komatic	Rotifera - Brachionidae	*Kellicottia*	23.9
	Crustacea - Daphniidae	*Daphnia*	22.2
	Crustacea - Holopedidae	*Holpedium*	20.2
Reference C	Crustacea - Diaptomidae	*Leptodiaptomus*	8.9
	Rotifera - Conochilidae	*Conochilus*	5.2
	Rotifera - Brachionidae	*Kellicottia*	4.8

Note: Nauplii and copepodites were not included in this table, individuals not identified to genus level were used only to calculate relative abundance.

3.7.2 Lake Benthic Macroinvertebrates

Lake benthic macroinvertebrate (benthos) samples were collected in August 2012. Figures 3.7-3 and 3.7-4 present 2012 lake benthos results, and all raw data are presented in Appendices 3.7-5 to 3.7-7. Note only four replicates were collected at Giraffe Lake South due to the substrate type limiting the sampling success with the Ekman. Sorting efficiencies for lake benthos samples were above 90% on the first sort for all but two samples, suggesting robust data free of sorting bias.

3.7.2.1 Density and Community Composition

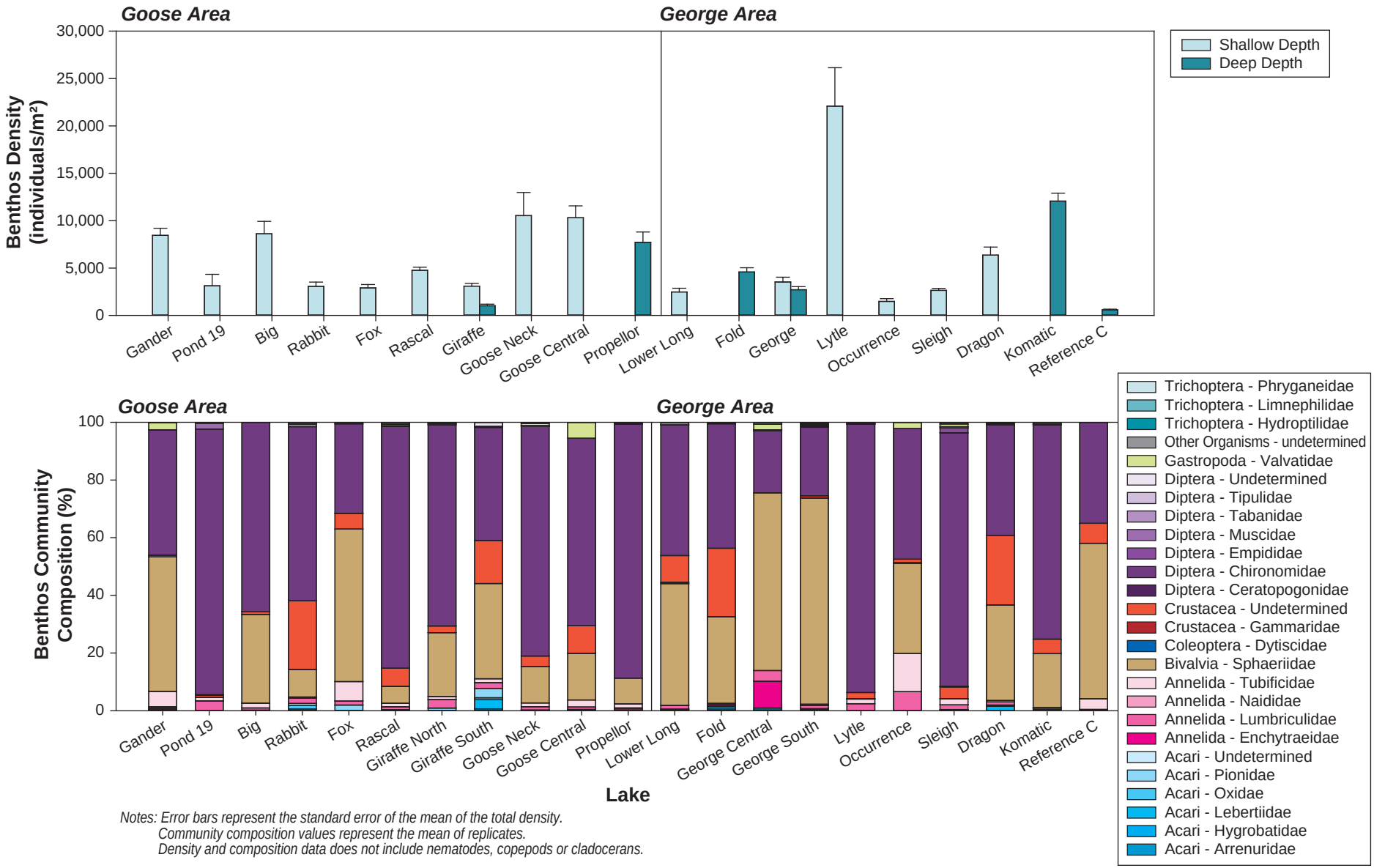
Average benthos densities varied considerably between lakes (Figure 3.7-3). Most lakes ranged from 600 individuals/m^2 (Reference Lake C; deep depth) to 10,500 individuals/m^2 (Goose Lake Neck), with considerably more benthic invertebrates at Lytle Lake (22,000 individuals/m^2).

Benthic communities at all lake sites were dominated by dipterans (true flies) and bivalves (small to tiny pea clams from the family Sphaeriidae; Plate 3.7-2). These two taxa averaged between 70% and 97% of lake benthic communities (Figure 3.7-3). Other benthic invertebrates found in lakes included annelids (ringed worms), crustaceans, coleopterans (true beetles) and trichopterans (caddisflies).



Plate 3.7-2. Bivalves from family Sphaeriidae were common in lake benthic communities, above seen on sediment surface at Rascal Lake in August 2012.

The most abundant three genera made up on average between 34% and 89% of the benthic community at each lake (Table 3.7-2). Approximately half the lakes had *Psidium* (the bivalve pea clam) and *Procladius* (the chironomid dipterans that are non-biting midges) in the top three genera. Other genera in the top three taxa for approximately a quarter of lakes sampled included the chironomid dipterans: *Paratanytarsus, Psectrocladius, Stictochironomus,* and *Tanytarsus*. There was no clear difference between abundant taxa in Goose area lakes and George area lakes.



Notes: Error bars represent the standard error of the mean of the total density.
Community composition values represent the mean of replicates.
Density and composition data does not include nematodes, copepods or cladocerans.

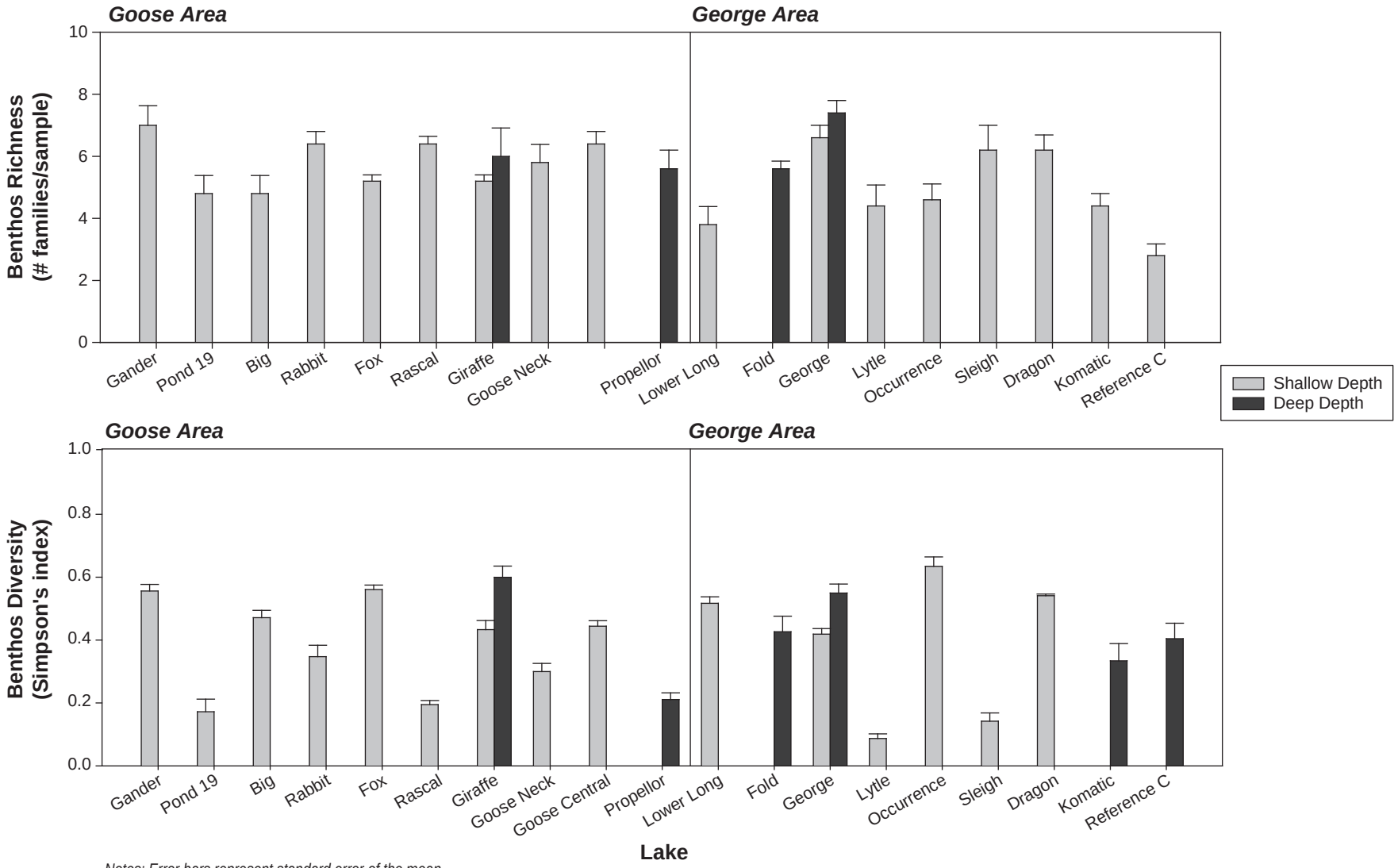
Figure 3.7-3

Sabina GOLD & SILVER CORP.

Benthos Density and Community Composition in Lakes, Back River Project, 2012

Figure 3.7-3

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Notes: Error bars represent standard error of the mean.
Diversity and richness data does not include nematodes, copepods, cladocerans or organisms not identified to the family level.

Figure 3.7-4

Sabina GOLD & SILVER CORP.

Benthos Richness and Diversity in Lakes, Back River Project, 2012

Figure 3.7-4

Rescan™ Engineers & Scientists

Table 3.7-2. Most Abundant Benthic Macroinvertebrate Genera in Lakes, Back River Project, 2012

Lake	Most Abundant Lake Benthos Genera		
	Major Taxonomic Group	Genus	% Relative Abundance
Goose Area			
Gander	Bivalvia	*Pisidium*	31.4
	Insecta - Diptera	*Dicrotendipes*	12.7
	Insecta - Diptera	*Procladius*	7.6
Pond 19	Insecta - Diptera	*Paratanytarsus*	35.9
	Insecta - Diptera	*Tanytarsus*	18.9
	Insecta - Diptera	*Psectrocladius*	13.5
Big	Insecta - Diptera	*Cladotanytarsus*	35.4
	Bivalvia	*Pisidium*	22.3
	Insecta - Diptera	*Tanytarsus*	12.7
Rabbit	Insecta - Diptera	*Psectrocladius*	20.0
	Insecta - Diptera	*Procladius*	16.2
	Insecta - Diptera	*Tanytarsus*	10.2
Fox	Bivalvia	*Pisidium*	44.7
	Insecta - Diptera	*Procladius*	10.0
	Insecta - Diptera	*Cladotanytarsus*	4.9
Rascal	Insecta - Diptera	*Corynocera*	34.4
	Insecta - Diptera	*Cladotanytarsus*	9.9
	Insecta - Diptera	*Paratanytarsus*	8.4
Giraffe North	Bivalvia	*Pisidium*	15.0
	Insecta - Diptera	*Procladius*	14.5
	Insecta - Diptera	*Tanytarsus*	12.9
Giraffe South	Bivalvia	*Pisidium*	15.8
	Insecta - Diptera	*Zalutschia*	9.8
	Insecta - Diptera	*Pagastiella*	8.4
Goose Neck	Insecta - Diptera	*Pagastiella*	49.4
	Insecta - Diptera	*Psectrocladius*	7.0
	Insecta - Diptera	*Stictochironomus*	6.7
Goose Central	Insecta - Diptera	*Stictochironomus*	15.5
	Insecta - Diptera	*Tanytarsus*	13.0
	Insecta - Diptera	*Corynocera*	8.7
Propellor	Insecta - Diptera	*Zalutschia*	61.1
	Bivalvia	*Pisidium*	6.2
	Insecta - Diptera	*Corynocera*	4.8
George Area			
Lower Long	Bivalvia	*Pisidium*	25.4
	Insecta - Diptera	*Paratanytarsus*	15.7
	Insecta - Diptera	*Microtendipes*	9.8
Fold	Insecta - Diptera	*Stictochironomus*	21.5
	Bivalvia	*Pisidium*	20.3
	Insecta - Diptera	*Procladius*	5.6

(continued)

Table 3.7-2. Most Abundant Benthic Macroinvertebrate Genera in Lakes, Back River Project, 2012 (completed)

Lake	Most Abundant Lake Benthos Genera		
	Major Taxonomic Group	Genus	% Relative Abundance
George Area *(cont'd)*			
George South	Bivalvia	*Pisidium*	41.5
	Insecta - Diptera	*Procladius*	7.4
	Insecta - Diptera	*Thienemannimyia*	4.5
George Central	Bivalvia	*Pisidium*	31.5
	Insecta - Diptera	*Procladius*	12.3
	Insecta - Diptera	*Psectrocladius*	4.5
Lytle	Insecta - Diptera	*Paratanytarsus*	83.4
	Insecta - Diptera	*Procladius*	3.9
	Insecta - Diptera	*Psectrocladius*	2.1
Occurrence	Insecta - Diptera	*Paratanytarsus*	19.1
	Bivalvia	*Pisidium*	17.7
	Insecta - Diptera	*Procladius*	7.6
Sleigh	Insecta - Diptera	*Paratanytarsus*	63.0
	Insecta - Diptera	*Tanytarsus*	6.3
	Insecta - Diptera	*Stictochironomus*	4.9
Dragon	Bivalvia	*Pisidium*	21.0
	Insecta - Diptera	*Procladius*	14.7
	Insecta - Diptera	*Stictochironomus*	8.2
Komatic	Insecta - Diptera	*Corynocera*	23.2
	Insecta - Diptera	*Micropsectra*	16.2
	Insecta - Diptera	*Microtendipes*	13.2
Reference C	Bivalvia	*Pisidium*	26.8
	Insecta - Diptera	*Stictochironomus*	23.4
	Insecta - Diptera	*Procladius*	4.9

Note: Nematodes, copepods and cladocerans were not included in this table, individuals not identified to genus level were used only to calculate relative abundance.

3.7.2.2 Richness and Diversity

Benthos family richness ranged from 2.4 to 7.4 families/sample, with Reference Lake C having the lowest family richness and George Lake Central and Gander Lake had the highest (Figure 3.7-4). Richness and diversities showed no clear patterns with depth.

Diversity in lake benthos communities was highly variable, ranging from low levels at Lytle (average Simpson's diversity index of 0.09) to moderate levels at Giraffe Lake South and Occurrence Lake (average Simpson's diversity index of 0.6). Note at Lytle Lake where diversity was particularly low, 83% of the community was made up of a single genus (*Paratanytarsus*).

3.7.3 Stream Benthic Macroinvertebrates

Stream benthos samples were collected in August 2012. No benthos samples could be collected at Echo OF as it was dry during August sampling; no samples could be collected from Llama OF due to the boulder substrate type. Only two replicates could be collected at Pond 19 OF due to the low water levels and flow.

Figures 3.7-5 and 3.7-6 present the 2012 results, and all raw data are presented in Appendices 3.7-8 to 3.7-10.

3.7.3.1 Density and Community Composition

In most streams, benthos densities ranged from an average of 500 organisms/m^2 (Chair OF) to 4,700 organisms/m^2 (Sleigh OF; Figure 3.7-5), which was a similar range of densities to those observed in the 2011 stream sampling program (Rescan 2012). There were no clear spatial patterns between Goose and George area lakes in 2012.

Stream benthos communities were dominated by dipterans, which averaged over half of the benthic organisms sampled at all streams (Figure 3.7-5). The majority of the dipterans were chironomids, also known as non-biting midges. Acari (arachnid mites and ticks) and annelid worms were also present, averaging between 5% and 10% of the benthos community.

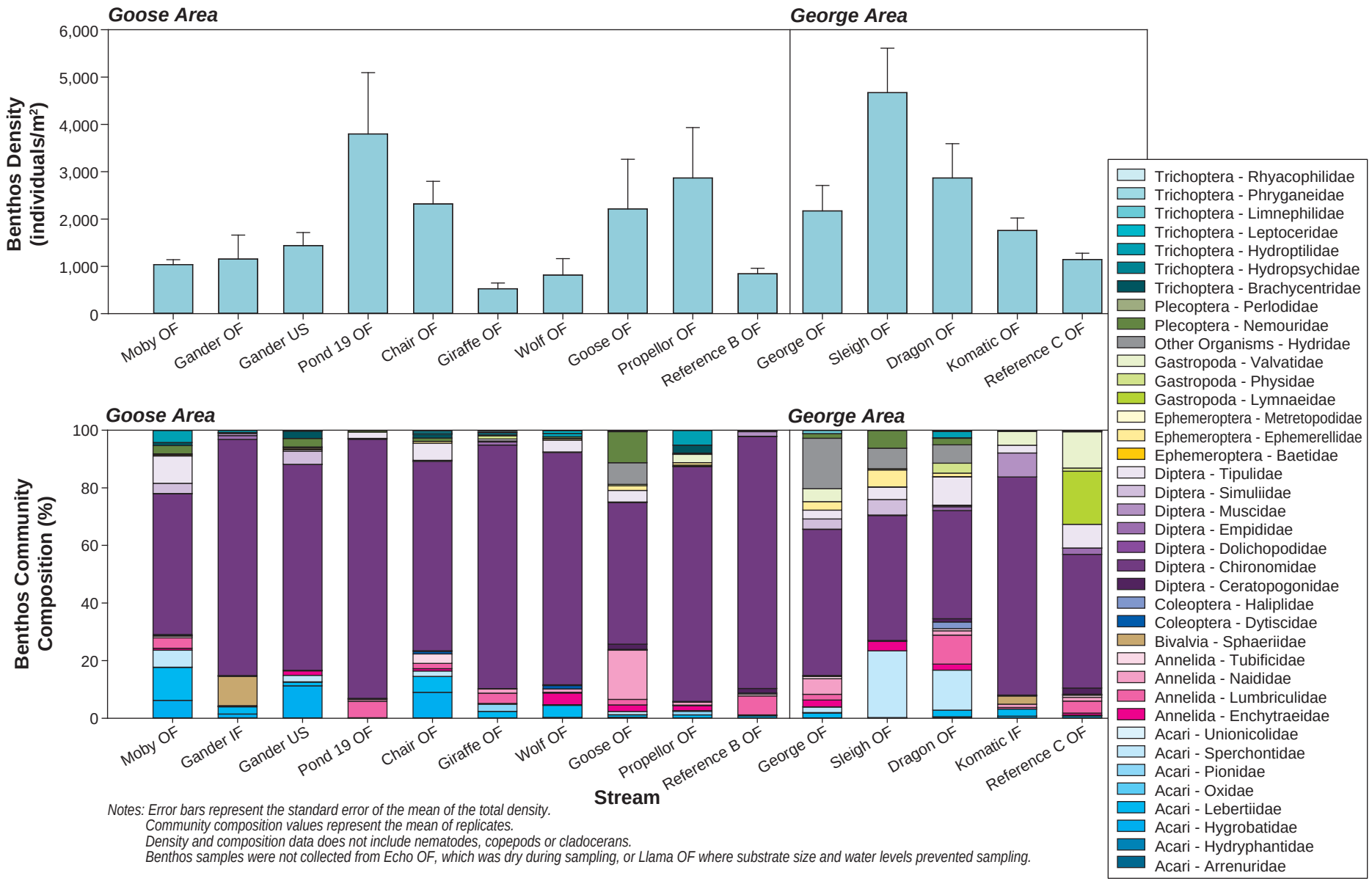
The remainder of the community was made up of bivalves (in the pea clam family Sphaeriidae), Coleoptera (snails and slugs), Ephemeroptera (mayflies), Gastropoda (snails), hydra (in the same phylum as jellies), Plecoptera (stoneflies) and Trichoptera (caddisflies), generally averaging less than 5% of the community. Ephemeroptera, Plecoptera, and Trichoptera (together termed EPT) are pollution sensitive taxa, often used as indicators of good water quality. On average, EPT made up between 0.3% (Komatic IF) and 12.9% (Goose OF) of the stream benthos communities. There was no clear spatial trend in EPT densities between Goose and George area streams.

The most abundant three genera averaged between 29% and 31% of stream benthic communities (Table 3.7-3). In several streams, a single genus made up over 20% of the benthic community, with the most dramatic example being the chironomid *Paratantarsus* at Giraffe OF, which made up 40.5%. Abundant genera were mainly dipterans, with the chironomid *Thienemannimyia* as the most common dominant genus being in the top three genera in a quarter of all stream benthic communities. Other abundant genera were acarins, gastropods, hydrozoans, and annelids.

3.7.3.2 Richness and Diversity

Family richness was higher in stream benthos communities than in lake benthos communities, and was somewhat variable among streams, ranging from 7.2 families/sample at Reference B OF to 17.6 families/sample at Dragon OF (Figure 3.7-6). The lowest richness was observed in the Goose area streams Gander IF, Pond 19 OF, Giraffe OF and Reference B OF.

Stream benthos communities had low to moderately high diversities, ranging from 0.19 at Pond 19 to 0.77 at Dragon OF on the Simpson's index. Spatial patterns in diversity followed those of richness, with lower richness and diversity at Gander IF, Pond 19 OF, Giraffe OF and Reference B OF, and highest richness and diversity at Dragon OF.



Notes: Error bars represent the standard error of the mean of the total density.
Community composition values represent the mean of replicates.
Density and composition data does not include nematodes, copepods or cladocerans.
Benthos samples were not collected from Echo OF, which was dry during sampling, or Llama OF where substrate size and water levels prevented sampling.

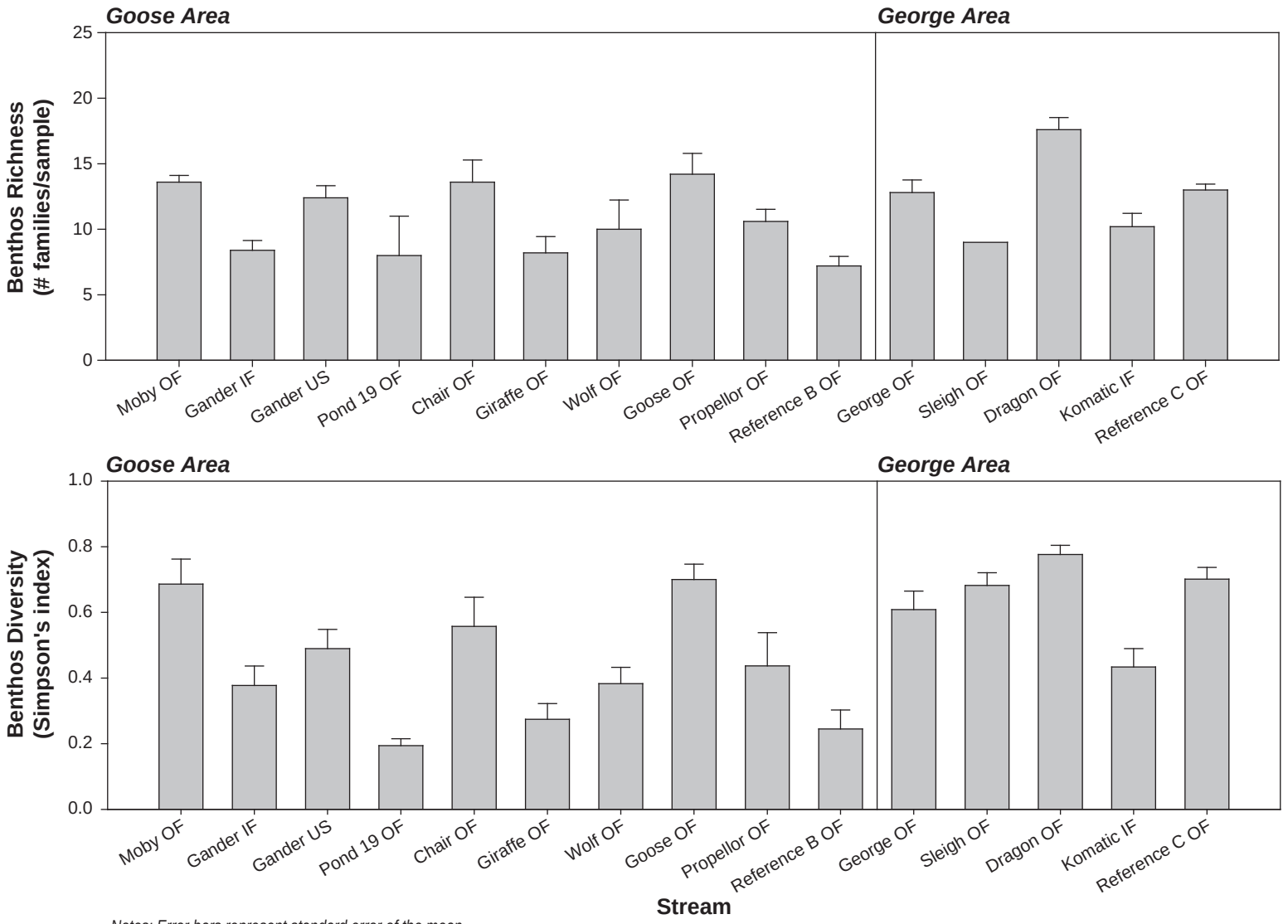
Figure 3.7-5

Sabina GOLD & SILVER CORP.

Benthos Density and Community Composition in Streams, Back River Project, 2012

Figure 3.7-5

Rescan™ Engineers & Scientists



Notes: Error bars represent standard error of the mean.
Diversity and richness data does not include nematodes, copepods, cladocerans or organisms not identified to the family level.
Benthos samples were not collected from Echo OF, which was dry during sampling, or Llama OF where boulders and low water levels prevented sampling.

Figure 3.7-6

Sabina GOLD & SILVER CORP.

Benthos Richness and Diversity in Streams, Back River Project, 2012

Figure 3.7-6

Rescan™ Engineers & Scientists

Table 3.7-3. Most Abundant Benthic Macroinvertebrate Genera in Streams, Back River Project, 2012

Stream	Most Abundant Stream Benthos Genera		
	Major Taxonomic Group	Genus	% Relative Abundance
Goose Area			
Moby OF	Acari	*Lebertia*	11.4
	Insecta - Diptera	*Thienemannimyia*	10.3
	Insecta - Diptera	*Tipula*	7.0
Gander IF	Insecta - Diptera	*Cladotanytarsus*	17.7
	Insecta - Diptera	*Polypedilum*	15.4
	Insecta - Diptera	*Stempellina*	12.4
Gander US	Insecta - Diptera	*Rheotanytarsus*	20.3
	Insecta - Diptera	*Euryhapsis*	18.2
	Insecta - Diptera	*Tvetenia*	15.5
Pond 19 OF	Insecta - Diptera	*Paratanytarsus*	25.3
	Insecta - Diptera	*Psectrocladius*	19.0
	Insecta - Diptera	*Zalutschia*	12.4
Chair OF	Insecta - Diptera	*Thienemannimyia*	20.7
	Insecta - Diptera	*Polypedilum*	19.8
	Acari	*Hygrobates*	8.9
Giraffe OF	Insecta - Diptera	*Paratanytarsus*	40.5
	Insecta - Diptera	*Psectrocladius*	12.0
	Insecta - Diptera	*Dicrotendipes*	8.4
Wolf OF	Insecta - Diptera	*Thienemannimyia*	14.6
	Insecta - Diptera	*Dicrotendipes*	13.0
	Insecta - Diptera	*Cricotopus*	8.3
Goose OF	Insecta - Diptera	*Cricotopus*	17.7
	Annelida	*Nais*	15.9
	Hydrozoa	*Hydra*	7.4
Propellor OF	Insecta - Diptera	*Cricotopus*	29.6
	Insecta - Diptera	*Zalutschia*	17.6
	Insecta - Diptera	*Paratanytarsus*	10.9
Reference B OF	Insecta - Diptera	*Procladius*	28.7
	Insecta - Diptera	*Psectrocladius*	20.0
	Insecta - Diptera	*Tanytarsus*	7.1
George Area			
George OF	Hydrozoa	*Hydra*	17.5
	Insecta - Diptera	*Cricotopus*	15.4
	Insecta - Diptera	*Thienemannimyia*	12.0
Sleigh OF	Acari	*Sperchon*	23.0
	Insecta - Diptera	*Euryhapsis*	18.3
	Insecta - Diptera	*Saetheria*	7.9
Dragon OF	Insecta - Diptera	*Thienemannimyia*	21.7
	Acari	*Sperchon*	13.7

(continued)

Table 3.7-3. Most Abundant Benthic Macroinvertebrate Genera in Streams, Back River Project, 2012 (completed)

Stream	Most Abundant Stream Benthos Genera		
	Major Taxonomic Group	Genus	% Relative Abundance
George Area *(cont'd)*			
	Insecta - Diptera	*Tipula*	9.7
Komatic IF	Insecta - Diptera	*Procladius*	17.0
	Insecta - Diptera	*Polypedilum*	16.5
	Insecta - Diptera	*Saetheria*	13.3
Reference C OF	Insecta - Diptera	*Paratanytarsus*	16.8
	Insecta - Diptera	*Thienemannimyia*	14.5
	Gastropoda	*Valvata*	12.4

Note: Nematodes, copepods, cladocerans and fish were not included in this table, individuals not identified to genus level were used only to calculate relative abundance.

4. Summary

4. Summary

The 2012 freshwater baseline program involved collecting information for the following: lake water quality and physical limnology (under-ice and open water), lake sediment quality, lake phytoplankton, lake zooplankton, lake benthos, stream water quality (freshet, summer and fall), stream sediment quality, stream periphyton, and stream benthos. The program included collecting samples from lakes and streams in areas that could potentially be influenced by the development of known deposits and proposed infrastructure. A reference lake and two reference streams, located well away from known deposits and proposed infrastructure, were also sampled.

A total of 20 lakes (24 sampling sites) and 16 streams (17 sampling sites) were sampled in the Goose and George areas in 2012. Lakes sampled in the Goose Property included Moby, Gander, Pond 19, Big, Rabbit, Fox, Echo, Rascal, Giraffe, Goose and Propellor. Lakes sampled in the George Property included Lower Long, Fold, George, Lytle, Occurrence, Sleigh, Dragon, Komatic and Reference C. Streams sampled in the Goose Property were Moby Outflow, Gander River, Pond 19 Outflow, Chair Watershed Outflow, Llama Watershed Outflow, Echo Watershed Outflow, Giraffe Watershed Outflow, Wolf Watershed Outflow, Goose Watershed Outflow, Propellor Watershed Outflow and Reference B Outflow. Streams sampled within the George Property were George Outflow, Sleigh Outflow, Dragon Outflow, Komatic Inflow and Reference C Outflow.

Lakes tended to be stratified in April and well mixed in August. Dissolved oxygen concentrations at bottom depths were below CCME minimum dissolved oxygen guidelines at most lakes sampled, with lakes in the George Property tending to be below guidelines at all depths in August. Lakes in the study area had slightly acidic to slightly basic pH, with Rabbit Lake and Rascal Lake in August being slightly below the CCME guideline of 6.5. Generally, lakes sampled had low hardness and conductivity. Reference Lake C in April and August and Dragon and Komatic lakes in April had higher hardness values and could be classified as moderately hard. Nutrients were generally low at all lake sampling sites, particularly bioavailable forms, and lake trophic status was usually ultra-oligotrophic to oligotrophic.

All lakes except Lower Long had naturally occurring waters that were higher than CCME guidelines in at least one sample for at least one of the following metals: total aluminum, total cadmium, total copper, total iron, total lead and total nickel. Average concentrations were naturally greater than CCME guidelines for at least one parameter out of aluminum, cadmium, copper, iron and lead at over two thirds of lakes. The soft waters meant lower hardness-dependent CCME guideline concentrations, which were in some cases lower than achievable analytical detection limits (e.g., for cadmium at Big Lake, Rabbit Lake and Propellor Lake). Goose Property lakes tended to have higher naturally occurring metal concentrations compared to George Property lakes.

Lake sediments had high concentrations of arsenic, cadmium, chromium, copper, and zinc that often were greater than their respective CCME ISQG. All lakes except Pond 19 had at least one sample greater than the CCME ISQGs for at least one metal, with most lakes having naturally elevated arsenic or copper. Over half of the sampled lakes had average lake sediment arsenic concentrations that were greater than CCME PELs, with the highest average concentrations 16.5 and 20.3 times the PEL (found at Fold and Komatic lakes, within the George Property).

Phytoplankton communities were made up of Chlorophyceae (green algae), Myxophyceae (cyanobacteria), Cryptophyceae (a class of flagellated algae), Bacillariophyceae (diatoms) and Chrysophyceae (golden algae) with compositions and densities varying between April and August

samples, and between lakes. Zooplankton communities were mainly composed of rotifers and crustaceans. Rotifers tended to be more dominant in Goose Property lakes, while crustaceans tended to be more dominant in George Property lakes. Benthic communities at all lake sites were dominated by dipterans (true flies) and bivalves (small to tiny clams from the family Sphaeriidae), and densities varied between lakes.

Echo Outflow in the Goose Property was dry during the August sampling, and many of the other streams in both the Goose Property and George Property had dry or underground sections. Streams in August had dissolved oxygen concentrations below 10.0 mg/L, with a third of the sampling sites below the CCME minimum dissolved oxygen guideline for the protection of freshwater aquatic life for early life stages (9.5 mg/L).

Streams and rivers in the study area had slightly acidic to slightly basic pH. The lowest pH values observed were outside of the CCME guideline range for freshwater aquatic health (pH range 6.5 to 9), at Chair Outflow in June (6.1), and Echo Outflow in June and Sept (6.0). Hardness, conductivity and total dissolved solids were low in most streams, although considerably higher in Llama OF and also Reference C Outflow during August and September (moderately hard). Nitrate, nitrite and ammonia concentrations were generally low, often near or below detection limits, with most sites reflecting ultra-oligotrophic to oligotrophic conditions.

All streams except Dragon Outflow and Reference C Outflow had naturally occurring waters that were greater than CCME guidelines in at least one sample for at least one of the following metals: total aluminum, total cadmium, total copper, total iron and total nickel. Average concentrations were greater than CCME guidelines for at least one metal parameter at most streams. Parameters where average stream concentrations were naturally greater than guidelines included aluminum (two streams), cadmium (most streams), copper (almost a third of streams), iron (one stream) and nickel (one stream).

Goose Property streams tended to have higher naturally occurring metal concentrations compared to George Property streams. The small Echo Outflow in the Goose Property had the greatest number of naturally elevated parameters (aluminum, cadmium and copper) with average aluminum concentrations 22 times higher and average cadmium concentrations 18 times higher than the CCME guidelines.

Stream sediments had metal concentrations that were similar or lower than in lake sediments, and in some cases were greater than the CCME ISQGs. Over half of the streams had at least one sediment sample that was naturally greater than the CCME ISQG for at least one of the following metals; arsenic, chromium and copper. Arsenic was the most commonly naturally elevated metal, with almost half of streams having average concentrations that were greater than ISQGs. Arsenic was the metal most naturally elevated in sediments, and concentrations were above the CCME PEL at Propellor Outflow, George Outflow and Dragon Outflow with the maximum concentration being 3.4 times the PEL.

Periphyton communities were dominated by cyanobacteria and diatoms, and densities varied between streams. Benthos communities were mainly composed of chironomid dipterans (nonbiting midges), and densities also varied between streams with highest densities at Pond 19 Outflow (Goose Property) and Sleigh Outflow (George Property).

A comprehensive summary table of results from all lakes sampled in 2012 is provided in Table 4-1, and a summary table of results from all streams sampled is provided in Table 4-2.

Table 4-1. Summary of 2012 Freshwater Baseline Results for Lakes

		Dissolved Oxygen	Water Quality			Sediment Quality	Primary producers	Aquatic Macroinvertebrates	
Lake	Summer Sampling Max Depth (m)	Seasons and Depths that Exceed CCME Guidelines*	General Description	Nutrient Status	CCME Guideline Exceedances*	CCME Guideline Exceedances*	Phytoplankton	Zooplankton	Benthos
Goose Area									
Moby	14.8	none	near neutral, soft, low TDS	ultraoligotrophic	Cd	nc	moderate chl a biomass, low densities, more than 60% chlorophytes	nc	nc
Gander	2.4	all life stages: Apr, all depths	near neutral, soft, low TDS	oligotrophic - mesotrophic	Cd, Cu	ISQG: As, Cr	euglenophytes present; highest richness	highest densities; vast majority rotifers; highest richness	high densities; high richness and diverstiy
Pond 19	1.5	none	slightly basic, soft, low TDS	ultraoligotrophic	Cu	PEL: As	nc	nc	low densities; vast majority dipteran; low richness and diversity
Big	5.0	all life stages: Apr, bottom depths	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	Cd	ISQG: As, Cu; PEL: As	moderate chl *a* biomass and densities, highest richness in Aug	rotifer dominated; high richness	high densities; over half dipteran; low richness; moderate diversity
Rabbit	3.6	none	slightly acidic, soft, low TDS	ultraoligotrophic	pH, Al, Cd and Cu	ISQG: As, Cu; PEL: As	low chl a biomass; almost 80% myxophyte (cyanobacteria)	moderate densities; crustacean dominated; moderate richness; high diversity	low densities; over half dipteran; high richness
Fox	5.8	early life stages: Apr, bottom depths	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	Cd and Pb	ISQG: As, Cu; PEL: As	low densities, only Goose area lake with significant chrysophyte component	highest copepodite densities; rotifer dominated; high richness	low densities; over half bivalves
Echo	0.4	none	near neutral, soft, low TDS	mesoeutrophic	Cu and Fe	ISQG: As, Cu	nc	nc	nc
Rascal	2.8	all life stages: Apr, all depths	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	pH, Al, Cd and Cu	ISQG: Cu	relatively high chl *a* biomass, low density, more than 90% cryptophytes, lowest richness and low diversity	nc	vast majority dipteran; moderate richness; low diversity
Giraffe North	3.7	none	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	Cd and Cu	ISQG: As, Cu	low chl *a* biomass, low densities, moderate richness and high diversity	nc	low densities; over half dipteran
Giraffe South	7.7	all life stages: Apr, bottom depths; Early life stages: Apr, bottom depths	near neutral, soft, low TDS	ultraoligotrophic	Cd and Cu	ISQG: As, Cu	low Apr biomass and densities, over 80% cryptophyte in Apr; greatest genera richness in Aug, high diversity	moderate densities; moderate richness and diversity	low densities; high diversity
Goose Neck	3.0	none	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	Cu	ISQG: As, Cu; PEL: As	low Apr densities; greatest genera richness in Aug; high diversity	moderate densities; high richness and diversity	high densities; vast majority dipteran
Goose Central	4.7	none	near neutral, soft, low TDS	ultraoligotrophic	-	ISQG: As, Cu	moderate chl *a* biomass; low Apr densities; high genera richness and diversity in Aug	moderate densities; high richness and diversity	high densities; over half dipteran; low richness; moderate diversity
Goose Tail	2.8	all life stages: Apr, mid to bottom depths; Early life stages: Apr, bottom depths	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	Cu	ISQG: none	low chl *a* biomass and densities; more than 80% cryptophytes; moderate diversity	nc	nc
Propellor	7.8	all life stages: Apr, mid to bottom depths; Early life stages: Apr, bottom depths	near neutral, soft, low TDS	ultraoligotrophic	Cd	ISQG: Cu	low chl a biomass and density; dominated by myxophyte (cyanobacteria)s; low richness and diversity	nc	high densities; vast majority dipteran; low diverstiy

(continued)

Table 4-1. Summary of 2012 Freshwater Baseline Results for Lakes (completed)

Lake	Summer Sampling Max Depth (m)	Dissolved Oxygen: Seasons and Depths that Exceed CCME Guidelines*	Water Quality: General Description	Water Quality: Nutrient Status	Water Quality: CCME Guideline Exceedances*	Sediment Quality: CCME Guideline Exceedances*	Primary producers: Phytoplankton	Aquatic Macroinvertebrates: Zooplankton	Aquatic Macroinvertebrates: Benthos
George Area									
Lower Long	5.2	all life stages: Apr, mid to bottom depths, Aug, all depths; Early life stages: Apr, bottom depths	slightly basic, soft, low TDS	ultraoligotrophic	-	ISQG: As, Cr, Cu; PEL: As	high chl *a* biomass; moderate densities; more than 5% chrysophytes; moderate richness and diversity	moderate densities; high richness and moderately high diversity	low densities; low richness
Fold	9.8	all life stages: Aug, all depths	slightly basic, soft, low TDS	ultraoligotrophic - oligotrophic	-	ISQG: As, Cr, Cu; PEL: As	higher Apr chl *a* biomass; high Aug densities; more than 5% chrysophytes; low Aug diversity	highest densities; highest copepodite densities; high richness and diversity	moderate densities, richness and diversity
George Central	14.5	all life stages: Aug, all depths	near neutral, soft, low TDS	ultraoligotrophic	-	ISQG: As; PEL: As	low chl a biomass; high Aug densities; more than 90% myxophyte (cyanobacteria)s in Aug; more than 5% chrysophytes; low diversity	crustacean dominated; lowest richness; very low diversity	over half bivalves; moderately high richness and diversity
George South	3.0	none	slightly acidic, soft, low TDS	ultraoligotrophic	-	ISQG: As, Cr; PEL: As	nc	nc	over half bivalves; moderate high richness and diversity
Lytle	1.4	all life stages: Aug, all depths	near neutral, soft, low TDS	ultraoligotrophic	Cu	ISQG: As, Cr, Cu, Zn; PEL: As	low chl *a* biomass; more than 5% chrysophytes; lowest genera richness	lowest densities; crustacean dominated; low richness and diversity	highest densities; vast majority dipteran; lowest diversity
Occurrence	1.5	all life stages: Aug, all depths	slightly basic, soft, low TDS	ultraoligotrophic	Cu	ISQG: As, Cr, Cu, Zn; PEL: AS, Cr	low chl *a* biomass; more than 5% chrysophytes; lowest genera richness	lowest densities; crustacean dominated; low richness and diversity	low densities; highest diversity
Sleigh	1.5	all life stages: Aug, all depths	near neutral, soft, low TDS	ultraoligotrophic	Cu	ISQG: As	low chl *a* biomass; more than 5% chrysophytes	lowest densities; crustacean dominated; low richness and diversity	low densities; vast majority dipteran; low diversity
Dragon	3.4	all life stages: Apr, bottom depths, Aug, all depths; Early life stages: Apr, bottom depths	near neutral, almost moderately hard in Apr, higher TDS in Apr	ultraoligotrophic	-	ISQG: As, Cr, Cu, Zn; PEL: As	higher Apr chl *a* biomass; more than 5% chrysophytes	crustacean dominated; high richness	moderate densities, richness and diversity
Komatic	7.0	all life stages: Apr, bottom depths, Aug, all depths; Early life stages: Apr, bottom depths	slightly basic, moderately hard in Apr, higher TDS in Apr	ultraoligotrophic - oligotrophic	Cu	ISQG: As, Cd, Cr, Cu, Zn; PEL: As	high Apr chl a biomass; high Aug densities; more than 50% bacillariophyte (diatoms) in Apr; more than 90% myxophyte (cyanobacteria)s in Aug; more than 5% chrysophytes; low Aug diversity	highest copepodite densities; crustacean dominated; high richness and diversity	high densities; vast majority dipteran
Reference C	35.0	all life stages: Aug, all depths above thermocline and most depths below thermocline	slightly basic, moderately hard, higher TDS	ultraoligotrophic - oligotrophic	-	ISQG: As, Cu	moderate chl a biomass and density; more than 90% myxophyte (cyanobacteria)s in Apr; very low diversity in Apr	moderate densities; crustacean dominated; moderate richness and diversity	lowest densities; over half bivalves; lowest richness

nc = not collected

** Parameters which, on average, exceeded CCME guidelines as calculated in tables.*

Half the detection limit was substituted for values that were below the detection limit for the calculation of exceedance factors.

Underlined values show sites where all samples that exceeded a particular parameters guideline were below the detection limit.

Table 4-2. Summary of 2012 Freshwater Baseline Results for Streams

			Dissolved Oxygen	Water Quality			Sediment Quality	Primary Producers	Aquatic Macroinvertebrates
Stream	General Description	Substrate	Seasons that Exceed CCME Guidelines	General Description	Nutrient Status	CCME Guideline Exceedances*	Parameters that Exceed CCME Guidelines	Periphyton	Benthos
Goose Area									
Moby OF	Small stream running through flood plain.	Mainly silt, few small stones	-	Slightly acidic, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd, Cu, Ni	-	dominated by myxophyceae (cyanobacteria)	high richness and diverstiy
Gander IF	Wide and deep, slow moving stream.	Mainly silt, few small stones	-	Near neutral, soft, low TDS	Oligotrophic	Cd	-	dominated by myxophyceae (cyanobacteria); highest richness	over 80% chironomids; over 10% bivalves; lowest richness; low diversity
Gander US	Medium stream with medium flow over cobble to boulders.	Mainly cobbles, some large stones, boulders	-	Near neutral, soft, low TDS	Oligotrophic	Cd	ISQG: As	low chl a biomass; dominated by myxophyceae (cyanobacteria); highest richness	high richness; moderate diversity
Pond 19 OF	Very small stream, nearly dry during summer sampling.	Mainly silt, few small stones	Early life stages: Aug	Near neutral, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd, Cu	-	low chl *a* biomass; dominated by bacillariophyceae	high and variable densities; over 80% chironomids; lowest richness and diversity
Chair OF	Small stream through floodplain.	Mainly silt, few small stones	-	Variable pH, soft, low TDS	Oligotrophic - Mesotrophic	pH, Al	ISQG: As, Cr	high chl *a* biomass; more than 20% chlorophyceae; high diversity	high richness; moderate diversity
Llama OF	Medium stream through large boulder field.	Cobbles, large stones, boulders	Early life stages: Aug, Sept; All life stages: Aug, Sept	Slighty acidic, soft (June) to hard (Sept) water, highest TDS particularly high in Sept	Ultraoligotrophic	Cd	nc	low chl *a* biomass; more than 20% chlorophyceae; lowest richness and diversity	nc
Echo OF	Very small stream through flood plain, dry during summer sampling.	Mainly silt, few small stones	-	Slightly acidic, soft, low TDS	Ultraoligotrophic	pH, Al, Cd, Cu	nc	nc	nc
Giraffe OF	Short, medium-sized stream, cobbles.	Cobbles, large stones, boulders	Early life stages: Aug	Slightly acidic, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd	-	highest and most variable densities; dominated by myxophyceae (cyanobacteria); high diversity	lowest densities; over 80% chironomids; lowest richness; low diversity
Wolf OF	Small stream running through flood plain.	Mainly silt, few small stones	-	Near neutral, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd	-	dominated by myxophyceae (cyanobacteria)	lowest densities; over 80% chironomids
Goose OF	Short, medium-sized stream, cobbles.	Cobbles, large stones, boulders	-	Slightly acidic, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd	-	dominated by myxophyceae (cyanobacteria); high diversity	high richness and diversity
Propellor OF	Large stream draining largest lake in the area. Runs through boulder field.	Large stones, boulders	Early life stages: Aug	Slightly acidic, soft, low TDS	Ultraoligotrophic - Oligotrophic	<u>Cd</u>	ISQG: As, Cr; PEL: As	dominated by myxophyceae (cyanobacteria); high diversity	over 80% chironomids; moderate richness and diversity
Reference B OF	Small stream through floodplain.	Mainly silt, few small stones	Early life stages: Aug	Near neutral, soft, low TDS	Oligotrophic - Mesotrophic	Cd, Fe	-	dominated by myxophyceae (cyanobacteria); more than 20% chlorophyceae; high richness; high diversity	lowest densities; over 80% chironomids; lowest richness; low diversity
George Area									
George OF	Short, small-sized stream, cobbles. Split into two channels.	Cobbles, gravel, sand	-	Near neutral, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd	ISQG: As, Cu; PEL: As	low densities; high diversity	moderately high richness and diversity
Sleigh OF	Small stream running through flood plain.	Cobbles, silt	Early life stages: Aug	Near neutral, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd, Cu	ISQG: As, Cr	low densities; low richness; high diversity	high densities; moderate richness; high diversity
Dragon OF	Small stream running through flood plain.	Cobbles, silt	Early life stages: Aug	Slightly basic, soft, low TDS	Ultraoligotrophic - Oligotrophic	-	ISQG: As, Cr; PEL: As	high chl biomass; low densities; high richness; high diversity	highest richness and diversity
Komatic IF	Medium stream meandering through grass plain. No rocks present.	Mainly silt, no stones present	-	Slightly basic, soft, low TDS	Oligotrophic - Mesotrophic	Cu	ISQG: As, Cr	low densities; moderate richness; high diversity	moderate richness and diversity
Reference C OF	Short, small-sized stream, cobbles. Nearly dry during summer. Split into two channels.	Cobbles, gravel, silt	-	Slightly basic, soft to moderately hard, low TDS	Ultraoligotrophic - Oligotrophic	-	-	high densities; dominated by myxophyceae (cyanobacteria); high diversity	over 10% gastropods; moderate richness; high diversity

nc = not collected

** Parameters which, on average, exceeded CCME guidelines as calculated in tables.*

Half the detection limit was substituted for values that were below the detection limit for the calculation of exceedance factors.

Underlined values show sites where all samples that exceeded a particular parameters guideline were below the detection limit.

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Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.

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Appendix 3.1-1

Under-ice Temperature and Dissolved Oxygen Profiles, Back River Project, April 2012

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Appendix 3.1-1. Under-ice Temperature and Dissolved Oxygen Profiles, Back River Project, April 2012

Moby Lake			
10-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1 1.5	Ice thickness = 1.8 m		
2	1.1	16.59	117.1
2.5	1.8	15.67	112.6
Bottom depth = 3.4 m			

Gander Lake			
10-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.6 m		
1.6	1.1	3.62	25.6
2	1.9	1.68	12.1
Bottom depth = 2.3 m			

Pond 19			
10-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5	Ice thickness = 0.6 m		
Ice to bottom			

Big Lake			
10-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1 1.5	Ice thickness = 1.7 m		
2	1.1	15.72	110.8
2.5	2.2	12.35	90.0
3	3.1	3.67	27.3
3.5	3.6	0.82	6.1
4	3.8	0.16	1.2
4.5	3.9	0.08	0.8
Bottom depth = 4.5 m			

Rabbit Lake			
10-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.2 m		
Ice to bottom			

Fox Lake			
10-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.4 m		
1.4	0	15.70	106.4
1.9	0	15.90	108.4
2.4	0.8	15.40	107.6
2.9	1.8	14.20	101.2
3.4	2.8	8.10	58.4
3.9	3.3	7.20	53.4
Bottom depth = 4.4 m			

Echo Lake			
12-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5	Ice thickness = 0.7 m		
Ice to bottom			

Rascal Lake			
11-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.5 m		
1.5	0.1	9.22	63.2
2	1	8.90	62.6
Bottom depth = 2.4 m			

Giraffe Lake North			
11-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.7 m		
1.7	1	17.17	121.2
2	1.3	17.02	121.0
2.5	2.2	15.29	111.1
3	2.9	10.15	75.3
Bottom depth = 3.9 m			

Giraffe Lake South			
11-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.6 m		
1.6	1.7	13.66	97.8
2	1.8	13.71	98.5
2.5	2.7	10.99	81.2
3	3	9.61	71.3
3.5	3.5	7.26	54.6
4	3.6	5.91	44.6
4.5	3.6	4.78	36.1
5	3.7	0.78	6.0
Bottom depth = 5.4 m			

Goose Lake Neck			
11-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.5 m		
1.5	0.3	16.14	111.3
2	0.6	16.11	112.0
2.5	1.2	14.50	102.6
3	1.4	13.65	97.0
Bottom depth = 3.2 m			

Goose Lake Central			
11-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.6 m		
1.6	0	13.26	90.7
2.1	0.5	15.65	108.8
2.6	1.1	15.82	111.6
3.1	1.6	15.14	108.2
3.6	1.9	14.60	105.0
4.1	2.3	11.37	82.9
Bottom depth = 4.3 m			

Goose Lake Tail			
11-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.7 m		
1.6	0.6	13.88	96.5
2	1	13.06	91.9
2.5	1.7	13.14	94.2
3	2.2	11.95	81.8
3.5	2.6	9.25	67.9
4	2.8	8.08	59.6
4.5	3	8.01	59.5
5	3.1	6.94	51.7
5.5	3.2	3.33	47.4
6	3.4	3.19	41.5
6.5	3.5	2.45	18.4
7	3.6	1.78	13.4
7.5	3.6	1.68	12.7
Bottom depth = 8.0 m			

Propellor Lake			
12-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.5 m		
1.5	1.2	14.74	102.3
2	1.5	13.09	93.3
2.5	1.6	12.55	89.7
3	1.8	12.08	86.5
3.5	1.9	11.44	82.5
4	2	11.30	81.7
4.5	2.2	11.25	81.8
5	2.4	9.66	70.5
5.5	2.6	6.21	45.6
6	2.8	3.93	29
6.5	2.9	0.31	2.2
7	2.9	0.23	1.7
Bottom depth = 7.3 m			

Lower Long Lake			
13-Apr-12			
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1 1.5	Ice thickness = 2.0 m		
2	1.2	16.87	119.3
2.5	2.1	15.96	115.7
3	2.3	15.15	110.4
3.5	2.3	16.13	117.5
4	2.3	16.43	119.8
4.5	2.5	7.3	53.5
Bottom depth = 5.3 m			

Appendix 3.1-1. Under-ice Temperature and Dissolved Oxygen Profiles, Back River Project, April 2012

	Fold Lake		
	15-Apr-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.7 m		
1.7	0.3	16.08	110.8
2.2	1.3	15.50	109.9
2.7	1.9	14.77	106.4
3.2	2.1	14.35	104.1
3.7	2.1	13.66	99.1
4.2	2.2	13.95	101.4
4.7	2.3	14.68	107
5.2	2.3	13.64	99.5
5.7	2.3	12.33	89.9
6.2	2.9	12.3	90.1
6.7	2.5	12.78	93.2
7.2	2.5	13.36	98
7.7	2.5	13.58	99.5
8.2	2.6	13.2	97
8.7	2.6	11.44	84.1
	Bottom depth = 9.8 m		

	George Lake Central		
	13-Apr-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1 1.5	Ice thickness = 1.9 m		
1.9	0.5	15.35	106.4
2.4	1.9	14.04	101.5
2.9	2.9	11.74	87.2
3.4	3.3	12.43	93.2
3.9	3.3	12.88	96.4
4.4	3.4	11.92	89.4
4.9	3.3	12.25	92
5.4	3.3	12.11	90.6
5.9	3.4	11.96	89.8
6.4	3.4	11.61	87.2
6.9	3.4	11.15	83.7
7.4	3.4	10.61	79.6
7.9	3.5	10.1	76
8.4	3.5	13.47	100.9
	Bottom depth = 9.2 m		

	George Lake South		
	13-Apr-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.4 m		
1.4	0.2	15.22	104.7
	Bottom depth = 1.8 m		

	Lytle Lake		
	15-Apr-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1 1.5	Ice thickness = ~ 1.2 m		
	Ice to bottom		

	Occurrence Lake		
	15-Apr-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1 1.5	Ice thickness = 1.3 m		
	Ice to bottom		

	Sleigh Lake		
	15-Apr-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1 1.5	Ice thickness = 1.1 m		
	Ice to bottom		

	Dragon Lake		
	15-Apr-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1 1.5	Ice thickness = 1.9 m		
2	1.9	13.03	94.0
2.5	3.7	12.70	96.1
3	4.0	12.46	95.0
3.5	4.0	3.26	25.0
	Bottom depth = 3.9 m		

	Komatic Lake		
	13-Apr-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1 1.5	Ice thickness = 1.9 m		
2	1.7	14.71	105.7
2.5	2.8	13.74	101.5
3	2.9	13.24	98.3
3.5	3	13.12	97.7
4	3.1	11.79	87.8
4.5	3.1	11.02	82.1
5	3.2	10.03	74.9
5.5	3.2	8.65	64.6
6	3.6	3.00	22.7
	Bottom depth = 7.1 m		

	Reference C Lake		
	13-Apr-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0 0.5 1	Ice thickness = 1.4 m		
1.5	0.6	14.52	101.9
2	0.5	14.48	100.4
2.5	0.6	14.40	100.2
3	0.7	14.29	99.7
3.5	0.7	14.21	99.3
4	0.8	14.15	99.0
4.5	0.9	14.08	98.7
5	0.9	14.02	98.4
5.5	1.0	13.92	97.9
6	1.0	13.87	97.5
6.5	1.0	13.84	97.3
7	1.1	13.65	96.2
	Bottom depth = 7.5 m		

Appendix 3.1-2

Open-water Temperature and Dissolved Oxygen Profiles, Back River Project, August 2012

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Appendix 3.1-2. Open Water Temperature and Dissolved Oxygen Profiles, Back River Project, August 2012

Moby Lake			
	22-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	12.1	9.89	92.0
0.5	12.1	9.89	92.0
1	12.1	9.88	91.9
1.5	12.2	9.85	91.8
2	12.2	9.85	91.8
2.5	12.2	9.83	91.6
3	12.2	9.83	91.6
3.5	12.2	9.82	91.5
4	12.2	9.81	91.5
4.5	12.2	9.81	91.4
5	12.2	9.79	91.3
5.5	12.2	9.79	91.3
6	12.2	9.80	91.1
6.5	12.1	9.79	91.0
7	12.1	9.78	91.0
7.5	12.1	9.77	90.9
8	12.1	9.76	90.8
8.5	12.1	9.76	90.8
9	12.1	9.75	90.7
9.5	12.1	9.75	90.6
10	12.1	9.74	90.6
10.5	12.1	9.71	90.3
11	12.1	9.72	90.2
11.5	12.1	9.72	90.4
12	12.1	9.68	90.0
12.5	12.1	9.69	89.9
13	12.0	9.68	89.8
13.5	12.0	9.67	89.7
14	12.0	9.66	89.6
14.5	12.0	9.63	89.4
Bottom depth = 14.8 m			

Gander Lake			
	18-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	10.6	10.22	91.8
0.5	10.6	10.22	91.8
1	10.6	10.20	91.7
1.5	10.5	10.22	91.6
2	10.5	10.20	91.7
Bottom depth = 2.4 m			

Pond 19			
	21-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	9.7	9.95	87.5
0.5	9.6	9.97	87.7
1	9.6	9.99	87.6
Bottom depth = 1.4 m			

Big Lake			
	16-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	10.8	9.95	90.0
0.5	10.9	9.91	89.7
1	11.0	9.86	89.4
1.5	11.0	9.85	89.3
2	11.0	9.85	89.3
2.5	11.0	9.83	89.2
3	11.0	9.82	89.0
3.5	10.9	9.83	88.9
4	10.9	9.82	88.8
4.5	10.8	9.82	88.6
Bottom depth = 5.0 m			

Rabbit Lake			
	15-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	10.2	10.02	89.5
0.5	10.3	10.01	89.3
1	10.3	10.01	89.3
1.5	10.4	9.97	89.2
2	10.4	9.95	89.0
2.5	10.4	9.94	88.9
3	10.5	9.92	88.9
3.5	10.5	9.92	89.0
Bottom depth = 3.6 m			

Fox Lake			
	20-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	12.3	9.88	92.3
0.5	12.3	9.88	92.3
1	12.3	9.88	92.3
1.5	12.3	9.88	92.3
2	12.2	9.88	92.3
2.5	12.2	9.89	92.2
3	12.2	9.88	92.1
3.5	12.2	9.88	92.1
4	12.2	9.87	92.0
4.5	12.2	9.87	92.0
5	12.2	9.86	91.9
5.5	12.2	9.83	91.7
Bottom depth = 5.8 m			

Echo Lake			
	17-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	10.4	11.10	99.3
Bottom depth = 0.35 m			

Rascal Lake			
	15-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	10.3	10.16	90.8
0.5	10.4	10.12	90.4
1	10.5	10.09	90.5
1.5	10.5	10.08	90.4
2	10.5	10.08	90.3
2.5	10.5	10.07	90.3
Bottom depth = 2.8 m			

Giraffe Lake North			
	19-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	12.6	9.96	93.7
0.5	12.6	9.96	93.7
1	12.6	9.98	93.6
1.5	12.5	9.97	93.5
2	12.5	9.96	93.5
2.5	12.5	9.95	93.4
3	12.5	9.94	93.3
3.5	12.5	9.94	93.3
Bottom depth = 3.7 m			

Giraffe Lake South			
	19-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	11.9	9.96	92.2
0.5	11.9	9.97	92.3
1	11.9	9.97	92.3
1.5	11.9	9.97	92.3
2	11.9	9.97	92.3
2.5	11.9	9.96	92.2
3	11.8	9.98	92.2
3.5	11.8	9.97	92.1
4	11.8	9.97	92.0
4.5	11.8	9.96	92.0
5	11.8	9.93	91.7
5.5	11.5	9.95	91.1
6	11.3	9.96	90.9
6.5	11.3	9.98	91.0
7	11.2	9.94	90.6
Bottom depth = 7.3 m			

Goose Lake Neck			
	14-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	12.8	9.66	91.3
0.5	12.8	9.66	91.3
1	12.8	9.65	91.2
1.5	12.8	9.64	91.1
2	12.8	9.64	91.1
2.5	12.8	9.64	91.0
Bottom depth = 3.0 m			

Goose Lake Central			
	17-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	11.4	9.83	90.0
0.5	11.4	9.82	89.9
1	11.4	9.82	89.9
1.5	11.4	9.81	89.8
2	11.4	9.81	89.7
2.5	11.4	9.80	89.7
3	11.4	9.79	89.6
3.5	11.5	9.76	89.6
4	11.5	9.75	89.5
Bottom depth = 4.5 m			

Goose Lake Tail			
	18-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	11.2	10.26	93.3
0.5	11.1	10.26	93.2
1	11.1	10.25	93.2
1.5	11.1	10.24	93.1
2	11.0	10.27	93.1
2.5	11.0	10.27	93.1
Bottom depth = 2.8 m			

Propellor Lake			
	21-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	12.7	9.81	92.2
0.5	12.6	9.80	92.2
1	12.6	9.80	92.2
1.5	12.6	9.79	92.1
2	12.6	9.78	92.0
2.5	12.5	9.79	91.9
3	12.5	9.78	91.8
3.5	12.5	9.77	91.7
4	12.5	9.76	91.6
4.5	12.5	9.75	91.5
5	12.4	9.76	91.4
5.5	12.4	9.75	91.3
6	12.4	9.74	91.2
6.5	12.4	9.74	91.2
7	12.4	9.73	91.1
Bottom depth = 7.4 m			

Appendix 3.1-2. Open Water Temperature and Dissolved Oxygen Profiles, Back River Project, August 2012

Lower Long Lake			
	21-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	11.5	8.32	76.3
0.5	11.5	8.32	76.3
1	11.4	8.33	76.3
1.5	11.4	8.33	76.2
2	11.4	8.32	76.1
2.5	11.4	8.31	76.1
3	11.4	8.30	76.0
3.5	11.4	8.28	75.8
4	11.4	8.27	75.7
Bottom depth = 4.1 m			

Fold Lake			
	19-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	11.7	8.42	77.5
0.5	11.7	8.41	77.5
1	11.7	8.41	77.5
1.5	11.7	8.41	77.5
2	11.7	8.40	77.4
2.5	11.7	8.39	77.4
3	11.6	8.40	77.3
3.5	11.6	8.39	77.3
4	11.6	8.40	77.2
4.5	11.6	8.39	77.1
5	11.6	8.38	77.1
5.5	11.6	8.38	77.0
6	11.6	8.37	77.0
6.5	11.6	8.35	76.8
7	11.5	8.34	76.5
7.5	11.5	8.34	76.5
8	11.5	8.33	76.4
8.5	11.5	8.32	76.3
9	11.5	8.31	76.3
9.5	11.5	8.30	76.1
10	11.5	8.29	76.1
10.5	11.5	8.29	76.1
11	11.5	8.29	76.0
11.5	11.5	8.26	75.8
Bottom depth ~ 12 m			

George Lake Central			
	18-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	11.1	8.38	76.1
0.5	11.1	8.37	76.1
1	11.1	8.35	76.1
1.5	11.1	8.35	76.0
2	11.1	8.33	75.9
2.5	11.1	8.35	75.9
3	11.1	8.34	75.8
3.5	11.1	8.34	75.8
4	11.1	8.33	75.7
4.5	11.1	8.33	75.7
5	11.1	8.32	75.6
5.5	11.1	8.32	75.6
6	11.1	8.31	75.6
6.5	11.1	8.31	75.5
7	11.1	8.30	75.4
7.5	11.1	8.30	75.4
8	11.1	8.29	75.4
8.5	11.1	8.29	75.3
9	11.1	8.28	75.3
9.5	11.1	8.28	75.2
10	11.1	8.27	75.2
10.5	11.1	8.27	75.1
11	11.1	8.27	75.1
11.5	11.1	8.26	75.1
12	11.1	8.26	75.1
12.5	11.0	8.27	75.0
13	11.0	8.27	75.0
13.5	10.9	8.30	75.1
14	10.9	8.29	75.0
14.5	10.9	8.30	75.1
Bottom depth = 14.5 m			

Lytle Lake			
	23-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	10.7	8.55	77.0
0.5	10.7	8.55	77.0
1	10.7	8.55	77.0
Bottom depth = 1.4 m			

Occurrence Lake			
	21-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	11.7	8.59	79.1
0.5	11.7	8.60	79.2
1	11.6	8.61	79.1
1.4	11.6	8.62	79.2
Bottom depth = 1.4 m			

Sleigh Lake			
	22-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	11.0	8.78	79.6
0.5	11.1	8.75	79.6
1	11.1	8.76	79.6
Bottom depth = 1.2 m			

Dragon Lake			
	20-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	11.4	8.48	77.6
0.5	11.5	8.46	77.6
1	11.5	8.46	77.6
1.5	11.5	8.46	77.6
2	11.5	8.45	77.5
2.5	11.5	8.44	77.4
3	11.5	8.44	77.4
Bottom depth = 3.4 m			

Komatic Lake			
	20-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.1	11.4	8.44	77.4
0.5	11.4	8.46	77.4
1	11.4	8.45	77.3
1.5	11.4	8.45	77.3
2	11.4	8.44	77.2
2.5	11.4	8.43	77.2
3	11.4	8.42	77.1
3.5	11.3	8.43	77.0
4	11.3	8.42	76.9
4.5	11.3	8.41	76.8
5	11.3	8.40	76.7
5.5	11.2	8.40	76.7
6	11.2	8.42	76.7
6.5	11.2	8.41	76.6
Bottom depth = 7.0 m			

Reference C Lake			
	22-Aug-12		
Depth (m)	Temp (˚C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0	11.4	8.59	78.6
0.5	11.4	8.59	78.6
1	11.4	8.59	78.6
1.5	11.4	8.59	78.6
2	11.5	8.55	78.4
2.5	11.5	8.55	78.4
3	11.5	8.54	78.3
3.5	11.5	8.54	78.3
4	11.5	8.53	78.2
4.5	11.5	8.52	78.2
5	11.5	8.52	78.1
5.5	11.5	8.51	78.1
6	11.5	8.50	78.0
6.5	11.5	8.50	77.9
7	11.5	8.49	77.9
7.5	11.5	8.49	77.9
8	11.4	8.50	77.8
8.5	11.4	8.50	77.8
9	11.4	8.49	77.7
9.5	11.4	8.48	77.6
10	11.4	8.47	77.5
11	11.4	8.45	77.3
12	11.3	8.42	76.9
13	11.3	8.39	76.7
14	11.2	8.40	76.5
15	11.1	8.41	76.4
16	11.1	8.40	76.3
17	11	8.41	76.2
18	10.7	8.50	76.5
19	8.7	9.22	78.9
20	7.5	9.53	79.4
21	6.8	9.58	78.3
22	6.6	9.52	77.6
23	6.4	9.48	77.0
24	6.4	9.40	76.3
25	6.3	9.33	75.6
26	6.3	9.27	75.1
27	6.3	9.18	74.4
28	6.2	9.14	73.8
29	6.2	9.01	73.0
30	6.2	8.94	72.3
31	6.2	8.91	72.0
32	6.1	8.87	71.4
33	6.1	8.80	71.0
34	6.1	8.75	70.5
Bottom depth = 35 m			

Appendix 3.2-1

Lake Water Quality Analytical Results, Back River Project, 2012

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Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Moby Lake	Gander Lake	Big Lake	Big Lake	Fox Lake	Fox Lake	Rascal Lake	Giraffe Lake North	Giraffe Lake North	Giraffe Lake South	Giraffe Lake South	Goose Lake Neck	Goose Lake Central	Goose Lake Central
Replicate				1	1	1	2	1	2	1	1	2	1	1	1	1	2
Duplicate?			Realised	-	-	-	duplicate	-	duplicate	-	-	duplicate	-	-	-	-	duplicate
Depth (m)		CCME Guideline	Detection	1	1	1	1	1	1	0	1	1	1	2	1	1	1
Date Sampled		for the Protection	Limit	10-Apr-12	10-Apr-12	10-Apr-12	10-Apr-12	10-Apr-12	10-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12
ALS Sample ID	Units	of Freshwater Aquatic Life[a]	(RDL)	L1133356-5	L1133356-6	L1133356-3	L1133356-10	L1133356-9	L1133356-4	L1133911-11	L1133911-7	L1133911-10	L1133911-8	L1133911-9	L1133911-3	L1133911-1	L1133911-2
Physical Tests																	
Conductivity	µS/cm		2.0	64.9	83.4	34.0	35.6	50.1	47.6	92.9	72.6	73.1	67.5	70.6	68.9	65.7	61.8
Hardness (as $CaCO_3$)	mg/L		0.50	24.9	34.3	12.7	12.5	21.4	20.6	36.6	27.7	27.5	25.5	24.6	25.2	22.4	22.1
pH	pH	6.5-9.0	0.10	6.80	6.88	6.83	7.68	7.10	7.13	7.94	8.07	8.11	8.09	8.10	8.06	6.82	8.05
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	4.8	16.0	7.1	6.7	12.6	12.4	23.2	10.8	10.6	10.2	10.4	7.3	7.4	6.6
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0 - 2.0	4.8	16.0	7.1	6.7	12.6	12.4	23.2	10.8	10.6	10.2	10.4	7.3	7.4	6.6
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	43	64	29	30	38	36	70	54	50	48	50	46	48	45
Turbidity	NTU	dependent on background levels	0.10	0.25	1.34	0.59	0.37	1.21	0.26	0.72	0.24	0.29	0.36	0.23	0.51	0.31	0.29
Nutrients																	
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	0.0254	0.0259	0.0257	0.0220	0.0396	0.0384	0.0429	0.0289	0.0292	0.0278	0.0272	0.0184	0.0205	0.0220
Nitrate (as N)	mg/L	2.935[b]	0.0050	0.0142	0.311	0.0176	0.0178	0.0066	0.0065	0.0289	0.0179	0.0170	0.0159	0.0195	0.0166	0.0109	0.0089
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	<0.050	0.171	<0.050	<0.050	0.143	0.104	0.506	0.261	0.274	0.225	0.228	0.249	0.266	0.245
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0037	0.0101	0.0042	0.0054	0.0043	0.0038	0.0059	0.0041	0.0030	0.0031	0.0039	0.0051	0.0032	0.0033
Anions																	
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	0.59	1.27	0.93	0.91	1.02	0.88	1.62	1.28	1.27	1.17	1.25	8.87	8.44	7.98
Fluoride (F)	mg/L	0.12[b]	0.02	0.043	0.044	0.024	0.024	0.033	0.031	0.036	0.036	0.036	0.031	0.033	0.026	0.028	0.026
Sulfate (SO_4)	mg/L		0.5	22.7	19.9	7.27	7.28	9.36	8.82	17.9	19.5	19.4	17.8	18.6	9.11	8.93	8.53
Cyanides																	
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	0.0013	<0.0010	<0.0010	0.0012	<0.0010	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon																	
Total Organic Carbon	mg/L		0.50	3.57	7.12	4.47	4.45	4.90	4.68	9.77	6.01	6.45	5.68	5.74	5.55	4.87	4.85
Total Metals																	
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0157	0.0304	0.0191	0.0170	0.0072	0.0065	0.0248	0.0298	0.0300	0.0325	0.0273	0.0703	0.0237	0.0259
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000295	0.000711	0.000463	0.000440	0.000359	0.000350	0.000468	0.000304	0.000285	0.000304	0.000277	0.000288	0.000272	0.000243
Barium (Ba)	mg/L		0.000050	0.00886	0.0175	0.00553	0.00570	0.00629	0.00527	0.0197	0.00927	0.00952	0.00935	0.00908	0.0131	0.0106	0.0105
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	0.0079	0.0078	0.0067	0.0071	0.0067	0.0070	0.0073	0.0071	0.0064	0.0066	0.0065	0.0060	0.0066	0.0059	0.0064
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	0.000044	0.000033	<0.000010	<0.000010	<0.000010	<0.000010	0.000010	0.000016	0.000016	0.000013	0.000014	0.000012	0.000011	<0.000010
Calcium (Ca)	mg/L		0.020	5.39	7.72	2.64	2.66	4.61	4.53	7.58	5.14	5.23	4.99	4.85	5.86	5.27	5.21
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00017	0.00045	0.00023	0.00029	0.00022	0.00017	0.00038	0.00027	0.00029	0.00031	0.00024	0.00028	0.00021	0.00020
Cobalt (Co)	mg/L		0.00010	0.00355	0.00506	0.00072	0.00130	<0.00010	<0.00010	0.00037	0.00068	0.00069	0.00079	0.00076	0.00031	0.00029	0.00031
Copper (Cu)	mg/L	≥0.002[e]	0.00050	0.00255	0.00296	0.00203	0.00180	0.00191	0.00168	0.00298	0.00382	0.00388	0.00367	0.00334	0.00267	0.00230	0.00229
Iron (Fe)	mg/L	0.3	0.010	0.012	0.498	0.061	0.115	0.015	0.014	0.202	0.029	0.028	0.027	0.031	0.062	0.010	<0.010
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.00986	0.000351	0.000780	<0.000050	<0.000050	0.000066	<0.000050	0.000160	0.000693	0.000400
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	3.00	4.05	1.65	1.58	2.52	2.44	4.44	3.65	3.65	3.45	3.40	2.76	2.57	2.54
Manganese (Mn)	mg/L		0.000050	0.0334	0.0873	0.0214	0.0382	0.00391	0.00532	0.0195	0.00726	0.00732	0.0110	0.0120	0.00440	0.00428	0.00435
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000053
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.0468	0.0278	0.00473	0.00460	0.00427	0.00406	0.0101	0.0159	0.0157	0.0155	0.0152	0.00864	0.00744	0.00745
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.481	0.734	0.468	0.450	0.647	0.619	0.861	0.631	0.630	0.622	0.597	0.556	0.509	0.502
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	1.35	2.58	0.590	0.601	0.796	0.764	2.46	1.68	1.71	1.58	1.54	1.10	0.968	0.960
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	1.13	1.87	0.943	0.887	1.09	1.04	2.02	1.51	1.53	1.50	1.41	1.26	1.13	1.12
Strontium (Sr)	mg/L		0.00010 - 0.00020	0.0215	0.0341	0.0115	0.0118	0.0151	0.0143	0.0294	0.0213	0.0216	0.0207	0.0204	0.0271	0.0245	0.0245
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

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Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Moby Lake	Gander Lake	Big Lake	Big Lake	Fox Lake	Fox Lake	Rascal Lake	Giraffe Lake North	Giraffe Lake North	Giraffe Lake South	Giraffe Lake South	Goose Lake Neck	Goose Lake Central	Goose Lake Central
Replicate				1	1	1	2	1	2	1	1	2	1	1	1	1	2
Duplicate?				-	-	-	duplicate	-	duplicate	-	-	duplicate	-	-	-	-	duplicate
Depth (m)		CCME Guideline	Realised Detection	1	1	1	1	1	1	0	1	1	1	2	1	1	1
Date Sampled		for the Protection	Limit	10-Apr-12	10-Apr-12	10-Apr-12	10-Apr-12	10-Apr-12	10-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12	11-Apr-12
ALS Sample ID	Units	of Freshwater Aquatic Life[a]	(RDL)	L1133356-5	L1133356-6	L1133356-3	L1133356-10	L1133356-9	L1133356-4	L1133911-11	L1133911-7	L1133911-10	L1133911-8	L1133911-9	L1133911-3	L1133911-1	L1133911-2
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	0.000032	0.000014	0.000013	<0.000010	<0.000010	<0.000010	0.000020	0.000019	0.000019	0.000015	0.000015	0.000011	0.000011
Vanadium (V)	mg/L		0.000050	<0.000050	0.000349	<0.000050	<0.000050	<0.000050	<0.000050	0.000069	0.000061	0.000051	0.000051	<0.000050	0.000128	<0.000050	<0.000050
Zinc (Zn)	mg/L	0.03	0.0030	0.0150	0.0075	0.0037	<0.0030	<0.0030	<0.0030	0.0057	0.0053	0.0053	0.0049	0.0045	0.0043	0.0032	0.0031
Dissolved Metals																	
Aluminum (Al)	mg/L		0.0030	0.0121	0.0187	0.0151	0.0116	0.0049	0.0044	0.0188	0.0263	0.0267	0.0264	0.0259	0.0219	0.0209	0.0211
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000273	0.000521	0.000419	0.000370	0.000354	0.000347	0.000422	0.000329	0.000318	0.000269	0.000250	0.000278	0.000237	0.000254
Barium (Ba)	mg/L		0.000050	0.00872	0.0166	0.00536	0.00555	0.00607	0.00518	0.0192	0.00914	0.00915	0.00896	0.00880	0.0126	0.0102	0.0101
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	<0.0050	0.0080	0.0061	0.0059	0.0061	0.0083	0.0066	0.0062	0.0060	0.0063	0.0053	0.0061	0.0051	0.0056
Cadmium (Cd)	mg/L		0.000010	0.000043	0.000025	<0.000010	<0.000010	<0.000010	<0.000010	0.000011	0.000012	0.000015	0.000012	0.000016	0.000013	0.000011	<0.000010
Calcium (Ca)	mg/L		0.020	5.17	7.20	2.53	2.51	4.52	4.37	7.43	5.17	5.10	4.75	4.64	5.65	4.95	4.86
Chromium (Cr)	mg/L		0.00010	<0.00010	0.00024	0.00020	0.00015	0.00016	0.00014	0.00030	0.00022	0.00020	0.00017	0.00016	0.00020	0.00017	0.00018
Cobalt (Co)	mg/L		0.00010	0.00314	0.00467	0.00072	0.00126	<0.00010	<0.00010	0.00028	0.00053	0.00054	0.00060	0.00083	0.00026	0.00022	0.00022
Copper (Cu)	mg/L		0.00050	0.00232	0.00247	0.00171	0.00156	0.00174	0.00152	0.00275	0.00358	0.00356	0.00337	0.00331	0.00234	0.00209	0.00205
Iron (Fe)	mg/L		0.010	<0.010	0.144	0.019	0.027	<0.010	<0.010	0.043	0.011	0.012	0.015	0.029	<0.010	<0.010	<0.010
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.00485	<0.000050	0.000219	<0.000050	<0.000050	<0.000050	<0.000050	0.000123	0.000307	0.000210
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	2.92	3.96	1.56	1.51	2.47	2.36	4.39	3.59	3.58	3.31	3.15	2.69	2.44	2.41
Manganese (Mn)	mg/L		0.000050	0.0295	0.0810	0.0221	0.0386	0.000502	0.000169	0.0166	0.00481	0.00509	0.00780	0.0134	0.00388	0.00298	0.00309
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	0.000069	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.0457	0.0255	0.00460	0.00444	0.00426	0.00399	0.00985	0.0157	0.0155	0.0149	0.0146	0.00831	0.00710	0.00715
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.469	0.712	0.446	0.424	0.628	0.606	0.847	0.616	0.626	0.588	0.565	0.542	0.492	0.478
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	1.34	2.48	0.561	0.581	0.779	0.731	2.39	1.65	1.67	1.49	1.46	1.02	0.913	0.901
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	1.09	1.76	0.889	0.836	1.07	1.01	2.00	1.49	1.46	1.42	1.35	1.22	1.07	1.06
Strontium (Sr)	mg/L		0.00010 - 0.00020	0.0207	0.0314	0.0110	0.0111	0.0148	0.0138	0.0290	0.0214	0.0214	0.0197	0.0194	0.0264	0.0233	0.0228
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	0.000023	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000018	0.000018	0.000016	0.000016	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	0.000144	<0.000050	<0.000050	<0.000050	<0.000050	0.000062	0.000051	<0.000050	<0.000050	<0.000050	0.000053	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.0030	0.0148	0.0064	<0.0030	<0.0030	<0.0030	<0.0030	0.0040	0.0039	0.0039	0.0039	0.0057	0.0037	<0.0030	<0.0030

** Due to a lab error, dissolved metals data is not available for Propellor Lake samples collected in April*

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

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Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2012

Area				Goose	Goose	Goose	Goose	George	George	George	George	George	George	George	George	George
Location				Goose Lake Tail	Goose Lake Tail	Propellor Lake*	Propellor Lake*	Lower Long Lake	Lower Long Lake	Fold Lake	Fold Lake	Fold Lake	George Lake Central	George Lake Central	George Lake Central	Dragon Lake
Replicate				1	1	1	1	1	2	1	1	2	1	1	2	1
Duplicate?			Realised	-	-	-	-	-	duplicate	-	-	duplicate	-	-	duplicate	-
Depth (m)		CCME Guideline	Detection	1	3.8	1	5.3	1	1	1	6.2	1	1	5.5	5.5	1
Date Sampled		for the Protection	Limit	11-Apr-12	11-Apr-12	12-Apr-12	12-Apr-12	13-Apr-12	13-Apr-12	15-Apr-12	15-Apr-12	15-Apr-12	13-Apr-12	13-Apr-12	13-Apr-12	15-Apr-12
ALS Sample ID	Units	of Freshwater Aquatic Life[a]	RDL	L1133911-5	L1133911-6	L1134512-1	L1134512-2	L1135132-4	L1135132-5	L1135132-14	L1135132-15	L1135132-16	L1135132-9	L1135132-10	L1135132-11	L1135132-13
Physical Tests																
Conductivity	µS/cm		2.0	66.7	69.9	30.9	25.9	53.6	52.0	75.0	73.3	71.6	89.0	104	103	125
Hardness (as $CaCO_3$)	mg/L		0.50	25.0	26.0	12.1	10.1	27.2	28.1	34.7	33.0	31.8	38.0	45.1	45.1	59.0
pH	pH	6.5-9.0	0.10	8.09	8.06	7.10	6.98	8.32	8.25	8.28	8.26	7.90	8.27	8.19	8.23	8.08
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	8.1	8.9	6.5	5.0	25.7	20.7	12.7	12.5	12.5	9.7	10.9	10.4	32.2
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0 - 2.0	8.1	8.9	6.5	5.0	25.7	20.7	12.7	12.5	12.5	9.7	10.9	10.4	32.2
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	3.3
Total Dissolved Solids	mg/L		10	45	41	26	22	32	30	46	42	42	51	62	62	84
Turbidity	NTU	dependent on background levels	0.10	0.27	0.40	0.14	0.21	0.51	0.63	0.80	1.11	0.23	0.49	0.35	0.91	0.91
Nutrients																
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	0.0225	0.0185	0.0248	0.0267	<0.0050	<0.0050	0.0068	<0.0050	0.0063	0.0106	0.0124	0.0127	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.0050	0.0097	0.0161	<0.0050	0.0269	0.0197	0.0195	0.0056	0.0119	0.0075	0.0104	0.0186	0.0174	0.0053
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.234	0.285	0.170	0.105	0.191	0.207	0.187	0.179	0.230	0.167	0.179	0.189	0.361
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0045	0.0040	0.0022	0.0031	0.0024	0.0027	0.0050	0.0053	0.0044	0.0023	0.0027	0.0024	0.0037
Anions																
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	8.24	8.50	1.96	1.62	0.61	0.59	1.88	1.83	1.80	5.32	6.32	6.29	2.46
Fluoride (F)	mg/L	0.12[b]	0.02	0.026	0.022	0.023	<0.020	<0.020	<0.020	0.026	0.025	0.025	0.034	0.035	0.035	0.035
Sulfate (SO_4)	mg/L		0.5	8.85	9.06	4.78	4.01	4.15	4.10	17.9	17.5	17.3	21.1	24.7	24.6	24.0
Cyanides																
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon																
Total Organic Carbon	mg/L		0.50	5.40	5.39	4.55	4.12	3.23	3.16	2.44	2.27	2.29	2.05	2.28	2.23	5.10
Total Metals																
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0237	0.0219	0.0124	0.0142	0.0038	0.0030	<0.0030	<0.0030	0.0040	0.0069	0.0079	0.0084	<0.0030
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000286	0.000256	0.000182	0.000139	0.000432	0.000439	0.000446	0.000471	0.000394	0.000442	0.000489	0.000508	0.000854
Barium (Ba)	mg/L		0.000050	0.0123	0.0137	0.00507	0.00544	0.00137	0.00129	0.00170	0.00198	0.00164	0.00384	0.00442	0.00453	0.00276
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	0.0062	0.0063	0.0057	0.0056	0.0071	0.0070	0.0075	0.0074	0.0073	0.0073	0.0080	0.0075	0.0077
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	0.000010	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	5.62	6.08	2.22	2.01	5.45	5.45	8.14	7.68	7.43	10.2	12.0	11.8	12.8
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00021	0.00020	0.00018	0.00016	0.00021	0.00011	0.00011	0.00014	0.00011	0.00010	0.00013	0.00013	0.00014
Cobalt (Co)	mg/L		0.00010	0.00021	0.00028	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00089	0.00090	0.00092	<0.00010
Copper (Cu)	mg/L	≥0.002[e]	0.00050	0.00254	0.00361	0.00167	0.00112	0.00127	0.00134	0.00136	0.00127	0.00127	0.00184	0.00201	0.00198	0.00244
Iron (Fe)	mg/L	0.3	0.010	0.014	0.025	0.012	0.016	0.011	<0.010	<0.010	0.015	<0.010	0.026	0.034	0.040	<0.010
Lead (Pb)	mg/L	≥0.001[f]	0.000050	0.000098	0.000068	0.000273	0.000573	<0.000050	<0.000050	0.000577	0.00128	0.000235	0.000764	0.00226	0.00170	0.000335
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	2.74	2.84	1.30	1.15	2.90	2.92	3.27	3.17	3.09	3.18	3.68	3.69	6.67
Manganese (Mn)	mg/L		0.000050	0.00579	0.00903	0.00131	0.00319	0.000576	0.000436	0.00114	0.00322	0.00120	0.0307	0.0275	0.0299	0.00188
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000066	0.000053	0.000055	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000061
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00761	0.00796	0.00254	0.00251	0.00064	0.00065	0.00212	0.00214	0.00206	0.00787	0.00797	0.00770	0.00440
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.570	0.585	0.383	0.331	0.346	0.348	0.590	0.571	0.549	0.576	0.658	0.650	0.805
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.993	1.06	0.303	0.307	0.592	0.596	0.274	0.311	0.259	0.447	0.469	0.466	1.09
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	1.26	1.28	0.719	0.622	0.550	0.550	1.08	1.04	0.994	1.20	1.39	1.38	1.33
Strontium (Sr)	mg/L		0.00010 - 0.00020	0.0274	0.0295	0.00992	0.00898	0.00943	0.00948	0.0267	0.0252	0.0241	0.0349	0.0421	0.0419	0.0259
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

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Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2012

Area				Goose	Goose	Goose	Goose	George	George	George	George	George	George	George	George	George
Location				Goose Lake Tail	Goose Lake Tail	Propellor Lake*	Propellor Lake*	Lower Long Lake	Lower Long Lake	Fold Lake	Fold Lake	Fold Lake	George Lake Central	George Lake Central	George Lake Central	Dragon Lake
Replicate				1	1	1	1	1	2	1	1	2	1	1	2	1
Duplicate?			Realised	-	-	-	-	-	duplicate	-	-	duplicate	-	-	duplicate	-
Depth (m)		CCME Guideline	Detection	1	3.8	1	5.3	1	1	1	6.2	1	1	5.5	5.5	1
Date Sampled		for the Protection	Limit	11-Apr-12	11-Apr-12	12-Apr-12	12-Apr-12	13-Apr-12	13-Apr-12	15-Apr-12	15-Apr-12	15-Apr-12	13-Apr-12	13-Apr-12	13-Apr-12	15-Apr-12
ALS Sample ID	Units	of Freshwater Aquatic Life[a]	RDL	L1133911-5	L1133911-6	L1134512-1	L1134512-2	L1135132-4	L1135132-5	L1135132-14	L1135132-15	L1135132-16	L1135132-9	L1135132-10	L1135132-11	L1135132-13
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	0.000011	<0.000010	<0.000010	<0.000010	0.000042	0.000039	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000011
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L	0.03	0.0030	0.0031	0.0044	<0.0030	0.0039	<0.0030	<0.0030	0.0033	<0.0030	0.0032	0.0073	0.0071	0.0070	0.0034
Dissolved Metals																
Aluminum (Al)	mg/L		0.0030	0.0201	0.0198	-	-	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0066	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000259	0.000226	-	-	0.000466	0.000449	0.000435	0.000413	0.000435	0.000350	0.000380	0.000390	0.000862
Barium (Ba)	mg/L		0.000050	0.0122	0.0134	-	-	0.00136	0.00129	0.00177	0.00199	0.00168	0.00392	0.00438	0.00487	0.00269
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	-	-	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	-	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	0.0053	0.0052	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cadmium (Cd)	mg/L		0.000010	<0.000010	0.000012	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000010	0.000011	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	5.57	5.82	-	-	5.11	5.00	7.04	6.64	6.61	8.58	9.91	10.0	10.8
Chromium (Cr)	mg/L		0.00010	0.00017	0.00016	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L		0.00010	0.00018	0.00026	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00057	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L		0.00050	0.00217	0.00209	-	-	0.00111	0.00110	0.00111	0.00100	0.00106	0.00164	0.00160	0.00164	0.00214
Iron (Fe)	mg/L		0.010	<0.010	0.010	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	-	-	<0.000050	<0.000050	0.000105	0.000112	<0.000050	0.000170	0.000056	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	2.70	2.79	-	-	2.92	2.89	3.19	3.07	3.07	3.11	3.52	3.63	6.44
Manganese (Mn)	mg/L		0.000050	0.00523	0.00830	-	-	0.000098	0.000097	0.000075	0.000069	0.000066	0.0221	0.00869	0.00954	0.000229
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	-	-	<0.000050	0.000053	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050
Nickel (Ni)	mg/L		0.00010	0.00740	0.00769	-	-	0.00065	0.00067	0.00221	0.00209	0.00203	0.00776	0.00780	0.00773	0.00441
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	-	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.565	0.577	-	-	0.352	0.345	0.587	0.560	0.550	0.568	0.636	0.654	0.786
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.974	1.04	-	-	0.594	0.580	0.276	0.292	0.256	0.427	0.448	0.465	1.08
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	-	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	1.24	1.28	-	-	0.562	0.544	1.05	1.01	1.00	1.16	1.37	1.40	1.31
Strontium (Sr)	mg/L		0.00010 - 0.00020	0.0271	0.0281	-	-	0.00919	0.00907	0.0233	0.0218	0.0216	0.0309	0.0354	0.0358	0.0217
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	-	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	-	-	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	-	-	0.000028	0.000029	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.0030	<0.0030	<0.0030	-	-	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0071	0.0054	0.0053	<0.0030

** Due to a lab error, dissolved metals data is not available for Propellor Lake samples collected in April*

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ /1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ /1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ /1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

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Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2012

Area				George	George	George	George	George	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Komatic Lake	Komatic Lake	Reference Lake C	Reference Lake C	Reference Lake C	Moby Lake	Moby Lake	Gander Lake	Pond 19	Big Lake	Rabbit Lake	Fox Lake	Fox Lake	Echo Lake
Replicate				1	1	1	1	2	1	1	1	1	1	1	1	2	1
Duplicate?			Realised	-	-	-	-	duplicate	-	-	-	-	-	-	-	duplicate	-
Depth (m)		CCME Guideline	Detection	1	5	1	5.5	5.5	1	7.4	1	0.1	1	1	1	1	0.1
Date Sampled		for the Protection	Limit	13-Apr-12	13-Apr-12	13-Apr-12	13-Apr-12	13-Apr-12	22-Aug-12	22-Aug-12	18-Aug-12	21-Aug-12	16-Aug-12	15-Aug-12	20-Aug-12	20-Aug-12	17-Aug-12
ALS Sample ID	Units	of Freshwater Aquatic Life[a]	RDL	L1135132-6	L1135132-7	L1135132-1	L1135132-2	L1135132-3	L1198584-11	L1198584-12	L1196499-3	L1198584-7	L1195581-8	L1195581-6	L1198584-5	L1198584-6	L1196499-2
Physical Tests																	
Conductivity	µS/cm		2.0	143	146	151	148	149	33.9	34.2	22.1	81.3	14.6	19.0	18.5	18.3	41.6
Hardness (as $CaCO_3$)	mg/L		0.50	62.4	61.6	78.8	76.0	79.1	12.8	13.1	8.32	34.8	5.44	7.55	7.28	7.41	18.2
pH	pH	6.5-9.0	0.10	8.07	8.12	8.05	8.23	8.27	6.63	6.62	6.84	7.46	6.59	6.30	6.85	6.87	7.33
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	18.7	19.3	78.0	77.7	77.6	2.4	2.6	3.4	21.5	2.5	4.5	4.9	4.7	13.9
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0 - 2.0	18.7	19.3	78.0	77.7	77.6	2.4	2.6	3.4	21.5	2.5	4.5	4.9	4.7	13.9
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	6.4
Total Dissolved Solids	mg/L		10	104	97	84	82	81	23	24	20	61	21	27	13	15	63
Turbidity	NTU	dependent on background levels	0.10	0.33	0.81	0.13	0.14	0.19	0.46	0.36	0.74	0.42	0.36	0.50	0.44	0.40	1.57
Nutrients																	
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	0.0091	<0.0050	0.0120	0.0122	0.0130	<0.0050	<0.0050	<0.0050	0.0067	<0.0050	0.0067	<0.0050	<0.0050	0.0081
Nitrate (as N)	mg/L	2.935[b]	0.0050	0.0320	0.0374	0.0061	0.0075	0.0083	<0.0050	<0.0050	<0.0050	0.0080	0.0082	0.0100	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.290	0.309	0.204	0.199	0.203	0.128	0.149	0.180	0.448	0.151	0.196	0.202	0.196	1.09
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0047	0.0056	0.0039	0.0024	0.0025	0.0035	0.0039	0.0066	0.0035	0.0032	0.0023	0.0034	0.0037	0.0225
Anions																	
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	5.50	5.65	0.82	0.79	0.79	<0.50	<0.50	<0.50	1.55	0.52	0.52	<0.50	<0.50	1.75
Fluoride (F)	mg/L	0.12[b]	0.02	0.039	0.038	0.020	0.020	0.021	0.031	0.031	0.023	0.045	<0.020	0.025	0.020	<0.020	0.046
Sulfate (SO_4)	mg/L		0.5	37.4	38.4	0.90	0.88	0.88	11.3	11.3	5.76	15.2	3.14	3.59	3.23	3.22	2.67
Cyanides																	
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon																	
Total Organic Carbon	mg/L		0.50	4.72	4.69	3.36	3.38	3.47	2.45	2.68	2.96	7.74	2.90	2.74	2.87	2.68	18.2
Total Metals																	
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0057	0.0054	<0.0030	<0.0030	<0.0030	0.0089	0.0085	0.0156	0.0067	0.0207	0.0149	0.0137	0.0061	0.0353
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000708	0.000741	0.000890	0.000206	0.000207	0.000224	0.000197	0.000383	0.000413	0.000361	0.000227	0.000208	0.000229	0.00156
Barium (Ba)	mg/L		0.000050	0.00554	0.00576	0.0254	0.0249	0.0247	0.00435	0.00423	0.00365	0.00671	0.00197	0.00206	0.00172	0.00171	0.00803
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	0.0077	0.0054	0.0066	0.0067	0.0089	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	0.000011	<0.000010	0.000044	<0.000010	<0.000010	0.000014	0.000018	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	14.3	15.0	19.3	19.2	20.1	2.72	2.71	1.66	7.17	0.924	1.65	1.47	1.57	3.69
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00017	0.00011	0.00015	0.00017	0.00012	<0.00010	<0.00010	0.00015	<0.00010	0.00015	0.00011	<0.00010	<0.00010	0.00031
Cobalt (Co)	mg/L		0.00010	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	0.00047	0.00045	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00029
Copper (Cu)	mg/L	≥0.002[e]	0.00050	0.00310	0.00305	0.00097	0.00102	0.00090	0.00163	0.00151	0.00166	0.00230	0.00174	0.00313	0.00091	0.00088	0.00252
Iron (Fe)	mg/L	0.3	0.010	0.019	0.027	<0.010	<0.010	<0.010	0.024	0.022	0.040	0.063	0.028	0.056	0.042	0.041	0.592
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000092	<0.000050	0.000144	<0.000050	<0.000050	<0.000050	<0.000050	0.000051	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	5.92	5.93	7.53	7.37	7.44	1.55	1.51	1.10	4.20	0.729	0.873	0.883	0.894	2.24
Manganese (Mn)	mg/L		0.000050	0.00309	0.00518	0.00123	0.00151	0.00147	0.00694	0.00690	0.00103	0.000474	0.00148	0.000709	0.00160	0.00151	0.00436
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	0.000051	<0.000050	0.000092	0.000105	0.000094	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.0117	0.0112	0.00015	0.00016	0.00013	0.0158	0.0153	0.00532	0.00594	0.00159	0.00183	0.00109	0.00112	0.00273
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.803	0.804	0.303	0.296	0.298	0.278	0.269	0.285	0.913	0.307	0.342	0.268	0.273	0.748
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	1.51	1.54	1.23	1.21	1.21	0.420	0.406	0.065	0.707	0.116	0.372	0.224	0.209	0.126
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	1.74	1.75	0.597	0.542	0.546	0.599	0.585	0.587	1.88	0.476	0.493	0.441	0.445	1.48
Strontium (Sr)	mg/L		0.00010 - 0.00020	0.0461	0.0489	0.00885	0.00863	0.00854	0.0108	0.0108	0.00757	0.0215	0.00504	0.00589	0.00486	0.00508	0.0149
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

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Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2012

Area				George	George	George	George	George	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Komatic Lake	Komatic Lake	Reference Lake C	Reference Lake C	Reference Lake C	Moby Lake	Moby Lake	Gander Lake	Pond 19	Big Lake	Rabbit Lake	Fox Lake	Fox Lake	Echo Lake
Replicate				1	1	1	1	2	1	1	1	1	1	1	1	2	1
Duplicate?			Realised	-	-	-	-	duplicate	-	-	-	-	-	-	-	duplicate	-
Depth (m)		CCME Guideline	Detection	1	5	1	5.5	5.5	1	7.4	1	0.1	1	1	1	1	0.1
Date Sampled		for the Protection	Limit	13-Apr-12	13-Apr-12	13-Apr-12	13-Apr-12	13-Apr-12	22-Aug-12	22-Aug-12	18-Aug-12	21-Aug-12	16-Aug-12	15-Aug-12	20-Aug-12	20-Aug-12	17-Aug-12
ALS Sample ID	Units	of Freshwater Aquatic Life[a]	RDL	L1135132-6	L1135132-7	L1135132-1	L1135132-2	L1135132-3	L1198584-11	L1198584-12	L1196499-3	L1198584-7	L1195581-8	L1195581-6	L1198584-5	L1198584-6	L1196499-2
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	0.000014	0.000013	0.000408	0.000402	0.000398	<0.000010	<0.000010	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	0.000050	0.000050	0.000113	0.000107	0.000300	0.000127	0.000360	0.000435	0.000066	0.000108	0.000450
Zinc (Zn)	mg/L	0.03	0.0030	0.0055	0.0054	<0.0030	<0.0030	<0.0030	0.0042	0.0040	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals																	
Aluminum (Al)	mg/L		0.0030	0.0043	0.0039	<0.0030	<0.0030	<0.0030	0.0039	0.0038	0.0046	0.0035	0.0098	0.0113	0.0052	<0.0030	0.0115
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000711	0.000685	0.000232	0.000185	0.000198	0.000195	0.000174	0.000351	0.000387	0.000284	0.000172	0.000207	0.000202	0.00129
Barium (Ba)	mg/L		0.000050	0.00562	0.00577	0.0256	0.0251	0.0251	0.00415	0.00440	0.00352	0.00670	0.00209	0.00208	0.00174	0.00172	0.00754
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0059	<0.0050	<0.0050	<0.0050	0.0101	<0.0050	<0.0050
Cadmium (Cd)	mg/L		0.000010	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	0.000015	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	13.3	13.7	18.7	18.6	18.7	2.62	2.74	1.60	7.20	1.08	1.65	1.44	1.49	3.65
Chromium (Cr)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00016	<0.00010	<0.00010	<0.00010	0.00029	<0.00010	0.00019
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00030	0.00028	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00013
Copper (Cu)	mg/L		0.00050	0.00275	0.00274	0.00087	0.00088	0.00082	0.00119	0.00120	0.00159	0.00198	0.00130	0.00129	0.00064	0.00066	0.00204
Iron (Fe)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.019	<0.010	0.018	<0.010	<0.010	0.193
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	5.85	5.98	7.38	7.31	7.39	1.52	1.53	1.05	4.07	0.670	0.835	0.895	0.893	2.21
Manganese (Mn)	mg/L		0.000050	0.000252	0.000181	0.000082	0.000117	0.000107	0.00474	0.00471	0.000624	0.000382	0.000717	0.000547	0.000412	0.000200	0.00111
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	0.000086	0.000083	0.000089	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.0110	0.0110	0.00013	0.00016	0.00015	0.0151	0.0152	0.00502	0.00576	0.00162	0.00181	0.00112	0.00107	0.00247
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.800	0.809	0.312	0.300	0.296	0.273	0.276	0.285	0.890	0.256	0.327	0.277	0.271	0.734
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	1.50	1.49	1.20	1.19	1.20	0.404	0.408	<0.050	0.709	0.109	0.360	0.211	0.197	0.102
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	1.73	1.77	0.572	0.558	0.551	0.583	0.590	0.577	1.78	0.446	0.480	0.442	0.439	1.47
Strontium (Sr)	mg/L		0.00010 - 0.00020	0.0441	0.0449	0.00834	0.00828	0.00842	0.0104	0.0108	0.00712	0.0227	0.00484	0.00586	0.00494	0.00485	0.0144
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	0.000010	<0.000010	0.000386	0.000381	0.000383	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000085	<0.000050	<0.000050	0.000114	<0.000050	<0.000050	0.000134
Zinc (Zn)	mg/L		0.0030	0.0042	0.0041	<0.0030	<0.0030	<0.0030	0.0037	0.0041	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

** Due to a lab error, dissolved metals data is not available for Propellor Lake samples collected in April*

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ /1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ /1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ /1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

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Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	George
Location				Rascal Lake	Giraffe Lake North	Giraffe Lake South	Giraffe Lake South	Giraffe Lake South	Goose Lake Neck	Goose Lake Neck	Goose Lake Central	Goose Lake Tail	Propellor Lake	Propellor Lake	Propellor Lake	Lower Long Lake
Replicate				1	1	1	1	2	1	2	1	1	1	2	1	1
Duplicate?			Realised	-	-	-	-	duplicate	-	duplicate	-	-	-	duplicate	-	-
Depth (m)		CCME Guideline	Detection	1	1	1	3.7	3.7	1	1	1	1	1	1	3.7	1
Date Sampled		for the Protection	Limit	15-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	14-Aug-12	14-Aug-12	17-Aug-12	18-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
ALS Sample ID	Units	of Freshwater Aquatic Life[a]	RDL	L1195581-7	L1198584-3	L1198584-1	L1198584-2	L1198584-4	L1195581-4	L1195581-5	L1196499-1	L1196499-4	L1198584-8	L1198584-9	L1198584-10	L1198951-1
Physical Tests																
Conductivity	µS/cm		2.0	18.7	24.0	25.8	24.1	24.0	36.1	36.1	32.8	32.5	19.5	19.3	19.2	26.5
Hardness (as $CaCO_3$)	mg/L		0.50	7.41	9.28	9.20	9.34	9.40	13.9	14.0	12.6	12.2	7.51	7.76	7.59	12.3
pH	pH	6.5-9.0	0.10	6.33	6.86	7.14	6.91	6.82	6.74	6.61	6.87	6.70	6.77	6.73	6.91	7.24
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	4.1	3.6	4.0	4.1	4.3	3.5	3.7	3.2	3.2	3.0	3.1	3.2	10.8
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0 - 2.0	4.1	3.6	4.0	4.1	4.3	3.5	3.7	3.2	3.2	3.0	3.1	3.2	10.8
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	20	18	18	18	15	23	34	26	32	18	15	17	15
Turbidity	NTU	dependent on background levels	0.10	0.38	0.59	0.45	0.28	0.30	0.41	0.36	0.32	0.34	0.42	0.31	0.39	0.24
Nutrients																
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0074	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.0050	0.0075	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0090	<0.0050	<0.0050	0.0076	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.207	0.162	0.187	0.202	0.179	0.168	0.151	0.164	0.159	0.181	0.151	0.160	0.132
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0031	0.0030	0.0027	0.0032	0.0037	0.0029	0.0030	0.0029	0.0028	0.0036	0.0036	0.0033	0.0029
Anions																
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	0.81	0.56	0.57	0.53	0.54	5.62	5.63	4.59	4.31	1.65	1.61	1.59	<0.50
Fluoride (F)	mg/L	0.12[b]	0.02	0.021	0.025	0.025	0.024	0.024	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Sulfate (SO_4)	mg/L		0.5	3.47	5.80	5.78	5.79	5.78	4.34	4.34	4.35	4.26	2.78	2.80	2.78	1.66
Cyanides																
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon																
Total Organic Carbon	mg/L		0.50	3.42	3.11	3.00	2.89	3.03	2.84	2.86	2.94	2.93	3.17	2.92	2.92	2.32
Total Metals																
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0193	0.0178	0.0190	0.0131	0.0142	0.0140	0.0137	0.0278	0.0094	0.0171	0.0102	0.0101	0.0046
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000202	0.000221	0.000204	0.000202	0.000231	0.000236	0.000195	0.000211	0.000200	0.000148	0.000147	0.000146	0.000414
Barium (Ba)	mg/L		0.000050	0.00324	0.00322	0.00316	0.00311	0.00303	0.00738	0.00694	0.00573	0.00501	0.00366	0.00361	0.00363	0.00111
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	0.0052	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0056	<0.0050	<0.0050	<0.0050	0.0057
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	1.52	1.67	1.73	1.67	1.66	3.63	3.49	2.96	2.85	1.72	1.62	1.58	2.48
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00015	0.00012	<0.00010	<0.00010	<0.00010	0.00013	0.00016	0.00011	0.00013	0.00154	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L		0.00010	<0.00010	0.00011	<0.00010	<0.00010	<0.00010	0.00013	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	≥0.002[e]	0.00050	0.00291	0.00205	0.00189	0.00184	0.00185	0.00505	0.00299	0.00136	0.00117	0.00102	0.00104	0.00088	0.00108
Iron (Fe)	mg/L	0.3	0.010	0.063	0.050	0.049	0.051	0.049	0.034	0.033	0.022	0.044	0.109	0.018	0.017	0.018
Lead (Pb)	mg/L	≥0.001[f]	0.000050	0.000089	0.000053	0.000059	<0.000050	<0.000050	0.000462	<0.000050	0.000199	<0.000050	0.000102	0.000065	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	0.918	1.32	1.24	1.22	1.22	1.40	1.33	1.34	1.35	0.871	0.870	0.868	1.53
Manganese (Mn)	mg/L		0.000050	0.000676	0.00154	0.00146	0.00147	0.00152	0.00286	0.00287	0.00211	0.00250	0.00412	0.00281	0.00279	0.00123
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000194	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00168	0.00422	0.00403	0.00394	0.00403	0.00363	0.00352	0.00332	0.00242	0.00263	0.00185	0.00185	0.00032
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.291	0.327	0.304	0.300	0.300	0.394	0.359	0.340	0.347	0.269	0.271	0.271	0.210
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.280	0.223	0.203	0.205	0.205	0.249	0.243	0.221	0.201	0.129	0.126	0.126	0.292
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.496	0.630	0.593	0.585	0.587	0.639	0.613	0.643	0.639	0.474	0.465	0.470	0.414
Strontium (Sr)	mg/L		0.00010 - 0.00020	0.00655	0.00711	0.00790	0.00712	0.00705	0.0208	0.0196	0.0159	0.0149	0.00812	0.00766	0.00750	0.00455
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

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Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	George
Location				Rascal Lake	Giraffe Lake North	Giraffe Lake South	Giraffe Lake South	Giraffe Lake South	Goose Lake Neck	Goose Lake Neck	Goose Lake Central	Goose Lake Tail	Propellor Lake	Propellor Lake	Propellor Lake	Lower Long Lake
Replicate				1	1	1	1	2	1	2	1	1	1	2	1	1
Duplicate?			Realised	-	-	-	-	duplicate	-	duplicate	-	-	-	duplicate	-	-
Depth (m)		CCME Guideline	Detection	1	1	1	3.7	3.7	1	1	1	1	1	1	3.7	1
Date Sampled		for the Protection	Limit	15-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	14-Aug-12	14-Aug-12	17-Aug-12	18-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
ALS Sample ID	Units	of Freshwater Aquatic Life[a]	RDL	L1195581-7	L1198584-3	L1198584-1	L1198584-2	L1198584-4	L1195581-4	L1195581-5	L1196499-1	L1196499-4	L1198584-8	L1198584-9	L1198584-10	L1198951-1
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000014
Vanadium (V)	mg/L		0.000050	0.000432	0.000154	0.000121	0.000123	0.000129	0.000645	0.000461	0.000188	0.000191	0.000138	0.000119	0.000123	0.000387
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0031	<0.0030	<0.0030
Dissolved Metals																
Aluminum (Al)	mg/L		0.0030	0.0089	0.0093	0.0096	0.0064	0.0073	0.0074	0.0067	0.0159	0.0042	0.0112	0.0058	0.0052	<0.0030
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000156	0.000178	0.000192	0.000182	0.000189	0.000175	0.000132	0.000179	0.000152	0.000125	0.000118	0.000124	0.000377
Barium (Ba)	mg/L		0.000050	0.00313	0.00307	0.00317	0.00379	0.00313	0.00701	0.00671	0.00567	0.00483	0.00352	0.00358	0.00343	0.00107
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	<0.0050	0.0059	<0.0050	<0.0050	<0.0050	<0.0050	0.0056	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0060
Cadmium (Cd)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	1.50	1.68	1.68	1.68	1.72	3.44	3.44	2.88	2.78	1.57	1.71	1.63	2.58
Chromium (Cr)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L		0.00050	0.00121	0.00146	0.00144	0.00134	0.00146	0.00143	0.00132	0.00108	0.00089	0.00068	0.00081	0.00072	0.00091
Iron (Fe)	mg/L		0.010	0.011	0.012	0.012	0.012	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	0.892	1.23	1.22	1.25	1.24	1.28	1.31	1.32	1.28	0.870	0.849	0.853	1.43
Manganese (Mn)	mg/L		0.000050	0.000476	0.00123	0.00122	0.00119	0.00117	0.00147	0.00115	0.000396	0.000933	0.000166	0.000216	0.000192	0.000141
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.00153	0.00390	0.00388	0.00399	0.00393	0.00343	0.00348	0.00318	0.00222	0.00179	0.00176	0.00176	0.00039
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.284	0.303	0.303	0.309	0.307	0.381	0.356	0.335	0.322	0.271	0.275	0.270	0.211
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.258	0.203	0.200	0.193	0.206	0.230	0.226	0.218	0.189	0.124	0.112	0.115	0.284
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.485	0.588	0.588	0.592	0.593	0.622	0.610	0.631	0.598	0.468	0.460	0.455	0.339
Strontium (Sr)	mg/L		0.00010 - 0.00020	0.00624	0.00712	0.00714	0.00732	0.00720	0.0191	0.0194	0.0151	0.0143	0.00734	0.00799	0.00759	0.00495
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000015
Vanadium (V)	mg/L		0.000050	0.000097	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000114	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

** Due to a lab error, dissolved metals data is not available for Propellor Lake samples collected in April*

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ /1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ /1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ /1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

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Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2012

Area				George	George	George	George	George	George	George	George	George	George	George	George
Location				George Lake Central	George Lake South	Lytle Lake	Occurrence Lake	Sleigh Lake	Dragon Lake	Dragon Lake	Komatic Lake	Komatic Lake	Reference C Lake	Reference C Lake	Reference C Lake
Replicate				1	1	1	1	1	1	2	1	1	1	2	1
Duplicate?			Realised	-	-	-	-	-	-	duplicate	-	-	-	duplicate	-
Depth (m)		CCME Guideline	Detection	7	0.5	0.5	1	0.5	1	1	1	3.5	1	1	29
Date Sampled		for the Protection	Limit	18-Aug-12	18-Aug-12	23-Aug-12	21-Aug-12	22-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12
ALS Sample ID	Units	of Freshwater Aquatic Life[a]	RDL	L1197323-6	L1197323-1	L1199564-1	L1198951-2	L1198951-6	L1197323-10	L1197323-11	L1197323-12	L1197323-13	L1198951-3	L1198951-4	L1198951-5
Physical Tests															
Conductivity	µS/cm		2.0	53.4	53.3	66.1	76.7	84.1	49.1	48.9	57.6	57.6	119	118	118
Hardness (as $CaCO_3$)	mg/L		0.50	20.6	20.4	26.1	29.5	33.0	20.9	21.3	22.8	23.1	63.1	60.7	66.3
pH	pH	6.5-9.0	0.10	6.96	6.81	7.26	7.07	7.13	7.30	7.32	7.17	7.16	8.01	8.06	7.88
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	5.0	5.5	6.4	7.4	6.9	12.1	12.2	8.3	8.5	65.3	65.9	65.1
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0 - 2.0	5.0	5.5	6.4	7.4	6.9	12.1	12.2	8.3	8.5	65.3	65.9	65.1
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	38	28	43	45	53	33	34	38	40	68	69	70
Turbidity	NTU	dependent on background levels	0.10	0.23	0.22	0.22	0.45	0.37	0.28	0.33	0.36	0.39	0.29	0.25	0.19
Nutrients															
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	0.0061	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0115
Nitrate (as N)	mg/L	2.935[b]	0.0050	<0.0050	<0.0050	0.0314	0.0059	0.0091	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0165
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.125	0.113	0.201	0.131	0.177	0.190	0.200	0.192	0.182	0.143	0.146	0.140
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0028	0.0025	0.0032	0.0038	0.0037	0.0034	0.0036	0.0039	0.0037	0.0033	0.0029	0.0040
Anions															
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	3.21	3.25	3.46	6.01	8.32	1.14	1.13	2.62	2.62	0.68	0.67	0.66
Fluoride (F)	mg/L	0.12[b]	0.02	0.027	0.027	0.033	0.036	0.036	0.021	0.021	0.028	0.028	<0.020	<0.020	<0.020
Sulfate (SO_4)	mg/L		0.5	13.4	13.5	16.7	17.7	17.8	9.19	9.21	13.4	13.5	0.66	0.65	0.70
Cyanides															
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon															
Total Organic Carbon	mg/L		0.50	1.24	1.18	2.00	2.12	2.47	2.09	2.13	2.21	2.26	2.71	2.54	2.58
Total Metals															
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0140	0.0112	0.0093	0.0328	0.0117	0.0051	0.0042	0.0076	0.0067	0.0031	0.0031	<0.0030
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000409	0.000424	0.000514	0.000653	0.000588	0.00115	0.00113	0.000988	0.000975	0.000215	0.000216	0.000214
Barium (Ba)	mg/L		0.000050	0.00203	0.00280	0.00287	0.00348	0.00407	0.00272	0.000966	0.00299	0.00229	0.0211	0.0205	0.0211
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	<0.0050	<0.0050	0.0078	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0051
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	<0.000010	<0.000010	<0.000010	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	4.73	4.79	6.52	6.97	8.69	4.09	4.09	5.24	5.28	14.6	15.2	15.8
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	<0.00010	<0.00010	<0.00010	0.00015	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L		0.00010	0.00015	0.00015	0.00070	0.00080	0.00027	<0.00010	<0.00010	0.00012	0.00013	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	≥0.002[e]	0.00050	0.00133	0.00131	0.00231	0.00313	0.00236	0.00164	0.00148	0.00202	0.00194	0.00097	0.00107	0.00097
Iron (Fe)	mg/L	0.3	0.010	<0.010	<0.010	0.021	0.043	0.057	0.035	0.034	0.074	0.071	<0.010	<0.010	<0.010
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	0.000054	<0.000050	0.000061	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.91	1.87	2.28	2.58	2.70	2.81	2.77	2.46	2.46	5.94	6.09	6.14
Manganese (Mn)	mg/L		0.000050	0.00172	0.00156	0.00425	0.00385	0.00407	0.00181	0.00170	0.00300	0.00290	0.00246	0.00250	0.00173
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	<0.000050	<0.000050	<0.000050	0.000076	0.000073	0.000074
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00209	0.00208	0.00532	0.00540	0.00373	0.00140	0.00133	0.00327	0.00314	0.00014	0.00012	0.00014
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.340	0.341	0.415	0.481	0.500	0.354	0.352	0.386	0.370	0.239	0.242	0.249
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.114	0.109	0.255	0.222	0.212	0.374	0.373	0.238	0.228	0.958	0.996	1.17
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.751	0.748	0.904	1.06	1.13	0.601	0.595	0.846	0.820	0.447	0.465	0.474
Strontium (Sr)	mg/L		0.00010 - 0.00020	0.0174	0.0174	0.0244	0.0328	0.0444	0.00846	0.00840	0.0180	0.0180	0.00681	0.00719	0.00721
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

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Appendix 3.2-1. Lake Water Quality Analytical Results, Back River Project, 2012

Area				George	George	George	George	George	George	George	George	George	George	George	George
Location				George Lake Central	George Lake South	Lytle Lake	Occurrence Lake	Sleigh Lake	Dragon Lake	Dragon Lake	Komatic Lake	Komatic Lake	Reference C Lake	Reference C Lake	Reference C Lake
Replicate				1	1	1	1	1	1	2	1	1	1	2	1
Duplicate?				-	-	-	-	-	-	duplicate	-	-	-	duplicate	-
Depth (m)			Realised	7	0.5	0.5	1	0.5	1	1	1	3.5	1	1	29
Date Sampled		CCME Guideline for the Protection	Detection Limit	18-Aug-12	18-Aug-12	23-Aug-12	21-Aug-12	22-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12
ALS Sample ID	Units	of Freshwater Aquatic Life[a]	RDL	L1197323-6	L1197323-1	L1199564-1	L1198951-2	L1198951-6	L1197323-10	L1197323-11	L1197323-12	L1197323-13	L1198951-3	L1198951-4	L1198951-5
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	0.000012	0.000015	0.000011	<0.000010	<0.000010	<0.000010	<0.000010	0.000293	0.000315	0.000304
Vanadium (V)	mg/L		0.000050	0.000068	0.000091	0.000101	0.000222	0.000201	0.000099	0.000098	0.000125	0.000137	0.000228	0.000203	0.000221
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	0.0038	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals															
Aluminum (Al)	mg/L		0.0030	0.0068	0.0075	0.0043	0.0124	0.0059	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000408	0.000424	0.000430	0.000559	0.000502	0.000918	0.000866	0.000748	0.000702	0.000215	0.000207	0.000188
Barium (Ba)	mg/L		0.000050	0.00217	0.00290	0.00285	0.00329	0.00426	0.00291	0.00103	0.00286	0.00232	0.0218	0.0214	0.0202
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	<0.0050	<0.0050	0.0056	<0.0050	0.0053	<0.0050	<0.0050	<0.0050	<0.0050	0.0056	0.0071	0.0056
Cadmium (Cd)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	5.11	5.00	6.61	7.52	8.86	4.12	4.15	5.17	5.32	15.8	14.8	16.7
Chromium (Cr)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	0.00010	0.00011	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	0.00011	<0.00010
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	0.00030	0.00073	0.00021	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L		0.00050	0.00104	0.00109	0.00168	0.00236	0.00187	0.00115	0.00119	0.00156	0.00152	0.00101	0.00083	0.00079
Iron (Fe)	mg/L		0.010	<0.010	<0.010	0.019	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	<0.010	<0.010	<0.010
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.91	1.93	2.33	2.61	2.64	2.59	2.65	2.40	2.38	5.74	5.76	5.98
Manganese (Mn)	mg/L		0.000050	0.000400	0.000543	0.00212	0.00316	0.00345	<0.000050	<0.000050	0.000642	0.000490	<0.000050	<0.000050	<0.000050
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000050	<0.000050	<0.000050	<0.000050	0.000089	0.000077	0.000069
Nickel (Ni)	mg/L		0.00010	0.00212	0.00219	0.00540	0.00525	0.00367	0.00128	0.00127	0.00301	0.00289	0.00016	0.00016	0.00014
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.361	0.359	0.418	0.479	0.508	0.340	0.345	0.361	0.358	0.242	0.238	0.249
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.103	0.107	0.251	0.193	0.208	0.354	0.354	0.216	0.215	0.978	0.994	1.14
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.778	0.783	0.949	1.07	1.10	0.562	0.567	0.795	0.781	0.461	0.454	0.465
Strontium (Sr)	mg/L		0.00010 - 0.00020	0.0182	0.0181	0.0243	0.0350	0.0452	0.00829	0.00833	0.0173	0.0177	0.00709	0.00704	0.00703
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000320	0.000311	0.000305
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000055
Zinc (Zn)	mg/L		0.0030	<0.0030	0.0033	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

** Due to a lab error, dissolved metals data is not available for Propellor Lake samples collected in April*

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ /1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ /1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ /1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.2-2

Lake Water Quality Analytical Results of Field Duplicates, Back River Project, 2012

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Appendix 3.2-2. Lake Water Quality Analytical Results of Field Duplicates

Location	Big Lake				Fox Lake				Giraffe Lake North				Goose Lake Central			
Replicate	1	2			1	2			1	2			1	2		
Duplicate	sample	duplicate			sample	duplicate			sample	duplicate			sample	duplicate		
Depth	1	1			1	1			1	1			1	1		
Date Sampled	10-Apr-12	10-Apr-12			10-Apr-12	10-Apr-12			11-Apr-12	11-Apr-12			11-Apr-12	11-Apr-12		
ALS Sample ID	L1133356-3	L1133356-10			L1133356-9	L1133356-4			L1133911-7	L1133911-10			L1133911-1	L1133911-2		
	Sample	Duplicate	5 x DL	RPD_a	Sample	Duplicate	5 x DL	RPD_a	Sample	Duplicate	5 x DL	RPD_a	Sample	Duplicate	5 x DL	RPD_a
Physical Tests																
Conductivity	34.0	35.6	10	4.6	50.1	47.6	10	5.1	72.6	73.1	10	0.7	65.7	61.8	10	6.1
Hardness (as $CaCO_3$)	12.7	12.5	2.5	1.6	21.4	20.6	2.5	3.8	27.7	27.5	2.5	0.7	22.4	22.1	2.5	1.3
pH	6.83	7.68	0.5	11.7	7.10	7.13	0.5	0.4	8.07	8.11	0.5	0.5	6.82	8.05	0.5	16.5
Alkalinity, Bicarbonate (as $CaCO_3$)	7.1	6.7	10	RPD-N/A	12.6	12.4	10	1.6	10.8	10.6	10	1.9	7.4	6.6	10	RPD-N/A
Alkalinity, Carbonate (as $CaCO_3$)	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A
Alkalinity, Hydroxide (as $CaCO_3$)	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A
Alkalinity, Total (as $CaCO_3$)	7.1	6.7	10	RPD-N/A	12.6	12.4	10	1.6	10.8	10.6	10	1.9	7.4	6.6	10	RPD-N/A
Total Suspended Solids	<3.0	<3.0	15	RPD-N/A	<3.0	<3.0	15	RPD-N/A	<3.0	<3.0	15	RPD-N/A	<3.0	<3.0	15	RPD-N/A
Total Dissolved Solids	29	30	50	RPD-N/A	38	36	50	RPD-N/A	54	50	50	RPD-N/A	48	45	50	RPD-N/A
Turbidity	0.59	0.37	0.5	RPD-N/A	1.21	0.26	0.5	RPD-N/A	0.24	0.29	0.5	RPD-N/A	0.31	0.29	0.5	RPD-N/A
Nutrients																
Ammonia, Total (as N)	0.0257	0.0220	0.025	RPD-N/A	0.0396	0.0384	0.025	3.1	0.0289	0.0292	0.025	1.0	0.0205	0.0220	0.025	RPD-N/A
Nitrate (as N)	0.0176	0.0178	0.025	RPD-N/A	0.0066	0.0065	0.025	RPD-N/A	0.0179	0.0170	0.025	RPD-N/A	0.0109	0.0089	0.025	RPD-N/A
Nitrite (as N)	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Total Kjeldahl Nitrogen	<0.050	<0.050	0.25	RPD-N/A	0.143	0.104	0.25	RPD-N/A	0.261	0.274	0.25	4.9	0.266	0.245	0.25	RPD-N/A
Ortho-phosphate (as P)	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Total Phosphorus (P)	0.0042	0.0054	0.01	RPD-N/A	0.0043	0.0038	0.01	RPD-N/A	0.0041	0.0030	0.01	RPD-N/A	0.0032	0.0033	0.01	RPD-N/A
Anions																
Bromide (Br)	<0.050	<0.050	0.25	RPD-N/A	<0.050	<0.050	0.25	RPD-N/A	<0.050	<0.050	0.25	RPD-N/A	<0.050	<0.050	0.25	RPD-N/A
Chloride (Cl)	0.93	0.91	2.5	RPD-N/A	1.02	0.88	2.5	RPD-N/A	1.28	1.27	2.5	RPD-N/A	8.44	7.98	2.5	5.6
Fluoride (F)	0.024	0.024	0.1	RPD-N/A	0.033	0.031	0.1	RPD-N/A	0.036	0.036	0.1	RPD-N/A	0.028	0.026	0.1	RPD-N/A
Sulfate (SO_4)	7.27	7.28	2.5	0.1	9.36	8.82	2.5	5.9	19.5	19.4	2.5	0.5	8.93	8.53	2.5	4.6
Cyanides																
Cyanide, Total	<0.0010	0.0013	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	0.0013	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Cyanide, Free	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Organic / Inorganic Carbon																
Total Organic Carbon	4.47	4.45	2.5	0.4	4.90	4.68	2.5	4.6	6.01	6.45	2.5	7.1	4.87	4.85	2.5	0.4
Total Metals																
Aluminum (Al)	0.0191	0.0170	0.015	11.6	0.0072	0.0065	0.015	RPD-N/A	0.0298	0.0300	0.015	0.7	0.0237	0.0259	0.015	8.9
Antimony (Sb)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Arsenic (As)	0.000463	0.000440	0.00015	5.1	0.000359	0.000350	0.00015	2.5	0.000304	0.000285	0.00015	6.5	0.000272	0.000243	0.00015	11.3
Barium (Ba)	0.00553	0.00570	0.00025	3.0	0.00629	0.00527	0.00025	17.6	0.00927	0.00952	0.00025	2.7	0.0106	0.0105	0.00025	0.9
Beryllium (Be)	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A
Bismuth (Bi)	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A
Boron (B)	0.0071	0.0067	0.025	RPD-N/A	0.0070	0.0073	0.025	RPD-N/A	0.0064	0.0066	0.025	RPD-N/A	0.0059	0.0064	0.025	RPD-N/A
Cadmium (Cd)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	0.000016	0.000016	0.00005	RPD-N/A	0.000011	<0.000010	0.00005	RPD-N/A
Calcium (Ca)	2.64	2.66	0.1	0.8	4.61	4.53	0.1	1.8	5.14	5.23	0.1	1.7	5.27	5.21	0.1	1.1
Chromium (Cr)	0.00023	0.00029	0.0005	RPD-N/A	0.00022	0.00017	0.0005	RPD-N/A	0.00027	0.00029	0.0005	RPD-N/A	0.00021	0.00020	0.0005	RPD-N/A
Cobalt (Co)	0.00072	0.00130	0.0005	**57.4**	<0.00010	<0.00010	0.0005	RPD-N/A	0.00068	0.00069	0.0005	1.5	0.00029	0.00031	0.0005	RPD-N/A
Copper (Cu)	0.00203	0.00180	0.0025	RPD-N/A	0.00191	0.00168	0.0025	RPD-N/A	0.00382	0.00388	0.0025	1.6	0.00230	0.00229	0.0025	RPD-N/A
Iron (Fe)	0.061	0.115	0.05	**61.4**	0.015	0.014	0.05	RPD-N/A	0.029	0.028	0.05	RPD-N/A	0.010	<0.010	0.05	RPD-N/A
Lead (Pb)	<0.000050	<0.000050	0.00025	RPD-N/A	0.00986	0.000351	0.00025	**186.3**	<0.000050	<0.000050	0.00025	RPD-N/A	0.000693	0.000400	0.00025	**53.6**
Lithium (Li)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Magnesium (Mg)	1.65	1.58	0.025	4.3	2.52	2.44	0.025	3.2	3.65	3.65	0.025	0.0	2.57	2.54	0.025	1.2
Manganese (Mn)	0.0214	0.0382	0.00025	**56.4**	0.00391	0.00532	0.00025	*30.6*	0.00726	0.00732	0.00025	0.8	0.00428	0.00435	0.00025	1.6
Mercury (Hg)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Molybdenum (Mo)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	0.000053	0.00025	RPD-N/A
Nickel (Ni)	0.00473	0.00460	0.0005	2.8	0.00427	0.00406	0.0005	5.0	0.0159	0.0157	0.0005	1.3	0.00744	0.00745	0.0005	0.1
Phosphorus (P)	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A
Potassium (K)	0.468	0.450	0.25	3.9	0.647	0.619	0.25	4.4	0.631	0.630	0.25	0.2	0.509	0.502	0.25	1.4
Selenium (Se)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Silicon (Si)	0.590	0.601	0.25	1.8	0.796	0.764	0.25	4.1	1.68	1.71	0.25	1.8	0.968	0.960	0.25	0.8
Silver (Ag)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Sodium (Na)	0.943	0.887	0.05	6.1	1.09	1.04	0.05	4.7	1.51	1.53	0.05	1.3	1.13	1.12	0.05	0.9

Appendix 3.2-2. Lake Water Quality Analytical Results of Field Duplicates

Location	Big Lake				Fox Lake				Giraffe Lake North				Goose Lake Central			
Replicate	**1**	**2**			**1**	**2**			**1**	**2**			**1**	**2**		
Duplicate	**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**		
Depth	**1**	**1**			**1**	**1**			**1**	**1**			**1**	**1**		
Date Sampled	**10-Apr-12**	**10-Apr-12**			**10-Apr-12**	**10-Apr-12**			**11-Apr-12**	**11-Apr-12**			**11-Apr-12**	**11-Apr-12**		
ALS Sample ID	**L1133356-3**	**L1133356-10**			**L1133356-9**	**L1133356-4**			**L1133911-7**	**L1133911-10**			**L1133911-1**	**L1133911-2**		
	Sample	**Duplicate**	**5 x DL**	**RPD$_a$**	**Sample**	**Duplicate**	**5 x DL**	**RPD$_a$**	**Sample**	**Duplicate**	**5 x DL**	**RPD$_a$**	**Sample**	**Duplicate**	**5 x DL**	**RPD$_a$**
Strontium (Sr)	0.0115	0.0118	0.0005	2.6	0.0151	0.0143	0.0005	5.4	0.0213	0.0216	0.0005	1.4	0.0245	0.0245	0.0005	0.0
Thallium (Tl)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Tin (Sn)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Titanium (Ti)	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A
Uranium (U)	0.000014	0.000013	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	0.000020	0.000019	0.00005	RPD-N/A	0.000011	0.000011	0.00005	RPD-N/A
Vanadium (V)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	0.000061	0.000051	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Zinc (Zn)	0.0037	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A	0.0053	0.0053	0.015	RPD-N/A	0.0032	0.0031	0.015	RPD-N/A
Dissolved Metals																
Aluminum (Al)	0.0151	0.0116	0.015	RPD-N/A	0.0049	0.0044	0.015	RPD-N/A	0.0263	0.0267	0.015	1.5	0.0209	0.0211	0.015	1.0
Antimony (Sb)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Arsenic (As)	0.000419	0.000370	0.00015	12.4	0.000354	0.000347	0.00015	2.0	0.000329	0.000318	0.00015	3.4	0.000237	0.000254	0.00015	6.9
Barium (Ba)	0.00536	0.00555	0.00025	3.5	0.00607	0.00518	0.00025	15.8	0.00914	0.00915	0.00025	0.1	0.0102	0.0101	0.00025	1.0
Beryllium (Be)	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A
Bismuth (Bi)	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A
Boron (B)	0.0061	0.0059	0.025	RPD-N/A	0.0061	0.0083	0.025	RPD-N/A	0.0062	0.0060	0.025	RPD-N/A	0.0051	0.0056	0.025	RPD-N/A
Cadmium (Cd)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	0.000012	0.000015	0.00005	RPD-N/A	0.000011	<0.000010	0.00005	RPD-N/A
Calcium (Ca)	2.53	2.51	0.1	0.8	4.52	4.37	0.1	3.4	5.17	5.10	0.1	1.4	4.95	4.86	0.1	1.8
Chromium (Cr)	0.00020	0.00015	0.0005	RPD-N/A	0.00016	0.00014	0.0005	RPD-N/A	0.00022	0.00020	0.0005	RPD-N/A	0.00017	0.00018	0.0005	RPD-N/A
Cobalt (Co)	0.00072	0.00126	0.0005	**54.5**	<0.00010	<0.00010	0.0005	RPD-N/A	0.00053	0.00054	0.0005	1.9	0.00022	0.00022	0.0005	RPD-N/A
Copper (Cu)	0.00171	0.00156	0.0025	RPD-N/A	0.00174	0.00152	0.0025	RPD-N/A	0.00358	0.00356	0.0025	0.6	0.00209	0.00205	0.0025	RPD-N/A
Iron (Fe)	0.019	0.027	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	0.011	0.012	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A
Lead (Pb)	<0.000050	<0.000050	0.00025	RPD-N/A	0.00485	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	0.000307	0.000210	0.00025	RPD-N/A
Lithium (Li)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Magnesium (Mg)	1.56	1.51	0.025	3.3	2.47	2.36	0.025	4.6	3.59	3.58	0.025	0.3	2.44	2.41	0.025	1.2
Manganese (Mn)	0.0221	0.0386	0.00025	**54.4**	0.000502	0.000169	0.00025	RPD-N/A	0.00481	0.00509	0.00025	5.7	0.00298	0.00309	0.00025	3.6
Mercury (Hg)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Molybdenum (Mo)	0.000069	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Nickel (Ni)	0.00460	0.00444	0.0005	3.5	0.00426	0.00399	0.0005	6.5	0.0157	0.0155	0.0005	1.3	0.00710	0.00715	0.0005	0.7
Phosphorus (P)	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A
Potassium (K)	0.446	0.424	0.25	5.1	0.628	0.606	0.25	3.6	0.616	0.626	0.25	1.6	0.492	0.478	0.25	2.9
Selenium (Se)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Silicon (Si)	0.561	0.581	0.25	3.5	0.779	0.731	0.25	6.4	1.65	1.67	0.25	1.2	0.913	0.901	0.25	1.3
Silver (Ag)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Sodium (Na)	0.889	0.836	0.05	6.1	1.07	1.01	0.05	5.8	1.49	1.46	0.05	2.0	1.07	1.06	0.05	0.9
Strontium (Sr)	0.0110	0.0111	0.0005	0.9	0.0148	0.0138	0.0005	7.0	0.0214	0.0214	0.0005	0.0	0.0233	0.0228	0.0005	2.2
Thallium (Tl)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Tin (Sn)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Titanium (Ti)	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A
Uranium (U)	0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	0.000018	0.000018	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Vanadium (V)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	0.000051	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Zinc (Zn)	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A	0.0039	0.0039	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A

a) Relative percent difference (RPD).

b) RPD-N/A -Not applicable when the values are less than five times the detection limit.

Italicized values exceed the 20% relative percent difference and are more than five times the detection limit.

Bold values exceed the 50% relative percent difference and are more than five times the detection limit.

Appendix 3.2-2. Lake Water Quality Analytical Results of Field Duplicates

Location	Lower Long Lake				Fold Lake				George Lake Central				Reference C Lake			
Replicate	**1**	**2**			**1**	**2**			**1**	**2**			**1**	**2**		
Duplicate	**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**		
Depth	**1**	**1**			**1**	**1**			**5.5**	**5.5**			**5.5**	**5.5**		
Date Sampled	**13-Apr-12**	**13-Apr-12**			**15-Apr-12**	**15-Apr-12**			**13-Apr-12**	**13-Apr-12**			**13-Apr-12**	**13-Apr-12**		
ALS Sample ID	**L1135132-4**	**L1135132-5**			**L1135132-14**	**L1135132-16**			**L1135132-10**	**L1135132-11**			**L1135132-2**	**L1135132-3**		
	Sample	**Duplicate**	**5 x DL**	**RPD_a**	**Sample**	**Duplicate**	**5 x DL**	**RPD_a**	**Sample**	**Duplicate**	**5 x DL**	**RPD_a**	**Sample**	**Duplicate**	**5 x DL**	**RPD_a**
Physical Tests																
Conductivity	53.6	52.0	10	3.0	75.0	71.6	10	4.6	104	103	10	1.0	148	149	0	0.7
Hardness (as $CaCO_3$)	27.2	28.1	2.5	3.3	34.7	31.8	2.5	8.7	45.1	45.1	2.5	0.0	76.0	79.1	0	4.0
pH	8.32	8.25	0.5	0.8	8.28	7.90	0.5	4.7	8.19	8.23	0.5	0.5	8.23	8.27	0	0.5
Alkalinity, Bicarbonate (as $CaCO_3$)	25.7	20.7	**5 and 10**	*21.6*	12.7	12.5	10	1.6	10.9	10.4	10	4.7	77.7	77.6	0	0.1
Alkalinity, Carbonate (as $CaCO_3$)	**<1.0**	**<2.0**	**5 and 10**	RPD-N/A	**<2.0**	**<2.0**	10	RPD-N/A	**<2.0**	**<2.0**	10	RPD-N/A	<2.0	<2.0	0	RPD-N/A
Alkalinity, Hydroxide (as $CaCO_3$)	**<1.0**	**<2.0**	**5 and 10**	RPD-N/A	**<2.0**	**<2.0**	10	RPD-N/A	**<2.0**	**<2.0**	10	RPD-N/A	<2.0	<2.0	0	RPD-N/A
Alkalinity, Total (as $CaCO_3$)	25.7	20.7	**5 and 10**	*21.6*	12.7	12.5	10	1.6	10.9	10.4	10	4.7	77.7	77.6	0	0.1
Total Suspended Solids	**<3.0**	**<3.0**	**15**	RPD-N/A	**<3.0**	**<3.0**	15	RPD-N/A	**<3.0**	**<3.0**	15	RPD-N/A	<3.0	<3.0	0	RPD-N/A
Total Dissolved Solids	32	30	50	RPD-N/A	46	42	50	RPD-N/A	62	62	50	0.0	82	81	0	1.2
Turbidity	0.51	0.63	0.50	*21.1*	0.80	0.23	0.5	RPD-N/A	0.35	0.91	0.5	RPD-N/A	0.14	0.19	0	*30.3*
Nutrients																
Ammonia, Total (as N)	**<0.0050**	**<0.0050**	**0.025**	RPD-N/A	0.0068	0.0063	0.025	RPD-N/A	0.0124	0.0127	0.025	RPD-N/A	0.0122	0.0130	0	6.3
Nitrate (as N)	0.0197	0.0195	0.0250	RPD-N/A	0.0056	0.0075	0.025	RPD-N/A	0.0186	0.0174	0.025	RPD-N/A	0.0075	0.0083	0	10.1
Nitrite (as N)	**<0.0010**	**<0.0010**	**0.005**	RPD-N/A	**<0.0010**	**<0.0010**	0.005	RPD-N/A	**<0.0010**	**<0.0010**	0.005	RPD-N/A	<0.0010	<0.0010	0	RPD-N/A
Total Kjeldahl Nitrogen	0.191	0.207	0.250	RPD-N/A	0.187	0.230	0.25	RPD-N/A	0.179	0.189	0.25	RPD-N/A	0.199	0.203	0	2.0
Ortho-phosphate (as P)	**<0.0010**	**<0.0010**	**0.005**	RPD-N/A	**<0.0010**	**<0.0010**	0.005	RPD-N/A	**<0.0010**	**<0.0010**	0.005	RPD-N/A	<0.0010	<0.0010	0	RPD-N/A
Total Phosphorus (P)	0.0024	0.0027	0.0100	RPD-N/A	0.0050	0.0044	0.01	RPD-N/A	0.0027	0.0024	0.01	RPD-N/A	0.0024	0.0025	0	4.1
Anions																
Bromide (Br)	**<0.050**	**<0.050**	**0.25**	RPD-N/A	**<0.050**	**<0.050**	0.25	RPD-N/A	**<0.050**	**<0.050**	0.25	RPD-N/A	<0.050	<0.050	0	RPD-N/A
Chloride (Cl)	0.61	0.59	2.50	RPD-N/A	1.88	1.80	2.5	RPD-N/A	6.32	6.29	2.5	0.5	0.79	0.79	0	0.0
Fluoride (F)	**<0.020**	**<0.020**	**0.1**	RPD-N/A	0.026	0.025	0.1	RPD-N/A	0.035	0.035	0.1	RPD-N/A	0.020	0.021	0	4.9
Sulfate (SO_4)	4.15	4.10	2.50	1.2	17.9	17.3	2.5	3.4	24.7	24.6	2.5	0.4	0.88	0.88	0	0.0
Cyanides																
Cyanide, Total	**<0.0010**	**<0.0010**	**0.005**	RPD-N/A	**<0.0010**	**<0.0010**	0.005	RPD-N/A	**<0.0010**	**<0.0010**	0.005	RPD-N/A	<0.0010	<0.0010	0	RPD-N/A
Cyanide, Free	**<0.0010**	**<0.0010**	**0.005**	RPD-N/A	**<0.0010**	**<0.0010**	0.005	RPD-N/A	**<0.0010**	**<0.0010**	0.005	RPD-N/A	<0.0010	<0.0010	0	RPD-N/A
Organic / Inorganic Carbon																
Total Organic Carbon	3.23	3.16	2.50	2.2	2.44	2.29	2.5	RPD-N/A	2.28	2.23	2.5	RPD-N/A	3.38	3.47	0	2.6
Total Metals																
Aluminum (Al)	0.0038	0.0030	0.0150	RPD-N/A	**<0.0030**	0.0040	0.015	RPD-N/A	0.0079	0.0084	0.015	RPD-N/A	<0.0030	<0.0030	0	RPD-N/A
Antimony (Sb)	**<0.000050**	**<0.000050**	**0.00025**	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	<0.000050	<0.000050	0	RPD-N/A
Arsenic (As)	0.000432	0.000439	0.000150	1.6	0.000446	0.000394	0.00015	12.4	0.000489	0.000508	0.00015	3.8	0.000206	0.000207	0	0.5
Barium (Ba)	0.00137	0.00129	0.00025	6.0	0.00170	0.00164	0.00025	3.6	0.00442	0.00453	0.00025	2.5	0.0249	0.0247	0	0.8
Beryllium (Be)	**<0.00020**	**<0.00020**	**0.001**	RPD-N/A	**<0.00020**	**<0.00020**	0.001	RPD-N/A	**<0.00020**	**<0.00020**	0.001	RPD-N/A	<0.00020	<0.00020	0	RPD-N/A
Bismuth (Bi)	**<0.00050**	**<0.00050**	**0.0025**	RPD-N/A	**<0.00050**	**<0.00050**	0.0025	RPD-N/A	**<0.00050**	**<0.00050**	0.0025	RPD-N/A	<0.00050	<0.00050	0	RPD-N/A
Boron (B)	0.0071	0.0070	0.0250	RPD-N/A	0.0075	0.0073	0.025	RPD-N/A	0.0080	0.0075	0.025	RPD-N/A	0.0067	0.0089	0	*28.2*
Cadmium (Cd)	**<0.000010**	**<0.000010**	**0.00005**	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	**<0.000010**	0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0	RPD-N/A
Calcium (Ca)	5.45	5.45	0.10	0.0	8.14	7.43	0.1	9.1	12.0	11.8	0.1	1.7	19.2	20.1	0	4.6
Chromium (Cr)	0.00021	0.00011	0.00050	RPD-N/A	0.00011	0.00011	0.0005	RPD-N/A	0.00013	0.00013	0.0005	RPD-N/A	0.00017	0.00012	0	*34.5*
Cobalt (Co)	**<0.00010**	**<0.00010**	**0.0005**	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	0.00090	0.00092	0.0005	2.2	<0.00010	<0.00010	0	RPD-N/A
Copper (Cu)	0.00127	0.00134	0.00250	RPD-N/A	0.00136	0.00127	0.0025	RPD-N/A	0.00201	0.00198	0.0025	RPD-N/A	0.00102	0.00090	0	12.5
Iron (Fe)	0.011	**<0.010**	**0.05**	RPD-N/A	**<0.010**	**<0.010**	0.05	RPD-N/A	0.034	0.040	0.05	RPD-N/A	<0.010	<0.010	0	RPD-N/A
Lead (Pb)	**<0.000050**	**<0.000050**	**0.00025**	RPD-N/A	0.000577	0.000235	0.00025	RPD-N/A	0.00226	0.00170	0.00025	*28.3*	<0.000050	<0.000050	0	RPD-N/A
Lithium (Li)	**<0.0050**	**<0.0050**	**0.025**	RPD-N/A	**<0.0050**	**<0.0050**	0.025	RPD-N/A	**<0.0050**	**<0.0050**	0.025	RPD-N/A	<0.0050	<0.0050	0	RPD-N/A
Magnesium (Mg)	2.90	2.92	0.03	0.7	3.27	3.09	0.025	5.7	3.68	3.69	0.025	0.3	7.37	7.44	0	0.9
Manganese (Mn)	0.000576	0.000436	0.000250	*27.7*	0.00114	0.00120	0.00025	5.1	0.0275	0.0299	0.00025	8.4	0.00151	0.00147	0	2.7
Mercury (Hg)	**<0.000010**	**<0.000010**	**0.00005**	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	<0.000010	<0.000010	0	RPD-N/A
Molybdenum (Mo)	0.000066	0.000053	0.000250	RPD-N/A	0.000055	**<0.000050**	0.00025	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	0.000105	0.000094	0	11.1
Nickel (Ni)	0.00064	0.00065	0.00050	1.6	0.00212	0.00206	0.0005	2.9	0.00797	0.00770	0.0005	3.4	0.00016	0.00013	0	*20.7*
Phosphorus (P)	**<0.30**	**<0.30**	**1.5**	RPD-N/A	**<0.30**	**<0.30**	1.5	RPD-N/A	**<0.30**	**<0.30**	1.5	RPD-N/A	<0.30	<0.30	0	RPD-N/A
Potassium (K)	0.346	0.348	0.250	0.6	0.590	0.549	0.25	7.2	0.658	0.650	0.25	1.2	0.296	0.298	0	0.7
Selenium (Se)	**<0.00010**	**<0.00010**	**0.0005**	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	<0.00010	<0.00010	0	RPD-N/A
Silicon (Si)	0.592	0.596	0.250	0.7	0.274	0.259	0.25	5.6	0.469	0.466	0.25	0.6	1.21	1.21	0	0.0
Silver (Ag)	**<0.000010**	**<0.000010**	**0.00005**	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	<0.000010	<0.000010	0	RPD-N/A
Sodium (Na)	0.550	0.550	0.050	0.0	1.08	0.994	0.05	8.3	1.39	1.38	0.05	0.7	0.542	0.546	0	0.7

Appendix 3.2-2. Lake Water Quality Analytical Results of Field Duplicates

Location	Lower Long Lake				Fold Lake				George Lake Central				Reference C Lake			
Replicate	**1**	**2**			**1**	**2**			**1**	**2**			**1**	**2**		
Duplicate	**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**		
Depth	**1**	**1**			**1**	**1**			**5.5**	**5.5**			**5.5**	**5.5**		
Date Sampled	**13-Apr-12**	**13-Apr-12**			**15-Apr-12**	**15-Apr-12**			**13-Apr-12**	**13-Apr-12**			**13-Apr-12**	**13-Apr-12**		
ALS Sample ID	**L1135132-4**	**L1135132-5**			**L1135132-14**	**L1135132-16**			**L1135132-10**	**L1135132-11**			**L1135132-2**	**L1135132-3**		
	Sample	**Duplicate**	**5 x DL**	**RPD$_a$**	**Sample**	**Duplicate**	**5 x DL**	**RPD$_a$**	**Sample**	**Duplicate**	**5 x DL**	**RPD$_a$**	**Sample**	**Duplicate**	**5 x DL**	**RPD$_a$**
Strontium (Sr)	0.00943	0.00948	0.00050	0.5	0.0267	0.0241	0.0005	10.2	0.0421	0.0419	0.0005	0.5	0.00863	0.00854	0	1.0
Thallium (Tl)	**<0.000050**	**<0.000050**	**0.00025**	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	<0.000050	<0.000050	0	RPD-N/A
Tin (Sn)	**<0.00010**	**<0.00010**	**0.0005**	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	<0.00010	<0.00010	0	RPD-N/A
Titanium (Ti)	**<0.010**	**<0.010**	**0.05**	RPD-N/A	**<0.010**	**<0.010**	0.05	RPD-N/A	**<0.010**	**<0.010**	0.05	RPD-N/A	<0.010	<0.010	0	RPD-N/A
Uranium (U)	0.000042	0.000039	0.000050	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	0.000402	0.000398	0	1.0
Vanadium (V)	**<0.000050**	**<0.000050**	**0.00025**	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	0.000050	0.000050	0	0.0
Zinc (Zn)	**<0.0030**	**<0.0030**	**0.015**	RPD-N/A	0.0033	0.0032	0.015	RPD-N/A	0.0071	0.0070	0.015	RPD-N/A	<0.0030	<0.0030	0	RPD-N/A
Dissolved Metals																
Aluminum (Al)	**<0.0030**	**<0.0030**	**0.015**	RPD-N/A	**<0.0030**	**<0.0030**	0.015	RPD-N/A	**<0.0030**	**<0.0030**	0.015	RPD-N/A	<0.0030	<0.0030	0	RPD-N/A
Antimony (Sb)	**<0.000050**	**<0.000050**	**0.00025**	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	<0.000050	<0.000050	0	RPD-N/A
Arsenic (As)	0.000466	0.000449	0.000150	3.7	0.000435	0.000435	0.00015	0.0	0.000380	0.000390	0.00015	2.6	0.000185	0.000198	0	6.8
Barium (Ba)	0.00136	0.00129	0.00025	5.3	0.00177	0.00168	0.00025	5.2	0.00438	0.00487	0.00025	10.6	0.0251	0.0251	0	0.0
Beryllium (Be)	**<0.00020**	**<0.00020**	**0.001**	RPD-N/A	**<0.00020**	**<0.00020**	0.001	RPD-N/A	**<0.00020**	**<0.00020**	0.001	RPD-N/A	<0.00020	<0.00020	0	RPD-N/A
Bismuth (Bi)	**<0.00050**	**<0.00050**	**0.0025**	RPD-N/A	**<0.00050**	**<0.00050**	0.0025	RPD-N/A	**<0.00050**	**<0.00050**	0.0025	RPD-N/A	<0.00050	<0.00050	0	RPD-N/A
Boron (B)	**<0.0050**	**<0.0050**	**0.025**	RPD-N/A	**<0.0050**	**<0.0050**	0.025	RPD-N/A	**<0.0050**	**<0.0050**	0.025	RPD-N/A	<0.0050	<0.0050	0	RPD-N/A
Cadmium (Cd)	**<0.000010**	**<0.000010**	**0.00005**	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	0.000011	**<0.000010**	0.00005	RPD-N/A	<0.000010	<0.000010	0	RPD-N/A
Calcium (Ca)	5.11	5.00	0.10	2.2	7.04	6.61	0.1	6.3	9.91	10.0	0.1	0.9	18.6	18.7	0	0.5
Chromium (Cr)	**<0.00010**	**<0.00010**	**0.0005**	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	<0.00010	<0.00010	0	RPD-N/A
Cobalt (Co)	**<0.00010**	**<0.00010**	**0.0005**	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	<0.00010	<0.00010	0	RPD-N/A
Copper (Cu)	0.00111	0.00110	0.00250	RPD-N/A	0.00111	0.00106	0.0025	RPD-N/A	0.00160	0.00164	0.0025	RPD-N/A	0.00088	0.00082	0	7.1
Iron (Fe)	**<0.010**	**<0.010**	**0.05**	RPD-N/A	**<0.010**	**<0.010**	0.05	RPD-N/A	**<0.010**	**<0.010**	0.05	RPD-N/A	<0.010	<0.010	0	RPD-N/A
Lead (Pb)	**<0.000050**	**<0.000050**	**0.00025**	RPD-N/A	0.000105	**<0.000050**	0.00025	RPD-N/A	0.000056	**<0.000050**	0.00025	RPD-N/A	<0.000050	<0.000050	0	RPD-N/A
Lithium (Li)	**<0.0050**	**<0.0050**	**0.025**	RPD-N/A	**<0.0050**	**<0.0050**	0.025	RPD-N/A	**<0.0050**	**<0.0050**	0.025	RPD-N/A	<0.0050	<0.0050	0	RPD-N/A
Magnesium (Mg)	2.92	2.89	0.03	1.0	3.19	3.07	0.025	3.8	3.52	3.63	0.025	3.1	7.31	7.39	0	1.1
Manganese (Mn)	0.000098	0.000097	0.000250	RPD-N/A	0.000075	0.000066	0.00025	RPD-N/A	0.00869	0.00954	0.00025	9.3	0.000117	0.000107	0	8.9
Mercury (Hg)	**<0.000010**	**<0.000010**	**0.00005**	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	<0.000010	<0.000010	0	RPD-N/A
Molybdenum (Mo)	**<0.000050**	0.000053	0.000250	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	0.000083	0.000089	0	7.0
Nickel (Ni)	0.00065	0.00067	0.00050	3.0	0.00221	0.00203	0.0005	8.5	0.00780	0.00773	0.0005	0.9	0.00016	0.00015	0	6.5
Phosphorus (P)	**<0.30**	**<0.30**	**1.5**	RPD-N/A	**<0.30**	**<0.30**	1.5	RPD-N/A	**<0.30**	**<0.30**	1.5	RPD-N/A	<0.30	<0.30	0	RPD-N/A
Potassium (K)	0.352	0.345	0.250	2.0	0.587	0.550	0.25	6.5	0.636	0.654	0.25	2.8	0.300	0.296	0	1.3
Selenium (Se)	**<0.00010**	**<0.00010**	**0.0005**	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	<0.00010	<0.00010	0	RPD-N/A
Silicon (Si)	0.594	0.580	0.250	2.4	0.276	0.256	0.25	7.5	0.448	0.465	0.25	3.7	1.19	1.20	0	0.8
Silver (Ag)	**<0.000010**	**<0.000010**	**0.00005**	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	<0.000010	<0.000010	0	RPD-N/A
Sodium (Na)	0.562	0.544	0.050	3.3	1.05	1.00	0.05	4.9	1.37	1.40	0.05	2.2	0.558	0.551	0	1.3
Strontium (Sr)	0.00919	0.00907	0.00050	1.3	0.0233	0.0216	0.0005	7.6	0.0354	0.0358	0.0005	1.1	0.00828	0.00842	0	1.7
Thallium (Tl)	**<0.000050**	**<0.000050**	**0.00025**	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	<0.000050	<0.000050	0	RPD-N/A
Tin (Sn)	**<0.00010**	**<0.00010**	**0.0005**	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	**<0.00010**	**<0.00010**	0.0005	RPD-N/A	<0.00010	<0.00010	0	RPD-N/A
Titanium (Ti)	**<0.010**	**<0.010**	**0.05**	RPD-N/A	**<0.010**	**<0.010**	0.05	RPD-N/A	**<0.010**	**<0.010**	0.05	RPD-N/A	<0.010	<0.010	0	RPD-N/A
Uranium (U)	0.000028	0.000029	0.000050	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	**<0.000010**	**<0.000010**	0.00005	RPD-N/A	0.000381	0.000383	0	0.5
Vanadium (V)	**<0.000050**	**<0.000050**	**0.00025**	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	**<0.000050**	**<0.000050**	0.00025	RPD-N/A	<0.000050	<0.000050	0	RPD-N/A
Zinc (Zn)	**<0.0030**	**<0.0030**	**0.015**	RPD-N/A	**<0.0030**	**<0.0030**	0.015	RPD-N/A	0.0054	0.0053	0.015	RPD-N/A	<0.0030	<0.0030	0	RPD-N/A

a) Relative percent difference (RPD).

b) RPD-N/A -Not applicable when the values are less than five times the detection limit.

Italicized values exceed the 20% relative percent difference and are more than five times the detection limit.

Bold values exceed the 50% relative percent difference and are more than five times the detection limit.

Appendix 3.2-2. Lake Water Quality Analytical Results of Field Duplicates

Location	Fox Lake				Giraffe Lake South				Goose Lake Neck				Propellor Lake			
Replicate	**1**	**2**			**1**	**2**			**1**	**2**			**1**	**2**		
Duplicate	**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**		
Depth	**1**	**1**			**3.7**	**3.7**			**1**	**1**			**1**	**1**		
Date Sampled	**20-Aug-12**	**20-Aug-12**			**19-Aug-12**	**19-Aug-12**			**14-Aug-12**	**14-Aug-12**			**21-Aug-12**	**21-Aug-12**		
ALS Sample ID	**L1198584-5**	**L1198584-6**			**L1198584-2**	**L1198584-3**			**L1195581-4**	**L1195581-5**			**L1198584-8**	**L1198584-9**		
	Sample	**Duplicate**	**5 x DL**	**RPD_a**	**Sample**	**Duplicate**	**5 x DL**	**RPD_a**	**Sample**	**Duplicate**	**5 x DL**	**RPD_a**	**Sample**	**Duplicate**	**5 x DL**	**RPD_a**
Physical Tests																
Conductivity	18.5	18.3	10	1.1	24.1	24.0	10	0.4	36.1	36.1	10	0.0	19.5	19.3	10	1.0
Hardness (as $CaCO_3$)	7.28	7.41	2.5	1.8	9.34	9.28	2.5	0.6	13.9	14.0	2.5	0.7	7.51	7.76	2.5	3.3
pH	6.85	6.87	0.5	0.3	6.91	6.86	0.5	0.7	6.74	6.61	0.5	1.9	6.77	6.73	0.5	0.6
Alkalinity, Bicarbonate (as $CaCO_3$)	4.9	4.7	10	RPD-N/A	4.1	3.6	10	RPD-N/A	3.5	3.7	10	RPD-N/A	3.0	3.1	10	RPD-N/A
Alkalinity, Carbonate (as $CaCO_3$)	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A
Alkalinity, Hydroxide (as $CaCO_3$)	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A
Alkalinity, Total (as $CaCO_3$)	4.9	4.7	10	RPD-N/A	4.1	3.6	10	RPD-N/A	3.5	3.7	10	RPD-N/A	3.0	3.1	10	RPD-N/A
Total Suspended Solids	**1.5**	**1.5**	15	RPD-N/A	<3.0	**1.5**	15	RPD-N/A	<3.0	<3.0	15	RPD-N/A	**1.5**	**1.5**	15	RPD-N/A
Total Dissolved Solids	13	15	50	RPD-N/A	18	18	50	RPD-N/A	23	34	50	RPD-N/A	18	15	50	RPD-N/A
Turbidity	0.44	0.40	0.5	RPD-N/A	0.28	0.59	0.5	RPD-N/A	0.41	0.36	0.5	RPD-N/A	0.42	0.31	0.5	RPD-N/A
Nutrients																
Ammonia, Total (as N)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Nitrate (as N)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	0.0076	0.025	RPD-N/A
Nitrite (as N)	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Total Kjeldahl Nitrogen	0.202	0.196	0.25	RPD-N/A	0.202	0.162	0.25	RPD-N/A	0.168	0.151	0.25	RPD-N/A	0.181	0.151	0.25	RPD-N/A
Ortho-phosphate (as P)	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Total Phosphorus (P)	0.0034	0.0037	0.01	RPD-N/A	0.0032	0.0030	0.01	RPD-N/A	0.0029	0.0030	0.01	RPD-N/A	0.0036	0.0036	0.01	RPD-N/A
Anions																
Bromide (Br)	<0.050	<0.050	0.25	RPD-N/A	<0.050	<0.050	0.25	RPD-N/A	<0.050	<0.050	0.25	RPD-N/A	<0.050	<0.050	0.25	RPD-N/A
Chloride (Cl)	<0.50	<0.50	2.5	RPD-N/A	0.53	0.56	2.5	RPD-N/A	5.62	5.63	2.5	0.2	1.65	1.61	2.5	RPD-N/A
Fluoride (F)	0.020	<0.020	0.1	RPD-N/A	0.024	0.025	0.1	RPD-N/A	<0.020	<0.020	0.1	RPD-N/A	<0.020	<0.020	0.1	RPD-N/A
Sulfate (SO_4)	3.23	3.22	2.5	0.3	5.79	5.80	2.5	0.2	4.34	4.34	2.5	0.0	2.78	2.80	2.5	0.7
Cyanides																
Cyanide, Total	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Cyanide, Free	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Organic / Inorganic Carbon																
Total Organic Carbon	2.87	2.68	2.5	6.8	2.89	3.11	2.5	7.3	2.84	2.86	2.5	0.7	3.17	2.92	2.5	8.2
Total Metals																
Aluminum (Al)	0.0137	0.0061	0.015	RPD-N/A	0.0131	0.0178	0.015	RPD-N/A	0.0140	0.0137	0.015	RPD-N/A	0.0171	0.0102	0.015	RPD-N/A
Antimony (Sb)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Arsenic (As)	0.000208	0.000229	0.00015	9.6	0.000202	0.000221	0.00015	9.0	0.000236	0.000195	0.00015	19.0	0.000148	0.000147	0.00015	RPD-N/A
Barium (Ba)	0.00172	0.00171	0.00025	0.6	0.00311	0.00322	0.00025	3.5	0.00738	0.00694	0.00025	6.1	0.00366	0.00361	0.00025	1.4
Beryllium (Be)	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A
Bismuth (Bi)	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A
Boron (B)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Cadmium (Cd)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Calcium (Ca)	1.47	1.57	0.1	6.6	1.67	1.67	0.1	0.0	3.63	3.49	0.1	3.9	1.72	1.62	0.1	6.0
Chromium (Cr)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	0.00012	0.0005	RPD-N/A	0.00013	0.00016	0.0005	RPD-N/A	0.00154	<0.00010	0.0005	RPD-N/A
Cobalt (Co)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	0.00011	0.0005	RPD-N/A	0.00013	0.00013	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Copper (Cu)	0.00091	0.00088	0.0025	RPD-N/A	0.00184	0.00205	0.0025	RPD-N/A	0.00505	0.00299	0.0025	**51.2**	0.00102	0.00104	0.0025	RPD-N/A
Iron (Fe)	0.042	0.041	0.05	RPD-N/A	0.051	0.050	0.05	RPD-N/A	0.034	0.033	0.05	RPD-N/A	0.109	0.018	0.05	RPD-N/A
Lead (Pb)	<0.000050	0.000051	0.00025	RPD-N/A	<0.000050	0.000053	0.00025	RPD-N/A	0.000462	<0.000050	0.00025	RPD-N/A	0.000102	0.000065	0.00025	RPD-N/A
Lithium (Li)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Magnesium (Mg)	0.883	0.894	0.025	1.2	1.22	1.32	0.025	7.9	1.40	1.33	0.025	5.1	0.871	0.870	0.025	0.1
Manganese (Mn)	0.00160	0.00151	0.00025	5.8	0.00147	0.00154	0.00025	4.7	0.00286	0.00287	0.00025	0.3	0.00412	0.00281	0.00025	*37.8*
Mercury (Hg)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Molybdenum (Mo)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	0.000194	<0.000050	0.00025	RPD-N/A
Nickel (Ni)	0.00109	0.00112	0.0005	2.7	0.00394	0.00422	0.0005	6.9	0.00363	0.00352	0.0005	3.1	0.00263	0.00185	0.0005	*34.8*
Phosphorus (P)	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A
Potassium (K)	0.268	0.273	0.25	1.8	0.300	0.327	0.25	8.6	0.394	0.359	0.25	9.3	0.269	0.271	0.25	0.7
Selenium (Se)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Silicon (Si)	0.224	0.209	0.25	RPD-N/A	0.205	0.223	0.25	RPD-N/A	0.249	0.243	0.25	RPD-N/A	0.129	0.126	0.25	RPD-N/A
Silver (Ag)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Sodium (Na)	0.441	0.445	0.05	0.9	0.585	0.630	0.05	7.4	0.639	0.613	0.05	4.2	0.474	0.465	0.05	1.9

Appendix 3.2-2. Lake Water Quality Analytical Results of Field Duplicates

Location	Fox Lake				Giraffe Lake South				Goose Lake Neck				Propellor Lake			
Replicate	**1**	**2**			**1**	**2**			**1**	**2**			**1**	**2**		
Duplicate	**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**		
Depth	**1**	**1**			**3.7**	**3.7**			**1**	**1**			**1**	**1**		
Date Sampled	**20-Aug-12**	**20-Aug-12**			**19-Aug-12**	**19-Aug-12**			**14-Aug-12**	**14-Aug-12**			**21-Aug-12**	**21-Aug-12**		
ALS Sample ID	**L1198584-5**	**L1198584-6**			**L1198584-2**	**L1198584-3**			**L1195581-4**	**L1195581-5**			**L1198584-8**	**L1198584-9**		
	Sample	**Duplicate**	**5 x DL**	**RPD$_a$**	**Sample**	**Duplicate**	**5 x DL**	**RPD$_a$**	**Sample**	**Duplicate**	**5 x DL**	**RPD$_a$**	**Sample**	**Duplicate**	**5 x DL**	**RPD$_a$**
Strontium (Sr)	0.00486	0.00508	0.001	4.4	0.00712	0.00711	0.001	0.1	0.0208	0.0196	0.001	5.9	0.00812	0.00766	0.0005	5.8
Thallium (Tl)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Tin (Sn)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Titanium (Ti)	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A
Uranium (U)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Vanadium (V)	0.000066	0.000108	0.00025	RPD-N/A	0.000123	0.000154	0.00025	RPD-N/A	0.000645	0.000461	0.00025	*33.3*	0.000138	0.000119	0.00025	RPD-N/A
Zinc (Zn)	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	0.0031	0.015	RPD-N/A
Dissolved Metals																
Aluminum (Al)	0.0052	<0.0030	0.015	RPD-N/A	0.0064	0.0093	0.015	RPD-N/A	0.0074	0.0067	0.015	RPD-N/A	0.0112	0.0058	0.015	RPD-N/A
Antimony (Sb)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Arsenic (As)	0.000207	0.000202	0.00015	2.4	0.000182	0.000178	0.00015	2.2	0.000175	0.000132	0.00015	RPD-N/A	0.000125	0.000118	0.00015	RPD-N/A
Barium (Ba)	0.00174	0.00172	0.00025	1.2	0.00379	0.00307	0.00025	*21.0*	0.00701	0.00671	0.00025	4.4	0.00352	0.00358	0.00025	1.7
Beryllium (Be)	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A
Bismuth (Bi)	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A
Boron (B)	0.0101	<0.0050	0.025	RPD-N/A	<0.0050	0.0059	0.025	RPD-N/A	<0.0050	0.0056	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Cadmium (Cd)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Calcium (Ca)	1.44	1.49	0.1	3.4	1.68	1.68	0.1	0.0	3.44	3.44	0.1	0.0	1.57	1.71	0.1	8.5
Chromium (Cr)	0.00029	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Cobalt (Co)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Copper (Cu)	0.00064	0.00066	0.0025	RPD-N/A	0.00134	0.00146	0.0025	RPD-N/A	0.00143	0.00132	0.0025	RPD-N/A	0.00068	0.00081	0.0025	RPD-N/A
Iron (Fe)	<0.010	<0.010	0.05	RPD-N/A	0.012	0.012	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A
Lead (Pb)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Lithium (Li)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Magnesium (Mg)	0.895	0.893	0.025	0.2	1.25	1.23	0.025	1.6	1.28	1.31	0.025	2.3	0.870	0.849	0.025	2.4
Manganese (Mn)	0.000412	0.000200	0.00025	RPD-N/A	0.00119	0.00123	0.00025	3.3	0.00147	0.00115	0.00025	*24.4*	0.000166	0.000216	0.00025	RPD-N/A
Mercury (Hg)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Molybdenum (Mo)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Nickel (Ni)	0.00112	0.00107	0.0005	4.6	0.00399	0.00390	0.0005	2.3	0.00343	0.00348	0.0005	1.4	0.00179	0.00176	0.0005	1.7
Phosphorus (P)	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A
Potassium (K)	0.277	0.271	0.25	2.2	0.309	0.303	0.25	2.0	0.381	0.356	0.25	6.8	0.271	0.275	0.25	1.5
Selenium (Se)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Silicon (Si)	0.211	0.197	0.25	RPD-N/A	0.193	0.203	0.25	RPD-N/A	0.230	0.226	0.25	RPD-N/A	0.124	0.112	0.25	RPD-N/A
Silver (Ag)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Sodium (Na)	0.442	0.439	0.05	0.7	0.592	0.588	0.05	0.7	0.622	0.610	0.05	1.9	0.468	0.460	0.05	1.7
Strontium (Sr)	0.00494	0.00485	0.001	1.8	0.00732	0.00712	0.001	2.8	0.0191	0.0194	0.001	1.6	0.00734	0.00799	0.0005	8.5
Thallium (Tl)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Tin (Sn)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Titanium (Ti)	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A
Uranium (U)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Vanadium (V)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	0.000114	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Zinc (Zn)	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A

a) Relative percent difference (RPD).

b) RPD-N/A -Not applicable when the values are less than five times the detection limit.

Italicized values exceed the 20% relative percent difference and are more than five times the detection limit.

Bold values exceed the 50% relative percent difference and are more than five times the detection limit.

Appendix 3.2-2. Lake Water Quality Analytical Results of Field Duplicates

Location	Fold Lake				Dragon Lake				Reference C Lake			
Replicate	**1**	**2**			**1**	**2**			**1**	**2**		
Duplicate	**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**		
Depth	**1**	**1**			**1**	**1**			**1**	**1**		
Date Sampled	**19-Aug-12**	**19-Aug-12**			**20-Aug-12**	**20-Aug-12**			**22-Aug-12**	**22-Aug-12**		
ALS Sample ID	**L1197323-7**	**L1197323-8**			**L1197323-10**	**L1197323-11**			**L1198951-3**	**L1198951-4**		
	Sample	**Duplicate**	**5 x DL**	**RPD_a**	**Sample**	**Duplicate**	**5 x DL**	**RPD_a**	**Sample**	**Duplicate**	**5 x DL**	**RPD_a**
Physical Tests												
Conductivity	51.0	47.7	10	6.7	49.1	48.9	10	0.4	119	118	10	0.8
Hardness (as $CaCO_3$)	18.6	19.6	2.5	5.2	20.9	21.3	2.5	1.9	63.1	60.7	2.5	3.9
pH	7.21	7.14	0.5	1.0	7.30	7.32	0.5	0.3	8.01	8.06	0.5	0.6
Alkalinity, Bicarbonate (as $CaCO_3$)	8.2	8.0	10	RPD-N/A	12.1	12.2	10	0.8	65.3	65.9	10	0.9
Alkalinity, Carbonate (as $CaCO_3$)	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A
Alkalinity, Hydroxide (as $CaCO_3$)	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A	<2.0	<2.0	10	RPD-N/A
Alkalinity, Total (as $CaCO_3$)	8.2	8.0	10	RPD-N/A	12.1	12.2	10	0.8	65.3	65.9	10	0.9
Total Suspended Solids	**1.5**	**1.5**	15	RPD-N/A	**1.5**	**1.5**	15	RPD-N/A	**1.5**	**1.5**	15	RPD-N/A
Total Dissolved Solids	34	30	50	RPD-N/A	33	34	50	RPD-N/A	68	69	50	1.5
Turbidity	0.29	0.27	0.5	RPD-N/A	0.28	0.33	0.5	RPD-N/A	0.29	0.25	0.5	RPD-N/A
Nutrients												
Ammonia, Total (as N)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Nitrate (as N)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Nitrite (as N)	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Total Kjeldahl Nitrogen	0.137	0.118	0.25	RPD-N/A	0.190	0.200	0.25	RPD-N/A	0.143	0.146	0.25	RPD-N/A
Ortho-phosphate (as P)	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Total Phosphorus (P)	0.0034	0.0036	0.01	RPD-N/A	0.0034	0.0036	0.01	RPD-N/A	0.0033	0.0029	0.01	RPD-N/A
Anions												
Bromide (Br)	<0.050	<0.050	0.25	RPD-N/A	<0.050	<0.050	0.25	RPD-N/A	<0.050	<0.050	0.25	RPD-N/A
Chloride (Cl)	1.36	1.35	2.5	RPD-N/A	1.14	1.13	2.5	RPD-N/A	0.68	0.67	2.5	RPD-N/A
Fluoride (F)	0.020	0.020	0.1	RPD-N/A	0.021	0.021	0.1	RPD-N/A	<0.020	<0.020	0.1	RPD-N/A
Sulfate (SO_4)	11.3	11.3	2.5	0.0	9.19	9.21	2.5	0.2	0.66	0.65	2.5	RPD-N/A
Cyanides												
Cyanide, Total	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Cyanide, Free	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A	<0.0010	<0.0010	0.005	RPD-N/A
Organic / Inorganic Carbon												
Total Organic Carbon	1.37	1.40	2.5	RPD-N/A	2.09	2.13	2.5	RPD-N/A	2.71	2.54	2.5	6.5
Total Metals												
Aluminum (Al)	0.0048	0.0037	0.015	RPD-N/A	0.0051	0.0042	0.015	RPD-N/A	0.0031	0.0031	0.015	RPD-N/A
Antimony (Sb)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Arsenic (As)	0.000535	0.000495	0.00015	7.8	0.00115	0.00113	0.00015	1.8	0.000215	0.000216	0.00015	0.5
Barium (Ba)	0.00145	0.00180	0.00025	*21.5*	0.00272	0.000966	0.00025	**95.2**	0.0211	0.0205	0.00025	2.9
Beryllium (Be)	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A
Bismuth (Bi)	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A
Boron (B)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Cadmium (Cd)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Calcium (Ca)	4.24	3.98	0.1	6.3	4.09	4.09	0.1	0.0	14.6	15.2	0.1	4.0
Chromium (Cr)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Cobalt (Co)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Copper (Cu)	0.00113	0.00107	0.0025	RPD-N/A	0.00164	0.00148	0.0025	RPD-N/A	0.00097	0.00107	0.0025	RPD-N/A
Iron (Fe)	0.018	0.017	0.05	RPD-N/A	0.035	0.034	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A
Lead (Pb)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Lithium (Li)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Magnesium (Mg)	2.05	1.85	0.025	10.3	2.81	2.77	0.025	1.4	5.94	6.09	0.025	2.5
Manganese (Mn)	0.00232	0.00208	0.00025	10.9	0.00181	0.00170	0.00025	6.3	0.00246	0.00250	0.00025	1.6
Mercury (Hg)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Molybdenum (Mo)	<0.000050	<0.000050	0.00025	RPD-N/A	0.000050	<0.000050	0.00025	RPD-N/A	0.000076	0.000073	0.00025	RPD-N/A
Nickel (Ni)	0.00102	0.00093	0.0005	9.2	0.00140	0.00133	0.0005	5.1	0.00014	0.00012	0.0005	RPD-N/A
Phosphorus (P)	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A
Potassium (K)	0.374	0.349	0.25	6.9	0.354	0.352	0.25	0.6	0.239	0.242	0.25	RPD-N/A
Selenium (Se)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Silicon (Si)	0.117	0.114	0.25	RPD-N/A	0.374	0.373	0.25	0.3	0.958	0.996	0.25	3.9
Silver (Ag)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Sodium (Na)	0.736	0.676	0.05	8.5	0.601	0.595	0.05	1.0	0.447	0.465	0.05	3.9

Appendix 3.2-2. Lake Water Quality Analytical Results of Field Duplicates

Location	Fold Lake				Dragon Lake				Reference C Lake			
Replicate	**1**	**2**			**1**	**2**			**1**	**2**		
Duplicate	**sample**	**duplicate**			**sample**	**duplicate**			**sample**	**duplicate**		
Depth	**1**	**1**			**1**	**1**			**1**	**1**		
Date Sampled	**19-Aug-12**	**19-Aug-12**			**20-Aug-12**	**20-Aug-12**			**22-Aug-12**	**22-Aug-12**		
ALS Sample ID	**L1197323-7**	**L1197323-8**			**L1197323-10**	**L1197323-11**			**L1198951-3**	**L1198951-4**		
	Sample	**Duplicate**	**5 x DL**	**RPD_a**	**Sample**	**Duplicate**	**5 x DL**	**RPD_a**	**Sample**	**Duplicate**	**5 x DL**	**RPD_a**
Strontium (Sr)	0.0144	0.0134	0.001	7.2	0.00846	0.00840	0.001	0.7	0.00681	0.00719	0.001	5.4
Thallium (Tl)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Tin (Sn)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Titanium (Ti)	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A
Uranium (U)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	0.000293	0.000315	0.00005	7.2
Vanadium (V)	0.000076	0.000084	0.00025	RPD-N/A	0.000099	0.000098	0.00025	RPD-N/A	0.000228	0.000203	0.00025	RPD-N/A
Zinc (Zn)	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A
Dissolved Metals												
Aluminum (Al)	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A
Antimony (Sb)	<0.000050	0.000114	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Arsenic (As)	0.000460	0.000468	0.00015	1.7	0.000918	0.000866	0.00015	5.8	0.000215	0.000207	0.00015	3.8
Barium (Ba)	0.00135	0.00148	0.00025	9.2	0.00291	0.00103	0.00025	**95.4**	0.0218	0.0214	0.00025	1.9
Beryllium (Be)	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A	<0.00020	<0.00020	0.001	RPD-N/A
Bismuth (Bi)	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A	<0.00050	<0.00050	0.0025	RPD-N/A
Boron (B)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	0.0056	0.0071	0.025	RPD-N/A
Cadmium (Cd)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Calcium (Ca)	4.20	4.50	0.1	6.9	4.12	4.15	0.1	0.7	15.8	14.8	0.1	6.5
Chromium (Cr)	<0.00010	0.00014	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	0.00012	0.00011	0.0005	RPD-N/A
Cobalt (Co)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Copper (Cu)	0.00082	0.00082	0.0025	RPD-N/A	0.00115	0.00119	0.0025	RPD-N/A	0.00101	0.00083	0.0025	RPD-N/A
Iron (Fe)	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A
Lead (Pb)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Lithium (Li)	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A	<0.0050	<0.0050	0.025	RPD-N/A
Magnesium (Mg)	1.98	2.03	0.025	2.5	2.59	2.65	0.025	2.3	5.74	5.76	0.025	0.3
Manganese (Mn)	0.000236	0.000178	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Mercury (Hg)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Molybdenum (Mo)	<0.000050	0.000128	0.00025	RPD-N/A	0.000050	<0.000050	0.00025	RPD-N/A	0.000089	0.000077	0.00025	RPD-N/A
Nickel (Ni)	0.00098	0.00103	0.0005	5.0	0.00128	0.00127	0.0005	0.8	0.00016	0.00016	0.0005	RPD-N/A
Phosphorus (P)	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A	<0.30	<0.30	1.5	RPD-N/A
Potassium (K)	0.370	0.391	0.25	5.5	0.340	0.345	0.25	1.5	0.242	0.238	0.25	RPD-N/A
Selenium (Se)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Silicon (Si)	0.110	0.108	0.25	RPD-N/A	0.354	0.354	0.25	0.0	0.978	0.994	0.25	1.6
Silver (Ag)	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A
Sodium (Na)	0.707	0.701	0.05	0.9	0.562	0.567	0.05	0.9	0.461	0.454	0.05	1.5
Strontium (Sr)	0.0139	0.0147	0.001	5.6	0.00829	0.00833	0.001	0.5	0.00709	0.00704	0.001	0.7
Thallium (Tl)	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Tin (Sn)	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A	<0.00010	<0.00010	0.0005	RPD-N/A
Titanium (Ti)	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A	<0.010	<0.010	0.05	RPD-N/A
Uranium (U)	<0.000010	0.000021	0.00005	RPD-N/A	<0.000010	<0.000010	0.00005	RPD-N/A	0.000320	0.000311	0.00005	2.9
Vanadium (V)	<0.000050	0.000068	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A	<0.000050	<0.000050	0.00025	RPD-N/A
Zinc (Zn)	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A	<0.0030	<0.0030	0.015	RPD-N/A

a) Relative percent difference (RPD).

b) RPD-N/A -Not applicable when the values are less than five times the detection limit.

Italicized values exceed the 20% relative percent difference and are more than five times the detection limit.

Bold values exceed the 50% relative percent difference and are more than five times the detection limit.

Appendix 3.2-3

Lake Water Quality QA/QC Results, Back River Project, 2012

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Appendix 3.2-3. Lake Water Quality QA/QC Results, Back River Project, 2012

Area			Realised	Goose	Goose	Goose	George	George	George	Goose	Goose	Goose	George	George	George
Blank Type		CCME Guideline	Detection	Equipment	Field	Travel	Equipment	Field	Travel	Equipment	Field	Travel	Equipment	Field	Travel
Date Sampled		for the Protection	Limit	10-Apr-12	11-Apr-12	10-Apr-12	10-Apr-12	13-Apr-12	13-Apr-12	14-Aug-12	14-Aug-12	14-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12
ALS Sample ID	Units	of Freshwater Aquatic Life[a]	(RDL)	L1133356-1	L1133911-4	L1133356-7	L1133356-2	L1135132-12	L1135132-8	L1195581-1	L1195581-2	L1195581-3	L1197323-3	L1197323-2	L1197323-4
Physical Tests															
Conductivity	µS/cm		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	3.1	<2.0	<2.0	<2.0	<2.0	<2.0
Hardness (as $CaCO_3$)	mg/L		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	-	-	<0.50	<0.50	<0.50
pH	pH	6.5-9.0	0.10	5.63	5.65	5.61	5.61	5.79	5.78	5.78	6.06	5.64	6.16	5.75	5.73
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		1.0 - 2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Turbidity	NTU	dependent on background levels	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nutrients															
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0086	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0463	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Anions															
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.71	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	0.12[b]	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Sulfate (SO_4)	mg/L		0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Cyanides															
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon															
Total Organic Carbon	mg/L		0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Metals															
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0941	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Barium (Ba)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	0.000176	<0.000050	<0.000050	0.000060	<0.000050	<0.000050	0.000719	<0.000050	<0.000050
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	≥0.002[e]	0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.3	0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000575	<0.000050	<0.000050	0.000057	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Manganese (Mn)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000282	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00018	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010

Appendix 3.2-3. Lake Water Quality QA/QC Results, Back River Project, 2012

Area Blank Type Date Sampled ALS Sample ID	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection Limit (RDL)	Goose Equipment 10-Apr-12 L1133356-1	Goose Field 11-Apr-12 L1133911-4	Goose Travel 10-Apr-12 L1133356-7	George Equipment 10-Apr-12 L1133356-2	George Field 13-Apr-12 L1135132-12	George Travel 13-Apr-12 L1135132-8	Goose Equipment 14-Aug-12 L1195581-1	Goose Field 14-Aug-12 L1195581-2	Goose Travel 14-Aug-12 L1195581-3	George Equipment 18-Aug-12 L1197323-3	George Field 18-Aug-12 L1197323-2	George Travel 18-Aug-12 L1197323-4
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.017	<0.010	<0.010	<0.010	<0.010	<0.010
Strontium (Sr)	mg/L		0.00010 -	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(hardness)]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(hardness)]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(hardness)]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(hardness)]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.3-1

Stream Water Quality Analytical Results, Back River Project, 2012

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Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Moby OF	Moby OF	Gander IF	Gander IF	Gander US	Gander US	Pond 19 OF	Pond 19 OF	Chair OF	Chair OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection Limit (RDL)	L1162486-1	L1162486-2	L1162486-3	L1162486-4	L1162486-5	L1162486-6	L1162486-9	L1162486-10	L1162486-7	L1162486-8
Physical Tests	µS/cm												
Conductivity			2.0	20.9	20.4	20.1	20.0	20.2	20.2	25.3	25.4	16.7	16.6
Hardness (as $CaCO_3$)	mg/L		0.50	8.09	8.38	7.72	8.11	7.92	7.93	11.2	11.1	6.96	7.03
pH	pH	6.5-9.0	0.10	6.79	6.67	6.83	6.82	6.80	6.80	6.98	7.00	5.73	6.47
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	2.9	3.1	3.9	3.9	4.0	4.2	6.6	6.3	4.0	4.3
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	2.9	3.1	3.9	3.9	4.0	4.2	6.6	6.3	4.0	4.3
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	4.7	<3.0	3.3	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	19	18	21	17	19	19	23	23	18	23
Turbidity	NTU	dependent on background levels	0.10	0.67	0.67	1.76	1.77	1.22	1.35	0.29	0.31	0.53	0.63
Nutrients													
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.135	0.137	0.187	0.159	0.163	0.174	0.155	0.165	0.178	0.170
Ortho-phosphate (as P)	mg/L		0.001	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0033	0.0034	0.0061	0.0065	0.0077	0.0072	0.0029	0.0032	0.0053	0.0056
Anions													
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	<0.50	<0.50	0.52	<0.50	0.52	0.52	<0.50	<0.50	<0.50	<0.50
Fluoride (F)	mg/L	0.12[b]	0.02	0.024	0.024	<0.020	<0.020	<0.020	<0.020	0.025	0.023	<0.020	<0.020
Sulfate (SO_4)	mg/L		0.5	5.86	5.86	4.65	4.66	4.83	4.87	5.23	5.24	3.10	3.09
Cyanides													
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L		0.50	3.19	3.34	3.54	3.54	3.46	3.41	3.97	4.01	3.93	3.95
Total Metals													
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0742	0.0686	0.0576	0.0547	0.0526	0.0468	0.0429	0.0384	0.0433	0.0425
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000249	0.000232	0.000345	0.000334	0.000333	0.000320	0.000317	0.000294	0.000307	0.000296
Barium (Ba)	mg/L		0.000050	0.00372	0.00366	0.00422	0.00404	0.00400	0.00392	0.00309	0.00308	0.00324	0.00315
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	0.0066	0.0059	0.0077	0.0067	0.0066	0.0063	0.0071	0.0067	0.0079	0.0061
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	0.000015	0.000013	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	1.80	1.64	1.59	1.57	1.57	1.59	2.27	2.06	1.29	1.22
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00023	0.00024	0.00026	0.00025	0.00024	0.00022	0.00022	0.00021	0.00018	0.00019
Cobalt (Co)	mg/L		0.00010	0.00117	0.00119	0.00044	0.00046	0.00033	0.00032	0.00012	0.00012	0.00013	0.00013
Copper (Cu)	mg/L	≥0.002[e]	0.0005 - 0.0015	0.00301	0.00302	0.00161	0.00166	0.00146	0.00146	0.00254	0.00251	0.00162	0.00158
Iron (Fe)	mg/L	0.3	0.010	0.092	0.087	0.124	0.118	0.113	0.104	0.044	0.041	0.083	0.084
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	0.000074	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	0.926	0.914	1.03	1.01	1.07	1.08	1.35	1.32	1.01	0.981
Manganese (Mn)	mg/L		0.000050	0.00307	0.00323	0.00664	0.00664	0.00621	0.00635	0.000399	0.000417	0.00158	0.00157
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.0157	0.0158	0.00584	0.00588	0.00517	0.00514	0.00536	0.00523	0.00297	0.00287
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.214	0.218	0.312	0.304	0.313	0.317	0.311	0.300	0.294	0.278
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.589	0.582	0.422	0.413	0.404	0.395	0.452	0.447	0.328	0.338
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.472	0.464	0.573	0.566	0.589	0.590	0.458	0.455	0.468	0.457

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Moby OF	Moby OF	Gander IF	Gander IF	Gander US	Gander US	Pond 19 OF	Pond 19 OF	Chair OF	Chair OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection Limit (RDL)	L1162486-1	L1162486-2	L1162486-3	L1162486-4	L1162486-5	L1162486-6	L1162486-9	L1162486-10	L1162486-7	L1162486-8
Strontium (Sr)	mg/L		0.00020	0.00738	0.00677	0.00702	0.00688	0.00695	0.00708	0.00726	0.00662	0.00522	0.00495
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	0.000030	0.000026	0.000015	0.000015	0.000013	0.000012	0.000012	0.000011	0.000015	0.000014
Vanadium (V)	mg/L		0.000050	0.000152	0.000154	0.000181	0.000179	0.000174	0.000153	<0.000050	0.000086	0.000166	0.000147
Zinc (Zn)	mg/L	0.03	0.0030	0.0054	0.0055	0.0032	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals													
Aluminum (Al)	mg/L		0.0030	0.0467	0.0457	0.0176	0.0225	0.0152	0.0166	0.0363	0.0374	0.0270	0.0272
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000205	0.000194	0.000265	0.000284	0.000285	0.000264	0.000276	0.000299	0.000249	0.000274
Barium (Ba)	mg/L		0.000050	0.00344	0.00335	0.00362	0.00374	0.00352	0.00351	0.00306	0.00308	0.00294	0.00303
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	0.0055	0.0050	0.0073	0.0060	0.0062	0.0062	0.0085	0.0074	0.0069	0.0059
Cadmium (Cd)	mg/L		0.000010	0.000015	0.000016	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	1.75	1.88	1.49	1.63	1.50	1.50	2.28	2.24	1.24	1.25
Chromium (Cr)	mg/L		0.00010	0.00016	0.00017	0.00018	0.00013	0.00012	<0.00010	0.00017	0.00019	0.00015	0.00015
Cobalt (Co)	mg/L		0.00010	0.00111	0.00112	0.00026	0.00039	0.00017	0.00017	0.00012	0.00012	<0.00010	<0.00010
Copper (Cu)	mg/L		0.00050	0.00264	0.00268	0.00138	0.00145	0.00120	0.00122	0.00243	0.00237	0.00135	0.00137
Iron (Fe)	mg/L		0.010	0.031	0.033	0.019	0.054	0.013	0.014	0.033	0.032	0.028	0.027
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	0.903	0.897	0.972	0.980	1.01	1.02	1.35	1.34	0.939	0.950
Manganese (Mn)	mg/L		0.000050	0.00286	0.00314	0.00412	0.00602	0.00382	0.00381	0.000411	0.000375	0.000990	0.00104
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.0148	0.0148	0.00532	0.00540	0.00462	0.00465	0.00529	0.00525	0.00279	0.00272
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.218	0.215	0.296	0.292	0.296	0.304	0.323	0.312	0.275	0.282
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.546	0.545	0.327	0.328	0.316	0.319	0.459	0.447	0.297	0.304
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.456	0.452	0.548	0.542	0.555	0.560	0.480	0.458	0.443	0.442
Strontium (Sr)	mg/L		0.00020	0.00716	0.00785	0.00655	0.00658	0.00656	0.00650	0.00722	0.00712	0.00494	0.00508
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	0.000024	0.000026	0.000010	0.000011	<0.000010	<0.000010	0.000011	0.000011	0.000012	0.000012
Vanadium (V)	mg/L		0.000050	0.000081	0.000081	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000068	0.000080
Zinc (Zn)	mg/L		0.0030	0.0045	0.0051	<0.0030	0.0044	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Note Echo OF was dry during August sampling.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Llama OF	Llama OF	Echo OF	Echo OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Goose OF	Goose OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				12-Jun-12	12-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	12-Jun-12	12-Jun-12	13-Jun-12	13-Jun-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1162486-11	L1162486-12	L1162486-21	L1162486-22	L1162486-23	L1162486-24	L1162486-17	L1162486-18	L1162486-25	L1162486-26
Physical Tests	µS/cm												
Conductivity			2.0	41.4	40.7	28.7	28.8	17.6	17.5	15.9	16.0	25.6	25.5
Hardness (as $CaCO_3$)	mg/L		0.50	16.2	16.4	11.3	11.7	6.89	6.96	6.68	6.68	10.1	10.1
pH	pH	6.5-9.0	0.10	6.78	6.76	5.90	6.10	6.62	6.67	6.51	6.51	6.70	6.74
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	4.1	3.7	3.2	2.9	3.0	3.1	3.6	4.1	3.9	3.9
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	4.1	3.7	3.2	2.9	3.0	3.1	3.6	4.1	3.9	3.9
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	41	37	37	40	17	11	21	21	29	26
Turbidity	NTU	dependent on background levels	0.10	0.20	0.17	0.26	0.27	0.43	0.39	0.26	0.25	0.57	0.46
Nutrients													
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	0.0640	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.132	0.146	0.285	0.299	0.135	0.146	0.168	0.162	0.200	0.216
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	0.0016	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0025	0.0023	0.0033	0.0033	0.0049	0.0046	0.0044	0.0041	0.0070	0.0078
Anions													
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	7.46	7.31	3.92	3.92	<0.50	<0.50	<0.50	<0.50	2.33	2.33
Fluoride (F)	mg/L	0.12[b]	0.02	<0.020	<0.020	0.026	0.027	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Sulfate (SO_4)	mg/L		0.5	3.62	3.64	3.42	3.43	4.39	4.40	3.21	3.16	4.30	4.30
Cyanides													
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L		0.50	3.32	3.30	9.65	9.65	3.51	3.49	3.77	3.75	4.38	4.37
Total Metals													
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0325	0.0363	0.142	0.131	0.0382	0.0373	0.0219	0.0225	0.0330	0.0352
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000200	0.000196	0.000418	0.000373	0.000167	0.000178	0.000175	0.000162	0.000215	0.000178
Barium (Ba)	mg/L		0.000050	0.00873	0.00901	0.0123	0.0119	0.00300	0.00306	0.00367	0.00369	0.00546	0.00551
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	<0.0050	0.0080	0.0075	0.0071	0.0069	0.0065	0.0077	0.0088	0.0069	0.0075
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	0.000016	0.000014	0.000016	0.000015	<0.000010	0.000011	<0.000010	<0.000010	<0.000010	0.000013
Calcium (Ca)	mg/L		0.020	4.09	4.19	2.91	2.85	1.30	1.33	1.35	1.37	2.27	2.30
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00013	0.00020	0.00048	0.00055	0.00016	0.00016	0.00026	0.00018	0.00020	0.00029
Cobalt (Co)	mg/L		0.00010	0.00049	0.00050	0.00105	0.00100	0.00048	0.00051	<0.00010	<0.00010	0.00060	0.00060
Copper (Cu)	mg/L	≥0.002[e]	0.0005 - 0.0015	0.00205	0.00205	0.00248	0.00231	0.00184	0.00194	0.00115	0.00115	0.00157	0.00156
Iron (Fe)	mg/L	0.3	0.010	0.015	0.016	0.142	0.144	0.050	0.052	0.048	0.050	0.082	0.082
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000073
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.48	1.49	1.22	1.18	0.874	0.920	0.810	0.808	1.11	1.10
Manganese (Mn)	mg/L		0.000050	0.00459	0.00486	0.00431	0.00395	0.00448	0.00468	0.000767	0.000725	0.0119	0.0116
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00504	0.00517	0.00464	0.00429	0.00691	0.00707	0.00274	0.00275	0.00534	0.00535
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.399	0.409	0.069	0.078	0.228	0.238	0.244	0.240	0.345	0.333
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.521	0.525	0.800	0.804	0.377	0.392	0.269	0.260	0.416	0.421
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.664	0.667	0.853	0.836	0.420	0.438	0.433	0.435	0.554	0.543

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Llama OF	Llama OF	Echo OF	Echo OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Goose OF	Goose OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				12-Jun-12	12-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	12-Jun-12	12-Jun-12	13-Jun-12	13-Jun-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1162486-11	L1162486-12	L1162486-21	L1162486-22	L1162486-23	L1162486-24	L1162486-17	L1162486-18	L1162486-25	L1162486-26
Strontium (Sr)	mg/L		0.00020	0.0234	0.0238	0.0126	0.0121	0.00562	0.00570	0.00575	0.00584	0.0124	0.0125
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000014	0.000016	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	0.000085	0.000078	0.000190	0.000224	0.000078	0.000075	0.000104	0.000108	0.000085	0.000097
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	0.0033	0.0035	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals													
Aluminum (Al)	mg/L		0.0030	0.0293	0.0317	0.126	0.131	0.0351	0.0329	0.0180	0.0180	0.0260	0.0277
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000186	0.000180	0.000340	0.000378	0.000160	0.000144	0.000159	0.000159	0.000177	0.000166
Barium (Ba)	mg/L		0.000050	0.00864	0.00873	0.0113	0.0118	0.00298	0.00297	0.00368	0.00358	0.00542	0.00534
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	0.0063	0.0061	0.0083	0.0070	0.0080	0.0057	0.0074	0.0078	0.0079	0.0080
Cadmium (Cd)	mg/L		0.000010	0.000015	0.000017	0.000016	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	4.11	4.17	2.68	2.76	1.30	1.30	1.36	1.35	2.24	2.25
Chromium (Cr)	mg/L		0.00010	0.00016	0.00013	0.00044	0.00041	0.00015	0.00014	0.00015	0.00016	0.00015	0.00017
Cobalt (Co)	mg/L		0.00010	0.00047	0.00050	0.00101	0.00097	0.00043	0.00047	<0.00010	<0.00010	0.00042	0.00040
Copper (Cu)	mg/L		0.00050	0.00186	0.00186	0.00223	0.00237	0.00176	0.00178	0.00107	0.00105	0.00142	0.00138
Iron (Fe)	mg/L		0.010	<0.010	<0.010	0.074	0.086	0.024	0.011	0.020	0.022	0.021	0.023
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.44	1.45	1.11	1.16	0.882	0.901	0.800	0.807	1.10	1.09
Manganese (Mn)	mg/L		0.000050	0.00444	0.00474	0.00383	0.00413	0.00398	0.00396	0.000487	0.000560	0.00915	0.00870
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.00495	0.00505	0.00429	0.00448	0.00670	0.00681	0.00268	0.00270	0.00519	0.00517
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.394	0.399	0.071	0.075	0.233	0.236	0.247	0.245	0.345	0.334
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.507	0.517	0.788	0.785	0.370	0.368	0.244	0.253	0.389	0.411
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.643	0.651	0.869	0.824	0.420	0.431	0.430	0.424	0.542	0.535
Strontium (Sr)	mg/L		0.00020	0.0232	0.0232	0.0114	0.0118	0.00557	0.00556	0.00559	0.00558	0.0121	0.0121
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000013	0.000013	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	0.000125	0.000138	<0.000050	<0.000050	0.000051	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.0030	<0.0030	<0.0030	0.0037	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Note Echo OF was dry during August sampling.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	George	George	George	George	George	George
Location				Propellor OF	Propellor OF	Reference B OF	Reference B OF	George OF	George OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1162486-15	L1162486-16	L1162486-13	L1162486-14	L1162486-29	L1162486-30	L1162486-35	L1162486-36	L1162486-33	L1162486-34
Physical Tests	µS/cm												
Conductivity			2.0	24.7	24.6	11.0	11.0	42.0	41.9	24.1	24.2	53.7	53.7
Hardness (as $CaCO_3$)	mg/L		0.50	10.0	10.1	5.05	5.00	16.2	16.5	9.48	9.52	23.6	23.8
pH	pH	6.5-9.0	0.10	6.87	6.91	6.50	6.81	6.99	6.99	6.77	6.74	7.40	7.41
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	4.9	4.9	4.7	4.6	5.3	5.4	3.2	3.3	14.3	14.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	4.9	4.9	4.7	4.6	5.3	5.4	3.2	3.3	14.3	14.0
Total Suspended Solids	mg/L	dependent on background levels	3.0	3.3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	22	21	13	11	29	21	20	18	28	38
Turbidity	NTU	dependent on background levels	0.10	0.28	0.34	0.37	0.52	0.38	0.25	0.51	0.38	0.41	0.36
Nutrients													
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.0050	0.0203	0.0226	<0.0050	<0.0050	<0.0050	<0.0050	0.0062	0.0058	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.188	0.185	0.200	0.223	0.118	0.113	0.125	0.126	0.178	0.190
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0041	0.0040	0.0062	0.0065	0.0030	0.0034	0.0038	0.0040	0.0041	0.0039
Anions													
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	1.88	1.88	<0.50	<0.50	2.35	2.34	1.30	1.32	1.13	1.13
Fluoride (F)	mg/L	0.12[b]	0.02	<0.020	<0.020	<0.020	<0.020	0.022	0.022	<0.020	<0.020	<0.020	<0.020
Sulfate (SO_4)	mg/L		0.5	3.80	3.79	0.97	0.96	10.3	10.3	6.08	6.05	10.4	10.4
Cyanides													
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L		0.50	4.01	3.98	3.95	3.94	2.07	2.02	2.16	2.18	2.92	2.97
Total Metals													
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0177	0.0220	0.0207	0.0229	0.0236	0.0234	0.0383	0.0361	0.0143	0.0124
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000174	0.000171	0.000105	0.000115	0.000447	0.000444	0.000434	0.000420	0.000596	0.000604
Barium (Ba)	mg/L		0.000050	0.00520	0.00528	0.00380	0.00396	0.00242	0.00239	0.00178	0.00186	0.00144	0.00152
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	0.0078	0.0082	0.0073	0.0066	0.0073	0.0070	0.0077	0.0072	0.0080	0.0072
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000016	0.000013	0.000011	0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	2.16	2.17	1.02	0.952	4.10	4.09	2.44	2.45	4.82	4.84
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00015	0.00020	0.00020	0.00019	0.00012	0.00012	0.00012	0.00016	0.00011	<0.00010
Cobalt (Co)	mg/L		0.00010	0.00016	0.00016	<0.00010	<0.00010	0.00142	0.00144	0.00062	0.00062	0.00054	0.00054
Copper (Cu)	mg/L	≥0.002[e]	0.0005 - 0.0015	0.00121	0.00117	0.00074	0.00074	0.00199	0.00196	0.00246	0.00251	0.00180	0.00176
Iron (Fe)	mg/L	0.3	0.010	0.039	0.040	0.167	0.135	0.049	0.045	0.056	0.057	0.046	0.044
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.17	1.17	0.627	0.636	1.50	1.51	0.885	0.888	2.99	3.01
Manganese (Mn)	mg/L		0.000050	0.00676	0.00666	0.00207	0.00207	0.00954	0.00950	0.00878	0.00880	0.00621	0.00631
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00317	0.00315	0.00127	0.00123	0.00621	0.00627	0.00669	0.00663	0.00401	0.00406
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.356	0.360	0.204	0.213	0.261	0.268	0.213	0.209	0.375	0.374
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.344	0.343	0.202	0.202	0.224	0.226	0.220	0.219	0.323	0.326
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.634	0.636	0.345	0.351	0.636	0.633	0.421	0.416	0.618	0.623

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	George	George	George	George	George	George
Location				Propellor OF	Propellor OF	Reference B OF	Reference B OF	George OF	George OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1162486-15	L1162486-16	L1162486-13	L1162486-14	L1162486-29	L1162486-30	L1162486-35	L1162486-36	L1162486-33	L1162486-34
Strontium (Sr)	mg/L		0.00020	0.0101	0.0102	0.00374	0.00352	0.0160	0.0157	0.0101	0.0100	0.0100	0.00998
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000013	0.000013	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	0.000074	0.000070	0.000096	0.000097	0.000064	0.000070	0.000073	0.000090	0.000083	0.000075
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0047	0.0051	0.0040	0.0038	<0.0030	<0.0030
Dissolved Metals													
Aluminum (Al)	mg/L		0.0030	0.0124	0.0172	0.0172	0.0176	0.0158	0.0149	0.0229	0.0266	0.0080	0.0089
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000154	0.000155	0.000107	0.000085	0.000396	0.000398	0.000355	0.000364	0.000531	0.000561
Barium (Ba)	mg/L		0.000050	0.00515	0.00527	0.00387	0.00378	0.00235	0.00241	0.00172	0.00174	0.00141	0.00136
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	0.0070	0.0066	0.0067	0.0073	0.0059	0.0066	0.0071	0.0067	0.0061	0.0074
Cadmium (Cd)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000010	0.000013	0.000011	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	2.12	2.14	0.998	0.989	4.06	4.13	2.38	2.35	4.72	4.75
Chromium (Cr)	mg/L		0.00010	0.00017	0.00013	0.00014	0.00016	<0.00010	0.00011	<0.00010	0.00013	<0.00010	<0.00010
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00130	0.00118	0.00055	0.00057	0.00040	0.00039
Copper (Cu)	mg/L		0.00050	0.00112	0.00110	0.00069	0.00067	0.00171	0.00172	0.00214	0.00220	0.00151	0.00150
Iron (Fe)	mg/L		0.010	<0.010	0.028	0.073	0.073	<0.010	<0.010	<0.010	<0.010	0.012	0.010
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.14	1.16	0.620	0.616	1.48	1.49	0.862	0.884	2.86	2.90
Manganese (Mn)	mg/L		0.000050	0.00262	0.00429	0.000703	0.000715	0.00830	0.00807	0.00805	0.00826	0.00454	0.00449
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.00301	0.00306	0.00123	0.00122	0.00601	0.00610	0.00635	0.00648	0.00382	0.00376
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.358	0.359	0.212	0.211	0.262	0.271	0.210	0.214	0.367	0.361
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.326	0.326	0.190	0.198	0.217	0.222	0.208	0.209	0.307	0.305
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.615	0.625	0.341	0.343	0.617	0.622	0.409	0.428	0.593	0.593
Strontium (Sr)	mg/L		0.00020	0.00974	0.00987	0.00363	0.00360	0.0156	0.0157	0.00967	0.00958	0.00969	0.00966
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000011	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	0.000051	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0040	0.0040	0.0034	0.0035	<0.0030	<0.0030

Note Echo OF was dry during August sampling.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				George	George	George	George	Goose	Goose	Goose	Goose	Goose	Goose
Location				Komatic IF	Komatic IF	Reference C OF	Reference C OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander US	Gander US
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1162486-31	L1162486-32	L1162486-27	L1162486-28	L1193094-1	L1193094-2	L1192523-5	L1192523-6	L1192523-7	L1192523-8
Physical Tests	µS/cm												
Conductivity			2.0	34.1	34.2	46.8	46.9	54.4	54.4	28.0	28.1	23.6	23.5
Hardness (as $CaCO_3$)	mg/L		0.50	14.4	14.4	24.8	24.7	20.6	20.6	10.6	10.3	8.89	8.57
pH	pH	6.5-9.0	0.10	7.13	7.11	7.68	7.72	6.86	6.86	7.00	7.00	6.99	6.99
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	7.0	7.8	26.0	25.9	4.4	4.5	4.6	4.7	4.4	4.6
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	7.0	7.8	26.0	25.9	4.4	4.5	4.6	4.7	4.4	4.6
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	3.5	<3.0	<3.0
Total Dissolved Solids	mg/L		10	27	25	27	29	44	46	23	20	17	20
Turbidity	NTU	dependent on background levels	0.10	0.69	0.69	0.21	0.20	0.79	0.75	1.01	0.85	0.51	0.54
Nutrients													
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0077	0.0071	0.0058	0.0058	<0.0050	0.0050
Nitrate (as N)	mg/L	2.935[b]	0.0050	<0.0050	<0.0050	0.0059	<0.0050	0.110	0.109	0.0157	0.0167	0.0083	0.0079
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.149	0.163	0.123	0.118	0.208	0.188	0.211	0.218	0.210	0.201
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0047	0.0049	0.0031	0.0046	0.0046	0.0044	0.0054	0.0059	0.0047	0.0041
Anions													
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	1.11	1.12	<0.50	<0.50	<0.50	<0.50	0.51	0.50	0.52	0.52
Fluoride (F)	mg/L	0.12[b]	0.02	<0.020	<0.020	<0.020	<0.020	0.037	0.038	0.023	0.024	0.022	0.022
Sulfate (SO_4)	mg/L		0.5	7.41	7.41	<0.50	<0.50	17.6	17.7	6.74	6.73	5.17	5.17
Cyanides													
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L		0.50	2.68	2.70	2.45	2.42	3.23	3.23	2.72	2.59	2.54	2.54
Total Metals													
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0341	0.0328	0.0049	0.0039	0.0589	0.0573	0.0218	0.0212	0.0085	0.0094
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000691	0.000707	0.000101	0.000109	0.000544	0.000519	0.000470	0.000476	0.000404	0.000454
Barium (Ba)	mg/L		0.000050	0.00172	0.00173	0.00983	0.00989	0.00954	0.00957	0.00416	0.00416	0.00329	0.00352
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	0.0069	0.0076	0.0075	0.0069	0.0080	0.0057	<0.0050	<0.0050	<0.0050	0.0060
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000041	0.000041	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	3.21	3.13	5.96	5.99	4.67	4.64	2.17	2.16	1.46	1.78
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00016	0.00018	0.00010	0.00010	0.00029	0.00053	0.00022	0.00030	0.00020	0.00017
Cobalt (Co)	mg/L		0.00010	0.00047	0.00046	<0.00010	<0.00010	0.00604	0.00606	0.00059	0.00059	<0.00010	0.00012
Copper (Cu)	mg/L	≥0.002[e]	0.0005 - 0.0015	0.00213	0.00207	0.00059	0.00063	0.00385	0.00375	0.00166	0.00162	0.00138	0.00187
Iron (Fe)	mg/L	0.3	0.010	0.068	0.065	0.014	0.013	0.378	0.391	0.137	0.139	0.087	0.087
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000062	0.000052	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.64	1.61	2.46	2.48	2.18	2.18	1.24	1.25	1.12	1.19
Manganese (Mn)	mg/L		0.000050	0.00359	0.00342	0.00179	0.00192	0.0208	0.0213	0.00317	0.00297	0.00195	0.00213
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00537	0.00517	<0.00010	0.00010	0.0394	0.0394	0.00706	0.00694	0.00267	0.00276
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.260	0.271	0.116	0.122	0.318	0.294	0.307	0.307	0.308	0.312
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.273	0.263	0.375	0.374	1.88	1.89	0.297	0.306	0.106	0.111
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.498	0.488	0.214	0.214	1.11	1.09	0.639	0.654	0.595	0.615

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				George	George	George	George	Goose	Goose	Goose	Goose	Goose	Goose
Location				Komatic IF	Komatic IF	Reference C OF	Reference C OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander US	Gander US
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1162486-31	L1162486-32	L1162486-27	L1162486-28	L1193094-1	L1193094-2	L1192523-5	L1192523-6	L1192523-7	L1192523-8
Strontium (Sr)	mg/L		0.00020	0.00972	0.00937	0.00278	0.00276	0.0209	0.0208	0.00968	0.00971	0.00672	0.00821
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	0.000013	0.000011	0.000061	0.000062	0.000027	0.000028	0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	0.000173	0.000175	0.000066	0.000069	0.000269	0.000256	0.000248	0.000236	0.000183	0.000213
Zinc (Zn)	mg/L	0.03	0.0030	0.0035	0.0032	<0.0030	<0.0030	0.0102	0.0101	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals													
Aluminum (Al)	mg/L		0.0030	0.0178	0.0178	<0.0030	<0.0030	0.0358	0.0369	0.0068	0.0053	0.0031	0.0033
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000642	0.000623	0.000078	0.000091	0.000416	0.000472	0.000399	0.000348	0.000372	0.000345
Barium (Ba)	mg/L		0.000050	0.00165	0.00163	0.00995	0.00974	0.00956	0.00944	0.00411	0.00380	0.00337	0.00320
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	0.0059	<0.0050	0.0061	0.0066	<0.0050	<0.0050	<0.0050	<0.0050	0.0056	<0.0050
Cadmium (Cd)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000037	0.000038	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	3.15	3.16	5.92	5.86	4.69	4.63	2.18	2.19	1.71	1.59
Chromium (Cr)	mg/L		0.00010	0.00012	0.00010	<0.00010	<0.00010	0.00022	0.00023	0.00014	<0.00010	0.00011	<0.00010
Cobalt (Co)	mg/L		0.00010	0.00040	0.00040	<0.00010	<0.00010	0.00569	0.00585	0.00048	0.00043	<0.00010	<0.00010
Copper (Cu)	mg/L		0.00050	0.00177	0.00177	0.00057	0.00058	0.00304	0.00310	0.00197	0.00124	0.00109	0.00117
Iron (Fe)	mg/L		0.010	0.016	0.014	<0.010	<0.010	0.203	0.209	0.050	0.052	0.029	0.026
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.58	1.59	2.44	2.44	2.16	2.18	1.26	1.17	1.12	1.12
Manganese (Mn)	mg/L		0.000050	0.00298	0.00306	0.000077	0.000111	0.0189	0.0196	0.00214	0.00191	0.00127	0.00111
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.00499	0.00499	0.00013	0.00011	0.0386	0.0388	0.00679	0.00635	0.00261	0.00252
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.258	0.255	0.116	0.124	0.298	0.294	0.312	0.283	0.307	0.302
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.247	0.247	0.361	0.375	1.86	1.84	0.278	0.277	0.096	0.098
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.478	0.477	0.213	0.210	1.08	1.10	0.648	0.602	0.596	0.593
Strontium (Sr)	mg/L		0.00020	0.00938	0.00936	0.00271	0.00271	0.0206	0.0206	0.00963	0.00964	0.00776	0.00717
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	0.000058	0.000056	0.000022	0.000022	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	0.000099	0.000094	<0.000050	<0.000050	0.000118	0.000107	0.000067	0.000050	0.000060	<0.000050
Zinc (Zn)	mg/L		0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0092	0.0098	<0.0030	<0.0030	<0.0030	<0.0030

Note Echo OF was dry during August sampling.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Pond 19 OF	Pond 19 OF	Chair OF	Chair OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				13-Aug-12	13-Aug-12	12-Aug-12	12-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	7-Aug-12	7-Aug-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1193081-1	L1193081-2	L1193094-3	L1193094-4	L1191588-1	L1191588-2	L1191588-3	L1191588-4	L1190634-1	L1190634-2
Physical Tests	µS/cm												
Conductivity			2.0	70.3	69.7	30.6	30.6	176	173	24.3	24.2	24.2	23.7
Hardness (as $CaCO_3$)	mg/L		0.50	30.4	29.2	12.6	12.6	67.0	66.0	9.40	9.28	9.48	9.51
pH	pH	6.5-9.0	0.10	7.36	7.30	7.16	7.16	7.00	6.79	6.91	6.89	7.19	7.18
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	15.6	15.2	8.9	9.2	4.8	5.3	4.3	3.7	6.9	6.7
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	15.6	15.2	8.9	9.2	4.8	5.3	4.3	3.7	6.9	6.7
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	6.3	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	52	50	23	23	124	117	22	18	20	21
Turbidity	NTU	dependent on background levels	0.10	0.83	0.74	1.15	1.23	0.15	0.16	0.30	0.27	0.53	0.52
Nutrients													
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	0.0076	0.0072	0.0070	0.0066	0.0082	0.0096	0.0091	0.0083
Nitrate (as N)	mg/L	2.935[b]	0.0050	0.153	0.153	<0.0050	<0.0050	0.471	0.471	0.0176	0.0176	0.0401	0.0453
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.218	0.236	0.367	0.433	0.087	0.105	0.168	0.172	0.223	0.221
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0054	0.0044	0.0139	0.0135	<0.0020	0.0021	0.0035	0.0037	0.0046	0.0044
Anions													
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	0.343	0.350	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	0.75	0.75	0.69	0.69	40.9	41.1	0.54	0.54	0.83	0.83
Fluoride (F)	mg/L	0.12[b]	0.02	0.026	0.026	0.026	0.025	<0.020	<0.020	0.023	0.023	0.020	0.020
Sulfate (SO_4)	mg/L		0.5	15.2	15.1	4.17	4.17	7.12	7.16	6.03	6.02	3.62	3.62
Cyanides													
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L		0.50	4.25	4.10	4.11	4.38	1.80	1.90	3.02	3.11	3.27	3.10
Total Metals													
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0405	0.0399	0.0361	0.0348	0.0190	0.0218	0.0122	0.0136	0.0125	0.0136
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000579	0.000543	0.00139	0.00141	0.000204	0.000207	0.000218	0.000205	0.000237	0.000260
Barium (Ba)	mg/L		0.000050	0.00798	0.00823	0.00435	0.00444	0.0343	0.0343	0.00343	0.00356	0.00437	0.00461
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	0.0073	0.0057	0.0055	<0.0050	0.0067	0.0076	<0.0050	0.0053	0.0053	<0.0050
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	0.000016	0.000016	<0.000010	<0.000010	0.000087	0.000091	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	6.79	6.69	2.09	2.15	17.4	17.1	1.73	1.76	1.89	1.99
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00029	0.00034	0.00028	0.00040	0.00011	0.00015	0.00011	<0.00010	0.00013	0.00014
Cobalt (Co)	mg/L		0.00010	0.00022	0.00020	0.00062	0.00062	0.00170	0.00178	0.00012	0.00012	<0.00010	0.00010
Copper (Cu)	mg/L	≥0.002[e]	0.0005 - 0.0015	0.00396	0.00394	0.00201	0.00199	0.00180	0.00154	0.00196	0.00200	0.00153	0.00135
Iron (Fe)	mg/L	0.3	0.010	0.207	0.201	0.500	0.492	<0.010	0.017	0.060	0.061	0.218	0.228
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	0.000058	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	3.14	3.16	1.65	1.69	5.48	5.65	1.25	1.29	1.13	1.19
Manganese (Mn)	mg/L		0.000050	0.00244	0.00249	0.0114	0.0114	0.0121	0.0126	0.00223	0.00240	0.00210	0.00225
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00985	0.00979	0.00313	0.00319	0.0189	0.0193	0.00428	0.00438	0.00177	0.00194
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.462	0.449	0.374	0.380	0.809	0.831	0.326	0.332	0.301	0.315
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	2.02	1.97	0.242	0.239	1.41	1.47	0.255	0.249	0.265	0.266
Silver (Ag)	mg/L	0.0001	0.000010	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	1.11	1.09	0.724	0.739	1.45	1.58	0.579	0.603	0.576	0.598

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Pond 19 OF	Pond 19 OF	Chair OF	Chair OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				13-Aug-12	13-Aug-12	12-Aug-12	12-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	7-Aug-12	7-Aug-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1193081-1	L1193081-2	L1193094-3	L1193094-4	L1191588-1	L1191588-2	L1191588-3	L1191588-4	L1190634-1	L1190634-2
Strontium (Sr)	mg/L		0.00020	0.0215	0.0215	0.00897	0.00903	0.0973	0.101	0.00761	0.00777	0.00838	0.00875
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	0.000023	0.000022	0.000016	0.000016	<0.000010	<0.000010	0.000012	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	0.000197	0.000203	0.000376	0.000368	0.000156	0.000226	0.000175	0.000173	0.000208	0.000215
Zinc (Zn)	mg/L	0.03	0.0030	0.0030	<0.0030	<0.0030	<0.0030	0.0099	0.0118	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals													
Aluminum (Al)	mg/L		0.0030	0.0282	0.0250	0.0107	0.0102	0.0123	0.0121	0.0068	0.0060	0.0052	0.0059
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000476	0.000434	0.00113	0.00117	0.000152	0.000161	0.000180	0.000173	0.000197	0.000195
Barium (Ba)	mg/L		0.000050	0.00815	0.00820	0.00441	0.00465	0.0339	0.0338	0.00337	0.00348	0.00443	0.00438
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0052	<0.0050	<0.0050	<0.0050	<0.0050
Cadmium (Cd)	mg/L		0.000010	0.000016	0.000012	<0.000010	<0.000010	0.000090	0.000091	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	6.82	6.53	2.19	2.17	17.7	17.1	1.68	1.65	1.92	1.92
Chromium (Cr)	mg/L		0.00010	0.00019	0.00023	0.00014	0.00014	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L		0.00010	0.00019	0.00017	0.00021	0.00017	0.00174	0.00170	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L		0.00050	0.00304	0.00305	0.00149	0.00145	0.00114	0.00115	0.00199	0.00161	0.00100	0.00103
Iron (Fe)	mg/L		0.010	0.099	0.095	0.143	0.137	<0.010	<0.010	0.014	0.014	0.094	0.088
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	3.26	3.13	1.73	1.74	5.57	5.64	1.26	1.25	1.14	1.14
Manganese (Mn)	mg/L		0.000050	0.00180	0.00185	0.00572	0.00478	0.0123	0.0120	0.00180	0.00174	0.000781	0.000967
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.00985	0.00967	0.00305	0.00306	0.0189	0.0188	0.00416	0.00420	0.00175	0.00174
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.469	0.453	0.387	0.403	0.822	0.823	0.323	0.322	0.308	0.305
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	2.00	1.96	0.223	0.217	1.47	1.44	0.234	0.234	0.255	0.254
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	1.12	1.10	0.753	0.768	1.53	1.43	0.582	0.592	0.576	0.574
Strontium (Sr)	mg/L		0.00020	0.0207	0.0210	0.00923	0.00906	0.0986	0.0953	0.00720	0.00699	0.00830	0.00825
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	0.000018	0.000018	0.000011	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	0.000062	0.000070	0.000099	0.000092	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.0030	0.0042	<0.0030	<0.0030	<0.0030	0.0096	0.0098	<0.0030	<0.0030	<0.0030	<0.0030

Note Echo OF was dry during August sampling.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	George	George	George	George
Location				Goose OF	Goose OF	Propellor OF	Propellor OF	Reference B OF	Reference B OF	George OF	George OF	Sleigh OF	Sleigh OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				7-Aug-12	7-Aug-12	9-Aug-12	9-Aug-12	10-Aug-12	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1190634-3	L1190634-4	L1192523-1	L1192523-2	L1192523-3	L1192523-4	L1190226-5	L1190219-1	L1190226-3	L1190226-4
Physical Tests	µS/cm												
Conductivity			2.0	30.9	31.2	21.3	21.3	20.5	20.4	53.5	54.3	75.8	75.0
Hardness (as $CaCO_3$)	mg/L		0.50	11.6	11.2	8.04	7.59	8.32	8.64	20.9	21.1	30.2	29.5
pH	pH	6.5-9.0	0.10	6.81	6.79	6.81	6.81	7.14	7.16	7.13	7.21	7.20	7.18
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	3.3	3.2	3.9	3.6	7.1	6.6	6.2	6.6	6.8	7.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	3.3	3.2	3.9	3.6	7.1	6.6	6.2	6.6	6.8	7.0
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	3.3	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	26	24	17	16	16	24	35	37	56	49
Turbidity	NTU	dependent on background levels	0.10	0.34	0.39	0.28	0.25	0.77	0.62	0.46	0.52	0.50	0.44
Nutrients													
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	0.0055	0.0068	0.0054	0.0054	0.0115	0.0118	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.0050	<0.0050	<0.0050	0.112	0.114	0.0119	<0.0050	<0.0050	<0.0050	0.0111	0.0106
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.206	0.181	0.144	0.151	0.274	0.267	0.149	0.142	0.186	0.195
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0033	0.0033	0.0031	0.0035	0.0066	0.0047	0.0040	0.0038	0.0046	0.0037
Anions													
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	4.30	4.31	1.58	1.57	<0.50	<0.50	3.27	3.27	6.13	6.01
Fluoride (F)	mg/L	0.12[b]	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.028	0.028	0.038	0.037
Sulfate (SO_4)	mg/L		0.5	4.32	4.32	2.89	2.89	2.16	2.17	13.4	13.5	18.2	18.2
Cyanides													
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L		0.50	3.39	3.20	2.43	2.25	2.88	2.79	1.98	2.01	2.65	2.70
Total Metals													
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0175	0.0115	0.0074	0.0077	0.0062	0.0060	0.0087	0.0095	0.0140	0.0131
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000227	0.000205	0.000146	0.000158	0.000261	0.000256	0.000568	0.000584	0.000773	0.000761
Barium (Ba)	mg/L		0.000050	0.00548	0.00504	0.00423	0.00429	0.00406	0.00401	0.00223	0.00238	0.00330	0.00326
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	<0.0050	<0.0050	0.0068	0.0066	<0.0050	0.0054	<0.0050	<0.0050	0.0057	<0.0050
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	2.64	2.65	1.71	1.76	1.58	1.58	5.16	5.49	7.71	7.52
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00012	0.00011	0.00020	0.00014	0.00015	0.00012	<0.00010	0.00027	<0.00010	0.00011
Cobalt (Co)	mg/L		0.00010	0.00027	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	0.00050	0.00054	0.00039	0.00036
Copper (Cu)	mg/L	≥0.002[e]	0.0005 - 0.0015	0.00147	0.00162	0.00122	0.00106	0.00076	0.00074	0.00151	0.00170	0.00249	0.00242
Iron (Fe)	mg/L	0.3	0.010	0.167	0.068	0.016	0.019	0.218	0.216	0.079	0.082	0.089	0.085
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.19	1.23	0.893	0.897	1.14	1.13	1.94	1.97	2.71	2.64
Manganese (Mn)	mg/L		0.000050	0.00624	0.00342	0.00206	0.00193	0.00402	0.00389	0.00787	0.00870	0.00572	0.00559
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00263	0.00228	0.00159	0.00168	0.00085	0.00082	0.00312	0.00331	0.00346	0.00342
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.342	0.332	0.296	0.298	0.316	0.320	0.357	0.372	0.501	0.497
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.214	0.202	0.178	0.184	0.199	0.201	0.165	0.176	0.226	0.223
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.614	0.588	0.458	0.467	0.492	0.491	0.817	0.769	1.11	1.09

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	George	George	George	George
Location				Goose OF	Goose OF	Goose	Goose	Goose	Goose	George OF	George OF	Sleigh OF	Sleigh OF
Replicate				1	2	Propellor OF 1	Propellor OF 2	Reference B OF 1	Reference B OF 2	1	2	1	2
Date Sampled				7-Aug-12	7-Aug-12	9-Aug-12	9-Aug-12	10-Aug-12	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1190634-3	L1190634-4	L1192523-1	L1192523-2	L1192523-3	L1192523-4	L1190226-5	L1190219-1	L1190226-3	L1190226-4
Strontium (Sr)	mg/L		0.00020	0.0148	0.0148	0.00850	0.00855	0.00602	0.00599	0.0199	0.0203	0.0355	0.0343
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	0.000235	0.000217	0.000090	0.000105	0.000112	0.000127	0.000120	0.000114	0.000151	0.000151
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals													
Aluminum (Al)	mg/L		0.0030	0.0047	0.0058	0.0045	0.0043	<0.0030	<0.0030	<0.0030	<0.0030	0.0053	0.0047
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000177	0.000151	0.000131	0.000108	0.000215	0.000217	0.000411	0.000420	0.000553	0.000541
Barium (Ba)	mg/L		0.000050	0.00489	0.00452	0.00420	0.00416	0.00369	0.00419	0.00210	0.00225	0.00333	0.00334
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0052	<0.0050	<0.0050	<0.0050
Cadmium (Cd)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	2.61	2.64	1.74	1.58	1.49	1.55	5.17	5.29	7.66	7.59
Chromium (Cr)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	0.00011	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00024	0.00022	0.00019	0.00020
Copper (Cu)	mg/L		0.00050	0.00109	0.00094	0.00087	0.00089	0.00055	0.00052	0.00109	0.00119	0.00198	0.00192
Iron (Fe)	mg/L		0.010	0.013	0.015	<0.010	<0.010	0.063	0.062	<0.010	<0.010	0.013	0.014
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.24	1.12	0.896	0.887	1.12	1.16	1.95	1.92	2.69	2.57
Manganese (Mn)	mg/L		0.000050	0.00157	0.00194	0.000888	0.000784	0.00102	0.00121	0.00514	0.00516	0.00352	0.00381
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.00225	0.00199	0.00161	0.00160	0.00080	0.00073	0.00291	0.00299	0.00343	0.00340
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.325	0.293	0.298	0.300	0.315	0.312	0.352	0.353	0.506	0.491
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.187	0.185	0.173	0.172	0.184	0.182	0.152	0.148	0.207	0.212
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.585	0.525	0.461	0.462	0.481	0.492	0.786	0.750	1.12	1.06
Strontium (Sr)	mg/L		0.00020	0.0139	0.0146	0.00841	0.00766	0.00566	0.00573	0.0188	0.0193	0.0353	0.0337
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Note Echo OF was dry during August sampling.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				George	George	George	George	George	George	Goose	Goose	Goose	Goose
Location				Dragon OF	Dragon OF	Komatic IF	Komatic IF	Reference C OF	Reference C OF	Moby OF	Moby OF	Gander IF	Gander IF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				5-Aug-12	5-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1190226-1	L1190226-2	L1190219-2	L1190219-3	L1190219-4	L1190219-5	L1212310-5	L1212310-6	L1212310-7	L1212310-8
Physical Tests	µS/cm												
Conductivity			2.0	46.5	45.9	76.5	69.7	114	115	72.5	72.6	41.8	41.3
Hardness (as $CaCO_3$)	mg/L		0.50	20.1	20.7	28.7	28.3	63.1	62.8	28.1	27.3	16.3	16.1
pH	pH	6.5-9.0	0.10	7.48	7.47	7.47	7.31	8.16	8.16	6.58	6.55	6.86	6.87
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	11.6	11.7	9.3	9.0	68.6	68.0	3.4	3.3	4.8	4.7
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	11.6	11.7	9.3	9.0	68.6	68.0	3.4	3.3	4.8	4.7
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	5.7	10.3	<3.0	<3.0	<3.0	<3.0	<3.0	4.3
Total Dissolved Solids	mg/L		10	37	34	53	51	72	67	56	56	29	33
Turbidity	NTU	dependent on background levels	0.10	0.40	0.73	2.52	2.75	0.28	0.26	0.67	0.93	1.10	1.31
Nutrients													
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0063	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.113	0.113	0.0364	0.0369
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.234	0.242	0.260	0.249	0.171	0.180	0.154	0.159	0.170	0.179
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0042	0.0044	0.0100	0.0108	0.0023	0.0023	0.0032	0.0035	0.0061	0.0074
Anions													
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	1.11	1.12	4.31	4.31	0.66	0.67	0.63	0.63	0.64	0.64
Fluoride (F)	mg/L	0.12[b]	0.02	0.021	0.022	0.035	0.035	<0.020	<0.020	0.037	0.037	0.024	0.025
Sulfate (SO_4)	mg/L		0.5	9.20	9.19	17.3	17.4	0.68	0.68	28.2	28.4	13.4	13.5
Cyanides													
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L		0.50	3.68	3.68	3.62	3.71	3.86	3.54	3.46	3.47	3.53	3.62
Total Metals													
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0081	0.0088	0.0936	0.0806	<0.0030	<0.0030	0.0668	0.0657	0.0476	0.0658
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.00128	0.00138	0.00146	0.00146	0.000243	0.000227	0.000263	0.000233	0.000418	0.000386
Barium (Ba)	mg/L		0.000050	0.000645	0.000704	0.00294	0.00287	0.0225	0.0224	0.0112	0.0109	0.00703	0.00647
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0077	0.0072	0.0070	0.0065
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000064	0.000061	0.000021	0.000017
Calcium (Ca)	mg/L		0.020	4.07	4.28	7.14	7.21	16.2	16.1	6.50	6.28	3.46	3.54
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	<0.00010	<0.00010	0.00034	0.00032	<0.00010	<0.00010	0.00033	0.00035	0.00041	0.00038
Cobalt (Co)	mg/L		0.00010	0.00018	0.00019	0.00046	0.00047	<0.00010	<0.00010	0.0108	0.0102	0.00275	0.00252
Copper (Cu)	mg/L	≥0.002[e]	0.0005 - 0.0015	0.00175	0.00178	0.00309	0.00321	0.00098	0.00101	0.00395	0.00339	0.00340	0.00197
Iron (Fe)	mg/L	0.3	0.010	0.079	0.078	0.283	0.263	<0.010	0.011	0.184	0.175	0.171	0.226
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	0.000072	0.000080	<0.000050	<0.000050	0.000065	<0.000050	0.000262	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	2.51	2.64	2.85	2.88	6.21	6.24	3.11	2.99	2.07	1.87
Manganese (Mn)	mg/L		0.000050	0.00281	0.00289	0.00547	0.00523	0.00266	0.00273	0.0428	0.0412	0.0114	0.0104
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	0.000056	0.000072	0.000069	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00140	0.00148	0.00435	0.00433	<0.00010	<0.00010	0.0568	0.0539	0.0184	0.0165
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.342	0.364	0.481	0.481	0.245	0.248	0.373	0.360	0.376	0.355
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.342	0.355	0.224	0.222	1.02	1.00	2.80	2.71	0.950	1.05
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.550	0.587	1.07	1.10	0.468	0.463	1.31	1.26	0.993	0.911

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				George	George	George	George	George	George	Goose	Goose	Goose	Goose
Location				Dragon OF	Dragon OF	Komatic IF	Komatic IF	Reference C OF	Reference C OF	Moby OF	Moby OF	Gander IF	Gander IF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				5-Aug-12	5-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1190226-1	L1190226-2	L1190219-2	L1190219-3	L1190219-4	L1190219-5	L1212310-5	L1212310-6	L1212310-7	L1212310-8
Strontium (Sr)	mg/L		0.00020	0.00859	0.00902	0.0273	0.0293	0.00749	0.00744	0.0279	0.0272	0.0148	0.0153
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	0.000015	0.000016	0.000311	0.000303	0.000027	0.000025	0.000015	0.000015
Vanadium (V)	mg/L		0.000050	0.000142	0.000140	0.000359	0.000346	0.000138	0.000133	0.000217	0.000197	0.000333	0.000339
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0180	0.0161	0.0083	0.0064
Dissolved Metals													
Aluminum (Al)	mg/L		0.0030	0.0033	0.0033	0.0066	0.0071	<0.0030	<0.0030	0.0403	0.0397	0.0097	0.0107
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000983	0.00100	0.000887	0.000930	0.000217	0.000212	0.000197	0.000193	0.000281	0.000310
Barium (Ba)	mg/L		0.000050	0.000573	0.000714	0.00272	0.00255	0.0210	0.0209	0.0109	0.0106	0.00600	0.00606
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0066	0.0063	0.0061	0.0057
Cadmium (Cd)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000064	0.000061	0.000015	0.000015
Calcium (Ca)	mg/L		0.020	4.11	4.23	7.06	6.87	15.3	15.3	6.34	6.15	3.51	3.46
Chromium (Cr)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	0.00012	<0.00010	<0.00010	0.00030	0.00022	0.00021	0.00018
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	0.00028	0.00029	<0.00010	<0.00010	0.0102	0.00992	0.00234	0.00228
Copper (Cu)	mg/L		0.00050	0.00137	0.00139	0.00203	0.00207	0.00083	0.00083	0.00290	0.00280	0.00136	0.00133
Iron (Fe)	mg/L		0.010	0.015	0.013	0.043	0.039	<0.010	<0.010	0.089	0.093	0.043	0.050
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	2.40	2.46	2.68	2.72	6.02	6.00	2.99	2.90	1.83	1.81
Manganese (Mn)	mg/L		0.000050	0.000172	0.000214	0.00314	0.00329	0.000057	0.000074	0.0411	0.0404	0.00941	0.00932
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000065	0.000059	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.00132	0.00131	0.00373	0.00384	<0.00010	<0.00010	0.0536	0.0522	0.0155	0.0153
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.341	0.346	0.448	0.459	0.241	0.233	0.358	0.349	0.326	0.321
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.326	0.329	0.087	0.080	0.972	0.977	2.66	2.70	0.911	0.936
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.554	0.552	1.01	1.05	0.452	0.451	1.26	1.22	0.881	0.883
Strontium (Sr)	mg/L		0.00020	0.00851	0.00879	0.0269	0.0271	0.00694	0.00696	0.0270	0.0263	0.0147	0.0147
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	0.000012	<0.000010	0.000297	0.000294	0.000025	0.000022	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	0.000052	0.000069	0.000050	0.000051	<0.000050	0.000058	0.000063	0.000062
Zinc (Zn)	mg/L		0.0030	<0.0030	0.0032	<0.0030	<0.0030	<0.0030	<0.0030	0.0161	0.0148	0.0048	0.0045

Note Echo OF was dry during August sampling.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ /1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ /1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ /1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Gander US	Gander US	Pond 19 OF	Pond 19 OF	Chair OF	Chair OF	Llama OF	Llama OF	Echo OF	Echo OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1212310-9	L1212310-10	L1212310-3	L1212310-4	L1212310-11	L1212310-12	L1212310-13	L1212310-14	L1212310-15	L1212310-16
Physical Tests	µS/cm												
Conductivity			2.0	29.3	29.5	108	109	59.8	60.0	335	336	116	116
Hardness (as $CaCO_3$)	mg/L		0.50	11.5	11.4	47.2	47.1	24.0	23.7	132	132	42.6	44.0
pH	pH	6.5-9.0	0.10	6.90	6.90	7.17	7.18	6.95	6.96	6.60	6.66	5.85	6.10
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	5.0	4.9	15.4	14.9	6.8	6.7	5.7	5.8	2.3	2.1
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	5.0	4.9	15.4	14.9	6.8	6.7	5.7	5.8	2.3	2.1
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	22	23	84	86	46	46	314	284	87	90
Turbidity	NTU	dependent on background levels	0.10	0.90	0.84	0.45	0.37	0.84	1.07	0.25	0.24	0.26	0.20
Nutrients													
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.0050	0.0098	0.0067	0.122	0.121	0.0522	0.0501	0.608	0.609	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.174	0.179	0.194	0.190	0.208	0.216	0.138	0.135	0.264	0.274
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0066	0.0058	0.0030	0.0023	0.0073	0.0060	<0.0020	<0.0020	0.0033	0.0032
Anions													
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.621	0.634	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	0.64	0.63	1.47	1.47	1.08	1.07	87.7	87.9	18.3	18.1
Fluoride (F)	mg/L	0.12[b]	0.02	0.021	0.021	0.022	0.024	<0.020	<0.020	<0.020	<0.020	0.020	0.020
Sulfate (SO_4)	mg/L		0.5	8.08	8.03	35.3	35.4	19.7	19.6	17.5	17.4	23.2	23.0
Cyanides													
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L		0.50	3.29	3.31	4.95	4.99	4.36	4.50	2.49	2.27	6.44	6.81
Total Metals													
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0212	0.0215	0.0223	0.0231	0.0426	0.0363	0.0243	0.0229	0.0881	0.0867
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000410	0.000384	0.000362	0.000376	0.000588	0.000605	0.000174	0.000178	0.000239	0.000217
Barium (Ba)	mg/L		0.000050	0.00441	0.00460	0.00959	0.00951	0.00798	0.00826	0.0551	0.0558	0.0415	0.0410
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	0.0064	0.0062	0.0068	0.0068	0.0060	0.0061	0.0088	0.0092	0.0062	0.0066
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	<0.000010	<0.000010	0.000016	0.000013	<0.000010	<0.000010	0.000209	0.000216	0.000054	0.000052
Calcium (Ca)	mg/L		0.020	2.38	2.41	9.45	9.62	3.93	4.09	32.4	32.7	10.5	10.3
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00027	0.00029	0.00033	0.00031	0.00036	0.00037	0.00019	0.00020	0.00049	0.00050
Cobalt (Co)	mg/L		0.00010	0.00018	0.00020	0.00028	0.00028	0.00062	0.00062	0.00598	0.00616	0.00464	0.00461
Copper (Cu)	mg/L	≥0.002[e]	0.0005 - 0.0015	0.00176	0.00146	0.00251	0.00273	0.00152	0.00166	0.00176	0.00177	0.00180	0.00159
Iron (Fe)	mg/L	0.3	0.010	0.126	0.125	0.071	0.072	0.315	0.298	0.012	<0.010	0.070	0.075
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000054	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.45	1.43	5.74	5.55	3.35	3.40	12.2	12.6	4.47	4.40
Manganese (Mn)	mg/L		0.000050	0.00247	0.00257	0.00282	0.00286	0.00683	0.00663	0.0467	0.0475	0.0380	0.0374
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00362	0.00361	0.00975	0.00949	0.00418	0.00474	0.0461	0.0470	0.00806	0.00800
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.330	0.347	0.680	0.667	0.441	0.439	1.03	1.04	0.244	0.240
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.310	0.305	2.61	2.50	1.45	1.44	2.12	2.10	3.90	3.86
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.759	0.765	1.50	1.47	1.13	1.15	2.21	2.24	1.73	1.68

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Gander US	Gander US	Pond 19 OF	Pond 19 OF	Chair OF	Chair OF	Llama OF	Llama OF	Echo OF	Echo OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1212310-9	L1212310-10	L1212310-3	L1212310-4	L1212310-11	L1212310-12	L1212310-13	L1212310-14	L1212310-15	L1212310-16
Strontium (Sr)	mg/L		0.00020	0.0106	0.0105	0.0289	0.0298	0.0161	0.0169	0.159	0.161	0.0439	0.0438
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	0.000013	0.000013	0.000011	0.000012	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	0.000289	0.000258	0.000146	0.000150	0.000309	0.000278	0.000114	0.000127	0.000220	0.000229
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	0.0040	0.0035	0.0039	0.0032	0.0034	0.0233	0.0239	0.0082	0.0083
Dissolved Metals													
Aluminum (Al)	mg/L		0.0030	0.0038	0.0038	0.0158	0.0158	0.0139	0.0131	0.0204	0.0191	0.0849	0.0835
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000299	0.000259	0.000306	0.000307	0.000461	0.000394	0.000123	0.000152	0.000184	0.000199
Barium (Ba)	mg/L		0.000050	0.00412	0.00410	0.00962	0.00945	0.00785	0.00785	0.0561	0.0563	0.0415	0.0421
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	0.0062	0.0051	0.0061	0.0072	0.0060	0.0062	0.0081	0.0089	<0.0050	0.0054
Cadmium (Cd)	mg/L		0.000010	<0.000010	<0.000010	0.000011	0.000012	<0.000010	<0.000010	0.000210	0.000221	0.000051	0.000050
Calcium (Ca)	mg/L		0.020	2.28	2.28	9.64	9.71	4.01	3.94	33.0	32.6	9.77	10.3
Chromium (Cr)	mg/L		0.00010	0.00020	0.00014	0.00021	0.00026	0.00028	0.00034	0.00016	0.00018	0.00035	0.00034
Cobalt (Co)	mg/L		0.00010	0.00012	0.00011	0.00026	0.00027	0.00050	0.00052	0.00603	0.00602	0.00459	0.00458
Copper (Cu)	mg/L		0.00050	0.00102	0.00100	0.00218	0.00217	0.00124	0.00121	0.00150	0.00151	0.00143	0.00144
Iron (Fe)	mg/L		0.010	0.021	0.020	0.036	0.043	0.092	0.093	<0.010	<0.010	0.055	0.056
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.40	1.38	5.63	5.55	3.39	3.36	12.1	12.3	4.42	4.43
Manganese (Mn)	mg/L		0.000050	0.00132	0.00147	0.00269	0.00266	0.00555	0.00552	0.0471	0.0463	0.0377	0.0376
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.00335	0.00337	0.00942	0.00946	0.00390	0.00393	0.0460	0.0455	0.00791	0.00797
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.314	0.315	0.665	0.666	0.443	0.437	1.04	1.04	0.241	0.245
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.255	0.255	2.50	2.58	1.33	1.35	2.10	2.09	3.89	3.82
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.730	0.722	1.46	1.47	1.14	1.13	2.23	2.22	1.70	1.70
Strontium (Sr)	mg/L		0.00020	0.0100	0.0101	0.0294	0.0294	0.0161	0.0160	0.162	0.157	0.0407	0.0431
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	0.000012	0.000011	<0.000010	<0.000010	<0.000010	0.000011	<0.000010	<0.000010
Vanadium (V)	mg/L		0.000050	0.000053	<0.000050	0.000057	<0.000050	0.000093	0.000074	<0.000050	<0.000050	0.000144	0.000121
Zinc (Zn)	mg/L		0.0030	<0.0030	<0.0030	<0.0030	0.0035	0.0034	<0.0030	0.0238	0.0227	0.0073	0.0076

Note Echo OF was dry during August sampling.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Reference B OF	Reference B OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				19-Sep-12	19-Sep-12	18-Sep-12	18-Sep-12	19-Sep-12	19-Sep-12	17-Sep-12	17-Sep-12	17-Sep-12	17-Sep-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1212370-1	L1212370-2	L1212310-1	L1212310-2	L1212370-3	L1212370-4	L1211487-3	L1211487-4	L1211487-5	L1211487-6
Physical Tests	µS/cm												
Conductivity			2.0	27.8	27.5	29.1	28.6	32.0	32.2	19.3	19.4	28.9	29.1
Hardness (as $CaCO_3$)	mg/L		0.50	10.8	10.7	12.0	11.9	12.4	12.3	7.96	8.01	13.0	12.9
pH	pH	6.5-9.0	0.10	6.91	6.86	7.02	6.98	6.85	6.79	6.69	6.76	7.06	7.02
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	4.5	4.8	6.3	5.5	3.5	3.5	3.8	3.9	10.7	10.9
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	4.5	4.8	6.3	5.5	3.5	3.5	3.8	3.9	10.7	10.9
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	20	20	23	21	19	<10	16	17	37	30
Turbidity	NTU	dependent on background levels	0.10	0.62	0.35	0.64	0.78	0.56	0.37	0.52	0.38	2.15	2.10
Nutrients													
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0488	0.0489
Nitrate (as N)	mg/L	2.935[b]	0.0050	0.0062	0.0068	0.0432	0.0420	<0.0050	<0.0050	0.0671	0.0675	0.0162	0.0192
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.156	0.152	0.176	0.183	0.155	0.160	0.120	0.122	0.558	0.683
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0032	0.0029	0.0035	0.0031	0.0035	0.0033	0.0035	0.0028	0.0139	0.0128
Anions													
Bromide (Br)	mg/L		0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	0.59	0.59	1.27	1.26	4.56	4.53	1.67	1.67	0.72	0.72
Fluoride (F)	mg/L	0.12[b]	0.02	0.024	0.023	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	0.022
Sulfate (SO_4)	mg/L		0.5	7.28	7.19	5.98	6.04	4.47	4.42	3.46	3.49	3.06	3.06
Cyanides													
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L		0.50	3.37	3.40	3.86	3.82	3.45	3.37	2.42	2.65	7.89	7.90
Total Metals													
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0109	0.0101	0.0157	0.0161	0.0063	0.0060	0.0088	0.0085	0.0534	0.0544
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000193	0.000202	0.000202	0.000179	0.000160	0.000188	0.000133	0.000142	0.000402	0.000398
Barium (Ba)	mg/L		0.000050	0.00330	0.00334	0.00519	0.00528	0.00480	0.00485	0.00365	0.00361	0.00850	0.00851
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	0.0069	0.0070	0.0061	0.0062	0.0063	0.0060	0.0065	0.0066	0.0065	0.0068
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	1.92	1.95	2.36	2.42	2.82	2.85	1.69	1.66	2.47	2.44
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00017	0.00021	0.00029	0.00027	0.00018	0.00018	0.00019	0.00019	0.00070	0.00071
Cobalt (Co)	mg/L		0.00010	0.00011	0.00011	0.00013	0.00014	<0.00010	<0.00010	<0.00010	<0.00010	0.00030	0.00029
Copper (Cu)	mg/L	≥0.002[e]	0.0005 - 0.0015	0.00209	0.00173	0.00105	0.00115	0.00119	0.00129	<0.0015	<0.0015	<0.0015	<0.0015
Iron (Fe)	mg/L	0.3	0.010	0.060	0.060	0.128	0.128	0.036	0.036	0.018	0.024	1.19	1.18
Lead (Pb)	mg/L	≥0.001[f]	0.000050	0.000056	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.51	1.50	1.47	1.47	1.35	1.37	0.966	0.955	1.70	1.70
Manganese (Mn)	mg/L		0.000050	0.00210	0.00203	0.00248	0.00260	0.00190	0.00197	0.00139	0.00144	0.00364	0.00354
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	0.000072	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00399	0.00406	0.00227	0.00223	0.00224	0.00228	0.00162	0.00167	0.00270	0.00268
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.333	0.330	0.281	0.281	0.324	0.332	0.263	0.263	0.307	0.298
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.307	0.312	0.788	0.795	0.173	0.177	0.195	0.194	0.637	0.635
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000017	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.663	0.656	0.704	0.697	0.626	0.642	0.491	0.486	0.934	0.941

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Reference B OF	Reference B OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				19-Sep-12	19-Sep-12	18-Sep-12	18-Sep-12	19-Sep-12	19-Sep-12	17-Sep-12	17-Sep-12	17-Sep-12	17-Sep-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1212370-1	L1212370-2	L1212310-1	L1212310-2	L1212370-3	L1212370-4	L1211487-3	L1211487-4	L1211487-5	L1211487-6
Strontium (Sr)	mg/L		0.00020	0.00808	0.00821	0.00991	0.0101	0.0150	0.0151	0.00773	0.00759	0.00904	0.00906
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000015	0.000016
Vanadium (V)	mg/L		0.000050	0.000129	0.000154	0.000169	0.000160	0.000118	0.000109	0.000092	0.000097	0.000647	0.000652
Zinc (Zn)	mg/L	0.03	0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0040
Dissolved Metals													
Aluminum (Al)	mg/L		0.0030	0.0049	0.0044	0.0091	0.0092	<0.0030	0.0045	0.0044	0.0048	0.0332	0.0330
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000147	0.000165	0.000150	0.000169	0.000170	0.000136	0.000103	0.000086	0.000329	0.000322
Barium (Ba)	mg/L		0.000050	0.00323	0.00322	0.00509	0.00521	0.00466	0.00473	0.00348	0.00347	0.00803	0.00795
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	0.0063	0.0064	0.0056	0.0059	0.0070	0.0055	<0.0050	0.0068	0.0063	0.0063
Cadmium (Cd)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	1.86	1.90	2.35	2.38	2.75	2.71	1.64	1.65	2.42	2.43
Chromium (Cr)	mg/L		0.00010	0.00011	0.00019	0.00021	0.00021	0.00022	0.00014	<0.00010	0.00017	0.00060	0.00052
Cobalt (Co)	mg/L		0.00010	<0.00010	<0.00010	0.00012	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	0.00026	0.00024
Copper (Cu)	mg/L		0.00050	0.00133	0.00134	0.00085	0.00083	0.00092	0.00097	0.00075	0.00076	0.00098	0.00096
Iron (Fe)	mg/L		0.010	0.011	<0.010	0.062	0.062	<0.010	<0.010	<0.010	<0.010	0.712	0.711
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	1.49	1.45	1.48	1.46	1.35	1.34	0.939	0.943	1.68	1.65
Manganese (Mn)	mg/L		0.000050	0.00153	0.00154	0.00245	0.00236	0.00106	0.00112	0.000206	0.000684	0.00326	0.00311
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L		0.00010	0.00386	0.00378	0.00215	0.00220	0.00220	0.00225	0.00159	0.00154	0.00254	0.00254
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.327	0.323	0.286	0.282	0.328	0.320	0.250	0.257	0.292	0.290
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.296	0.288	0.762	0.774	0.159	0.160	0.182	0.182	0.587	0.585
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.655	0.635	0.702	0.694	0.627	0.623	0.472	0.475	0.914	0.905
Strontium (Sr)	mg/L		0.00020	0.00767	0.00787	0.00970	0.00982	0.0145	0.0142	0.00738	0.00735	0.00870	0.00873
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000013	0.000012
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000365	0.000376
Zinc (Zn)	mg/L		0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Note Echo OF was dry during August sampling.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				George	George	George	George	George	George	George	George	George	George
Location				George OF	George OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF	Komatic IF	Komatic IF	Reference C OF	Reference C OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1212370-5	L1212370-6	L1212370-7	L1212370-8	L1212370-9	L1212370-10	L1212370-11	L1212370-12	L1212370-15	L1212370-16
Physical Tests	µS/cm												
Conductivity			2.0	69.2	69.4	106	106	60.9	61.1	121	122	118	118
Hardness (as $CaCO_3$)	mg/L		0.50	28.0	28.3	42.2	42.4	26.4	26.7	51.0	51.3	62.8	63.6
pH	pH	6.5-9.0	0.10	7.09	7.03	7.07	7.12	7.43	7.43	7.31	7.36	8.13	8.14
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		2.0	5.8	5.4	6.9	6.9	12.6	12.5	11.5	11.7	67.0	66.5
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		2.0	5.8	5.4	6.9	6.9	12.6	12.5	11.5	11.7	67.0	66.5
Total Suspended Solids	mg/L	dependent on background levels	3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
Total Dissolved Solids	mg/L		10	40	33	64	60	44	38	86	88	64	66
Turbidity	NTU	dependent on background levels	0.10	0.67	0.29	0.43	0.75	0.36	0.80	0.63	0.88	0.38	0.24
Nutrients													
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	0.0050	0.0097	0.0110	0.0334	0.0337	<0.0050	<0.0050	0.0219	0.0227	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		0.05	0.145	0.143	0.183	0.178	0.202	0.209	0.222	0.214	0.164	0.159
Ortho-phosphate (as P)	mg/L		0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework[c]	0.002	0.0023	0.0022	0.0036	0.0041	0.0049	0.0042	0.0074	0.0043	0.0027	0.0025
Anions													
Bromide (Br)	mg/L		0.050	<0.050	<0.050	0.084	0.068	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	0.50	2.88	2.86	10.7	10.6	1.20	1.19	4.53	4.52	0.68	0.68
Fluoride (F)	mg/L	0.12[b]	0.02	0.028	0.028	0.034	0.034	0.022	0.021	0.027	0.027	<0.020	<0.020
Sulfate (SO_4)	mg/L		0.5	21.7	21.6	25.9	25.7	14.6	14.5	37.8	37.6	0.71	0.70
Cyanides													
Cyanide, Total	mg/L		0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon													
Total Organic Carbon	mg/L		0.50	2.57	2.59	3.09	3.27	3.78	5.35	4.78	4.73	6.94	5.15
Total Metals													
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	0.0030	0.0190	0.0211	0.0220	0.0219	0.0064	0.0096	0.0283	0.0274	<0.0030	<0.0030
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	0.000030	0.000453	0.000411	0.000541	0.000476	0.000962	0.00109	0.00107	0.00100	0.000228	0.000203
Barium (Ba)	mg/L		0.000050	0.00275	0.00267	0.00494	0.00490	0.00103	0.00106	0.00406	0.00403	0.0186	0.0189
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	0.005	0.0059	0.0063	0.0072	0.0069	0.0056	0.0056	0.0064	0.0065	0.0056	<0.0050
Cadmium (Cd)	mg/L	equation[b,d]	0.000010	0.000013	0.000013	0.000021	0.000019	<0.000010	<0.000010	0.000017	0.000019	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	7.09	6.83	10.9	11.0	5.21	5.19	11.0	11.0	14.3	15.1
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	0.00010	0.00013	0.00017	0.00020	0.00020	0.00018	0.00020	0.00027	0.00029	0.00013	<0.00010
Cobalt (Co)	mg/L		0.00010	0.00190	0.00200	0.00164	0.00166	0.00102	0.00118	0.00270	0.00267	<0.00010	<0.00010
Copper (Cu)	mg/L	≥0.002[e]	0.0005 - 0.0015	0.00190	0.00180	0.00270	0.00286	0.00174	0.00182	0.00314	0.00317	0.00095	0.00096
Iron (Fe)	mg/L	0.3	0.010	0.064	0.066	0.088	0.089	0.063	0.109	0.193	0.197	<0.010	<0.010
Lead (Pb)	mg/L	≥0.001[f]	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	2.68	2.63	3.75	3.79	3.47	3.34	5.97	6.08	6.32	6.33
Manganese (Mn)	mg/L		0.000050	0.00737	0.00820	0.0189	0.0187	0.00260	0.00452	0.0125	0.0129	0.00226	0.00256
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073	0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	0.00010	0.00815	0.00811	0.00881	0.00889	0.00460	0.00463	0.0146	0.0144	0.00011	<0.00010
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.370	0.346	0.555	0.559	0.375	0.365	0.532	0.547	0.239	0.239
Selenium (Se)	mg/L	0.001	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.573	0.554	0.549	0.552	0.507	0.510	1.15	1.18	1.02	1.02
Silver (Ag)	mg/L	0.0001	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.973	0.948	1.32	1.33	0.661	0.645	1.20	1.21	0.456	0.460

Appendix 3.3-1. Stream Water Quality Analytical Results, Back River, 2012

Area				George	George	George	George	George	George	George	George	George	George
Location				George OF	George OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF	Komatic IF	Komatic IF	Reference C OF	Reference C OF
Replicate				1	2	1	2	1	2	1	2	1	2
Date Sampled				19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12
ALS Sample ID #	Units	CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Realised Detection (RDL)	L1212370-5	L1212370-6	L1212370-7	L1212370-8	L1212370-9	L1212370-10	L1212370-11	L1212370-12	L1212370-15	L1212370-16
Strontium (Sr)	mg/L		0.00020	0.0254	0.0247	0.0573	0.0580	0.0109	0.0109	0.0345	0.0347	0.00667	0.00701
Thallium (Tl)	mg/L	0.0008	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000010	0.000022	0.000027	0.000318	0.000338
Vanadium (V)	mg/L		0.000050	0.000120	0.000124	0.000138	0.000143	0.000110	0.000120	0.000206	0.000204	0.000110	0.000139
Zinc (Zn)	mg/L	0.03	0.0030	0.0058	0.0056	0.0050	0.0054	0.0032	0.0034	0.0067	0.0075	<0.0030	<0.0030
Dissolved Metals													
Aluminum (Al)	mg/L		0.0030	0.0084	0.0098	0.0089	0.0090	<0.0030	<0.0030	0.0147	0.0141	<0.0030	<0.0030
Antimony (Sb)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L		0.000030	0.000351	0.000293	0.000369	0.000408	0.000735	0.000758	0.000764	0.000711	0.000217	0.000200
Barium (Ba)	mg/L		0.000050	0.00272	0.00272	0.00472	0.00466	0.000996	0.000996	0.00397	0.00384	0.0188	0.0191
Beryllium (Be)	mg/L		0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L		0.005	0.0064	0.0065	0.0070	0.0069	0.0058	0.0059	0.0062	0.0066	0.0061	0.0066
Cadmium (Cd)	mg/L		0.000010	0.000010	0.000012	0.000020	0.000017	<0.000010	<0.000010	0.000016	0.000015	<0.000010	<0.000010
Calcium (Ca)	mg/L		0.020	6.90	6.98	10.9	10.8	5.04	5.11	10.7	10.8	14.8	15.0
Chromium (Cr)	mg/L		0.00010	0.00015	0.00014	0.00011	<0.00010	0.00020	<0.00010	0.00032	0.00020	0.00013	0.00012
Cobalt (Co)	mg/L		0.00010	0.00169	0.00173	0.00154	0.00153	0.00082	0.00074	0.00256	0.00247	<0.00010	<0.00010
Copper (Cu)	mg/L		0.00050	0.00138	0.00141	0.00202	0.00201	0.00130	0.00136	0.00243	0.00236	0.00071	0.00077
Iron (Fe)	mg/L		0.010	0.017	0.019	0.021	0.020	0.014	0.013	0.114	0.110	<0.010	<0.010
Lead (Pb)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		0.0050	2.61	2.63	3.66	3.71	3.36	3.38	5.89	5.92	6.26	6.36
Manganese (Mn)	mg/L		0.000050	0.00600	0.00615	0.0180	0.0177	0.00143	0.00126	0.0120	0.0120	0.000068	<0.000050
Mercury (Hg)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000051	0.000080
Nickel (Ni)	mg/L		0.00010	0.00777	0.00799	0.00849	0.00858	0.00435	0.00429	0.0141	0.0137	0.00015	0.00012
Phosphorus (P)	mg/L		0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		0.050	0.350	0.350	0.543	0.554	0.365	0.379	0.520	0.522	0.234	0.241
Selenium (Se)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		0.050	0.535	0.542	0.515	0.518	0.496	0.494	1.13	1.14	1.02	1.02
Silver (Ag)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		0.010	0.946	0.942	1.29	1.30	0.641	0.651	1.17	1.18	0.454	0.461
Strontium (Sr)	mg/L		0.00020	0.0241	0.0245	0.0558	0.0560	0.0105	0.0105	0.0334	0.0336	0.00677	0.00684
Thallium (Tl)	mg/L		0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L		0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000017	0.000018	0.000329	0.000331
Vanadium (V)	mg/L		0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000061	0.000070	<0.000050	<0.000050
Zinc (Zn)	mg/L		0.0030	0.0047	0.0046	0.0043	0.0036	<0.0030	<0.0030	0.0055	0.0049	<0.0030	<0.0030

Note Echo OF was dry during August sampling.

a) Canadian water quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment, (accessed 2012).

b) Interim guideline.

c) Total phosphorus trigger ranges for lakes and rivers (mg/L): <0.004 = Ultraoligotriphic; 0.004-0.01 = Oligotrophic; 0.01-0.02 = Mesotrophic; 0.02-0.035 = Mesoeutrophic; 0.035-0.1 = Eutrophic; >0.1 = Hypereutrophic.

d) Guideline is hardness-dependent: cadmium guideline (mg/L) = $10^{\{0.86[\log(\text{hardness})]-3.2\}}$ / 1000.

*e) Guideline is hardness-dependent: copper guideline (mg/L) = $e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ * 0.0002. Copper guideline is a minimum of 0.002 mg/L regardless of water hardness.*

f) Guideline is hardness-dependent: lead guideline (mg/L) = $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ / 1000. Lead guideline is a minumum of 0.001 mg/L regardless of hardness.

g) Guideline is hardness-dependent: nickel guideline (mg/L) = $e^{\{0.76[\ln(\text{hardness})]+1.06\}}$ / 1000. Nickel guideline is a minimum of 0.025 mg/L regardless of water hardness.

h) RDL = Realised detection limit

Appendix 3.3-2

Stream Water Quality Analytical Results of Field Duplicates, Back River Project, 2012

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Appendix 3.3-2. Stream Water Quality Analytical Results of Field Duplicates, Back River, 2012

Location		Moby OF	Gander IF	Gander US	Pond 19 OF	Chair OF	Llama OF	Echo OF	Giraffe OF	Wolf OF	Goose OF	Propellor OF	Reference B OF
Depth	Realised	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	13-Jun-12	13-Jun-12	12-Jun-12	13-Jun-12	12-Jun-12	12-Jun-12
	Detection	L1162486-1	L1162486-3	L1162486-5	L1162486-9	L1162486-7	L1162486-11	L1162486-21	L1162486-23	L1162486-17	L1162486-25	L1162486-15	L1162486-13
ALS Sample ID	Limit	L1162486-2	L1162486-4	L1162486-6	L1162486-10	L1162486-8	L1162486-12	L1162486-22	L1162486-24	L1162486-18	L1162486-26	L1162486-16	L1162486-14
	(RDL)	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a
Physical Tests													
Conductivity	2.0	2.4	0.5	0.0	0.4	0.6	1.7	0.3	0.6	0.6	0.4	0.4	0.0
Hardness (as $CaCO_3$)	0.50	3.5	4.9	0.1	0.9	1.0	1.2	3.5	1.0	0.0	0.0	1.0	1.0
pH	0.10	1.8	0.1	0.0	0.3	12.1	0.3	3.3	0.8	0.0	0.6	0.6	4.7
Alkalinity, Bicarbonate (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Alkalinity, Carbonate (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Alkalinity, Hydroxide (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Alkalinity, Total (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Suspended Solids	3.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Dissolved Solids	10	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Turbidity	0.10	0.0	0.6	10.1	RPD-N/A	17.2	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nutrients													
Ammonia, Total (as N)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nitrate (as N)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nitrite (as N)	0.001	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Kjeldahl Nitrogen	0.05	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	4.8	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Ortho-phosphate (as P)	0.001	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Phosphorus (P)	0.002	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Anions													
Bromide (Br)	0.050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Chloride (Cl)	0.50	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	2.0	0.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Fluoride (F)	0.02	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sulfate (SO_4)	0.5	0.0	0.2	0.8	0.2	0.3	0.6	0.3	0.2	1.6	0.0	0.3	RPD-N/A
Cyanides													
Cyanide, Total	0.0010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cyanide, Free	0.0010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Organic / Inorganic Carbon													
Total Organic Carbon	0.50	4.6	0.0	1.5	1.0	0.5	0.6	0.0	0.6	0.5	0.2	0.8	0.3
Total Metals													
Aluminum (Al)	0.0030	7.8	5.2	11.7	11.1	1.9	11.0	8.1	2.4	2.7	6.5	21.7	10.1
Antimony (Sb)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Arsenic (As)	0.000030	7.1	3.2	4.0	7.5	3.6	2.0	11.4	6.4	7.7	18.8	1.7	RPD-N/A
Barium (Ba)	0.000050	1.6	4.4	2.0	0.3	2.8	3.2	3.3	2.0	0.5	0.9	1.5	4.1
Beryllium (Be)	0.00020	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Bismuth (Bi)	0.00050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Boron (B)	0.005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cadmium (Cd)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Calcium (Ca)	0.020	9.3	1.3	1.3	9.7	5.6	2.4	2.1	2.3	1.5	1.3	0.5	6.9
Chromium (Cr)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cobalt (Co)	0.00010	1.7	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	4.9	RPD-N/A	RPD-N/A	0.0	RPD-N/A	RPD-N/A
Copper (Cu)	0.0005 - 0.0015	0.3	RPD-N/A	RPD-N/A	1.2	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Iron (Fe)	0.010	5.6	5.0	8.3	RPD-N/A	1.2	RPD-N/A	1.4	RPD-N/A	RPD-N/A	0.0	RPD-N/A	21.2
Lead (Pb)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Lithium (Li)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Magnesium (Mg)	0.0050	1.3	2.0	0.9	2.2	2.9	0.7	3.3	5.1	0.2	0.9	0.0	1.4
Manganese (Mn)	0.000050	5.1	0.0	2.2	4.4	0.6	5.7	8.7	4.4	5.6	2.6	1.5	0.0
Mercury (Hg)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Molybdenum (Mo)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nickel (Ni)	0.00010	0.6	0.7	0.6	2.5	3.4	2.5	7.8	2.3	0.4	0.2	0.6	3.2
Phosphorus (P)	0.30	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Potassium (K)	0.050	RPD-N/A	2.6	1.3	3.6	5.6	2.5	RPD-N/A	RPD-N/A	RPD-N/A	3.5	1.1	RPD-N/A
Selenium (Se)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Silicon (Si)	0.050	1.2	2.2	2.3	1.1	3.0	0.8	0.5	3.9	3.4	1.2	0.3	RPD-N/A
Silver (Ag)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sodium (Na)	0.010	1.7	1.2	0.2	0.7	2.4	0.5	2.0	4.2	0.5	2.0	0.3	1.7

Appendix 3.3-2. Stream Water Quality Analytical Results of Field Duplicates, Back River, 2012

Location		Moby OF	Gander IF	Gander US	Pond 19 OF	Chair OF	Llama OF	Echo OF	Giraffe OF	Wolf OF	Goose OF	Propellor OF	Reference B OF
Depth	Realised	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	12-Jun-12	13-Jun-12	13-Jun-12	12-Jun-12	13-Jun-12	12-Jun-12	12-Jun-12
	Detection	L1162486-1	L1162486-3	L1162486-5	L1162486-9	L1162486-7	L1162486-11	L1162486-21	L1162486-23	L1162486-17	L1162486-25	L1162486-15	L1162486-13
ALS Sample ID	Limit	L1162486-2	L1162486-4	L1162486-6	L1162486-10	L1162486-8	L1162486-12	L1162486-22	L1162486-24	L1162486-18	L1162486-26	L1162486-16	L1162486-14
	(RDL)	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a
Strontium (Sr)	0.00020	8.6	2.0	1.9	9.2	5.3	1.7	4.0	1.4	1.6	0.8	1.0	6.1
Thallium (Tl)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Tin (Sn)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Titanium (Ti)	0.010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Uranium (U)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Vanadium (V)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Zinc (Zn)	0.0030	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Dissolved Metals													
Aluminum (Al)	0.0030	2.2	24.4	8.8	3.0	0.7	7.9	3.9	6.5	0.0	6.3	RPD-N/A	2.3
Antimony (Sb)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Arsenic (As)	0.000030	5.5	6.9	7.7	8.0	9.6	3.3	10.6	RPD-N/A	0.0	6.4	0.6	RPD-N/A
Barium (Ba)	0.000050	2.7	3.3	0.3	0.7	3.0	1.0	4.3	0.3	2.8	1.5	2.3	2.4
Beryllium (Be)	0.00020	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Bismuth (Bi)	0.00050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Boron (B)	0.005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cadmium (Cd)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Calcium (Ca)	0.020	7.2	9.0	0.0	1.8	0.8	1.4	2.9	0.0	0.7	0.4	0.9	0.9
Chromium (Cr)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cobalt (Co)	0.00010	0.9	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	4.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Copper (Cu)	0.00050	1.5	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Iron (Fe)	0.010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	15.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.0
Lead (Pb)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Lithium (Li)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Magnesium (Mg)	0.0050	0.7	0.8	1.0	0.7	1.2	0.7	4.4	2.1	0.9	0.9	1.7	0.6
Manganese (Mn)	0.000050	9.3	37.5	0.3	9.2	4.9	6.5	7.5	0.5	13.9	5.0	48.3	1.7
Mercury (Hg)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Molybdenum (Mo)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nickel (Ni)	0.00010	0.0	1.5	0.6	0.8	2.5	2.0	4.3	1.6	0.7	0.4	1.6	0.8
Phosphorus (P)	0.30	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Potassium (K)	0.050	RPD-N/A	1.4	2.7	3.5	2.5	1.3	RPD-N/A	RPD-N/A	RPD-N/A	3.2	0.3	RPD-N/A
Selenium (Se)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Silicon (Si)	0.050	0.2	0.3	0.9	2.6	2.3	2.0	0.4	0.5	RPD-N/A	5.5	0.0	RPD-N/A
Silver (Ag)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sodium (Na)	0.010	0.9	1.1	0.9	4.7	0.2	1.2	5.3	2.6	1.4	1.3	1.6	0.6
Strontium (Sr)	0.00020	9.2	0.5	0.9	1.4	2.8	0.0	3.4	0.2	0.2	0.0	1.3	0.8
Thallium (Tl)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Tin (Sn)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Titanium (Ti)	0.010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Uranium (U)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Vanadium (V)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Zinc (Zn)	0.0030	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A

a) Relative percent difference (RPD).

b) RPD-N/A Not applicable when the values are less than five times the detection limit.

Italicized values exceed the 20% relative percent difference and are more than five times the detection limit.

Bold values exceed the 50% relative percent difference and are more than five times the detection limit.

Appendix 3.3-2. Stream Water Quality Analytical Results of Field Duplicates, Back River, 2012

Location		George OF	Sleigh OF	Dragon OF	Komatic IF	Reference C OF	Moby OF	Gander IF	Gander US	Pond 19 OF	Chair OF	Llama OF	Giraffe OF	Wolf OF
Depth	Realised	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	12-Aug-12	11-Aug-12	11-Aug-12	13-Aug-12	12-Aug-12	8-Aug-12	8-Aug-12	7-Aug-12
	Detection	L1162486-29	L1162486-35	L1162486-33	L1162486-31	L1162486-27	L1193094-1	L1192523-5	L1192523-7	L1193081-1	L1193094-3	L1191588-1	L1191588-3	L1190634-1
ALS Sample ID	Limit	L1162486-30	L1162486-36	L1162486-34	L1162486-32	L1162486-28	L1193094-2	L1192523-6	L1192523-8	L1193081-2	L1193094-4	L1191588-2	L1191588-4	L1190634-2
	(RDL)	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a
Physical Tests														
Conductivity	2.0	0.2	0.4	0.0	0.3	0.2	0.0	0.4	0.4	0.9	0.0	1.7	0.4	2.1
Hardness (as $CaCO_3$)	0.50	1.8	0.4	0.8	0.0	0.4	0.0	2.9	3.7	4.0	0.0	1.5	1.3	0.3
pH	0.10	0.0	0.4	0.1	0.3	0.5	0.0	0.0	0.0	0.8	0.0	3.0	0.3	0.1
Alkalinity, Bicarbonate (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	2.1	RPD-N/A	0.4	RPD-N/A	RPD-N/A	RPD-N/A	2.6	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Alkalinity, Carbonate (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Alkalinity, Hydroxide (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Alkalinity, Total (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	2.1	RPD-N/A	0.4	RPD-N/A	RPD-N/A	RPD-N/A	2.6	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Suspended Solids	3.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Dissolved Solids	10	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	5.8	RPD-N/A	RPD-N/A
Turbidity	0.10	RPD-N/A	RPD-N/A	RPD-N/A	0.0	RPD-N/A	5.2	17.2	5.7	11.5	6.7	RPD-N/A	RPD-N/A	1.9
Nutrients														
Ammonia, Total (as N)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nitrate (as N)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.9	RPD-N/A	RPD-N/A	0.0	RPD-N/A	0.0	RPD-N/A	12.2
Nitrite (as N)	0.001	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Kjeldahl Nitrogen	0.05	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	16.5	RPD-N/A	RPD-N/A	RPD-N/A
Ortho-phosphate (as P)	0.001	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Phosphorus (P)	0.002	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	2.9	RPD-N/A	RPD-N/A	RPD-N/A
Anions														
Bromide (Br)	0.050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	2.0	RPD-N/A	RPD-N/A
Chloride (Cl)	0.50	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.5	RPD-N/A	RPD-N/A
Fluoride (F)	0.02	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sulfate (SO_4)	0.5	0.0	0.5	0.0	0.0	RPD-N/A	0.6	0.1	0.0	0.7	0.0	0.6	0.2	0.0
Cyanides														
Cyanide, Total	0.0010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cyanide, Free	0.0010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Organic / Inorganic Carbon														
Total Organic Carbon	0.50	RPD-N/A	RPD-N/A	1.7	0.7	RPD-N/A	0.0	4.9	0.0	3.6	6.4	RPD-N/A	2.9	5.3
Total Metals														
Aluminum (Al)	0.0030	0.9	5.9	RPD-N/A	3.9	RPD-N/A	2.8	2.8	RPD-N/A	1.5	3.7	13.7	RPD-N/A	RPD-N/A
Antimony (Sb)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Arsenic (As)	0.000030	0.7	3.3	1.3	2.3	RPD-N/A	4.7	1.3	11.7	6.4	1.4	1.5	6.1	9.3
Barium (Ba)	0.000050	1.2	4.4	5.4	0.6	0.6	0.3	0.0	6.8	3.1	2.0	0.0	3.7	5.3
Beryllium (Be)	0.00020	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Bismuth (Bi)	0.00050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Boron (B)	0.005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cadmium (Cd)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	4.5	RPD-N/A	RPD-N/A
Calcium (Ca)	0.020	0.2	0.4	0.4	2.5	0.5	0.6	0.5	19.8	1.5	2.8	1.7	1.7	5.2
Chromium (Cr)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cobalt (Co)	0.00010	1.4	0.0	0.0	RPD-N/A	RPD-N/A	0.3	0.0	RPD-N/A	RPD-N/A	0.0	4.6	RPD-N/A	RPD-N/A
Copper (Cu)	0.0005 - 0.0015	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	2.6	RPD-N/A	RPD-N/A	0.5	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Iron (Fe)	0.010	RPD-N/A	1.8	RPD-N/A	4.5	RPD-N/A	3.4	1.4	0.0	2.9	1.6	RPD-N/A	1.7	4.5
Lead (Pb)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Lithium (Li)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Magnesium (Mg)	0.0050	0.7	0.3	0.7	1.8	0.8	0.0	0.8	6.1	0.6	2.4	3.1	3.1	5.2
Manganese (Mn)	0.000050	0.4	0.2	1.6	4.9	7.0	2.4	6.5	8.8	2.0	0.0	4.0	7.3	6.9
Mercury (Hg)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Molybdenum (Mo)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nickel (Ni)	0.00010	1.0	0.9	1.2	3.8	RPD-N/A	0.0	1.7	3.3	0.6	1.9	2.1	2.3	9.2
Phosphorus (P)	0.30	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Potassium (K)	0.050	2.6	RPD-N/A	0.3	4.1	RPD-N/A	7.8	0.0	1.3	2.9	1.6	2.7	1.8	4.5
Selenium (Se)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Silicon (Si)	0.050	RPD-N/A	RPD-N/A	0.9	3.7	0.3	0.5	3.0	RPD-N/A	2.5	RPD-N/A	4.2	RPD-N/A	0.4
Silver (Ag)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sodium (Na)	0.010	0.5	1.2	0.8	2.0	0.0	1.8	2.3	3.3	1.8	2.1	8.6	4.1	3.7

Appendix 3.3-2. Stream Water Quality Analytical Results of Field Duplicates, Back River, 2012

Location		George OF	Sleigh OF	Dragon OF	Komatic IF	Reference C OF	Moby OF	Gander IF	Gander US	Pond 19 OF	Chair OF	Llama OF	Giraffe OF	Wolf OF
Depth	Realised	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	13-Jun-12	12-Aug-12	11-Aug-12	11-Aug-12	13-Aug-12	12-Aug-12	8-Aug-12	8-Aug-12	7-Aug-12
	Detection	L1162486-29	L1162486-35	L1162486-33	L1162486-31	L1162486-27	L1193094-1	L1192523-5	L1192523-7	L1193081-1	L1193094-3	L1191588-1	L1191588-3	L1190634-1
ALS Sample ID	Limit	L1162486-30	L1162486-36	L1162486-34	L1162486-32	L1162486-28	L1193094-2	L1192523-6	L1192523-8	L1193081-2	L1193094-4	L1191588-2	L1191588-4	L1190634-2
	(RDL)	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a
Strontium (Sr)	0.00020	1.9	1.0	0.2	3.7	0.7	0.5	0.3	20.0	0.0	0.7	3.7	2.1	4.3
Thallium (Tl)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Tin (Sn)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Titanium (Ti)	0.010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Uranium (U)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	1.6	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Vanadium (V)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	5.0	RPD-N/A	RPD-N/A	RPD-N/A	2.2	RPD-N/A	RPD-N/A	RPD-N/A
Zinc (Zn)	0.0030	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Dissolved Metals														
Aluminum (Al)	0.0030	RPD-N/A	14.9	RPD-N/A	0.0	RPD-N/A	3.0	RPD-N/A	RPD-N/A	12.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Antimony (Sb)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Arsenic (As)	0.000030	0.5	2.5	5.5	3.0	RPD-N/A	12.6	13.7	7.5	9.2	3.5	5.8	4.0	1.0
Barium (Ba)	0.000050	2.5	1.2	3.6	1.2	2.1	1.3	7.8	5.2	0.6	5.3	0.3	3.2	1.1
Beryllium (Be)	0.00020	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Bismuth (Bi)	0.00050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Boron (B)	0.005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cadmium (Cd)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	1.1	RPD-N/A	RPD-N/A
Calcium (Ca)	0.020	1.7	1.3	0.6	0.3	1.0	1.3	0.5	7.3	4.3	0.9	3.4	1.8	0.0
Chromium (Cr)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cobalt (Co)	0.00010	9.7	3.6	RPD-N/A	RPD-N/A	RPD-N/A	2.8	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	2.3	RPD-N/A	RPD-N/A
Copper (Cu)	0.00050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	2.0	RPD-N/A	RPD-N/A	0.3	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Iron (Fe)	0.010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	2.9	RPD-N/A	RPD-N/A	4.1	4.3	RPD-N/A	RPD-N/A	6.6
Lead (Pb)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Lithium (Li)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Magnesium (Mg)	0.0050	0.7	2.5	1.4	0.6	0.0	0.9	7.4	0.0	4.1	0.6	1.2	0.8	0.0
Manganese (Mn)	0.000050	2.8	2.6	1.1	2.6	RPD-N/A	3.6	11.4	13.4	2.7	17.9	2.5	3.4	21.3
Mercury (Hg)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Molybdenum (Mo)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nickel (Ni)	0.00010	1.5	2.0	1.6	0.0	RPD-N/A	0.5	6.7	3.5	1.8	0.3	0.5	1.0	0.6
Phosphorus (P)	0.30	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Potassium (K)	0.050	3.4	RPD-N/A	1.6	1.2	RPD-N/A	1.4	9.7	1.6	3.5	4.1	0.1	0.3	1.0
Selenium (Se)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Silicon (Si)	0.050	RPD-N/A	RPD-N/A	0.7	RPD-N/A	3.8	1.1	0.4	RPD-N/A	2.0	RPD-N/A	2.1	RPD-N/A	0.4
Silver (Ag)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sodium (Na)	0.010	0.8	4.5	0.0	0.2	1.4	1.8	7.4	0.5	1.8	2.0	6.8	1.7	0.3
Strontium (Sr)	0.00020	0.6	0.9	0.3	0.2	0.0	0.0	0.1	7.9	1.4	1.9	3.4	3.0	0.6
Thallium (Tl)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Tin (Sn)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Titanium (Ti)	0.010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Uranium (U)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	3.5	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Vanadium (V)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Zinc (Zn)	0.0030	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A

a) Relative percent difference (RPD).

b) RPD-N/A Not applicable when the values are less than five times the detection limit.

Italicized values exceed the 20% relative percent difference and are more than five times the detection limit.

Bold values exceed the 50% relative percent difference and are more than five times the detection limit.

Appendix 3.3-2. Stream Water Quality Analytical Results of Field Duplicates, Back River, 2012

Location		Goose OF	Propellor OF	Reference B OF	George OF	Sleigh OF	Dragon OF	Komatic IF	Reference C OF	Moby OF	Gander IF	Gander US	Pond 19 OF	Chair OF
Depth	Realised	7-Aug-12	9-Aug-12	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	6-Aug-12	6-Aug-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12
	Detection	L1190634-3	L1192523-1	L1192523-3	L1190226-5	L1190226-3	L1190226-1	L1190219-2	L1190219-4	L1212310-5	L1212310-7	L1212310-9	L1212310-3	L1212310-11
ALS Sample ID	Limit	L1190634-4	L1192523-2	L1192523-4	L1190219-1	L1190226-4	L1190226-2	L1190219-3	L1190219-5	L1212310-6	L1212310-8	L1212310-10	L1212310-4	L1212310-12
	(RDL)	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a
Physical Tests														
Conductivity	2.0	1.0	0.0	0.5	1.5	1.1	1.3	9.3	0.9	0.1	1.2	0.7	0.9	0.3
Hardness (as $CaCO_3$)	0.50	3.5	5.8	3.8	1.0	2.3	2.9	1.4	0.5	2.9	1.2	0.9	0.2	1.3
pH	0.10	0.3	0.0	0.3	1.1	0.3	0.1	2.2	0.0	0.5	0.1	0.0	0.1	0.1
Alkalinity, Bicarbonate (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.9	RPD-N/A	0.9	RPD-N/A	RPD-N/A	RPD-N/A	3.3	RPD-N/A
Alkalinity, Carbonate (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Alkalinity, Hydroxide (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Alkalinity, Total (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.9	RPD-N/A	0.9	RPD-N/A	RPD-N/A	RPD-N/A	3.3	RPD-N/A
Total Suspended Solids	3.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Dissolved Solids	10	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	3.8	7.2	0.0	RPD-N/A	RPD-N/A	2.4	RPD-N/A
Turbidity	0.10	RPD-N/A	RPD-N/A	21.6	RPD-N/A	RPD-N/A	RPD-N/A	8.7	RPD-N/A	32.5	17.4	6.9	RPD-N/A	24.1
Nutrients														
Ammonia, Total (as N)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nitrate (as N)	0.0050	RPD-N/A	1.8	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.0	1.4	RPD-N/A	0.8	4.1
Nitrite (as N)	0.001	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Kjeldahl Nitrogen	0.05	RPD-N/A	RPD-N/A	2.6	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Ortho-phosphate (as P)	0.001	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Phosphorus (P)	0.002	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Anions														
Bromide (Br)	0.050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Chloride (Cl)	0.50	0.2	RPD-N/A	RPD-N/A	0.0	2.0	RPD-N/A	0.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Fluoride (F)	0.02	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sulfate (SO_4)	0.5	0.0	0.0	RPD-N/A	0.7	0.0	0.1	0.6	RPD-N/A	0.7	0.7	0.6	0.3	0.5
Cyanides														
Cyanide, Total	0.0010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cyanide, Free	0.0010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Organic / Inorganic Carbon														
Total Organic Carbon	0.50	5.8	RPD-N/A	3.2	RPD-N/A	1.9	0.0	2.5	8.6	0.3	2.5	0.6	0.8	3.2
Total Metals														
Aluminum (Al)	0.0030	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	14.9	RPD-N/A	1.7	32.1	1.4	3.5	16.0
Antimony (Sb)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Arsenic (As)	0.000030	10.2	RPD-N/A	1.9	2.8	1.6	7.5	0.0	6.8	12.1	8.0	6.5	3.8	2.8
Barium (Ba)	0.000050	8.4	1.4	1.2	6.5	1.2	8.7	2.4	0.4	2.7	8.3	4.2	0.8	3.4
Beryllium (Be)	0.00020	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Bismuth (Bi)	0.00050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Boron (B)	0.005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cadmium (Cd)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	4.8	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Calcium (Ca)	0.020	0.4	2.9	0.0	6.2	2.5	5.0	1.0	0.6	3.4	2.3	1.3	1.8	4.0
Chromium (Cr)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cobalt (Co)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	5.7	8.7	RPD-N/A	RPD-N/A	0.0
Copper (Cu)	0.0005 - 0.0015	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.0025	RPD-N/A	3.8	RPD-N/A	15.3	RPD-N/A	RPD-N/A	8.4	RPD-N/A
Iron (Fe)	0.010	84.3	RPD-N/A	0.9	3.7	4.6	1.3	7.3	RPD-N/A	5.0	27.7	0.8	1.4	5.5
Lead (Pb)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Lithium (Li)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Magnesium (Mg)	0.0050	3.3	0.4	0.9	1.5	2.6	5.0	1.0	0.5	3.9	10.2	1.4	3.4	1.5
Manganese (Mn)	0.000050	58.4	6.5	3.3	10.0	2.3	2.8	4.5	2.6	3.8	9.2	4.0	1.4	3.0
Mercury (Hg)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Molybdenum (Mo)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nickel (Ni)	0.00010	14.3	5.5	3.6	5.9	1.2	5.6	0.5	RPD-N/A	5.2	10.9	0.3	2.7	12.6
Phosphorus (P)	0.30	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Potassium (K)	0.050	3.0	0.7	1.3	4.1	0.8	6.2	0.0	RPD-N/A	3.5	5.7	5.0	1.9	0.5
Selenium (Se)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Silicon (Si)	0.050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	3.7	RPD-N/A	2.0	3.3	10.0	1.6	4.3	0.7
Silver (Ag)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sodium (Na)	0.010	4.3	1.9	0.2	6.1	1.8	6.5	2.8	1.1	3.9	8.6	0.8	2.0	1.8

Appendix 3.3-2. Stream Water Quality Analytical Results of Field Duplicates, Back River, 2012

Location		Goose OF	Propellor OF	Reference B OF	George OF	Sleigh OF	Dragon OF	Komatic IF	Reference C OF	Moby OF	Gander IF	Gander US	Pond 19 OF	Chair OF
Depth	Realised	7-Aug-12	9-Aug-12	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	6-Aug-12	6-Aug-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12	18-Sep-12
	Detection	L1190634-3	L1192523-1	L1192523-3	L1190226-5	L1190226-3	L1190226-1	L1190219-2	L1190219-4	L1212310-5	L1212310-7	L1212310-9	L1212310-3	L1212310-11
ALS Sample ID	Limit	L1190634-4	L1192523-2	L1192523-4	L1190219-1	L1190226-4	L1190226-2	L1190219-3	L1190219-5	L1212310-6	L1212310-8	L1212310-10	L1212310-4	L1212310-12
	(RDL)	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a
Strontium (Sr)	0.00020	0.0	0.6	0.5	2.0	3.4	4.9	7.1	0.7	2.5	3.3	0.9	3.1	4.8
Thallium (Tl)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Tin (Sn)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Titanium (Ti)	0.010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Uranium (U)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	2.6	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Vanadium (V)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	3.7	RPD-N/A	RPD-N/A	1.8	11.3	RPD-N/A	10.6
Zinc (Zn)	0.0030	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	11.1	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Dissolved Metals														
Aluminum (Al)	0.0030	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	1.5	RPD-N/A	RPD-N/A	0.0	RPD-N/A
Antimony (Sb)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Arsenic (As)	0.000030	15.9	RPD-N/A	0.9	2.2	2.2	1.7	4.7	2.3	2.1	9.8	14.3	0.3	15.7
Barium (Ba)	0.000050	7.9	1.0	12.7	6.9	0.3	21.9	6.5	0.5	2.8	1.0	0.5	1.8	0.0
Beryllium (Be)	0.00020	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Bismuth (Bi)	0.00050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Boron (B)	0.005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cadmium (Cd)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	4.8	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Calcium (Ca)	0.020	1.1	9.6	3.9	2.3	0.9	2.9	2.7	0.0	3.0	1.4	0.0	0.7	1.8
Chromium (Cr)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cobalt (Co)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	2.8	2.6	RPD-N/A	RPD-N/A	RPD-N/A
Copper (Cu)	0.00050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	3.5	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Iron (Fe)	0.010	RPD-N/A	RPD-N/A	1.6	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	4.4	RPD-N/A	RPD-N/A	RPD-N/A	1.1
Lead (Pb)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Lithium (Li)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Magnesium (Mg)	0.0050	10.2	1.0	3.5	1.6	4.6	2.5	1.5	0.3	3.1	1.1	1.4	1.4	0.9
Manganese (Mn)	0.000050	21.1	12.4	17.0	0.4	7.9	RPD-N/A	4.7	RPD-N/A	1.7	1.0	10.8	1.1	0.5
Mercury (Hg)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Molybdenum (Mo)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nickel (Ni)	0.00010	12.3	0.6	9.2	2.7	0.9	0.8	2.9	RPD-N/A	2.6	1.3	0.6	0.4	0.8
Phosphorus (P)	0.30	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Potassium (K)	0.050	10.4	0.7	1.0	0.3	3.0	1.5	2.4	RPD-N/A	2.5	1.5	0.3	0.2	1.4
Selenium (Se)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Silicon (Si)	0.050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.9	RPD-N/A	0.5	1.5	2.7	0.0	3.1	1.5
Silver (Ag)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sodium (Na)	0.010	10.8	0.2	2.3	4.7	5.5	0.4	3.9	0.2	3.2	0.2	1.1	0.7	0.9
Strontium (Sr)	0.00020	4.9	9.3	1.2	2.6	4.6	3.2	0.7	0.3	2.6	0.0	1.0	0.0	0.6
Thallium (Tl)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Tin (Sn)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Titanium (Ti)	0.010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Uranium (U)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	1.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Vanadium (V)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Zinc (Zn)	0.0030	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A

a) Relative percent difference (RPD).

b) RPD-N/A Not applicable when the values are less than five times the detection limit.

Italicized values exceed the 20% relative percent difference and are more than five times the detection limit.

Bold values exceed the 50% relative percent difference and are more than five times the detection limit.

Appendix 3.3-2. Stream Water Quality Analytical Results of Field Duplicates, Back River, 2012

Location		Llama OF	Echo OF	Giraffe OF	Wolf OF	Goose OF	Propellor OF	Reference B OF	George OF	Sleigh OF	Dragon OF	Komatic IF	Reference C OF
Depth	Realised	18-Sep-12	18-Sep-12	19-Sep-12	18-Sep-12	19-Sep-12	17-Sep-12	17-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12
	Detection	L1212310-13	L1212310-15	L1212370-1	L1212310-1	L1212370-3	L1211487-3	L1211487-5	L1212370-5	L1212370-7	L1212370-9	L1212370-11	L1212370-15
ALS Sample ID	Limit	L1212310-14	L1212310-16	L1212370-2	L1212310-2	L1212370-4	L1211487-4	L1211487-6	L1212370-6	L1212370-8	L1212370-10	L1212370-12	L1212370-16
	(RDL)	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a
Physical Tests													
Conductivity	2.0	0.3	0.0	1.1	1.7	0.6	0.5	0.7	0.3	0.0	0.3	0.8	0.0
Hardness (as $CaCO_3$)	0.50	0.0	3.2	0.9	0.8	0.8	0.6	0.8	1.1	0.5	1.1	0.6	1.3
pH	0.10	0.9	4.2	0.7	0.6	0.9	1.0	0.6	0.8	0.7	0.0	0.7	0.1
Alkalinity, Bicarbonate (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	1.9	RPD-N/A	RPD-N/A	0.8	1.7	0.7
Alkalinity, Carbonate (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Alkalinity, Hydroxide (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Alkalinity, Total (as $CaCO_3$)	2.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	1.9	RPD-N/A	RPD-N/A	0.8	1.7	0.7
Total Suspended Solids	3.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Dissolved Solids	10	10.0	3.4	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	6.5	RPD-N/A	2.3	3.1
Turbidity	0.10	RPD-N/A	RPD-N/A	RPD-N/A	19.7	RPD-N/A	RPD-N/A	2.4	RPD-N/A	RPD-N/A	RPD-N/A	33.1	RPD-N/A
Nutrients													
Ammonia, Total (as N)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.2	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nitrate (as N)	0.0050	0.2	RPD-N/A	RPD-N/A	2.8	RPD-N/A	0.6	RPD-N/A	RPD-N/A	0.9	RPD-N/A	RPD-N/A	RPD-N/A
Nitrite (as N)	0.001	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Kjeldahl Nitrogen	0.05	RPD-N/A	3.7	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	20.1	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Ortho-phosphate (as P)	0.001	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Total Phosphorus (P)	0.002	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	8.2	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Anions													
Bromide (Br)	0.050	2.1	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Chloride (Cl)	0.50	0.2	1.1	RPD-N/A	RPD-N/A	0.7	RPD-N/A	RPD-N/A	0.7	0.9	RPD-N/A	0.2	RPD-N/A
Fluoride (F)	0.02	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sulfate (SO_4)	0.5	0.6	0.9	1.2	1.0	1.1	0.9	0.0	0.5	0.8	0.7	0.5	RPD-N/A
Cyanides													
Cyanide, Total	0.0010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cyanide, Free	0.0010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Organic / Inorganic Carbon													
Total Organic Carbon	0.50	RPD-N/A	5.6	0.9	1.0	2.3	RPD-N/A	0.1	0.8	5.7	34.4	1.1	29.6
Total Metals													
Aluminum (Al)	0.0030	5.9	1.6	RPD-N/A	2.5	RPD-N/A	RPD-N/A	1.9	10.5	0.5	RPD-N/A	3.2	RPD-N/A
Antimony (Sb)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Arsenic (As)	0.000030	2.3	9.6	4.6	12.1	16.1	RPD-N/A	1.0	9.7	12.8	12.5	6.8	11.6
Barium (Ba)	0.000050	1.3	1.2	1.2	1.7	1.0	1.1	0.1	3.0	0.8	2.9	0.7	1.6
Beryllium (Be)	0.00020	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Bismuth (Bi)	0.00050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Boron (B)	0.005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cadmium (Cd)	0.000010	3.3	3.8	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Calcium (Ca)	0.020	0.9	1.9	1.6	2.5	1.1	1.8	1.2	3.7	0.9	0.4	0.0	5.4
Chromium (Cr)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	1.4	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cobalt (Co)	0.00010	3.0	0.6	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	5.1	1.2	14.5	1.1	RPD-N/A
Copper (Cu)	0.0005 - 0.0015	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	5.8	RPD-N/A	1.0	RPD-N/A
Iron (Fe)	0.010	RPD-N/A	6.9	0.0	0.0	RPD-N/A	RPD-N/A	0.8	3.1	1.1	53.5	2.1	RPD-N/A
Lead (Pb)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Lithium (Li)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Magnesium (Mg)	0.0050	3.2	1.6	0.7	0.0	1.5	1.1	0.0	1.9	1.1	3.8	1.8	0.2
Manganese (Mn)	0.000050	1.7	1.6	3.4	4.7	3.6	3.5	2.8	10.7	1.1	53.9	3.1	12.4
Mercury (Hg)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Molybdenum (Mo)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nickel (Ni)	0.00010	1.9	0.7	1.7	1.8	1.8	3.0	0.7	0.5	0.9	0.7	1.4	RPD-N/A
Phosphorus (P)	0.30	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Potassium (K)	0.050	1.0	RPD-N/A	0.9	0.0	2.4	0.0	3.0	6.7	0.7	2.7	2.8	RPD-N/A
Selenium (Se)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Silicon (Si)	0.050	0.9	1.0	1.6	0.9	RPD-N/A	RPD-N/A	0.3	3.4	0.5	0.6	2.6	0.0
Silver (Ag)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sodium (Na)	0.010	1.3	2.9	1.1	1.0	2.5	1.0	0.7	2.6	0.8	2.5	0.8	0.9

Appendix 3.3-2. Stream Water Quality Analytical Results of Field Duplicates, Back River, 2012

Location		Llama OF	Echo OF	Giraffe OF	Wolf OF	Goose OF	Propellor OF	Reference B OF	George OF	Sleigh OF	Dragon OF	Komatic IF	Reference C OF
Depth	Realised	18-Sep-12	18-Sep-12	19-Sep-12	18-Sep-12	19-Sep-12	17-Sep-12	17-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12	19-Sep-12
	Detection	L1212310-13	L1212310-15	L1212370-1	L1212310-1	L1212370-3	L1211487-3	L1211487-5	L1212370-5	L1212370-7	L1212370-9	L1212370-11	L1212370-15
ALS Sample ID	Limit	L1212310-14	L1212310-16	L1212370-2	L1212310-2	L1212370-4	L1211487-4	L1211487-6	L1212370-6	L1212370-8	L1212370-10	L1212370-12	L1212370-16
	(RDL)	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a	RPD_a
Strontium (Sr)	0.00020	1.3	0.2	1.6	1.9	0.7	1.8	0.2	2.8	1.2	0.0	0.6	5.0
Thallium (Tl)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Tin (Sn)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Titanium (Ti)	0.010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Uranium (U)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	6.1
Vanadium (V)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.8	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Zinc (Zn)	0.0030	2.5	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Dissolved Metals													
Aluminum (Al)	0.0030	6.6	1.7	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.6	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Antimony (Sb)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Arsenic (As)	0.000030	RPD-N/A	7.8	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	2.2	18.0	10.0	3.1	7.2	8.2
Barium (Ba)	0.000050	0.4	1.4	0.3	2.3	1.5	0.3	1.0	0.0	1.3	0.0	3.3	1.6
Beryllium (Be)	0.00020	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Bismuth (Bi)	0.00050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Boron (B)	0.005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cadmium (Cd)	0.000010	5.1	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Calcium (Ca)	0.020	1.2	5.3	2.1	1.3	1.5	0.6	0.4	1.2	0.9	1.4	0.9	1.3
Chromium (Cr)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	14.3	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Cobalt (Co)	0.00010	0.2	0.2	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	2.3	0.7	10.3	3.6	RPD-N/A
Copper (Cu)	0.00050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Iron (Fe)	0.010	RPD-N/A	1.8	RPD-N/A	0.0	RPD-N/A	RPD-N/A	0.1	RPD-N/A	RPD-N/A	RPD-N/A	3.6	RPD-N/A
Lead (Pb)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Lithium (Li)	0.0050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Magnesium (Mg)	0.0050	1.6	0.2	2.7	1.4	0.7	0.4	1.8	0.8	1.4	0.6	0.5	1.6
Manganese (Mn)	0.000050	1.7	0.3	0.7	3.7	5.5	RPD-N/A	4.7	2.5	1.7	12.6	0.0	RPD-N/A
Mercury (Hg)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Molybdenum (Mo)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Nickel (Ni)	0.00010	1.1	0.8	2.1	2.3	2.2	3.2	0.0	2.8	1.1	1.4	2.9	RPD-N/A
Phosphorus (P)	0.30	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Potassium (K)	0.050	0.0	RPD-N/A	1.2	1.4	2.5	RPD-N/A	0.7	0.0	2.0	3.8	0.4	RPD-N/A
Selenium (Se)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Silicon (Si)	0.050	0.5	1.8	2.7	1.6	RPD-N/A	RPD-N/A	0.3	1.3	0.6	0.4	0.9	0.0
Silver (Ag)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Sodium (Na)	0.010	0.4	0.0	3.1	1.1	0.6	0.6	1.0	0.4	0.8	1.5	0.9	1.5
Strontium (Sr)	0.00020	3.1	5.7	2.6	1.2	2.1	0.4	0.3	1.6	0.4	0.0	0.6	1.0
Thallium (Tl)	0.00005	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Tin (Sn)	0.00010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Titanium (Ti)	0.010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Uranium (U)	0.000010	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	0.6
Vanadium (V)	0.000050	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	3.0	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A
Zinc (Zn)	0.0030	4.7	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A	RPD-N/A

a) Relative percent difference (RPD).

b) RPD-N/A Not applicable when the values are less than five times the detection limit.

Italicized values exceed the 20% relative percent difference and are more than five times the detection limit.

Bold values exceed the 50% relative percent difference and are more than five times the detection limit.

Appendix 3.3-3

Stream Water Quality QA/QC Results, Back River Project, 2012

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Appendix 3.3-3. Stream Water Quality QA/QC Results, Back River, 2012

Area		CCME Guideline for the Protection of Freshwater Aquatic Life[a]	Field	Travel	Field	Travel	Field	Travel	Field	Travel	Field	Travel
Blank Type			Goose	Goose	George	George	Goose	Goose	Goose	Goose	George	George
Date Sampled			12-Jun-12	12-Jun-12	13-Jun-12	13-Jun-12	7-Aug-12	7-Aug-12	17-Sep-12	17-Sep-12	19-Sep-12	19-Sep-12
ALS Sample ID	Units		L1162486-19	L1162486-20	L1162486-37	L1162486-38	L1190634-6	L1190634-5	L1211487-2	L1211487-1	L1212370-13	L1212370-14
Physical Tests												
Conductivity	µS/cm		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0
Hardness (as $CaCO_3$)	mg/L		<0.50	<0.50	<0.50	<0.50	-	-	-	-	-	-
pH	pH	6.5-9.0	5.65	6.18	5.71	6.17	5.97	5.87	5.96	-	5.91	5.96
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0
Alkalinity, Carbonate (as $CaCO_3$)	mg/L		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	<2.0	<2.0
Total Suspended Solids	mg/L	dependent on background levels	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	-	<3.0	<3.0
Total Dissolved Solids	mg/L		<10	<10	<10	<10	<10	<10	<10	-	<10	<10
Turbidity	NTU	dependent on background levels	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10
Nutrients												
Ammonia, Total (as N)	mg/L	pH- and temperature-dependent	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0128	<0.0050	<0.0050
Nitrate (as N)	mg/L	2.935[b]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	-	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.06	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L		<0.050	0.058	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Ortho-phosphate (as P)	mg/L		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	-	<0.0010	<0.0010
Total Phosphorus (P)	mg/L	Trigger ranges from guidance framework	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	-	<0.0020	<0.0020
Anions												
Bromide (Br)	mg/L		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	<0.050	<0.050
Chloride (Cl)	mg/L	short-term: 120; long-term: 640	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	<0.50	<0.50
Fluoride (F)	mg/L	0.12[b]	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	-	<0.020	<0.020
Sulfate (SO_4)	mg/L		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	-	<0.50	<0.50
Cyanides												
Cyanide, Total	mg/L		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Cyanide, Free	mg/L	0.005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Organic / Inorganic Carbon												
Total Organic Carbon	mg/L		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total Metals												
Aluminum (Al)	mg/L	0.005 if pH<6.5; 0.1 if pH≥6.5	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Antimony (Sb)	mg/L		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Arsenic (As)	mg/L	0.005	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Barium (Ba)	mg/L		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Beryllium (Be)	mg/L		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Bismuth (Bi)	mg/L		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)	mg/L	short-term: 29; long-term: 1.5	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Cadmium (Cd)	mg/L	equation[b,d]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010

Appendix 3.3-3. Stream Water Quality QA/QC Results, Back River, 2012

Area		CCME Guideline for the Protection of Freshwater	Field	Travel	Field	Travel	Field	Travel	Field	Travel	Field	Travel
Blank Type			Goose	Goose	George	George	Goose	Goose	Goose	Goose	George	George
Date Sampled			12-Jun-12	12-Jun-12	13-Jun-12	13-Jun-12	7-Aug-12	7-Aug-12	17-Sep-12	17-Sep-12	19-Sep-12	19-Sep-12
ALS Sample ID	Units	Aquatic Life[a]	L1162486-19	L1162486-20	L1162486-37	L1162486-38	L1190634-6	L1190634-5	L1211487-2	L1211487-1	L1212370-13	L1212370-14
Calcium (Ca)	mg/L		<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Chromium (Cr)	mg/L	Cr(VI): 0.001 ; Cr(III): 0.0089[b]	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Copper (Cu)	mg/L	≥0.002[e]	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Iron (Fe)	mg/L	0.3	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead (Pb)	mg/L	≥0.001[f]	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)	mg/L		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Magnesium (Mg)	mg/L		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Manganese (Mn)	mg/L		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Mercury (Hg)	mg/L	Inorganic Mercury: 0.000026	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)	mg/L	0.073[d]	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel (Ni)	mg/L	≥0.025[g]	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Phosphorus (P)	mg/L		<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)	mg/L		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Selenium (Se)	mg/L	0.001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Silicon (Si)	mg/L		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Silver (Ag)	mg/L	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)	mg/L		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Strontium (Sr)	mg/L		<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)	mg/L	0.0008	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Tin (Sn)	mg/L		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)	mg/L		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)	mg/L	short-term: 0.033; long-term: 0.015	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Vanadium (V)	mg/L		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Zinc (Zn)	mg/L	0.03	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

Note the September travel blank from the Goose Area could not be analyzed for some parameters due to a handling error.

Appendix 3.4-1

Lake Sediment Quality Analytical Results, Back River Project, August 2012

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Appendix 3.4-1. Lake Sediment Quality Analytical Results, Back River Project, 2012

Area					Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location					Gander	Gander	Gander	Pond 19	Pond 19	Pond 19	Big	Big	Big	Rabbit	Rabbit	Rabbit	Fox	Fox	Fox	Echo	Echo	Echo
Depth (m):					2.4	2.4	2.4	1.4	1.5	1.5	5.0	5.0	5.0	3.6	3.6	3.6	5.8	5.8	5.8	0.6	0.6	0.4
Replicate:		CCME Guidelines for the Protection of Aquatic Life[a]		Realised Detection Limits (RDL[d])	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled:					18-Aug-12	18-Aug-12	18-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	17-Aug-12	17-Aug-12	17-Aug-12
ALS Sample ID:	Units	ISQG[b]	PEL[c]		L1196505-7	L1196505-8	L1196505-9	L1198607-10	L1198607-11	L1198607-12	L1195586-10	L1195586-11	L1195586-12	L1195586-4	L1195586-5	L1195586-6	L1198607-7	L1198607-8	L1198607-9	L1196505-4	L1196505-5	L1196505-6
Physical Tests																						
Moisture	%			0.25	68.1	70.5	70.1	87.9	76.9	89.1	83.9	87.8	87.8	86.1	82.1	81.5	87.8	86.8	85.7	71.3	68.1	84.9
pH	pH			0.10	5.61	5.70	5.42	6.73	6.22	7.13	5.03	5.13	5.05	5.27	5.78	5.76	5.23	5.01	5.20	5.44	5.53	5.29
Particle Size																						
% Gravel (>2 mm)	%			0.10	<0.10	<0.10	<0.10	22.4	11.2	21.8	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
% Sand (2.0 mm - 0.063 mm)	%			0.10	0.78	0.64	0.69	46.6	53.3	40.6	11.0	11.2	10.7	6.96	8.45	11.0	11.3	20.1	18.6	7.88	5.89	8.64
% Silt (0.063 mm - 4 µm)	%			0.10	86.8	84.8	85.1	27.6	34.2	35.2	79.5	80.3	82.1	85.1	84.1	81.6	84.6	75.9	77.7	89.9	89.5	89.6
% Clay (<4 µm)	%			0.10	12.4	14.5	14.2	3.43	1.36	2.43	9.48	8.42	7.26	7.97	7.45	7.36	4.14	3.94	3.72	2.10	4.59	1.72
Texture					Silt	Silt	Silt	Sandy loam	Sandy loam	Sandy loam	Silt	Silt	Silt	Silt	Silt	Silt	Silt	Silt loam	Silt loam	Silt	Silt	Silt
Leachable Nutrients																						
Total Nitrogen by LECO	%			0.020	0.242	0.244	0.077	0.511	0.441	0.484	0.584	0.719	0.718	0.648	0.481	0.469	0.793	0.764	0.711	0.989	0.639	1.12
Plant Available Nutrients																						
Available Ammonium (as N)	mg/kg			1 - 2.4	33.6	17.0	30.2	14.4	11.1	11.5	-	-	-	18.0	8.4	9.4	29.7	23.4	24.7	-	23.0	-
Nitrate and Nitrite (as N)	mg/kg			2 - 6.0	-	-	-	-	<4.0	<4.0	-	-	-	-	-	-	-	<6.0	-	-	-	-
Nitrate (as N)	mg/kg			2 - 6.0	-	-	-	-	<4.0	<4.0	-	-	-	-	-	-	-	<6.0	-	-	-	-
Nitrite (as N)	mg/kg			0.4 - 1.2	-	-	-	-	<0.80	<0.80	-	-	-	-	-	-	-	<1.2	-	-	-	-
Available Phosphate (as P)	mg/kg			2 - 6.0	<4.0	17.9	17.6	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	8.1	9.7	4.1	4.4	5.0	<4.0	<4.0	<4.0
Cyanides																						
Cyanide, Weak Acid Dissociable	mg/kg			0.05	0.074	0.053	0.065	<0.050	<0.050	<0.050	0.138	0.105	0.089	0.119	0.093	0.096	0.123	0.135	0.119	0.091	<0.050	0.121
Cyanide, Total	mg/kg			0.05	0.194	0.180	0.176	0.144	0.067	0.127	0.297	0.350	0.349	0.304	0.236	0.158	0.376	0.404	0.359	0.196	0.136	0.360
Organic / Inorganic Carbon																						
Total Organic Carbon	%			0.10	3.04	2.87	0.70	7.19	6.10	6.76	7.16	8.51	8.61	7.58	5.78	5.49	10.2	9.46	9.04	15.0	9.51	15.2
Metals																						
Aluminum (Al)	mg/kg			50.0 - 100.0	12500	12600	12000	5660	6550	5760	9550	9560	9540	7540	7450	6910	7910	6970	7250	6480	7200	5560
Antimony (Sb)	mg/kg			0.10 - 0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	0.12	0.10	<0.10	0.13	0.16	0.14	0.15	<0.10	<0.10	<0.10
Arsenic (As)	mg/kg	5.9	17	0.050 - 0.10	9.57	9.25	8.50	3.35	3.27	3.83	26.8	29.4	27.6	24.9	15.1	11.6	19.5	16.7	16.7	14.9	10.1	23.4
Barium (Ba)	mg/kg			0.50 - 1.0	84.8	88.2	80.7	57.5	56.0	53.0	36.4	38.7	40.3	50.3	49.4	56.7	35.1	31.3	34.6	56.1	57.9	65.3
Beryllium (Be)	mg/kg			0.20 - 0.40	0.47	0.49	0.45	<0.20	<0.20	<0.20	0.34	0.31	0.31	0.29	0.26	0.23	0.30	0.27	0.26	0.22	0.24	0.21
Bismuth (Bi)	mg/kg			0.2 - 0.4	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.6	3.5	0.050 - 0.10	0.182	0.170	0.167	0.149	0.117	0.126	0.283	0.239	0.290	0.382	0.471	0.516	0.331	0.251	0.290	0.270	0.195	0.216
Calcium (Ca)	mg/kg			50.0 - 100.0	2710	2730	2410	3670	3220	3230	1930	2190	2820	3000	3010	2710	2620	2280	2670	2840	3490	3210
Chromium (Cr)	mg/kg	37.3	90	0.50 - 1.0	41.7	41.5	40.5	18.2	21.5	19.3	30.4	29.1	30.0	26.9	24.7	23.2	23.9	20.7	21.3	27.7	29.6	24.8
Cobalt (Co)	mg/kg			0.10 - 0.20	15.8	16.5	14.6	5.24	5.82	4.97	15.4	17.5	16.9	15.5	13.2	13.0	26.7	21.9	22.3	14.0	13.6	18.5
Copper (Cu)	mg/kg	35.7	197	0.50 - 1.0	34.6	34.8	33.4	30.2	30.7	29.5	74.4	72.8	75.0	86.0	67.1	60.2	87.5	71.3	74.8	48.9	37.2	34.9
Iron (Fe)	mg/kg			50.0 - 100.0	18400	18200	17800	9560	10800	9460	20000	23800	22500	16900	12800	12000	26200	23100	23000	14300	15900	28100
Lead (Pb)	mg/kg	35	91.3	0.50 - 1.0	6.05	6.15	5.77	1.94	2.11	2.02	5.39	5.86	5.94	5.26	4.88	4.72	6.27	5.57	5.90	3.42	3.65	4.04
Lithium (Li)	mg/kg			5.0 - 10.0	21.6	21.7	20.9	11.8	13.5	12.0	13.0	13.0	13.0	10.8	11.2	10.9	8.0	8.1	8.0	7.8	9.7	6.4
Magnesium (Mg)	mg/kg			20.0 - 40.0	6680	6680	6350	4180	4680	4200	4110	3970	4100	4010	3920	3800	2820	2560	2640	2940	3940	2550
Manganese (Mn)	mg/kg			1.0 - 2.0	148	150	136	81.5	94.4	82.1	111	115	117	102	98.4	93.7	111	102	103	92.2	122	147
Mercury (Hg)	mg/kg	0.17	0.486	0.0050- 0.0210	0.0263	0.0256	0.0256	0.0161	0.0123	0.0138	0.0554	0.0676	0.0699	0.0213	0.0176	0.0428	0.0719	0.0646	0.0682	0.0356	0.0312	0.0433
Molybdenum (Mo)	mg/kg			0.50 - 1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	1.39	1.24	1.23	1.52	1.27	0.92	0.87	0.73	0.79	0.52	0.51	0.62
Nickel (Ni)	mg/kg			0.50 - 1.0	68.9	71.3	66.5	61.0	56.2	55.4	59.9	61.2	61.1	106	91.9	91.5	84.2	69.2	71.2	44.9	36.8	43.3
Phosphorus (P)	mg/kg			50.0 - 100.0	697	677	714	438	468	403	575	632	682	552	555	507	721	697	648	492	600	618
Potassium (K)	mg/kg			100.0 - 200.0	1400	1380	1250	670	720	610	640	670	700	920	950	920	480	460	470	520	740	540
Selenium (Se)	mg/kg			0.20 - 0.40	0.22	<0.20	0.20	<0.20	<0.20	<0.20	0.48	0.47	0.43	0.66	0.48	0.41	0.61	0.52	0.56	0.36	0.26	0.30
Silver (Ag)	mg/kg			0.10 - 0.20	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.18	0.17	0.17	<0.15	<0.10	<0.10	0.23	0.18	0.19	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg			100.0 - 200.0	170	170	150	110	<100	<100	<100	100	110	150	150	130	<100	<100	<100	140	200	140
Strontium (Sr)	mg/kg			0.50 - 1.0	37.0	36.2	30.4	15.6	11.5	13.8	10.1	11.3	12.2	16.1	15.4	13.5	10.1	9.28	10.0	14.1	17.0	16.8
Sulphur (S)	mg/kg			500	1700	1400	500	2700	2800	3100	3300	3200	3700	7200	5900	5500	4200	3600	3700	3400	2700	3000
Thallium (Tl)	mg/kg			0.050 - 0.10	0.131	0.133	0.118	<0.050	0.062	<0.050	0.087	0.090	0.084	0.116	0.140	0.134	0.074	0.063	0.068	0.091	0.077	0.066
Tin (Sn)	mg/kg			2.0 - 4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0 - 2.0	719	693	611	255	306	229	244	241	243	376	389	412	177	179	185	330	432	291
Uranium (U)	mg/kg			0.050 - 0.10	1.28	1.30	1.23	0.337	0.419	0.380	1.53	1.50	1.52	1.50	1.36	1.05	0.873	0.721	0.749	0.809	0.733	0.619
Vanadium (V)	mg/kg			0.20 - 0.40	39.8	39.8	37.7	13.7	17.0	13.8	29.4	28.9	29.1	33.5	30.9	28.3	27.3	24.1	25.5	37.9	38.5	35.0
Zinc (Zn)	mg/kg	123	315	1.0 - 2.0	71.1	71.0	68.2	52.1	44.9	46.8	64.3	62.1	62.7	75.1	85.8	101	64.2	52.5	55.4	56.6	51.2	49.6

Notes: Nutrient data could not be analyzed for some samples due to insufficient volume.

a) Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment (accessed 2012)

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

Appendix 3.4-1. Lake Sediment Quality Analytical Results, Back River Project, 2012

Area					Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location					Rascal	Rascal	Rascal	Giraffe North	Giraffe North	Giraffe North	Giraffe South	Giraffe South	Giraffe South	Goose Neck	Goose Neck	Goose Neck	Goose Central	Goose Central	Goose Central	Goose Tail	Goose Tail	Goose Tail
Depth (m):					2.8	2.8	2.8	3.7	3.7	3.7	7.3	7.3	7.3	3.0	3.0	3.0	4.5	4.5	4.5	2.8	2.8	2.8
Replicate:		CCME Guidelines for the Protection of Aquatic Life[a]		Realised Detection Limits	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled:					15-Aug-12	15-Aug-12	15-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	17-Aug-12	17-Aug-12	17-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12
ALS Sample ID:	Units	ISQG[b]	PEL[c]	(RDL[d])	L1195586-7	L1195586-8	L1195586-9	L1198607-4	L1198607-5	L1198607-6	L1198607-1	L1198607-2	L1198607-3	L1195586-1	L1195586-2	L1195586-3	L1196505-1	L1196505-2	L1196505-3	L1196505-10	L1196499-5	L1196499-6
Physical Tests																						
Moisture	%			0.25	80.9	83.8	83.3	88.8	88.8	87.3	72.7	76.8	71.6	85.2	87.8	87.1	86.0	86.0	86.5	64.4	55.7	63.9
pH	pH			0.10	5.73	5.87	5.86	5.70	5.58	5.63	5.49	5.45	5.55	5.85	6.02	5.60	6.01	6.07	5.91	5.98	5.91	6.21
Particle Size																						
% Gravel (>2 mm)	%			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	2.11	1.52	11.7	0.26	<0.10	<0.10	0.52	<0.10	<0.10	<0.10	<0.10	1.73
% Sand (2.0 mm - 0.063 mm)	%			0.10	49.7	44.1	48.6	5.90	4.09	2.60	63.1	52.4	44.2	10.9	7.19	4.01	5.16	6.40	6.47	55.0	73.5	64.5
% Silt (0.063 mm - 4 µm)	%			0.10	45.9	50.8	46.9	82.5	83.6	87.2	33.2	44.0	40.9	79.7	80.3	84.9	83.8	85.8	87.0	43.5	24.4	31.6
% Clay (<4 µm)	%			0.10	4.34	5.11	4.52	11.6	12.3	10.2	1.60	2.10	3.28	9.17	12.5	11.1	10.5	7.76	6.49	1.54	2.09	2.12
Texture					Sandy loam	Sandy loam	Sandy loam	Silt	Silt	Silt	Sandy loam	Sandy loam	Sandy loam	Silt	Silt	Silt	Silt	Silt	Silt	Sandy loam	Loamy sand	Sandy loam
Leachable Nutrients																						
Total Nitrogen by LECO	%			0.020	0.481	0.533	0.464	0.865	0.851	0.896	0.184	0.287	0.300	0.637	0.668	0.771	0.536	0.542	0.639	0.174	0.097	0.125
Plant Available Nutrients																						
Available Ammonium (as N)	mg/kg			1 - 2.4	6.1	7.7	8.8	20.4	14.5	18.1	11.0	15.6	5.4	26.1	18.2	52.8	-	-	-	5.5	2.7	5.5
Nitrate and Nitrite (as N)	mg/kg			2 - 6.0	-	-	-	<4.0	<6.0	-	<2.0	<2.0	<2.0	-	-	-	-	-	-	-	-	-
Nitrate (as N)	mg/kg			2 - 6.0	-	-	-	<4.0	<6.0	-	<2.0	<2.0	<2.0	-	-	-	-	-	-	-	-	-
Nitrite (as N)	mg/kg			0.4 - 1.2	-	-	-	<0.80	<1.2	-	<0.40	<0.40	<0.40	-	-	-	-	-	-	-	-	-
Available Phosphate (as P)	mg/kg			2 - 6.0	<4.0	4.7	4.4	5.0	5.0	6.5	3.1	<2.0	4.0	7.0	8.8	16.2	8.3	8.3	9.0	4.4	<4.0	6.7
Cyanides																						
Cyanide, Weak Acid Dissociable	mg/kg			0.05	0.057	0.067	0.071	0.138	0.142	0.127	0.052	0.121	0.054	0.085	0.094	0.173	<0.050	<0.050	0.141	<0.050	<0.050	<0.050
Cyanide, Total	mg/kg			0.05	0.123	0.151	0.137	0.453	0.411	0.403	0.191	0.244	0.217	0.304	0.378	0.468	0.292	0.310	0.346	0.094	0.070	0.086
Organic / Inorganic Carbon																						
Total Organic Carbon	%			0.10	5.67	6.49	5.53	11.3	11.6	12.1	3.09	4.41	4.78	7.61	8.05	9.40	6.15	6.41	7.25	1.94	1.00	1.42
Metals																						
Aluminum (Al)	mg/kg			50.0 - 100.0	3860	4110	3640	10600	11000	8700	6350	6390	7160	9620	11500	11300	10600	10500	9620	6290	4510	4750
Antimony (Sb)	mg/kg			0.10 - 0.20	<0.10	<0.10	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	0.13	0.14	<0.20	<0.10	0.11	<0.10	<0.10	<0.10	<0.10
Arsenic (As)	mg/kg	5.9	17	0.050 - 0.10	3.61	3.42	3.15	12.2	14.1	10.9	8.76	11.5	12.9	29.1	17.1	30.2	11.5	10.7	12.1	5.41	4.33	3.35
Barium (Ba)	mg/kg			0.50 - 1.0	30.8	31.8	27.5	54.6	58.1	47.5	29.8	29.3	34.1	58.9	73.3	65.5	64.2	63.7	62.1	43.0	22.0	31.5
Beryllium (Be)	mg/kg			0.20 - 0.40	<0.20	<0.20	<0.20	0.64	0.71	0.54	0.33	0.35	0.43	0.54	0.66	0.65	0.55	0.53	0.46	0.27	<0.20	<0.20
Bismuth (Bi)	mg/kg			0.2 - 0.4	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.40	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.6	3.5	0.050 - 0.10	0.182	0.156	0.150	0.478	0.581	0.404	0.180	0.181	0.137	0.313	0.385	0.37	0.249	0.289	0.294	0.122	<0.050	0.093
Calcium (Ca)	mg/kg			50.0 - 100.0	1680	1830	1760	3370	3090	2620	1780	1860	1900	2570	3210	2760	3050	2690	2890	2230	1270	1550
Chromium (Cr)	mg/kg	37.3	90	0.50 - 1.0	12.4	13.0	11.4	24.4	25.5	20.6	16.1	15.2	19.5	27.3	33.2	32.9	29.3	29.6	26.9	18.3	12.2	13.7
Cobalt (Co)	mg/kg			0.10 - 0.20	3.32	3.53	3.10	15.3	16.0	13.1	12.4	13.5	17.2	36.5	21.9	33.4	14.1	15.6	14.3	7.89	4.34	5.89
Copper (Cu)	mg/kg	35.7	197	0.50 - 1.0	36.6	38.3	34.1	115	122	97.0	41.5	41.8	59.8	77.3	95.2	97.0	84.9	86.8	80.1	38.4	19.3	23.2
Iron (Fe)	mg/kg			50.0 - 100.0	7320	7510	6420	14700	14900	11900	14400	15500	32000	35200	23900	31400	22800	20700	24600	8880	7660	7500
Lead (Pb)	mg/kg	35	91.3	0.50 - 1.0	2.88	3.00	2.61	5.00	5.11	4.43	2.80	2.83	3.18	5.51	6.63	6.4	5.39	5.44	5.29	3.41	1.99	2.32
Lithium (Li)	mg/kg			5.0 - 10.0	5.5	5.8	5.3	10.1	10.2	7.8	9.7	9.5	8.9	10.5	12.7	12	11.0	11.0	9.6	9.9	7.5	7.6
Magnesium (Mg)	mg/kg			20.0 - 40.0	1630	1710	1530	2850	2950	2270	2870	2690	2850	2990	3700	3780	3220	3270	2970	2700	1950	2140
Manganese (Mn)	mg/kg			1.0 - 2.0	42.8	44.6	38.5	69.2	71.3	55.3	76.3	74.7	92.8	436	178	150	135	163	161	77.1	62.4	64.3
Mercury (Hg)	mg/kg	0.17	0.486	0.0050- 0.0210	0.0415	0.0439	0.0389	0.0909	0.0889	0.0816	0.0384	0.0499	0.0436	0.0715	0.079	0.079	0.0722	0.0694	0.0795	0.0248	0.0139	0.0226
Molybdenum (Mo)	mg/kg			0.50 - 1.0	<0.50	<0.50	<0.50	0.90	1.02	0.74	<0.50	<0.50	0.56	1.18	1.35	1.5	1.02	0.96	0.98	<0.50	<0.50	<0.50
Nickel (Ni)	mg/kg			0.50 - 1.0	30.6	33.4	30.0	121	127	108	58.4	57.4	67.1	74.1	76.2	97.6	58.6	58.6	54.3	35.7	17.8	23.2
Phosphorus (P)	mg/kg			50.0 - 100.0	315	314	309	599	579	502	485	512	585	609	750	850	615	610	647	550	326	358
Potassium (K)	mg/kg			100.0 - 200.0	320	330	290	630	660	510	470	440	450	630	850	1000	670	660	660	620	390	430
Selenium (Se)	mg/kg			0.20 - 0.40	0.24	0.25	0.22	0.57	0.65	0.48	0.22	0.25	0.29	0.49	0.50	0.59	0.48	0.49	0.45	0.22	<0.20	<0.20
Silver (Ag)	mg/kg			0.10 - 0.20	<0.10	<0.10	<0.10	0.26	0.28	0.23	0.11	0.11	0.15	0.15	0.17	<0.20	0.18	0.18	0.19	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg			100.0 - 200.0	<100	<100	<100	120	100	<100	<100	<100	<100	<100	130	<200	110	110	120	<100	<100	<100
Strontium (Sr)	mg/kg			0.50 - 1.0	9.90	10.7	9.81	18.3	18.6	15.5	8.95	8.85	9.89	15.8	19.8	20.0	19.0	17.7	18.6	13.0	7.50	8.74
Sulphur (S)	mg/kg			500	2200	2500	2000	4700	5200	5400	3000	2500	2300	2700	3000	3600	2600	2600	2700	1100	900	1100
Thallium (Tl)	mg/kg			0.050 - 0.10	<0.050	<0.050	<0.050	0.090	0.106	0.076	0.061	0.061	<0.050	0.091	0.099	0.10	0.074	0.077	0.075	<0.050	<0.050	<0.050
Tin (Sn)	mg/kg			2.0 - 4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0 - 2.0	157	161	139	212	215	174	241	224	264	210	331	405	242	241	230	289	216	232
Uranium (U)	mg/kg			0.050 - 0.10	0.455	0.511	0.443	1.98	2.13	1.70	0.781	0.745	1.00	1.50	1.73	1.89	1.44	1.43	1.32	0.936	0.550	0.572
Vanadium (V)	mg/kg			0.20 - 0.40	13.2	13.5	12.1	24.5	26.0	20.8	21.1	20.5	23.7	29.0	35.5	36.2	31.5	31.1	29.1	19.6	14.9	15.7
Zinc (Zn)	mg/kg	123	315	1.0 - 2.0	40.2	33.9	32.1	90.5	109	80.5	45.1	41.6	61.6	84.1	98.6	106	67.6	69.8	64.5	43.2	24.4	30.9

Notes: Nutrient data could not be analyzed for some samples due to insufficient volume.

a) Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment (accessed 2012)

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

Appendix 3.4-1. Lake Sediment Quality Analytical Results, Back River Project, 2012

Area					George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George
Location					Lower Long	Fold	Fold	Fold	Central	Central	Central	South	South	South	Lytle	Lytle	Lytle	Occurrence	Occurrence	Occurrence	Sleigh	Sleigh	Sleigh
Depth (m):					5.2	9.8	9.8	9.8	14.5	14.5	14.5	1.6	1.6	1.6	1.4	1.4	1.4	1.4	1.4	1.4	1.2	1.2	1.2
Replicate:					3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled:		CCME Guidelines for the Protection of Aquatic Life[a]		Realised Detection Limits	21-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	23-Aug-12	23-Aug-12	23-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12
ALS Sample ID:	Units	ISQG[b]	PEL[c]	(RDL[d])	L1199578-3	L1197332-7	L1197332-8	L1197332-9	L1197332-4	L1197332-5	L1197332-6	L1197332-1	L1197332-2	L1197332-3	L1199578-16	L1199578-17	L1199578-18	L1199578-7	L1199578-8	L1199578-9	L1199578-13	L1199578-14	L1199578-15
Physical Tests																							
Moisture	%			0.25	89.0	61.7	65.6	74.3	29.9	40.0	41.8	26.8	24.2	27.3	48.4	47.7	52.1	59.4	54.1	55.9	25.5	17.2	21.9
pH	pH			0.10	6.37	6.14	5.82	5.74	6.83	6.44	6.11	6.84	6.71	6.87	6.22	6.08	6.32	6.09	6.02	6.07	6.22	5.91	6.20
Particle Size																							
% Gravel (>2 mm)	%			0.10	<0.10	<0.10	<0.10	<0.10	0.78	0.72	<0.10	3.12	4.60	5.39	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.58	0.35	0.85
% Sand (2.0 mm - 0.063 mm)	%			0.10	1.34	4.60	3.25	7.62	80.9	76.3	78.2	95.9	94.4	93.7	0.31	0.23	0.22	0.43	0.17	0.28	80.1	72.5	85.3
% Silt (0.063 mm - 4 µm)	%			0.10	83.5	85.4	86.9	83.7	17.3	21.7	20.7	0.72	0.74	0.64	87.5	85.4	87.2	80.5	80.1	78.4	18.5	26.5	12.8
% Clay (<4 µm)	%			0.10	15.2	9.98	9.84	8.71	0.97	1.29	1.08	0.28	0.24	0.26	12.2	14.4	12.6	19.1	19.8	21.3	0.85	0.62	1.07
Texture					Silt	Silt	Silt	Silt	Sand	Loamy sand	Loamy sand	Sand	Sand	Sand	Silt	Silt	Silt	Silt	Silt	Silt	Loamy sand	Loamy sand	Sand
Leachable Nutrients																							
Total Nitrogen by LECO	%			0.020	0.616	0.194	0.212	0.294	0.044	0.049	0.048	0.024	0.021	0.024	0.187	0.170	0.197	0.197	0.230	0.200	0.024	0.024	0.020
Plant Available Nutrients																							
Available Ammonium (as N)	mg/kg			1 - 2.4	6.5	5.5	9.8	9.2	3.0	3.6	2.7	1.2	<1.0	1.0	12.4	10.9	13.2	3.5	5.5	3.7	<1.0	<1.0	<1.0
Nitrate and Nitrite (as N)	mg/kg			2 - 6.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<2.0	<2.0	<2.0	<2.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<2.0	<2.0	<2.0
Nitrate (as N)	mg/kg			2 - 6.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<2.0	<2.0	<2.0	<2.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<2.0	<2.0	<2.0
Nitrite (as N)	mg/kg			0.4 - 1.2	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.40	<0.40	<0.40	<0.40	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.40	<0.40	<0.40
Available Phosphate (as P)	mg/kg			2 - 6.0	10.7	36.2	13.0	10.6	<2.0	<2.0	8.2	<2.0	<2.0	<2.0	4.5	<4.0	4.4	8.8	8.1	11.2	<2.0	<2.0	<2.0
Cyanides																							
Cyanide, Weak Acid Dissociable	mg/kg			0.05	0.077	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.085	0.095	0.126	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cyanide, Total	mg/kg			0.05	0.185	0.126	0.137	0.166	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.139	0.220	0.131	0.077	0.083	0.075	<0.050	<0.050	<0.050
Organic / Inorganic Carbon																							
Total Organic Carbon	%			0.10	7.85	1.81	2.07	3.04	0.37	0.48	0.46	0.20	0.18	0.20	2.37	2.14	2.47	2.07	2.53	2.18	0.22	0.23	0.18
Metals																							
Aluminum (Al)	mg/kg			50.0 - 100.0	13100	11700	11300	10500	8130	8540	8420	15900	14000	14500	17400	17400	17700	32300	34000	33500	10200	7730	10600
Antimony (Sb)	mg/kg			0.10 - 0.20	0.27	0.16	0.19	0.27	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	<0.10	0.11	<0.10	0.17	<0.10	0.16
Arsenic (As)	mg/kg	5.9	17	0.050 - 0.10	28.9	38.7	263	542	33.7	31.8	55.6	20.0	16.7	17.8	40.2	38.6	51.0	55.1	53.8	48.8	12.3	13.7	15.7
Barium (Ba)	mg/kg			0.50 - 1.0	47.0	57.1	76.7	97.3	15.0	19.9	41.5	11.0	10.2	9.45	58.6	56.7	59.9	143	145	144	13.0	11.4	13.7
Beryllium (Be)	mg/kg			0.20 - 0.40	0.71	0.33	0.33	0.37	<0.20	0.21	0.22	0.24	0.23	0.21	0.50	0.54	0.56	0.97	1.06	1.07	<0.20	<0.20	<0.20
Bismuth (Bi)	mg/kg			0.2 - 0.4	0.35	<0.20	0.20	0.22	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.21	0.21	0.22	0.38	0.39	0.38	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.6	3.5	0.050 - 0.10	0.587	0.292	0.341	0.467	0.123	0.157	0.203	<0.050	<0.050	<0.050	0.212	0.178	0.234	0.272	0.326	0.289	<0.050	<0.050	<0.050
Calcium (Ca)	mg/kg			50.0 - 100.0	2480	2310	2050	2260	586	635	643	878	886	805	2290	2230	2310	3160	3330	3410	1330	1270	1340
Chromium (Cr)	mg/kg	37.3	90	0.50 - 1.0	38.9	41.0	40.0	36.2	30.4	30.0	30.1	62.0	54.5	55.2	64.7	64.9	66.0	121	125	124	37.0	29.5	40.0
Cobalt (Co)	mg/kg			0.10 - 0.20	10.7	18.3	30.2	49.4	54.1	58.9	104	14.5	14.5	14.1	46.6	42.4	49.6	51.1	53.5	52.1	7.87	6.17	7.21
Copper (Cu)	mg/kg	35.7	197	0.50 - 1.0	108	62.2	78.0	101	23.0	33.0	34.5	14.3	13.3	12.7	45.2	46.4	48.3	111	111	112	18.3	15.8	17.8
Iron (Fe)	mg/kg			50.0 - 100.0	20500	22100	42700	86600	18800	18000	24900	27800	24800	25100	29700	30100	32700	48700	49200	49200	17800	14700	18600
Lead (Pb)	mg/kg	35	91.3	0.50 - 1.0	8.76	5.92	6.20	6.72	1.80	2.23	2.38	1.68	1.70	1.76	7.15	7.11	7.26	12.1	12.0	11.7	3.20	2.65	3.31
Lithium (Li)	mg/kg			5.0 - 10.0	18.6	21.2	19.7	17.7	18.4	18.9	18.1	38.4	35.1	36.7	34.6	34.8	35.5	66.4	66.2	68.8	23.7	17.2	25.5
Magnesium (Mg)	mg/kg			20.0 - 40.0	6070	7390	7070	6180	5660	5670	5680	11800	10400	10700	11000	11100	11500	20000	20700	20800	7080	5680	7270
Manganese (Mn)	mg/kg			1.0 - 2.0	171	542	1910	1530	1870	1740	4000	339	331	320	299	296	310	497	509	507	176	137	182
Mercury (Hg)	mg/kg	0.17	0.486	0.0050- 0.0210	0.0488	0.0305	0.0333	0.0492	<0.0050	0.0078	0.0084	<0.0050	<0.0050	<0.0050	0.0150	0.0136	0.0140	0.0191	0.0215	0.0219	<0.0050	<0.0050	<0.0050
Molybdenum (Mo)	mg/kg			0.50 - 1.0	2.01	1.54	2.24	3.91	0.69	0.68	0.99	<0.50	<0.50	<0.50	0.70	0.72	0.73	0.89	0.93	0.94	0.51	<0.50	0.65
Nickel (Ni)	mg/kg			0.50 - 1.0	47.9	57.2	66.8	72.3	53.6	64.5	70.5	50.8	46.9	47.5	93.7	85.1	102	130	142	136	26.4	20.7	25.2
Phosphorus (P)	mg/kg			50.0 - 100.0	560	658	1250	2040	206	254	286	255	248	237	489	467	457	481	514	453	367	343	346
Potassium (K)	mg/kg			100.0 - 200.0	850	1040	990	870	260	320	340	510	420	400	1190	1170	1150	2740	3050	2970	400	330	440
Selenium (Se)	mg/kg			0.20 - 0.40	0.56	0.26	0.40	0.62	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.26	0.30	0.30	<0.20	<0.20	<0.20
Silver (Ag)	mg/kg			0.10 - 0.20	0.23	0.14	0.16	0.17	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.14	0.13	0.17	0.20	0.23	0.21	0.24	<0.20	0.11
Sodium (Na)	mg/kg			100.0 - 200.0	<100	130	130	110	<100	<100	<100	<100	<100	<100	150	140	130	190	210	220	<100	<100	<100
Strontium (Sr)	mg/kg			0.50 - 1.0	8.86	10.6	11.5	12.2	3.17	3.66	4.87	3.87	3.77	3.57	11.9	11.3	12.0	19.3	20.8	21.4	5.33	5.15	5.34
Sulphur (S)	mg/kg			500	3300	1200	1400	1400	<500	<500	<500	<500	<500	<500	2200	1700	2100	1300	1400	1400	<500	<500	<500
Thallium (Tl)	mg/kg			0.050 - 0.10	0.067	0.100	0.113	0.189	<0.050	0.053	0.073	<0.050	<0.050	<0.050	0.101	0.098	0.105	0.210	0.212	0.209	<0.050	<0.050	<0.050
Tin (Sn)	mg/kg			2.0 - 4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0 - 2.0	174	405	377	290	184	196	187	328	350	296	643	643	625	1180	1280	1300	304	283	310
Uranium (U)	mg/kg			0.050 - 0.10	2.84	1.12	1.23	1.30	0.446	0.476	0.511	0.483	0.473	0.470	1.10	1.10	1.13	1.91	2.16	2.10	0.600	0.518	0.558
Vanadium (V)	mg/kg			0.20 - 0.40	29.5	30.6	30.8	28.9	17.0	17.7	17.8	31.2	29.2	29.1	43.1	44.1	44.4	83.5	88.0	87.2	22.6	18.8	22.7
Zinc (Zn)	mg/kg	123	315	1.0 - 2.0	75.8	82.8	94.3	116	52.1	64.7	69.7	66.7	59.9	61.8	146	142	156	252	267	265	39.1	30.5	38.4

Notes: Nutrient data could not be analyzed for some samples due to insufficient volume.

a) Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment (accessed 2012)

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

Appendix 3.4-1. Lake Sediment Quality Analytical Results, Back River Project, 2012

Area					George	George	George	George	George	George	George	George	George
Location					Dragon	Dragon	Dragon	Komatic	Komatic	Komatic	Reference C	Reference C	Reference C
Depth (m):					3.4	3.4	3.4	7.0	7.0	7.0	35	35	35
Replicate:		CCME Guidelines for the		Realised	1	2	3	1	2	3	1	2	3
Date Sampled:		Protection of Aquatic Life[a]		Detection Limits	20-Aug-12	20-Aug-12	20-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12
ALS Sample ID:	Units	ISQG[b]	PEL[c]	(RDL[d])	L1197332-10	L1197332-11	L1197332-12	L1199578-4	L1199578-5	L1199578-6	L1199578-10	L1199578-11	L1199578-12
Physical Tests													
Moisture	%			0.25	72.0	75.1	79.9	81.2	80.1	81.2	85.0	82.3	84.9
pH	pH			0.10	6.64	6.77	6.71	6.22	6.12	6.04	6.45	6.59	6.31
Particle Size													
% Gravel (>2 mm)	%			0.10	2.43	11.6	26.4	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
% Sand (2.0 mm - 0.063 mm)	%			0.10	13.2	23.4	12.5	2.08	2.54	2.42	0.94	1.80	1.61
% Silt (0.063 mm - 4 µm)	%			0.10	72.0	60.0	54.8	85.2	86.7	85.9	86.5	87.2	86.3
% Clay (<4 µm)	%			0.10	12.4	5.05	6.31	12.7	10.8	11.7	12.6	11.0	12.1
Texture					Silt loam / Silt	Silt loam	Silt loam	Silt	Silt	Silt	Silt	Silt	Silt
Leachable Nutrients													
Total Nitrogen by LECO	%			0.020	0.287	0.307	0.420	0.514	0.506	0.534	0.663	0.505	0.697
Plant Available Nutrients													
Available Ammonium (as N)	mg/kg			1 - 2.4	12.8	11.6	18.9	20.9	23.3	19.2	5.3	4.6	7.6
Nitrate and Nitrite (as N)	mg/kg			2 - 6.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Nitrate (as N)	mg/kg			2 - 6.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Nitrite (as N)	mg/kg			0.4 - 1.2	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80
Available Phosphate (as P)	mg/kg			2 - 6.0	4.7	3.3	3.1	<4.0	<4.0	<4.0	6.6	54.8	9.1
Cyanides													
Cyanide, Weak Acid Dissociable	mg/kg			0.05	0.081	<0.050	<0.050	0.092	0.110	0.080	<0.050	<0.050	<0.050
Cyanide, Total	mg/kg			0.05	0.138	0.094	0.119	0.281	0.274	0.273	0.153	0.100	0.124
Organic / Inorganic Carbon													
Total Organic Carbon	%			0.10	3.41	3.72	5.11	5.88	5.79	5.99	6.57	5.11	7.14
Metals													
Aluminum (Al)	mg/kg			50.0 - 100.0	15200	10800	10900	14500	15100	15200	10200	10900	10200
Antimony (Sb)	mg/kg			0.10 - 0.20	0.30	0.40	0.39	0.24	0.24	0.24	0.29	0.26	0.30
Arsenic (As)	mg/kg	5.9	17	0.050 - 0.10	52.2	82.4	57.3	345	298	391	14.2	4.35	14.9
Barium (Ba)	mg/kg			0.50 - 1.0	63.1	42.2	48.2	73.6	68.9	73.8	236	140	332
Beryllium (Be)	mg/kg			0.20 - 0.40	0.34	0.38	0.40	0.61	0.62	0.59	0.69	0.74	0.70
Bismuth (Bi)	mg/kg			0.2 - 0.4	0.20	<0.20	<0.20	0.32	0.35	0.34	0.37	0.36	0.38
Cadmium (Cd)	mg/kg	0.6	3.5	0.050 - 0.10	0.377	0.432	0.472	0.664	0.735	0.673	0.403	0.359	0.533
Calcium (Ca)	mg/kg			50.0 - 100.0	2890	2560	2640	2980	3320	3300	4180	3590	4260
Chromium (Cr)	mg/kg	37.3	90	0.50 - 1.0	50.7	36.2	36.4	51.2	53.0	53.4	26.3	28.2	25.8
Cobalt (Co)	mg/kg			0.10 - 0.20	29.9	23.2	24.6	65.7	55.0	62.2	10.5	6.48	11.0
Copper (Cu)	mg/kg	35.7	197	0.50 - 1.0	71.1	92.3	107	126	135	135	91.3	103	97.6
Iron (Fe)	mg/kg			50.0 - 100.0	25400	22400	22200	65800	59800	69500	24200	15100	23200
Lead (Pb)	mg/kg	35	91.3	0.50 - 1.0	6.52	6.27	6.91	10.2	9.26	9.12	6.39	4.46	6.70
Lithium (Li)	mg/kg			5.0 - 10.0	30.9	20.4	20.2	25.5	26.4	25.7	16.5	17.3	16.5
Magnesium (Mg)	mg/kg			20.0 - 40.0	9210	6270	6270	7610	7960	7900	6130	6210	5910
Manganese (Mn)	mg/kg			1.0 - 2.0	226	192	190	1390	700	1100	1270	283	2400
Mercury (Hg)	mg/kg	0.17	0.486	0.0050- 0.0210	0.0188	0.0228	0.0281	0.0660	0.0736	0.0690	0.0951	0.0556	0.102
Molybdenum (Mo)	mg/kg			0.50 - 1.0	1.80	2.20	2.10	3.41	3.31	3.40	0.75	<0.50	0.92
Nickel (Ni)	mg/kg			0.50 - 1.0	121	94.0	99.0	156	144	146	25.5	22.9	27.0
Phosphorus (P)	mg/kg			50.0 - 100.0	520	480	501	797	826	826	855	785	845
Potassium (K)	mg/kg			100.0 - 200.0	1520	730	760	770	800	870	890	1000	1030
Selenium (Se)	mg/kg			0.20 - 0.40	0.38	0.35	0.38	0.70	0.73	0.77	0.94	1.02	1.02
Silver (Ag)	mg/kg			0.10 - 0.20	0.11	0.14	0.16	0.27	0.29	0.28	0.15	0.15	0.15
Sodium (Na)	mg/kg			100.0 - 200.0	130	<100	110	150	120	130	110	110	120
Strontium (Sr)	mg/kg			0.50 - 1.0	11.3	8.49	8.58	14.8	15.7	15.9	6.77	7.16	7.35
Sulphur (S)	mg/kg			500	4800	2000	3000	3600	3300	2600	2000	1700	2100
Thallium (Tl)	mg/kg			0.050 - 0.10	0.141	0.108	0.106	0.130	0.128	0.130	0.085	0.069	0.100
Tin (Sn)	mg/kg			2.0 - 4.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0 - 2.0	566	302	272	340	349	372	173	209	189
Uranium (U)	mg/kg			0.050 - 0.10	1.42	1.28	1.38	1.82	1.86	1.85	6.28	7.08	6.58
Vanadium (V)	mg/kg			0.20 - 0.40	37.1	29.5	28.3	40.1	42.1	42.4	28.7	28.3	29.7
Zinc (Zn)	mg/kg	123	315	1.0 - 2.0	102	130	143	175	178	176	64.8	55.9	68.6

Notes: Nutrient data could not be analyzed for some samples due to insufficient volume.

a) Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment (accessed 2012)

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

Appendix 3.5-1

Stream Sediment Quality Analytical Results, Back River Project, August 2012

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Appendix 3.5-1. Stream Sediment Quality Analytical Results, Back River Project, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Moby OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander IF	Gander US	Gander US	Gander US	Pond 19 OF	Pond 19 OF	Pond 19 OF
Replicate:				1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled:				12-Aug-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	13-Aug-12	13-Aug-12	13-Aug-12
ALS Sample ID:		CCME Guidelines for the Protection of Aquatic Life[a]		Realised Detection Limits (RDL)	MN-01-OF 1	MN-01-OF 2	MN-01-OF 3	MN-02-0F 1	MN-02-0F 2	MN-02-0F 3	MN-02-US 1	MN-02-US 2	MN-02-US 3	POND 19 OF 1	POND 19 OF 2	POND 19 OF 3
ALS Sample ID #:	Units	ISQG[b]	PEL[c]		L1193089-1	L1193089-2	L1193089-3	L1192524-7	L1192524-8	L1192524-9	L1192524-10	L1192524-11	L1192524-12	L1193085-1	L1193085-2	L1193085-3
Physical Tests																
Moisture	%			0.25	13.7	22.4	20.1	14.6	21.6	20.3	11.9	4.23	16.2	21.4	30.7	16.7
pH	pH			0.10	5.71	6.05	5.61	6.11	5.82	5.55	6.47	6.50	6.42	6.07	6.00	6.55
Particle Size																
% Gravel (>2 mm)	%			0.10	22.1	17.7	9.73	4.93	0.35	1.12	42.8	29.9	30.0	19.5	39.9	21.0
% Sand (2.0 mm - 0.063 mm)	%			0.10	67.6	75.1	76.9	91.5	91.6	90.7	56.6	69.6	69.1	66.6	50.9	67.6
% Silt (0.063 mm - 4 µm)	%			0.10	9.90	7.00	12.9	2.82	6.70	6.73	<0.10	0.17	0.36	13.2	8.48	10.6
% Clay (<4 µm)	%			0.10	0.40	0.22	0.44	0.77	1.38	1.42	0.53	0.37	0.59	0.75	0.70	0.84
Texture					Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Loamy sand	Sand / Loamy	Sand
Leachable Nutrients																
Total Nitrogen by LECO	%			0.020	0.022	<0.020	0.020	<0.020	0.022	<0.020	<0.020	<0.020	<0.020	0.045	0.031	0.044
Plant Available Nutrients																
Available Ammonium (as N)	mg/kg			1 - 4.0	1.7	1.1	1.3	3.9	4.2	4.3	<1.6	<1.0	1.2	2.4	2.0	1.7
Nitrate and Nitrite (as N)	mg/kg			0.5 - 6.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<0.50	<0.50	<0.50
Nitrate (as N)	mg/kg			0.5 - 6.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<0.50	<0.50	<0.50
Nitrite (as N)	mg/kg			0.4 - 1.2	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.50	<0.50	<0.50
Available Phosphate (as P)	mg/kg			2 - 8.0	<2.0	2.3	<2.0	<2.0	2.4	2.3	<4.0	<2.0	<2.0	<2.0	<2.0	<2.0
Cyanides																
Cyanide, Weak Acid Dissociable	mg/kg			0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cyanide, Total	mg/kg			0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Organic / Inorganic Carbon																
Total Organic Carbon	%			0.10	0.39	0.19	0.28	0.23	0.39	0.28	<0.10	<0.10	0.16	0.64	0.42	0.62
Metals																
Aluminum (Al)	mg/kg			50	4520	6480	3970	4750	3770	4510	6180	6920	6070	7830	9660	9780
Antimony (Sb)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic (As)	mg/kg	5.9	17	0.050	3.61	5.02	3.23	4.23	3.65	3.18	8.89	7.75	8.79	2.70	3.23	2.82
Barium (Ba)	mg/kg			0.50	17.1	15.3	16.8	15.6	15.5	17.7	24.0	21.5	19.2	24.4	16.6	19.9
Beryllium (Be)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Bismuth (Bi)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.6	3.5	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Calcium (Ca)	mg/kg			50	1340	882	1250	812	980	824	1300	1430	928	1300	1350	1260
Chromium (Cr)	mg/kg	37.3	90	0.50	13.9	21.5	12.4	14.9	11.5	14.4	20.7	22.9	21.0	27.8	32.1	31.2
Cobalt (Co)	mg/kg			0.10	3.38	4.21	2.97	3.23	3.06	3.30	6.10	5.34	6.44	4.26	5.14	4.96
Copper (Cu)	mg/kg	35.7	197	0.50	5.74	5.39	5.32	4.45	4.65	4.86	6.65	5.42	7.40	10.9	8.45	10.8
Iron (Fe)	mg/kg			50	8230	11800	6910	8670	6850	7680	12400	12900	11800	12100	15800	15000
Lead (Pb)	mg/kg	35	91.3	0.50	1.63	1.16	1.71	1.06	1.32	1.19	1.90	1.40	1.47	1.79	1.63	2.11
Lithium (Li)	mg/kg			5.0	9.6	14.9	8.3	11.1	8.4	10.7	14.4	15.3	14.8	17.1	21.2	22.5
Magnesium (Mg)	mg/kg			20	3050	4890	2580	3460	2470	3140	4660	5190	4790	5870	7430	6890
Manganese (Mn)	mg/kg			1.0	80.8	109	69.3	68.6	56.1	64.0	122	129	128	126	161	154
Mercury (Hg)	mg/kg	0.17	0.486	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0066	<0.0050	0.0068
Molybdenum (Mo)	mg/kg			0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Nickel (Ni)	mg/kg			0.50	12.4	15.6	12.7	11.1	9.90	11.4	13.8	13.5	13.9	20.9	20.9	20.9
Phosphorus (P)	mg/kg			50	384	270	360	238	245	217	300	359	297	244	273	274
Potassium (K)	mg/kg			100	340	270	250	380	290	320	680	650	460	470	400	360

Appendix 3.5-1. Stream Sediment Quality Analytical Results, Back River Project, 2012

Area					Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location					Moby OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander IF	Gander US	Gander US	Gander US	Pond 19 OF	Pond 19 OF	Pond 19 OF
Replicate:					1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled:					12-Aug-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	13-Aug-12	13-Aug-12	13-Aug-12
ALS Sample ID:		CCME Guidelines for the Protection of Aquatic Life[a]		Realised Detection Limits (RDL)	MN-01-OF 1	MN-01-OF 2	MN-01-OF 3	MN-02-0F 1	MN-02-0F 2	MN-02-0F 3	MN-02-US 1	MN-02-US 2	MN-02-US 3	POND 19 OF 1	POND 19 OF 2	POND 19 OF 3
ALS Sample ID #:	Units	ISQG[b]	PEL[c]		L1193089-1	L1193089-2	L1193089-3	L1192524-7	L1192524-8	L1192524-9	L1192524-10	L1192524-11	L1192524-12	L1193085-1	L1193085-2	L1193085-3
Selenium (Se)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silver (Ag)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg			100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Strontium (Sr)	mg/kg			0.50	5.45	3.96	5.75	3.66	4.66	4.17	5.67	5.43	4.02	4.87	5.70	4.89
Sulphur (S)	mg/kg			500	<500	<500	<500	<500	<500	<500	<500	<500	<500	700	600	700
Thallium (Tl)	mg/kg			0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Tin (Sn)	mg/kg			2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0	258	150	243	181	194	192	298	260	193	413	371	299
Uranium (U)	mg/kg			0.050	0.438	0.317	0.510	0.216	0.259	0.242	0.398	0.304	0.319	0.381	0.393	0.368
Vanadium (V)	mg/kg			0.20	15.2	15.9	12.7	12.4	11.6	12.3	18.9	18.5	17.2	19.9	24.4	20.3
Zinc (Zn)	mg/kg	123	315	1.0	18.3	24.1	16.2	17.8	15.3	17.2	23.5	24.9	23.4	30.0		34.5

Note Echo OF was dry during August sampling.

Nutrient data could not be analyzed for some samples due to insufficient volume.

Depths are the mean of the two grabs in each replicate.

a) Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment (accessed 2012)

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

d) Realised Detection Limits

Appendix 3.5-1. Stream Sediment Quality Analytical Results, Back River Project, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location				Chair OF	Chair OF	Chair OF	Giraffe OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Goose OF
Replicate:				1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled:		CCME Guidelines for the Protection of Aquatic Life[a]		13-Aug-12	13-Aug-12	13-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12
ALS Sample ID:			Realised Detection Limits (RDL)	CHAIR OF 1	CHAIR OF 2	CHAIR OF 3	GIRAFFE OF 1	GIRAFFE OF 2	GIRAFFE OF 3	WOLF OF 1	WOLF OF 2	WOLF OF 3	GOOSE OF 1	GOOSE OF 2	GOOSE OF 3
ALS Sample ID #:	Units	ISQG[b] PEL[c]		L1193085-4	L1193085-5	L1193085-6	L1191592-1	L1191592-2	L1191592-3	L1190642-1	L1190642-2	L1190642-3	L1190642-4	L1190642-5	L1190642-6
Physical Tests															
Moisture	%		0.25	17.4	12.5	14.6	17.2	19.9	19.1	38.0	34.7	18.8	13.4	14.1	15.4
pH	pH		0.10	6.44	6.25	5.65	5.70	6.34	6.32	5.78	5.94	6.42	6.21	6.50	6.60
Particle Size															
% Gravel (>2 mm)	%		0.10	31.0	36.7	35.3	42.8	41.0	23.8	11.1	4.39	23.7	43.1	52.6	63.7
% Sand (2.0 mm - 0.063 mm)	%		0.10	60.3	55.8	53.1	52.8	56.3	72.8	76.1	84.6	74.2	49.2	45.7	34.6
% Silt (0.063 mm - 4 µm)	%		0.10	8.09	6.98	10.8	3.97	2.36	2.94	12.2	10.7	2.09	7.37	1.62	1.64
% Clay (<4 µm)	%		0.10	0.55	0.54	0.82	0.45	0.35	0.53	0.64	0.26	<0.10	0.37	0.10	<0.10
Texture				Sand	Sand	Loamy sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Leachable Nutrients															
Total Nitrogen by LECO	%		0.020	<0.020	0.021	0.035	<0.020	0.026	<0.020	0.087	0.072	0.030	0.025	<0.020	<0.020
Plant Available Nutrients															
Available Ammonium (as N)	mg/kg		1 - 4.0	1.9	1.4	2.1	1.8	1.1	<1.0	3.0	3.1	1.5	1.1	1.6	1.8
Nitrate and Nitrite (as N)	mg/kg		0.5 - 6.0	<0.50	<0.50	<0.50	<2.0	<2.0	<2.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0
Nitrate (as N)	mg/kg		0.5 - 6.1	<0.50	<0.50	<0.50	<2.0	<2.0	<2.0	<2.0	<4.0	<2.0	<4.0	<4.0	<4.0
Nitrite (as N)	mg/kg		0.4 - 1.2	<0.50	<0.50	<0.50	<0.40	<0.40	<0.40	<0.40	<0.80	<0.40	<0.80	<0.80	<0.80
Available Phosphate (as P)	mg/kg		2 - 8.0	<2.0	<2.0	<2.0	2.0	<2.0	2.8	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Cyanides															
Cyanide, Weak Acid Dissociable	mg/kg		0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cyanide, Total	mg/kg		0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.069	<0.050	<0.050	<0.050	<0.050	<0.050
Organic / Inorganic Carbon															
Total Organic Carbon	%		0.10	0.17	0.27	0.52	0.10	0.29	0.19	1.39	1.10	0.29	0.34	<0.10	<0.10
Metals															
Aluminum (Al)	mg/kg		50	12800	12100	9850	7740	9380	9060	2990	3020	2400	4240	4500	7190
Antimony (Sb)	mg/kg		0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic (As)	mg/kg	5.9 17	0.050	14.5	17.0	9.98	6.33	3.72	7.45	1.58	1.75	1.39	2.84	2.17	3.87
Barium (Ba)	mg/kg		0.50	16.0	23.4	17.6	34.4	21.5	19.6	14.6	15.7	11.9	18.4	17.3	23.3
Beryllium (Be)	mg/kg		0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Bismuth (Bi)	mg/kg		0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.6 3.5	0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.055
Calcium (Ca)	mg/kg		50	1400	1280	1240	1740	1360	1130	979	966	917	1360	1140	1600
Chromium (Cr)	mg/kg	37.3 90	0.50	42.8	41.3	32.3	26.9	29.1	31.5	7.44	7.48	5.68	12.7	13.0	20.6
Cobalt (Co)	mg/kg		0.10	6.22	5.73	4.57	9.52	6.49	13.5	1.89	1.97	1.60	4.59	5.03	17.2
Copper (Cu)	mg/kg	35.7 197	0.50	7.88	8.56	12.5	18.6	8.98	10.6	5.32	4.18	3.23	6.25	4.84	8.56
Iron (Fe)	mg/kg		50	21600	22100	17300	15100	16500	16800	5290	5550	4650	8420	8800	14400
Lead (Pb)	mg/kg	35 91.3	0.50	2.80	2.68	2.27	3.08	2.45	2.35	1.11	1.07	1.11	1.70	1.30	1.90
Lithium (Li)	mg/kg		5.0	32.0	31.5	24.5	15.5	20.9	20.6	5.3	6.0	<5.0	8.1	9.1	15.8
Magnesium (Mg)	mg/kg		20	9340	8980	7050	5990	7400	7040	1730	1830	1440	2630	3310	5840
Manganese (Mn)	mg/kg		1.0	210	200	153	129	167	209	44.3	48.5	37.8	100	121	373
Mercury (Hg)	mg/kg	0.17 0.486	0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Molybdenum (Mo)	mg/kg		0.50	0.78	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Nickel (Ni)	mg/kg		0.50	23.1	21.7	19.3	22.7	21.4	26.0	7.12	7.02	5.46	9.54	10.8	18.3
Phosphorus (P)	mg/kg		50	406	429	362	488	363	342	258	241	267	311	257	425
Potassium (K)	mg/kg		100	380	450	370	900	660	630	190	200	170	350	400	680

Appendix 3.5-1. Stream Sediment Quality Analytical Results, Back River Project, 2012

Area					Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location					Chair OF	Chair OF	Chair OF	Giraffe OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Goose OF
Replicate:					1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled:					13-Aug-12	13-Aug-12	13-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12
		CCME Guidelines for the Protection of Aquatic Life[a]		Realised Detection Limits (RDL)												
ALS Sample ID:					CHAIR OF 1	CHAIR OF 2	CHAIR OF 3	GIRAFFE OF 1	GIRAFFE OF 2	GIRAFFE OF 3	WOLF OF 1	WOLF OF 2	WOLF OF 3	GOOSE OF 1	GOOSE OF 2	GOOSE OF 3
ALS Sample ID #:	Units	ISQG[b]	PEL[c]		L1193085-4	L1193085-5	L1193085-6	L1191592-1	L1191592-2	L1191592-3	L1190642-1	L1190642-2	L1190642-3	L1190642-4	L1190642-5	L1190642-6
Selenium (Se)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silver (Ag)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg			100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Strontium (Sr)	mg/kg			0.50	3.90	5.78	4.80	6.07	4.78	3.98	5.65	5.59	4.54	5.86	5.04	5.39
Sulphur (S)	mg/kg			500	<500	<500	<500	600	600	<500	700	<500	700	600	600	<500
Thallium (Tl)	mg/kg			0.050	<0.050	<0.050	<0.050	0.056	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Tin (Sn)	mg/kg			2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0	400	336	311	406	315	277	189	187	149	291	241	314
Uranium (U)	mg/kg			0.050	0.658	0.426	0.517	0.555	0.334	0.371	0.242	0.205	0.250	0.359	0.263	0.313
Vanadium (V)	mg/kg			0.20	27.8	31.3	25.0	29.2	27.7	25.7	10.0	10.5	8.18	18.0	15.6	25.6
Zinc (Zn)	mg/kg	123	315	1.0	42.4	40.4	33.1	29.8	33.6	33.7	11.0	11.2	9.7	13.5	15.5	23.6

Note Echo OF was dry during August sampling.

Nutrient data could not be analyzed for some samples due to insufficient volume.

Depths are the mean of the two grabs in each replicate.

a) Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment (accessed 2012)

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

d) Realised Detection Limits

Appendix 3.5-1. Stream Sediment Quality Analytical Results, Back River Project, 2012

Area				Goose	Goose	Goose	Goose	Goose	Goose	George	George	George	George	George
Location				Propellor OF	Propellor OF	Propellor OF	Reference B OF	Reference B OF	Reference B OF	George OF	George OF	George OF	Sleigh OF	Sleigh OF
Replicate:				1	2	3	1	2	3	1	2	3	1	2
Date Sampled:				9-Aug-12	9-Aug-12	9-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
ALS Sample ID:		CCME Guidelines for the Protection of Aquatic Life[a]		PROPELLOR OF 1	PROPELLOR OF 2	PROPELLOR OF 3	REF B OF 1	REF B OF 2	REF B OF 3	GEORGE LAKE OF-1	GEORGE LAKE OF-2	GEORGE LAKE OF-3	SLEIGH LAKE OF-1	SLEIGH LAKE OF-2
ALS Sample ID #:	Units	ISQG[b]	PEL[c]	Realised Detection Limits (RDL)	L1192524-1	L1192524-2	L1192524-3	L1192524-4	L1192524-5	L1192524-6	L1190254-1	L1190254-2	L1190254-3	L1190254-4	L1190254-5
Physical Tests															
Moisture	%			0.25	9.43	16.2	14.6	49.3	16.7	64.2	82.1	79.7	85.0	20.5	18.4
pH	pH			0.10	7.21	5.72	6.23	5.59	6.12	5.35	6.13	6.50	6.64	6.86	6.85
Particle Size															
% Gravel (>2 mm)	%			0.10	72.7	74.5	41.8	11.4	10.6	16.8	2.69	0.18	1.31	28.2	25.0
% Sand (2.0 mm - 0.063 mm)	%			0.10	24.0	19.7	47.0	69.0	80.0	65.7	22.8	15.8	21.3	67.5	69.5
% Silt (0.063 mm - 4 µm)	%			0.10	2.41	4.63	9.62	18.4	8.05	15.9	62.0	69.6	66.0	3.56	4.82
% Clay (<4 µm)	%			0.10	0.85	1.21	1.58	1.14	1.35	1.58	12.6	14.5	11.4	0.71	0.66
Texture					Sand	Loamy sand	Loamy sand	Loamy sand	Sand	Loamy sand	Silt loam	Silt loam	Silt loam	Sand	Sand
Leachable Nutrients															
Total Nitrogen by LECO	%			0.020	0.042	0.046	0.021	0.132	0.051	0.293	0.913	0.952	1.13	0.020	0.022
Plant Available Nutrients															
Available Ammonium (as N)	mg/kg			1 - 4.0	2.7	-	2.2	4.5	3.1	14.1	31.2	19.3	32.8	2.0	1.7
Nitrate and Nitrite (as N)	mg/kg			0.5 - 6.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<6.0	<6.0	<6.0	<2.0	<2.0
Nitrate (as N)	mg/kg			0.5 - 6.1	<2.0	-	<2.0	<2.0	<2.0	<2.0	<6.0	<6.0	<6.0	<2.0	<2.0
Nitrite (as N)	mg/kg			0.4 - 1.2	<0.40	-	<0.40	<0.40	<0.40	<0.40	<1.2	<1.2	<1.2	<0.40	<0.40
Available Phosphate (as P)	mg/kg			2 - 8.0	2.2	-	<6.0	<2.0	<4.0	<8.0	10.0	7.8	2.1	2.1	<2.0
Cyanides															
Cyanide, Weak Acid Dissociable	mg/kg			0.05	<0.050	<0.050	<0.050	<0.050	<0.050	0.064	0.266	0.142	0.203	<0.050	<0.050
Cyanide, Total	mg/kg			0.05	<0.050	<0.050	<0.050	0.062	<0.050	0.171	0.553	0.337	0.516	<0.050	<0.050
Organic / Inorganic Carbon															
Total Organic Carbon	%			0.10	0.54	0.60	0.30	1.97	0.80	4.54	10.8	11.3	12.3	0.29	0.34
Metals															
Aluminum (Al)	mg/kg			50	17400	18300	23700	3550	4570	3380	12500	11100	10900	15300	17100
Antimony (Sb)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.23	<0.10	0.15	<0.10	<0.10
Arsenic (As)	mg/kg	5.9	17	0.050	23.9	27.5	23.9	3.10	2.37	2.18	46.8	28.2	96.6	8.04	8.68
Barium (Ba)	mg/kg			0.50	13.5	91.7	8.06	29.0	15.9	16.1	33.9	26.1	27.0	10.1	8.56
Beryllium (Be)	mg/kg			0.20	0.32	0.49	0.35	<0.20	<0.20	<0.20	0.64	0.57	0.70	<0.20	<0.20
Bismuth (Bi)	mg/kg			0.20	0.27	0.27	0.29	<0.20	<0.20	<0.20	0.24	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.6	3.5	0.050	<0.050	0.209	<0.050	<0.050	<0.050	<0.050	0.263	0.155	0.255	<0.050	<0.050
Calcium (Ca)	mg/kg			50	1130	1380	1070	1270	1410	907	2730	2520	2790	1210	1190
Chromium (Cr)	mg/kg	37.3	90	0.50	52.9	54.3	75.3	10.7	12.8	12.0	36.6	33.8	30.0	58.7	62.8
Cobalt (Co)	mg/kg			0.10	15.0	51.2	16.6	4.18	2.54	2.41	78.4	37.6	172	9.57	11.5
Copper (Cu)	mg/kg	35.7	197	0.50	8.72	36.2	19.4	9.12	6.38	8.80	102	91.2	122	12.0	11.5
Iron (Fe)	mg/kg			50	33800	37200	45400	7780	8570	7880	22000	17200	28300	25300	28000
Lead (Pb)	mg/kg	35	91.3	0.50	4.07	11.4	4.62	1.78	1.21	1.47	10.5	7.25	8.41	2.43	2.43
Lithium (Li)	mg/kg			5.0	37.1	41.1	54.1	6.6	9.4	6.4	18.1	16.3	13.7	36.4	41.9
Magnesium (Mg)	mg/kg			20	13800	13600	18500	2290	3000	1940	6040	5340	4550	11500	12900
Manganese (Mn)	mg/kg			1.0	487	6960	643	66.8	74.5	40.3	407	252	1250	300	345
Mercury (Hg)	mg/kg	0.17	0.486	0.0050	<0.0050	0.0060	<0.0050	<0.0050	<0.0050	0.0063	0.0501	0.0484	0.0702	<0.0050	<0.0050
Molybdenum (Mo)	mg/kg			0.50	0.93	1.14	1.47	<0.50	<0.50	<0.50	0.79	0.59	1.09	<0.50	<0.50
Nickel (Ni)	mg/kg			0.50	30.5	81.0	50.5	11.8	8.52	9.52	83.3	62.6	84.7	38.6	42.6
Phosphorus (P)	mg/kg			50	602	654	626	285	420	232	913	787	929	405	386
Potassium (K)	mg/kg			100	320	660	130	460	190	200	500	480	490	340	310

Appendix 3.5-1. Stream Sediment Quality Analytical Results, Back River Project, 2012

Area					Goose	Goose	Goose	Goose	Goose	Goose	George	George	George	George	George
Location					Propellor OF	Propellor OF	Propellor OF	Reference B OF	Reference B OF	Reference B OF	George OF	George OF	George OF	Sleigh OF	Sleigh OF
Replicate:					1	2	3	1	2	3	1	2	3	1	2
Date Sampled:					9-Aug-12	9-Aug-12	9-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
ALS Sample ID:		CCME Guidelines for the Protection of Aquatic Life[a]		Realised Detection Limits (RDL)	PROPELLOR OF 1	PROPELLOR OF 2	PROPELLOR OF 3	REF B OF 1	REF B OF 2	REF B OF 3	GEORGE LAKE OF-1	GEORGE LAKE OF-2	GEORGE LAKE OF-3	SLEIGH LAKE OF-1	SLEIGH LAKE OF-2
ALS Sample ID #:	Units	ISQG[b]	PEL[c]		L1192524-1	L1192524-2	L1192524-3	L1192524-4	L1192524-5	L1192524-6	L1190254-1	L1190254-2	L1190254-3	L1190254-4	L1190254-5
Selenium (Se)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.78	0.63	1.21	<0.20	<0.20
Silver (Ag)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.12	0.12	0.14	<0.10	<0.10
Sodium (Na)	mg/kg			100	<100	<100	<100	<100	<100	<100	<100	<100	160	<100	<100
Strontium (Sr)	mg/kg			0.50	4.70	7.16	2.42	5.96	8.65	4.95	13.7	12.5	12.6	4.50	4.26
Sulphur (S)	mg/kg			500	<500	<500	<500	800	<500	1100	3300	3300	2900	<500	<500
Thallium (Tl)	mg/kg			0.050	<0.050	0.089	<0.050	<0.050	<0.050	<0.050	0.082	0.064	0.109	<0.050	<0.050
Tin (Sn)	mg/kg			2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0	86.1	269	79.1	262	201	196	201	187	132	233	249
Uranium (U)	mg/kg			0.050	0.682	0.865	0.974	0.340	0.237	0.280	1.49	1.34	1.48	0.538	0.492
Vanadium (V)	mg/kg			0.20	25.8	41.6	32.9	19.0	16.1	24.5	22.4	19.1	20.0	30.4	30.7
Zinc (Zn)	mg/kg	123	315	1.0	60.1	86.7	78.7	19.8	12.2	15.6	101	78.1	98.5	52.0	56.9

Note Echo OF was dry during August sampling.

Nutrient data could not be analyzed for some samples due to insufficient volume.

Depths are the mean of the two grabs in each replicate.

a) Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment (accessed 2012)

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

d) Realised Detection Limits

Appendix 3.5-1. Stream Sediment Quality Analytical Results, Back River Project, 2012

Area				George	George	George	George	George	George	George	George	George	George
Location				Sleigh OF	Dragon OF	Dragon OF	Dragon OF	Komatic OF	Komatic OF	Komatic OF	Reference C OF	Reference C OF	Reference C OF
Replicate:				3	1	2	3	1	2	3	1	2	3
Date Sampled:				5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12
ALS Sample ID:		CCME Guidelines for the Protection of Aquatic Life[a]		Realised Detection Limits (RDL)	SLEIGH LAKE OF-3	DRAGON LAKE OF-1	DRAGON LAKE OF-2	DRAGON LAKE OF-3	KOMATIC LAKE OF-1	KOMATIC LAKE OF-2	KOMATIC LAKE OF-3	REFERENCE LAKE C OF-1	REFERENCE LAKE C OF-2	REFERENCE LAKE C OF-3
ALS Sample ID #:	Units	ISQG[b]	PEL[c]		L1190254-6	L1190254-7	L1190254-8	L1190254-9	L1190254-10	L1190254-11	L1190254-12	L1190254-13	L1190254-14	L1190254-15
Physical Tests														
Moisture	%			0.25	19.9	40.4	22.0	29.1	16.4	16.4	15.9	38.6	25.1	31.1
pH	pH			0.10	6.72	6.63	6.72	6.80	6.48	6.69	6.71	7.28	6.98	7.17
Particle Size														
% Gravel (>2 mm)	%			0.10	28.8	38.6	33.9	48.1	<0.10	<0.10	<0.10	68.3	57.1	66.0
% Sand (2.0 mm - 0.063 mm)	%			0.10	66.7	45.5	52.7	40.4	96.8	97.7	98.3	23.0	35.0	28.2
% Silt (0.063 mm - 4 µm)	%			0.10	3.79	14.5	12.1	10.4	2.68	1.87	1.34	8.10	7.08	5.01
% Clay (<4 µm)	%			0.10	0.68	1.50	1.34	1.11	0.50	0.47	0.41	0.66	0.81	0.85
Texture					Sand	Loamy sand	Loamy sand	Loamy sand	Sand	Sand	Sand	Loamy sand	Loamy sand	Loamy sand
Leachable Nutrients														
Total Nitrogen by LECO	%			0.020	0.021	0.046	0.037	0.024	<0.020	<0.020	<0.020	0.182	0.052	0.080
Plant Available Nutrients														
Available Ammonium (as N)	mg/kg			1 - 4.0	1.4	1.8	2.2	2.2	1.2	<1.0	<1.0	1.8	1.4	1.6
Nitrate and Nitrite (as N)	mg/kg			0.5 - 6.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Nitrate (as N)	mg/kg			0.5 - 6.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Nitrite (as N)	mg/kg			0.4 - 1.2	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Available Phosphate (as P)	mg/kg			2 - 8.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	<2.0	<2.0
Cyanides														
Cyanide, Weak Acid Dissociable	mg/kg			0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cyanide, Total	mg/kg			0.05	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Organic / Inorganic Carbon														
Total Organic Carbon	%			0.10	0.35	0.64	0.45	0.30	0.19	0.14	0.11	2.71	0.86	1.11
Metals														
Aluminum (Al)	mg/kg			50	14800	14300	14300	16000	11100	16700	13800	6820	6340	8840
Antimony (Sb)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	<0.10	0.10
Arsenic (As)	mg/kg	5.9	17	0.050	8.72	31.1	37.6	39.3	7.66	14.9	9.72	1.66	1.39	3.56
Barium (Ba)	mg/kg			0.50	9.33	30.5	22.8	18.8	9.57	11.4	9.78	41.8	37.7	39.5
Beryllium (Be)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.30	0.30	0.37
Bismuth (Bi)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium (Cd)	mg/kg	0.6	3.5	0.050	<0.050	0.067	<0.050	<0.050	<0.050	<0.050	<0.050	0.060	<0.050	<0.050
Calcium (Ca)	mg/kg			50	1190	1340	1370	1320	1040	1300	1140	3020	1630	1520
Chromium (Cr)	mg/kg	37.3	90	0.50	52.5	48.9	55.4	55.2	40.7	66.6	52.6	16.2	14.4	22.9
Cobalt (Co)	mg/kg			0.10	8.90	19.9	16.4	15.4	5.63	8.06	6.82	5.04	5.11	7.70
Copper (Cu)	mg/kg	35.7	197	0.50	12.0	18.2	16.7	12.3	7.82	9.85	9.71	9.52	6.38	4.33
Iron (Fe)	mg/kg			50	23600	33200	38000	39200	18400	29300	23600	12900	12200	20100
Lead (Pb)	mg/kg	35	91.3	0.50	2.58	3.00	3.11	2.60	1.64	2.07	1.75	2.06	1.69	1.56
Lithium (Li)	mg/kg			5.0	35.7	27.8	29.1	32.9	25.4	41.5	34.5	12.1	11.2	16.0
Magnesium (Mg)	mg/kg			20	10700	9950	10500	11400	8310	13200	11100	7170	5480	8270
Manganese (Mn)	mg/kg			1.0	280	370	318	347	184	277	231	136	85.4	159
Mercury (Hg)	mg/kg	0.17	0.486	0.0050	<0.0050	0.0054	0.0053	<0.0050	<0.0050	<0.0050	<0.0050	0.0102	<0.0050	<0.0050
Molybdenum (Mo)	mg/kg			0.50	<0.50	<0.50	0.60	0.61	<0.50	0.59	<0.50	<0.50	<0.50	<0.50
Nickel (Ni)	mg/kg			0.50	34.9	38.8	35.6	35.8	26.2	40.9	32.6	13.0	13.0	18.7
Phosphorus (P)	mg/kg			50	344	394	447	479	324	472	390	346	235	321
Potassium (K)	mg/kg			100	300	390	360	380	210	360	260	370	330	490

Appendix 3.5-1. Stream Sediment Quality Analytical Results, Back River Project, 2012

Area					George	George	George	George	George	George	George	George	George	George
Location					Sleigh OF	Dragon OF	Dragon OF	Dragon OF	Komatic OF	Komatic OF	Komatic OF	Reference C OF	Reference C OF	Reference C OF
Replicate:					3	1	2	3	1	2	3	1	2	3
Date Sampled:					5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12
ALS Sample ID:		CCME Guidelines for the Protection of Aquatic Life[a]		Realised Detection Limits (RDL)	SLEIGH LAKE OF-3	DRAGON LAKE OF-1	DRAGON LAKE OF-2	DRAGON LAKE OF-3	KOMATIC LAKE OF-1	KOMATIC LAKE OF-2	KOMATIC LAKE OF-3	REFERENCE LAKE C OF-1	REFERENCE LAKE C OF-2	REFERENCE LAKE C OF-3
ALS Sample ID #:	Units	ISQG[b]	PEL[c]		L1190254-6	L1190254-7	L1190254-8	L1190254-9	L1190254-10	L1190254-11	L1190254-12	L1190254-13	L1190254-14	L1190254-15
Selenium (Se)	mg/kg			0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silver (Ag)	mg/kg			0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)	mg/kg			100	<100	<100	<100	<100	<100	<100	<100	<100	110	<100
Strontium (Sr)	mg/kg			0.50	4.62	5.32	5.12	5.05	3.91	4.79	4.35	4.25	4.62	3.20
Sulphur (S)	mg/kg			500	<500	500	<500	<500	<500	<500	<500	<500	<500	<500
Thallium (Tl)	mg/kg			0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Tin (Sn)	mg/kg			2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)	mg/kg			1.0	283	277	261	256	216	200	194	242	316	201
Uranium (U)	mg/kg			0.050	0.422	0.488	0.510	0.444	0.366	0.460	0.410	2.08	0.881	1.11
Vanadium (V)	mg/kg			0.20	27.5	27.5	30.3	31.2	20.2	32.2	25.4	16.3	16.9	19.2
Zinc (Zn)	mg/kg	123	315	1.0	50.1	48.2	49.5	51.0	37.3	54.4	45.2	17.5	13.8	19.5

Note Echo OF was dry during August sampling.

Nutrient data could not be analyzed for some samples due to insufficient volume.

Depths are the mean of the two grabs in each replicate.

a) Canadian sediment quality guidelines for the protection of freshwater aquatic life, Canadian Council of Ministers of the Environment (accessed 2012)

b) ISQG = Interim Sediment Quality Guideline

c) PEL = Probable Effects Level

d) Realised Detection Limits

Appendix 3.6-1

Lake Phytoplankton Biomass as Chl *a* Results, Back River Project, 2012

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Appendix 3.6-1. Lake Phytoplankton Biomass as Chl *a* Results, Back River Project, 2012

Area			Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location			Moby	Moby	Moby	Gander	Gander	Gander	Big	Big	Big	Fox	Fox	Fox	Rascal	Rascal	Rascal
Replicate		Realised	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Depth (m)		Detection	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Date Sampled		Limit	10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012
ALS Sample ID	Units	(RDL)	L1135625-7	L1135625-8	L1135625-9	L1135625-4	L1135625-5	L1135625-6	L1135625-1	L1135625-2	L1135625-3	L1135625-10	L1135625-11	L1135625-12	L1135625-28	L1135625-29	L1135625-30
Plant Pigments																	
Chlorophyll a	ug/L	0.010	0.173	0.279	0.409	0.157	0.117	0.206	0.037	0.066	<0.010	0.181	0.297	0.282	1.03	0.328	0.895
Pheopigments	ug/L	0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Area			Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location			Giraffe North	Giraffe North	Giraffe North	Giraffe South	Giraffe South	Giraffe South	Goose Neck	Goose Neck	Goose Neck	Goose Central	Goose Central	Goose Central	Goose Tail	Goose Tail	Goose Tail
Replicate		Realised	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Depth (m)		Detection	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Date Sampled		Limit	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012
ALS Sample ID	Units	(RDL)	L1135625-13	L1135625-14	L1135625-15	L1135625-16	L1135625-17	L1135625-18	L1135625-25	L1135625-26	L1135625-27	L1135625-22	L1135625-23	L1135625-24	L1135625-19	L1135625-20	L1135625-21
Plant Pigments																	
Chlorophyll a	ug/L	0.010	0.134	0.139	0.201	0.104	0.06	0.142	0.122	0.163	0.195	0.35	0.324	0.389	0.107	0.187	0.053
Pheopigments	ug/L	0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Area			Goose	Goose	Goose	George	George	George	George	George	George	George	George	George	George	George	George
Location			Propellor	Propellor	Propellor	Lower Long	Lower Long	Lower Long	Fold	Fold	Fold	George Central	George Central	George Central	Dragon	Dragon	Dragon
Replicate		Realised	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Depth (m)		Detection	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Date Sampled		Limit	12-Apr-2012	12-Apr-2012	12-Apr-2012	13-Apr-2012	13-Apr-2012	13-Apr-2012	15-Apr-2012	15-Apr-2012	15-Apr-2012	13-Apr-2012	13-Apr-2012	13-Apr-2012	15-Apr-2012	15-Apr-2012	15-Apr-2012
ALS Sample ID	Units	(RDL)	L1135625-31	L1135625-32	L1135625-33	L1135623-4	L1135623-5	L1135623-6	L1135623-16	L1135623-17	L1135623-18	L1135623-10	L1135623-11	L1135623-12	L1135623-13	L1135623-14	L1135623-15
Plant Pigments																	
Chlorophyll a	ug/L	0.010	0.111	0.06	0.063	0.844	0.558	0.979	0.699	2.26	0.504	0.094	0.188	0.099	0.826	1.55	1.45
Pheopigments	ug/L	0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Area			George	George	George	George	George	George
Location			Komatic	Komatic	Komatic	Reference C	Reference C	Reference C
Replicate		Realised	1	2	3	1	2	3
Depth (m)		Detection	1	1	1	1	1	1
Date Sampled		Limit	13-Apr-2012	13-Apr-2012	13-Apr-2012	13-Apr-2012	13-Apr-2012	13-Apr-2012
ALS Sample ID	Units	(RDL)	L1135623-7	L1135623-8	L1135623-9	L1135623-1	L1135623-2	L1135623-3
Plant Pigments								
Chlorophyll a	ug/L	0.010	2.24	2.13	0.758	0.262	0.139	0.325
Pheopigments	ug/L	0.010	-	-	-	-	-	-

Appendix 3.6-1. Lake Phytoplankton Biomass as Chl *a* Results, Back River Project, 2012

Area			Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location			Gander	Gander	Gander	Big	Big	Big	Rabbit	Rabbit	Rabbit	Fox	Fox	Fox
Replicate		Realised	1	2	3	1	2	3	1	2	3	1	2	3
Depth (m)		Detection	1	1	1	1	1	1	1	1	1	1	1	1
Date Sampled		Limit	18-Aug-12	18-Aug-12	18-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12
ALS Sample ID	Units	(RDL)	L1199756-13	L1199756-14	L1199756-15	L1199756-7	L1199756-8	L1199756-9	L1199756-4	L1199756-5	L1199756-6	L1199756-19	L1199756-20	L1199756-21
Plant Pigments														
Chlorophyll a	ug/L	0.010	1.04	0.882	0.481	0.472	0.488	0.372	0.135	0.159	0.158	0.334	0.838	0.646
Pheopigments	ug/L	0.010	-	-	-	-	-	-	-	-	-	-	-	-

Area			Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	George	George	George
Location			Giraffe South	Giraffe South	Giraffe South	Goose Neck	Goose Neck	Goose Neck	Goose Central	Goose Central	Goose Central	Lower Long	Lower Long	Lower Long
Replicate		Realised	1	2	3	1	2	3	1	2	3	1	2	3
Depth (m)		Detection	1	1	1	1	1	1	1	1	1	1	1	1
Date Sampled		Limit	19-Aug-12	19-Aug-12	19-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	17-Aug-12	17-Aug-12	17-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
ALS Sample ID	Units	(RDL)	L1199756-16	L1199756-17	L1199756-18	L1199756-1	L1199756-2	L1199756-3	L1199756-10	L1199756-11	L1199756-12	L1200353-13	L1200353-14	L1200353-15
Plant Pigments														
Chlorophyll a	ug/L	0.010	0.253	0.437	0.460	0.536	0.193	0.236	0.299	0.339	0.231	0.819	0.873	0.593
Pheopigments	ug/L	0.010	-	-	-	-	-	-	-	-	-	0.490	0.030	0.800

Area			George	George	George	George	George	George	George	George	George	George	George	George
Location			Fold	Fold	Fold	George Central	George Central	George Central	Lytle	Lytle	Lytle	Occurrence	Occurrence	Occurrence
Replicate		Realised	1	2	3	1	2	3	1	2	3	1	2	3
Depth (m)		Detection	1	1	1	1	1	1	1	1	1	1	1	1
Date Sampled		Limit	19-Aug-12	19-Aug-12	19-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	23-Aug-12	23-Aug-12	23-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
ALS Sample ID	Units	(RDL)	L1200353-4	L1200353-5	L1200353-6	L1200353-1	L1200353-2	L1200353-3	L1200353-25	L1200353-26	L1200353-27	L1200353-16	L1200353-17	L1200353-18
Plant Pigments														
Chlorophyll a	ug/L	0.010	0.303	0.180	0.143	0.291	0.103	0.213	0.067	0.257	0.085	0.394	0.164	0.071
Pheopigments	ug/L	0.010	0.220	0.090	0.290	0.160	0.200	0.030	0.200	0.070	0.170	0.150	0.170	0.120

Area			George	George	George	George	George	George	George	George	George	George	George	George
Location			Sleigh	Sleigh	Sleigh	Dragon	Dragon	Dragon	Komatic	Komatic	Komatic	Reference C	Reference C	Reference C
Replicate		Realised	1	2	3	1	2	3	1	2	3	1	2	3
Depth (m)		Detection	1	1	1	1	1	1	1	1	1	1	1	1
Date Sampled		Limit	22-Aug-12	22-Aug-12	22-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12
ALS Sample ID	Units	(RDL)	L1200353-22	L1200353-23	L1200353-24	L1200353-7	L1200353-8	L1200353-9	L1200353-10	L1200353-11	L1200353-12	L1200353-19	L1200353-20	L1200353-21
Plant Pigments														
Chlorophyll a	ug/L	0.010	0.339	0.301	0.136	0.679	0.633	0.111	0.469	0.663	0.374	0.125	0.590	0.509
Pheopigments	ug/L	0.010	0.090	0.100	0.160	0.340	0.960	0.100	0.180	0.500	0.890	0.360	0.570	0.200

Appendix 3.6-2

Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

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Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Lake	Moby	Gander	Big	Fox	Rascal	Giraffe North	Giraffe South	Goose Neck	Goose Central
				Replicate	1	1	1	1	1	1	1	1	1
				Lab Duplicate	no	no	no	no	no	no	no	no	no
				Date Sampled	10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012
				Sample ID	6138.4-7	6138.4-10	6138.4-9	6138.4-8	6138.4-2	6138.4-3	6138.4-11	6138.4-4	6138.4-5
Class	**Order**	**Family**	**Genus**	**Final Designation**									
Bacillariophyceae	Centrales	Stephanodiscaceae	*Cyclotella*	*Cyclotella* sp.	1.99			0.21		2.47		2.51	0.37
				Cyclotella sp. < 6µm									
				Cyclotella sp. 6-10 µm									
			Stephanodiscus	*Stephanodiscus* sp.									
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.									
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.									
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.								1.00	
		Bacillariaceae	*Nitzschia*	*Nitzschia* sp.	0.33	0.11	0.11	0.41					0.37
				Nitzschia spp.									
		Catenulaceae	*Amphora*	*Amphora* sp.									
		Cymbellaceae	*Cymbella*	*Cymbella* sp.		0.22						0.13	
		Diploneidaceae	*Diploneis*	*Diploneis* sp.									
		Eunotiaceae	*Eunotia*	*Eunotia* sp.									
		Fragilariaceae	*Fragilaria*	*Fragilaria* sp.								6.03	
			Synedra	*Synedra* sp.						0.31			
		Naviculaceae	*Navicula*	*Navicula* sp.		0.45			1.77				
		Pinnulariaceae	*Caloneis*	*Caloneis* sp.		0.34							
			Pinnularia	*Pinnularia biceps*		0.22						0.75	
				Pinnularia sp.	0.33	0.56	0.11				0.17	1.38	
		Pleurosigmataceae	*Pleurosigma*	*Pleurosigma* sp.									
		Rhopalodiaceae	*Epithemia*	*Epithemia* sp.									
		Stauroneidaceae	*Stauroneis*	*Stauroneis* sp.		0.22						1.13	
		Surirellaceae	*Surirella*	*Surirella* sp.								0.13	
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*									
				Tabellaria flocculosa									
				Tabellaria sp.		2.02		0.82			1.36	1.00	
Chlorodendrophyceae	Chlorodendrales	Chlorodendraceae	*Tetraselmis*	*Tetraselmis* sp.									
Chlorophyceae	Chlorococcales	Chlorococcaceae	*Tetraedron*	*Tetraedron caudatum*									
				Tetraedron minimum									
				Tetraedron sp.						0.15			
		Hydrodictyaceae	*Pediastrum*	*Pediastrum* sp.						21.62		2.01	
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus* sp.									
			Botryococcus	*Botryococcus* sp.			16.99						
			Closteriopsis	*Closteriopsis acicularis*									
			Monoraphidium	*Monoraphidium arcuatum*									
				Monoraphidium contortum									
				Monoraphidium sp.	79.72	5.95	1.02	17.63	2.66	7.26	6.28	2.51	7.80
				Monoraphidium tortile									
			Oocystis	*Oocystis* sp.		0.11	0.11			1.08	0.68		
			Quadrigula	*Quadrigula chodati*									
				Quadrigula closterioides									
		Scenedesmaceae	*Coelastrum*	*Coelastrum* sp.									
			Crucigenia	*Crucigenia* sp.		0.45							
			Crucigeniella	*Crucigeniella rectangularis*								1.51	
			Scenedesmus	*Scenedesmus bijuga*									
				Scenedesmus brasiliensis									
				Scenedesmus sp.	1.33	1.12				1.24	0.68	0.50	
	Sphaeropleales	Characiaceae	*Ankyra*	*Ankyra judayi*									
		Radiococcaceae	*Coenococcus*	*Coenococcus fottii*									
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*									
				Elakatothrix sp.	2.33			0.82		4.32	0.34		
		Palmellaceae	*Gloeocystis*	*Gloeocystis gigas*									
			Sphaerocystis	*Sphaerocystis planctonica*	1.33	0.90	0.23			13.44		2.76	3.71
				Sphaerocystis sp.									

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification													
Class	Order	Family	Genus	Final Designation									
Area					Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Lake					Moby	Gander	Big	Fox	Rascal	Giraffe North	Giraffe South	Goose Neck	Goose Central
Replicate					1	1	1	1	1	1	1	1	1
Lab Duplicate					no	no	no	no	no	no	no	no	no
Date Sampled					10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012
Sample ID					6138.4-7	6138.4-10	6138.4-9	6138.4-8	6138.4-2	6138.4-3	6138.4-11	6138.4-4	6138.4-5
	Volvocales	Chlamydomonadaceae	*Carteria*	*Carteria* sp.			0.23		3.54	0.77		1.26	
			Chlamydomonas	*Chlamydomonas* sp.									
	Zygnematales	Desmidiaceae	*Closterium*	*Closterium* sp.									
			Cosmarium	*Cosmarium* sp.						0.77		0.25	
			Euastrum	*Euastrum* sp.		0.11							
			Spondylosium	*Spondylosium* sp.									
			Staurastrum	*Staurastrum* sp.						0.15			0.37
			Staurodesmus	*Staurodesmus* sp.	0.33			0.21			0.17		
			Teilingia	*Teilingia granulata*	1.33	0.11		0.21			0.17	0.25	
			Xanthidium	*Xanthidium* sp.		0.11							
		Mesotaeniaceae	*Gonatozygon*	*Gonatozygon* sp.									
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.	0.33	0.34	0.45	1.03			0.68	0.13	0.37
Chrysophyceae	Chromulinales	Chromulinaceae	*Chromulina*	*Chromulina* sp.									
			Kephyrion	*Kephyrion* sp.									
		Chrysocapsaceae	*Chrysocapsa*	*Chrysocapsa planktonica*									
				Chrysocapsa sp.									
	Chrysomonadales	Dinobryaceae	*Chrysococcus*	*Chrysococcus* sp.									
			Chrysolykos	*Chrysolykos planctonicus*									
			Dinobryon	*Dinobryon bavaricum*									
				Dinobryon divergens									
				Dinobryon sertularia									
				Dinobryon sociale									
				Dinobryon sp.	1.66	0.45	0.11	0.82	3.54			0.25	0.37
		Synuraceae	*Mallomonas*	*Mallomonas* sp.									
			Synura	*Synura* sp.									
	Hibberdiales	Stylococcaceae	*Diceras*	*Diceras* sp.									
	Ochromonadales	Ochromonadaceae	*Ochromonas*	*Ochromonas* sp.									
	Prymnesiales	Prymnesiaceae	*Chrysochromulina*	*Chrysochromulina parva*									
Cryptophyceae	Cryptomonadales	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.	13.62	17.29	3.29	35.88	73.47	7.11	13.07	11.68	40.83
				Cryptomonas spp.									
			Komma	*Komma caudata*	1.99	1.23	1.47	5.33	189.44	23.48	29.70	11.05	63.10
	Pyrenomonadales	Pyrenomonadaceae	*Rhodomonas*	*Rhodomonas lacustris var. nannoplanctica*									
Cyanophyceae	Synechococcales	Synechococcaceae	*Cyanodictyon*	*Cyanodictyon* sp.									
Dinophyceae	Dinophysales	Amphisoleniaceae	*Dinophysis*	*Dinophysis* sp.							0.17		
	Gymnodiniales	Gymondiniaceae	*Gymnodinium*	*Gymnodinium* sp.									
	Peridiniales	Peridiniaceae	*Glenodinium*	*Glenodinium* sp.									
			Peridinium	*Peridinium* sp.	0.33	1.23	0.11	0.41	0.89	1.70	1.02	0.38	1.11
Euglenophyceae	Euglenales	Euglenaceae	*Euglena*	*Euglena* sp.		0.56			0.89				
			Lepocinclis	*Lepocinclis* sp.		2.13							
			Phacus	*Phacus* sp.									
			Trachelomonas	*Trachelomonas* sp.									
Myxophyceae	Chroococcales	Chroococcaceae	*Chroococcus*	*Chroococcus limneticus*									
				Chroococcus minimus									
				Chroococcus prescottii									
				Chroococcus sp.									
		Merismopediaceae	*Aphanocapsa*	*Aphanocapsa conferta*									
				Aphanocapsa holsatica									
				Aphanocapsa incerta									
				Aphanocapsa sp.									
			Coelomoron	*Coelomoron* sp.									
			Coelosphaerium	*Coelosphaerium* sp.									
			Merismopedia	*Merismopedia* sp.						7.41			
				Merismopedia tenuissima									
			Snowella	*Snowella lacustris*									

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Lake	Moby	Gander	Big	Fox	Rascal	Giraffe North	Giraffe South	Goose Neck	Goose Central
				Replicate	1	1	1	1	1	1	1	1	1
				Lab Duplicate	no	no	no	no	no	no	no	no	no
				Date Sampled	10-Apr-2012	10-Apr-2012	10-Apr-2012	10-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012	11-Apr-2012
				Sample ID	6138.4-7	6138.4-10	6138.4-9	6138.4-8	6138.4-2	6138.4-3	6138.4-11	6138.4-4	6138.4-5
Class	**Order**	**Family**	**Genus**	**Final Designation**									
			Woronichinia	*Woronichinia compacta*									
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa* sp.									
			Microcystis	*Microcystis aeruginosa*									
		Synechococcaceae	*Aphanothece*	*Aphanothece minutissima*									
				Aphanothece sp.									
			Rhabdoderma	*Rhabdoderma lineare*									
			Synechococcus	*Synechococcus* sp.								1.00	
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.	7.97	0.90						0.50	
			Nostoc	*Nostoc* sp.									
	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria* sp.		35.47							
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya* sp.				6.97					
			Planktolyngbya	*Planktolyngbya limnetica*									
			Pseudanabaena	*Pseudanabaena galeata*									
				Pseudanabaena sp.		2.69							
Trebouxiophyceae	Prasiolales	Koliellaceae	*Koliella*	*Koliella longiseta*									
Xanthophyceae	Heterococcales	Sciadaceae	*Centritractus*	*Centritractus* sp.									
	Mischococcales	Characiopsidaceae	*Characiopsis*	*Characiopsis* sp.			0.11						
Undetermined	Undetermined	Katablepharidaceae	*Katablepharis*	*Katablepharis ovalis*									
		Undetermined	Undetermined	unknown Chlorophyte coccoid		0.11							
				Total	**114.92**	**75.44**	**24.36**	**70.74**	**276.19**	**93.30**	**54.49**	**50.09**	**118.41**

Note: George Central Rep 3 (ID 6141.4-9) contained too much detritus and silt for taxonomists to enumerate.

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	Goose	Goose	Goose	George	George	George	George	George	George
				Lake	Goose Tail	Goose Tail	Propellor	Lower Long	Fold	George Central	Dragon	Komatic	Reference C
				Replicate	1	1 DUP	1	1	1	1	1	1	1
				Lab Duplicate	no	yes	no	no	no	no	no	no	no
				Date Sampled	11-Apr-2012	11-Apr-2012	12-Apr-2012	13-Apr-2012	15-Apr-2012	13-Apr-2012	15-Aug-2012	13-Apr-2012	13-Apr-2012
				Sample ID	6138.4-6	6138.4-6-DUP	6138.4-1	6141.4-3	6141.4-5	6141.4-1	6141.4-6	6141.4-4	6141.4-2
Class	**Order**	**Family**	**Genus**	**Final Designation**									
Bacillariophyceae	Centrales	Stephanodiscaceae	*Cyclotella*	*Cyclotella* sp.	1.07	0.86		2.00			6.00	0.50	1.00
				Cyclotella sp. < 6µm					51.00	1.00	40.80	586.50	
				Cyclotella sp. 6-10 µm									0.50
			Stephanodiscus	*Stephanodiscus* sp.									
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.	0.21	0.21							
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.									
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.									
		Bacillariaceae	*Nitzschia*	*Nitzschia* sp.	0.43	0.86							
				Nitzschia spp.									
		Catenulaceae	*Amphora*	*Amphora* sp.									
		Cymbellaceae	*Cymbella*	*Cymbella* sp.									
		Diploneidaceae	*Diploneis*	*Diploneis* sp.									
		Eunotiaceae	*Eunotia*	*Eunotia* sp.									
		Fragilariaceae	*Fragilaria*	*Fragilaria* sp.									
			Synedra	*Synedra* sp.				2.50			7.50		
		Naviculaceae	*Navicula*	*Navicula* sp.			0.45						
		Pinnulariaceae	*Caloneis*	*Caloneis* sp.									
			Pinnularia	*Pinnularia biceps*									
				Pinnularia sp.									
		Pleurosigmataceae	*Pleurosigma*	*Pleurosigma* sp.									
		Rhopalodiaceae	*Epithemia*	*Epithemia* sp.			0.11						
		Stauroneidaceae	*Stauroneis*	*Stauroneis* sp.									
		Surirellaceae	*Surirella*	*Surirella* sp.									
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*									
				Tabellaria flocculosa									
				Tabellaria sp.			1.81						
Chlorodendrophyceae	Chlorodendrales	Chlorodendraceae	*Tetraselmis*	*Tetraselmis* sp.									
Chlorophyceae	Chlorococcales	Chlorococcaceae	*Tetraedron*	*Tetraedron caudatum*									
				Tetraedron minimum									
				Tetraedron sp.			0.34				5.00	35.70	
		Hydrodictyaceae	*Pediastrum*	*Pediastrum* sp.		11.16							
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus* sp.									
			Botryococcus	*Botryococcus* sp.									
			Closteriopsis	*Closteriopsis acicularis*									2.50
			Monoraphidium	*Monoraphidium arcuatum*									
				Monoraphidium contortum									
				Monoraphidium sp.	2.58	2.79	7.12	5.00					
				Monoraphidium tortile									
			Oocystis	*Oocystis* sp.									
			Quadrigula	*Quadrigula chodati*									
				Quadrigula closterioides									
		Scenedesmaceae	*Coelastrum*	*Coelastrum* sp.							8.00		
			Crucigenia	*Crucigenia* sp.	0.86	0.86							
			Crucigeniella	*Crucigeniella rectangularis*	2.15								
			Scenedesmus	*Scenedesmus bijuga*							2.00	6.00	4.00
				Scenedesmus brasiliensis									
				Scenedesmus sp.	0.86	0.86							
	Sphaeropleales	Characiaceae	*Ankyra*	*Ankyra judayi*									
		Radiococcaceae	*Coenococcus*	*Coenococcus fottii*				8.00	36.00				
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*									
				Elakatothrix sp.	1.72	0.86							
		Palmellaceae	*Gloeocystis*	*Gloeocystis gigas*									
			Sphaerocystis	*Sphaerocystis planctonica*	1.29	2.58							
				Sphaerocystis sp.									

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification														
Class	Order	Family	Genus	Final Designation	Goose	Goose	Goose	George	George	George	George	George	George
				Area	Goose	Goose	Goose	George	George	George	George	George	George
				Lake	Goose Tail	Goose Tail	Propellor	Lower Long	Fold	George Central	Dragon	Komatic	Reference C
				Replicate	1	1 DUP	1	1	1	1	1	1	1
				Lab Duplicate	no	yes	no	no	no	no	no	no	no
				Date Sampled	11-Apr-2012	11-Apr-2012	12-Apr-2012	13-Apr-2012	15-Apr-2012	13-Apr-2012	15-Aug-2012	13-Apr-2012	13-Apr-2012
				Sample ID	6138.4-6	6138.4-6-DUP	6138.4-1	6141.4-3	6141.4-5	6141.4-1	6141.4-6	6141.4-4	6141.4-2
	Volvocales	Chlamydomonadaceae	*Carteria*	*Carteria* sp.	0.64	0.64							
			Chlamydomonas	*Chlamydomonas* sp.						1.00			
	Zygnematales	Desmidiaceae	*Closterium*	*Closterium* sp.					2.00		0.50		
			Cosmarium	*Cosmarium* sp.			0.11						
			Euastrum	*Euastrum* sp.									
			Spondylosium	*Spondylosium* sp.									
			Staurastrum	*Staurastrum* sp.									
			Staurodesmus	*Staurodesmus* sp.			0.23						
			Teilingia	*Teilingia granulata*	0.21	0.21							
			Xanthidium	*Xanthidium* sp.									
		Mesotaeniaceae	*Gonatozygon*	*Gonatozygon* sp.									
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.									
Chrysophyceae	Chromulinales	Chromulinaceae	*Chromulina*	*Chromulina* sp.									
			Kephyrion	*Kephyrion* sp.							5.10		
		Chrysocapsaceae	*Chrysocapsa*	*Chrysocapsa planktonica*									
				Chrysocapsa sp.									
	Chrysomonadales	Dinobryaceae	*Chrysococcus*	*Chrysococcus* sp.									
			Chrysolykos	*Chrysolykos planctonicus*									
			Dinobryon	*Dinobryon bavaricum*									
				Dinobryon divergens									
				Dinobryon sertularia					9.00		2.50		
				Dinobryon sociale				3.50				1.50	
				Dinobryon sp.	0.21	0.43		3.50					
		Synuraceae	*Mallomonas*	*Mallomonas* sp.									
			Synura	*Synu* ra sp.									
	Hibberdiales	Stylococcaceae	*Diceras*	*Diceras* sp.									
	Ochromonadales	Ochromonadaceae	*Ochromonas*	*Ochromonas* sp.									
	Prymnesiales	Prymnesiaceae	*Chrysochromulina*	*Chrysochromulina parva*				44.00	107.10	5.10	173.40	132.60	10.20
Cryptophyceae	Cryptomonadales	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.	33.69	34.12	7.46						
				Cryptomonas spp.				5.50	51.00		44.00	114.00	1.50
			Komma	*Komma caudata*	22.75	22.53	15.83						
	Pyrenomonadales	Pyrenomonadaceae	*Rhodomonas*	*Rhodomonas lacustris var. nannoplanctica*				132.00	122.00	1.00	180.00	79.00	37.00
Cyanophyceae	Synechococcales	Synechococcaceae	*Cyanodictyon*	*Cyanodictyon* sp.									
Dinophyceae	Dinophysales	Amphisoleniaceae	*Dinophysis*	*Dinophysis* sp.									
	Gymnodiniales	Gymondiniaceae	*Gymnodinium*	*Gymnodinium* sp.				2.50			4.00	40.00	1.00
	Peridiniales	Peridiniaceae	*Glenodinium*	*Glenodinium* sp.									
			Peridinium	*Peridinium* sp.	1.50	1.50		0.50					
Euglenophyceae	Euglenales	Euglenaceae	*Euglena*	*Euglena* sp.			0.23						
			Lepocinclis	*Lepocinclis* sp.									
			Phacus	*Phacus* sp.									
			Trachelomonas	*Trachelomonas* sp.									
Myxophyceae	Chroococcales	Chroococcaceae	*Chroococcus*	*Chroococcus limneticus*									
				Chroococcus minimus									
				Chroococcus prescottii									
				Chroococcus sp.									
		Merismopediaceae	*Aphanocapsa*	*Aphanocapsa conferta*									
				Aphanocapsa holsatica									
				Aphanocapsa incerta									
				Aphanocapsa sp.									
			Coelomoron	*Coelomoron* sp.									
			Coelosphaerium	*Coelosphaerium* sp.									
			Merismopedia	*Merismopedia* sp.									
				Merismopedia tenuissima									
			Snowella	*Snowella lacustris*									

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	Goose	Goose	Goose	George	George	George	George	George	George
				Lake	Goose Tail	Goose Tail	Propellor	Lower Long	Fold	George Central	Dragon	Komatic	Reference C
				Replicate	1	1 DUP	1	1	1	1	1	1	1
				Lab Duplicate	no	yes	no	no	no	no	no	no	no
				Date Sampled	11-Apr-2012	11-Apr-2012	12-Apr-2012	13-Apr-2012	15-Apr-2012	13-Apr-2012	15-Aug-2012	13-Apr-2012	13-Apr-2012
Class	Order	Family	Genus	Sample ID	6138.4-6	6138.4-6-DUP	6138.4-1	6141.4-3	6141.4-5	6141.4-1	6141.4-6	6141.4-4	6141.4-2
			Woronichinia	*Woronichinia compacta*									
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa* sp.									
			Microcystis	*Microcystis aeruginosa*									
		Synechococcaceae	*Aphanothece*	*Aphanothece minutissima*									
				Aphanothece sp.			129.83						
			Rhabdoderma	*Rhabdoderma lineare*									
			Synechococcus	*Synechococcus* sp.									
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.									
			Nostoc	*Nostoc* sp.									
	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria* sp.									
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya* sp.			5.65						
			Planktolyngbya	*Planktolyngbya limnetica*				480.00					768.00
			Pseudanabaena	*Pseudanabaena galeata*									
				Pseudanabaena sp.									
Trebouxiophyceae	Prasiolales	Koliellaceae	*Koliella*	*Koliella longiseta*									
Xanthophyceae	Heterococcales	Sciadaceae	*Centritractus*	*Centritractus* sp.									
	Mischococcales	Characiopsidaceae	*Characiopsis*	*Characiopsis* sp.									
Undetermined	Undetermined	Katablepharidaceae	*Katablepharis*	*Katablepharis ovalis*									
		Undetermined	Undetermined	unknown Chlorophyte coccoid									
				Total	**70.17**	**80.47**	**169.19**	**689.00**	**342.10**	**44.10**	**478.80**	**995.80**	**825.70**

Note: George Central Rep 3 (ID 6141.4-9) contained too much detritus and silt for taxonomists to enumerate.

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Lake	Gander	Gander	Gander	Big	Big	Big	Rabbit	Rabbit	Rabbit	Rabbit
				Replicate	1	2	3	1	2	3	1	2	2-DUP	3
				Lab Duplicate	no	no	no	no	no	no	no	no	no	yes
				Date Sampled	18-Aug-2012	18-Aug-2012	18-Aug-2012	16-Aug-2012	16-Aug-2012	16-Aug-2012	15-Aug-2012	15-Aug-2012	15-Aug-2012	15-Aug-2012
Taxonomic Classification				Sample ID	6138.5-13	6138.5-14	6138.5-15	6138.5-7	6138.5-8	6138.5-9	6138.5-4	6138.5-5	6138.5-6	6138.5-5_DUP
Class	**Order**	**Family**	**Genus**	**Final Designation**										
Bacillariophyceae	Centrales	Stephanodiscaceae	*Cyclotella*	*Cyclotella* sp.	0.88			0.96	8.56	5.64		1.33	7.59	4.99
				Cyclotella sp. < 6µm										
				Cyclotella sp. 6-10 µm										
			Stephanodiscus	*Stephanodiscus* sp.										
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.	1.77	1.00	1.92	0.96				0.67	0.63	1.66
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.										
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.				0.96						0.83
		Bacillariaceae	*Nitzschia*	*Nitzschia* sp.	5.30	8.03	8.65	0.96	1.22	1.41				0.83
				Nitzschia spp.										
		Catenulaceae	*Amphora*	*Amphora* sp.										
		Cymbellaceae	*Cymbella*	*Cymbella* sp.	0.88									
		Diploneidaceae	*Diploneis*	*Diploneis* sp.										
		Eunotiaceae	*Eunotia*	*Eunotia* sp.				1.91						
		Fragilariaceae	*Fragilaria*	*Fragilaria* sp.		6.02	4.80							
			Synedra	*Synedra* sp.										
		Naviculaceae	*Navicula*	*Navicula* sp.	1.77	2.01	1.92	0.96	1.22	0.71		2.66	1.90	
		Pinnulariaceae	*Caloneis*	*Caloneis* sp.										
			Pinnularia	*Pinnularia biceps*	0.88			0.96						
				Pinnularia sp.	0.88	1.00								
		Pleurosigmataceae	*Pleurosigma*	*Pleurosigma* sp.										
		Rhopalodiaceae	*Epithemia*	*Epithemia* sp.										
		Stauroneidaceae	*Stauroneis*	*Stauroneis* sp.			0.96							
		Surirellaceae	*Surirella*	*Surirella* sp.										
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*			17.29							
				Tabellaria flocculosa										
				Tabellaria sp.	47.69	32.12	23.06	5.74	39.15	97.35	6.80	15.97	18.97	3.32
Chlorodendrophyceae	Chlorodendrales	Chlorodendraceae	*Tetraselmis*	*Tetraselmis* sp.					0.61					
Chlorophyceae	Chlorococcales	Chlorococcaceae	*Tetraedron*	*Tetraedron caudatum*					0.61					
				Tetraedron minimum										
				Tetraedron sp.	2.65	2.01		1.91	0.61	0.71				
		Hydrodictyaceae	*Pediastrum*	*Pediastrum* sp.	42.39	52.19	11.53							
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus* sp.			8.65							
			Botryococcus	*Botryococcus* sp.				53.62						
			Closteriopsis	*Closteriopsis acicularis*										
			Monoraphidium	*Monoraphidium arcuatum*										
				Monoraphidium contortum										
				Monoraphidium sp.	110.40	103.38	104.72	61.28	23.25	40.21	110.52	83.20	75.88	108.03
				Monoraphidium tortile										
			Oocystis	*Oocystis* sp.	8.83	14.05	10.57	61.28	24.47	26.10	5.95	7.32	6.32	9.97
			Quadrigula	*Quadrigula chodati*										
				Quadrigula closterioides										
		Scenedesmaceae	*Coelastrum*	*Coelastrum* sp.										
			Crucigenia	*Crucigenia* sp.			34.59	3.83	2.45	2.82				
			Crucigeniella	*Crucigeniella rectangularis*										
			Scenedesmus	*Scenedesmus bijuga*										
				Scenedesmus brasiliensis										
				Scenedesmus sp.	3.53	4.01				2.82				
	Sphaeropleales	Characiaceae	*Ankyra*	*Ankyra judayi*										
		Radiococcaceae	*Coenococcus*	*Coenococcus fottii*										
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*										
				Elakatothrix sp.	50.34	64.23	64.37	255.65	184.13	200.35	68.01	46.59	49.32	63.99
		Palmellaceae	*Gloeocystis*	*Gloeocystis gigas*										
			Sphaerocystis	*Sphaerocystis planctonica*	25.61	17.06		19.15	39.15	28.22	35.71	10.65	0.63	8.31
				Sphaerocystis sp.										

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification														
				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Lake	Gander	Gander	Gander	Big	Big	Big	Rabbit	Rabbit	Rabbit	Rabbit
				Replicate	1	2	3	1	2	3	1	2	2-DUP	3
				Lab Duplicate	no	no	no	no	no	no	no	no	no	yes
				Date Sampled	18-Aug-2012	18-Aug-2012	18-Aug-2012	16-Aug-2012	16-Aug-2012	16-Aug-2012	15-Aug-2012	15-Aug-2012	15-Aug-2012	15-Aug-2012
				Sample ID	6138.5-13	6138.5-14	6138.5-15	6138.5-7	6138.5-8	6138.5-9	6138.5-4	6138.5-5	6138.5-6	6138.5-5_DUP
Class	**Order**	**Family**	**Genus**	**Final Designation**										
	Volvocales	Chlamydomonadaceae	*Carteria*	*Carteria* sp.										
			Chlamydomonas	*Chlamydomonas* sp.	0.88	3.01	0.96							
	Zygnematales	Desmidiaceae	*Closterium*	*Closterium* sp.										
			Cosmarium	*Cosmarium* sp.	1.77	2.01								0.83
			Euastrum	*Euastrum* sp.	1.77			0.96				1.33	0.63	
			Spondylosium	*Spondylosium* sp.										
			Staurastrum	*Staurastrum* sp.			0.96	0.96	1.22					0.83
			Staurodesmus	*Staurodesmus* sp.	0.88	1.00	0.96		1.84	0.71				
			Teilingia	*Teilingia granulata*	5.30	1.00		12.45	8.56	9.88				
			Xanthidium	*Xanthidium* sp.		1.00								
		Mesotaeniaceae	*Gonatozygon*	*Gonatozygon* sp.										
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.		2.01	0.96	10.53	7.95	5.64	1.70	1.33	0.63	3.32
Chrysophyceae	Chromulinales	Chromulinaceae	*Chromulina*	*Chromulina* sp.										
			Kephyrion	*Kephyrion* sp.										
		Chrysocapsaceae	*Chrysocapsa*	*Chrysocapsa planktonica*										
				Chrysocapsa sp.										
	Chrysomonadales	Dinobryaceae	*Chrysococcus*	*Chrysococcus* sp.										
			Chrysolykos	*Chrysolykos planctonicus*										
			Dinobryon	*Dinobryon bavaricum*										
				Dinobryon divergens										
				Dinobryon sertularia										
				Dinobryon sociale										
				Dinobryon sp.	3.53	32.12	20.18	0.96	2.45		0.85	2.00	1.90	1.66
		Synuraceae	*Mallomonas*	*Mallomonas* sp.	1.77	1.00	0.96			0.71	0.85			
			Synura	*Synu* ra sp.										
	Hibberdiales	Stylococcaceae	*Diceras*	*Diceras* sp.										
	Ochromonadales	Ochromonadaceae	*Ochromonas*	*Ochromonas* sp.										
	Prymnesiales	Prymnesiaceae	*Chrysochromulina*	*Chrysochromulina parva*										
Cryptophyceae	Cryptomonadales	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.	7.95	9.03	9.61	3.83	5.51	2.82	85.87	65.23	66.39	80.61
				Cryptomonas spp.										
			Komma	*Komma caudata*										
	Pyrenomonadales	Pyrenomonadaceae	*Rhodomonas*	*Rhodomonas lacustris var. nannoplanctica*										
Cyanophyceae	Synechococcales	Synechococcaceae	*Cyanodictyon*	*Cyanodictyon* sp.										
Dinophyceae	Dinophysales	Amphisoleniaceae	*Dinophysis*	*Dinophysis* sp.										
	Gymnodiniales	Gymondiniaceae	*Gymnodinium*	*Gymnodinium* sp.										
	Peridiniales	Peridiniaceae	*Glenodinium*	*Glenodinium* sp.										
			Peridinium	*Peridinium* sp.	44.16	39.14	42.27	0.96	1.22	1.41	1.70	0.67	1.26	1.66
Euglenophyceae	Euglenales	Euglenaceae	*Euglena*	*Euglena* sp.										
			Lepocinclis	*Lepocinclis* sp.										
			Phacus	*Phacus* sp.	0.88		0.96	0.96	0.61					
			Trachelomonas	*Trachelomonas* sp.	0.88					0.71				
Myxophyceae	Chroococcales	Chroococcaceae	*Chroococcus*	*Chroococcus limneticus*										
				Chroococcus minimus										
				Chroococcus prescottii										
				Chroococcus sp.		4.01		15.32	29.36					
		Merismopediaceae	*Aphanocapsa*	*Aphanocapsa conferta*										
				Aphanocapsa holsatica										
				Aphanocapsa incerta										
				Aphanocapsa sp.				99.58	14.68	22.57		31.95	30.35	
			Coelomoron	*Coelomoron* sp.										
			Coelosphaerium	*Coelosphaerium* sp.				49.79	217.16	67.72	27.21	31.95	60.70	46.54
			Merismopedia	*Merismopedia* sp.	91.86	136.50	53.80	53.62	9.79	98.77	54.41			26.59
				Merismopedia tenuissima										
			Snowella	*Snowella lacustris*										

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Lake	Gander	Gander	Gander	Big	Big	Big	Rabbit	Rabbit	Rabbit	Rabbit
				Replicate	1	2	3	1	2	3	1	2	2-DUP	3
				Lab Duplicate	no	no	no	no	no	no	no	no	no	yes
				Date Sampled	18-Aug-2012	18-Aug-2012	18-Aug-2012	16-Aug-2012	16-Aug-2012	16-Aug-2012	15-Aug-2012	15-Aug-2012	15-Aug-2012	15-Aug-2012
Class	Order	Family	Genus	Sample ID / Final Designation	6138.5-13	6138.5-14	6138.5-15	6138.5-7	6138.5-8	6138.5-9	6138.5-4	6138.5-5	6138.5-6	6138.5-5_DUP
			Woronichinia	*Woronichinia compacta*										
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa* sp.										
			Microcystis	*Microcystis aeruginosa*								332.79	303.51	415.52
		Synechococcaceae	*Aphanothece*	*Aphanothece minutissima*										
				Aphanothece sp.							51.01			
			Rhabdoderma	*Rhabdoderma lineare*										
			Synechococcus	*Synechococcus* sp.										
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.	298.53	208.76	276.70	57.45	63.01	53.62	6.80	7.99	5.69	10.80
			Nostoc	*Nostoc* sp.						84.66	35.71			
	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria* sp.		58.21								
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya* sp.	88.32		125.86	1339.54	916.36	1193.65	737.09	260.91	281.38	624.94
			Planktolyngbya	*Planktolyngbya limnetica*										
			Pseudanabaena	*Pseudanabaena galeata*										
				Pseudanabaena sp.		80.29	47.08		19.58	8.47	52.71	10.65	10.75	41.55
Trebouxiophyceae	Prasiolales	Koliellaceae	*Koliella*	*Koliella longiseta*										
Xanthophyceae	Heterococcales	Sciadaceae	*Centritractus*	*Centritractus* sp.				0.96	0.61					
	Mischococcales	Characiopsidaceae	*Characiopsis*	*Characiopsis* sp.										
Undetermined	Undetermined	Katablepharidaceae	*Katablepharis*	*Katablepharis ovalis*										
		Undetermined	Undetermined	unknown Chlorophyte coccoid										
				Total	**852.31**	**886.23**	**874.31**	**2117.98**	**1625.35**	**1957.67**	**1282.89**	**915.18**	**924.43**	**1456.80**

Note: George Central Rep 3 (ID 6141.4-9) contained too much detritus and silt for taxonomists to enumerate.

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Lake	Fox	Fox	Fox	Giraffe South	Giraffe South	Giraffe South	Goose Neck	Goose Neck	Goose Neck
				Replicate	1	2	3	1	2	3	1	2	3
				Lab Duplicate	no	no	no	no	no	no	no	no	no
				Date Sampled	20-Aug-2012	20-Aug-2012	20-Aug-2012	19-Aug-2012	19-Aug-2012	19-Aug-2012	14-Aug-2012	14-Aug-2012	14-Aug-2012
				Sample ID	6138.5-19	6138.5-20	6138.5-21	6138.5-16	6138.5-17	6138.5-18	6138.5-1	6138.5-2	6138.5-3
Class	**Order**	**Family**	**Genus**	**Final Designation**									
Bacillariophyceae	Centrales	Stephanodiscaceae	*Cyclotella*	*Cyclotella* sp.	1.14	1.04				0.81	13.69	11.95	17.46
				Cyclotella sp. < 6µm									
				Cyclotella sp. 6-10 µm									
			Stephanodiscus	*Stephanodiscus* sp.									
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.	1.14			0.70	0.94				
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.									
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.									
		Bacillariaceae	*Nitzschia*	*Nitzschia* sp.	2.27	2.08	3.91	0.70	0.94	0.81	3.99	1.56	1.40
				Nitzschia spp.									
		Catenulaceae	*Amphora*	*Amphora* sp.									
		Cymbellaceae	*Cymbella*	*Cymbella* sp.									
		Diploneidaceae	*Diploneis*	*Diploneis* sp.									
		Eunotiaceae	*Eunotia*	*Eunotia* sp.		1.04				1.63			
		Fragilariaceae	*Fragilaria*	*Fragilaria* sp.									
			Synedra	*Synedra* sp.									
		Naviculaceae	*Navicula*	*Navicula* sp.	3.41	1.04	3.13		1.88	1.63	1.14	1.56	2.79
		Pinnulariaceae	*Caloneis*	*Caloneis* sp.									
			Pinnularia	*Pinnularia biceps*	1.14								0.70
				Pinnularia sp.		1.04		0.70					
		Pleurosigmataceae	*Pleurosigma*	*Pleurosigma* sp.								0.52	0.70
		Rhopalodiaceae	*Epithemia*	*Epithemia* sp.									
		Stauroneidaceae	*Stauroneis*	*Stauroneis* sp.			0.78						
		Surirellaceae	*Surirella*	*Surirella* sp.									
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*	3.41								
				Tabellaria flocculosa									
				Tabellaria sp.	38.61	109.07	101.77		16.91	58.53	141.48	178.78	166.25
Chlorodendrophyceae	Chlorodendrales	Chlorodendraceae	*Tetraselmis*	*Tetraselmis* sp.									
Chlorophyceae	Chlorococcales	Chlorococcaceae	*Tetraedron*	*Tetraedron caudatum*									
				Tetraedron minimum									
				Tetraedron sp.	1.14		0.78		0.94	0.81	0.57	0.52	
		Hydrodictyaceae	*Pediastrum*	*Pediastrum* sp.									
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus* sp.					1.88				
			Botryococcus	*Botryococcus* sp.							11.41		
			Closteriopsis	*Closteriopsis acicularis*									
			Monoraphidium	*Monoraphidium arcuatum*									
				Monoraphidium contortum									
				Monoraphidium sp.	228.25	186.98	109.60	134.19	170.98	116.25	49.06	46.77	47.50
				Monoraphidium tortile									
			Oocystis	*Oocystis* sp.	2.27	9.35	3.13	5.62	5.64	7.32	19.40	25.99	40.52
			Quadrigula	*Quadrigula chodati*									
				Quadrigula closterioides									
		Scenedesmaceae	*Coelastrum*	*Coelastrum* sp.									
			Crucigenia	*Crucigenia* sp.									
			Crucigeniella	*Crucigeniella rectangularis*			72.02	12.65	93.00	22.76			
			Scenedesmus	*Scenedesmus bijuga*									
				Scenedesmus brasiliensis									
				Scenedesmus sp.			3.13						
	Sphaeropleales	Characiaceae	*Ankyra*	*Ankyra judayi*									
		Radiococcaceae	*Coenococcus*	*Coenococcus fottii*									
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*									
				Elakatothrix sp.	11.36	16.62	14.09	131.38	121.19	121.95	63.33	60.29	64.97
		Palmellaceae	*Gloeocystis*	*Gloeocystis gigas*									
			Sphaerocystis	*Sphaerocystis planctonica*		8.31	3.13	11.24	7.52		36.51	21.31	27.94
				Sphaerocystis sp.						4.88			

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification													
				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Lake	Fox	Fox	Fox	Giraffe South	Giraffe South	Giraffe South	Goose Neck	Goose Neck	Goose Neck
				Replicate	1	2	3	1	2	3	1	2	3
				Lab Duplicate	no	no	no	no	no	no	no	no	no
				Date Sampled	20-Aug-2012	20-Aug-2012	20-Aug-2012	19-Aug-2012	19-Aug-2012	19-Aug-2012	14-Aug-2012	14-Aug-2012	14-Aug-2012
				Sample ID	6138.5-19	6138.5-20	6138.5-21	6138.5-16	6138.5-17	6138.5-18	6138.5-1	6138.5-2	6138.5-3
Class	**Order**	**Family**	**Genus**	**Final Designation**									
	Volvocales	Chlamydomonadaceae	*Carteria*	*Carteria* sp.									
			Chlamydomonas	*Chlamydomonas* sp.		1.04		0.70		0.81			
	Zygnematales	Desmidiaceae	*Closterium*	*Closterium* sp.									
			Cosmarium	*Cosmarium* sp.	1.14		0.78		0.94		0.57		
			Euastrum	*Euastrum* sp.					0.94			0.52	0.70
			Spondylosium	*Spondylosium* sp.									
			Staurastrum	*Staurastrum* sp.							0.57		0.70
			Staurodesmus	*Staurodesmus* sp.	1.14	2.08	1.57		0.94		0.57	1.04	2.10
			Teilingia	*Teilingia granulata*	2.27	7.27	5.48	3.51	2.82	4.06	4.56	1.56	4.89
			Xanthidium	*Xanthidium* sp.	1.14				0.94	0.81			0.70
		Mesotaeniaceae	*Gonatozygon*	*Gonatozygon* sp.	1.14								
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.	1.14	1.04			0.94	0.81	0.57		2.79
Chrysophyceae	Chromulinales	Chromulinaceae	*Chromulina*	*Chromulina* sp.									
			Kephyrion	*Kephyrion* sp.									
		Chrysocapsaceae	*Chrysocapsa*	*Chrysocapsa planktonica*									
				Chrysocapsa sp.									
	Chrysomonadales	Dinobryaceae	*Chrysococcus*	*Chrysococcus* sp.									
			Chrysolykos	*Chrysolykos planctonicus*									
			Dinobryon	*Dinobryon bavaricum*									
				Dinobryon divergens									
				Dinobryon sertularia									
				Dinobryon sociale									
				Dinobryon sp.	42.02	50.90	54.02	3.51	4.70	8.13	3.42	4.16	1.40
		Synuraceae	*Mallomonas*	*Mallomonas* sp.	1.14	1.04	1.57	2.81	0.94	3.25	1.14	1.04	4.19
			Synura	*Synu* ra sp.									
	Hibberdiales	Stylococcaceae	*Diceras*	*Diceras* sp.									
	Ochromonadales	Ochromonadaceae	*Ochromonas*	*Ochromonas* sp.									
	Prymnesiales	Prymnesiaceae	*Chrysochromulina*	*Chrysochromulina parva*									
Cryptophyceae	Cryptomonadales	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.	32.93	45.71	31.31	14.05	6.58	17.07	43.93	31.18	47.50
				Cryptomonas spp.									
			Komma	*Komma caudata*	1.14			0.70	0.94	1.63	1.71	4.16	4.89
	Pyrenomonadales	Pyrenomonadaceae	*Rhodomonas*	*Rhodomonas lacustris var. nannoplanctica*									
Cyanophyceae	Synechococcales	Synechococcaceae	*Cyanodictyon*	*Cyanodictyon* sp.									
Dinophyceae	Dinophysales	Amphisoleniaceae	*Dinophysis*	*Dinophysis* sp.									
	Gymnodiniales	Gymondiniaceae	*Gymnodinium*	*Gymnodinium* sp.									
	Peridiniales	Peridiniaceae	*Glenodinium*	*Glenodinium* sp.									
			Peridinium	*Peridinium* sp.	7.95	3.12	7.83		2.82	0.81	2.85	2.08	0.70
Euglenophyceae	Euglenales	Euglenaceae	*Euglena*	*Euglena* sp.									
			Lepocinclis	*Lepocinclis* sp.									
			Phacus	*Phacus* sp.	1.14			0.70	0.94		1.71	1.04	1.40
			Trachelomonas	*Trachelomonas* sp.							0.57		0.70
Myxophyceae	Chroococcales	Chroococcaceae	*Chroococcus*	*Chroococcus limneticus*									
				Chroococcus minimus									
				Chroococcus prescottii									
				Chroococcus sp.		8.31		5.62	1.88	29.27			5.59
		Merismopediaceae	*Aphanocapsa*	*Aphanocapsa conferta*									
				Aphanocapsa holsatica									
				Aphanocapsa incerta									
				Aphanocapsa sp.	9.08								
			Coelomoron	*Coelomoron* sp.									
			Coelosphaerium	*Coelosphaerium* sp.	18.17	45.71		191.10	266.80	243.89	36.51	16.63	33.53
			Merismopedia	*Merismopedia* sp.			75.15	562.05	232.98	347.14	241.89	93.55	69.85
				Merismopedia tenuissima									
			Snowella	*Snowella lacustris*									

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Lake	Fox	Fox	Fox	Giraffe South	Giraffe South	Giraffe South	Goose Neck	Goose Neck	Goose Neck
				Replicate	1	2	3	1	2	3	1	2	3
				Lab Duplicate	no	no	no	no	no	no	no	no	no
				Date Sampled	20-Aug-2012	20-Aug-2012	20-Aug-2012	19-Aug-2012	19-Aug-2012	19-Aug-2012	14-Aug-2012	14-Aug-2012	14-Aug-2012
Class	Order	Family	Genus	Sample ID / Final Designation	6138.5-19	6138.5-20	6138.5-21	6138.5-16	6138.5-17	6138.5-18	6138.5-1	6138.5-2	6138.5-3
			Woronichinia	*Woronichinia compacta*									
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa* sp.									
			Microcystis	*Microcystis aeruginosa*									
		Synechococcaceae	*Aphanothece*	*Aphanothece minutissima*									
				Aphanothece sp.								50.93	75.44
			Rhabdoderma	*Rhabdoderma lineare*									
			Synechococcus	*Synechococcus* sp.									
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.	43.15	9.35	38.36	6.32	11.27	46.34	5.71	4.68	12.57
			Nostoc	*Nostoc* sp.									
	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria* sp.									
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya* sp.				288.05	146.55	595.90	90.71	219.84	412.14
			Planktolyngbya	*Planktolyngbya limnetica*									
			Pseudanabaena	*Pseudanabaena galeata*									
				Pseudanabaena sp.									
Trebouxiophyceae	Prasiolales	Koliellaceae	*Koliella*	*Koliella longiseta*									
Xanthophyceae	Heterococcales	Sciadaceae	*Centritractus*	*Centritractus* sp.				1.41	0.94	1.63	1.71	1.04	
	Mischococcales	Characiopsidaceae	*Characiopsis*	*Characiopsis* sp.									
Undetermined	Undetermined	Katablepharidaceae	*Katablepharis*	*Katablepharis ovalis*									
		Undetermined	Undetermined	unknown Chlorophyte coccoid									
				Total	**458.77**	**512.12**	**531.56**	**1377.73**	**1106.65**	**1638.94**	**779.31**	**782.68**	**1052.02**

Note: George Central Rep 3 (ID 6141.4-9) contained too much detritus and silt for taxonomists to enumerate.

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	George	George	George	George	George	George
				Lake	Goose Central	Goose Central	Goose Central	Goose Central	Lower Long	Lower Long	Lower Long	Fold	Fold	Fold
				Replicate	1	2	2 DUP	3	1	2	3	1	2	3
				Lab Duplicate	no	no	yes	no	no	no	no	no	no	no
				Date Sampled	17-Aug-2012	17-Aug-2012	17-Aug-2012	17-Aug-2012	21-Aug-2012	21-Aug-2012	21-Aug-2012	19-Aug-2012	19-Aug-2012	19-Aug-2012
Class	Order	Family	Genus	Sample ID / Final Designation	6138.5-10	6138.5-11	6138.5-11_DUP	6138.5-12	6141.4-19	6141.4-20	6141.4-21	6141.4-10	6141.4-11	6141.4-12
Bacillariophyceae	Centrales	Stephanodiscaceae	*Cyclotella*	*Cyclotella* sp.	8.58	8.32	2.90	3.40				14.00	31.00	32.00
				Cyclotella sp. < 6µm					2.00	9.00	43.00	51.00		102.00
				Cyclotella sp. 6-10 µm										
			Stephanodiscus	*Stephanodiscus* sp.										0.50
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.										
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.					4.00		6.00		61.20	22.00
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.		0.59	0.58							
		Bacillariaceae	*Nitzschia*	*Nitzschia* sp.	4.57	5.95	5.22	8.17						
				Nitzschia spp.										
		Catenulaceae	*Amphora*	*Amphora* sp.								30.00	30.00	66.00
		Cymbellaceae	*Cymbella*	*Cymbella* sp.				0.68						
		Diploneidaceae	*Diploneis*	*Diploneis* sp.	0.57									
		Eunotiaceae	*Eunotia*	*Eunotia* sp.										
		Fragilariaceae	*Fragilaria*	*Fragilaria* sp.		3.57	1.16	25.87						
			Synedra	*Synedra* sp.					1.50	0.50	1.00		0.50	
		Naviculaceae	*Navicula*	*Navicula* sp.	1.14			2.04						
		Pinnulariaceae	*Caloneis*	*Caloneis* sp.										
			Pinnularia	*Pinnularia biceps*										
				Pinnularia sp.	0.57									
		Pleurosigmataceae	*Pleurosigma*	*Pleurosigma* sp.										
		Rhopalodiaceae	*Epithemia*	*Epithemia* sp.										
		Stauroneidaceae	*Stauroneis*	*Stauroneis* sp.										
		Surirellaceae	*Surirella*	*Surirella* sp.										
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*										
				Tabellaria flocculosa					5.00					
				Tabellaria sp.	456.22	160.54	255.15	397.54						
Chlorodendrophyceae	Chlorodendrales	Chlorodendraceae	*Tetraselmis*	*Tetraselmis* sp.				0.68						
Chlorophyceae	Chlorococcales	Chlorococcaceae	*Tetraedron*	*Tetraedron caudatum*										
				Tetraedron minimum										
				Tetraedron sp.					12.00	20.40	2.00			
		Hydrodictyaceae	*Pediastrum*	*Pediastrum* sp.										
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus* sp.										
			Botryococcus	*Botryococcus* sp.										
			Closteriopsis	*Closteriopsis acicularis*					7.00	3.00	3.00			
			Monoraphidium	*Monoraphidium arcuatum*										
				Monoraphidium contortum										
				Monoraphidium sp.	38.30	42.81	40.59	38.12						
				Monoraphidium tortile										
			Oocystis	*Oocystis* sp.	31.44	24.97	23.20	25.87					13.00	
			Quadrigula	*Quadrigula chodati*							0.50			
				Quadrigula closterioides					15.50	42.00	14.50			
		Scenedesmaceae	*Coelastrum*	*Coelastrum* sp.										
			Crucigenia	*Crucigenia* sp.										
			Crucigeniella	*Crucigeniella rectangularis*										
			Scenedesmus	*Scenedesmus bijuga*							4.00		2.00	
				Scenedesmus brasiliensis										
				Scenedesmus sp.										
	Sphaeropleales	Characiaceae	*Ankyra*	*Ankyra judayi*										
		Radiococcaceae	*Coenococcus*	*Coenococcus fottii*										
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*					4.00	16.00	4.00	28.00	35.00	74.00
				Elakatothrix sp.	81.18	101.67	95.68	113.00						
		Palmellaceae	*Gloeocystis*	*Gloeocystis gigas*										8.00
			Sphaerocystis	*Sphaerocystis planctonica*	7.43	11.89	9.28	1.36						
				Sphaerocystis sp.										

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification																
Class	Order	Family	Genus	Final Designation	Area	Goose	Goose	Goose	Goose	George	George	George	George	George	George
					Lake	Goose Central	Goose Central	Goose Central	Goose Central	Lower Long	Lower Long	Lower Long	Fold	Fold	Fold
					Replicate	1	2	2 DUP	3	1	2	3	1	2	3
					Lab Duplicate	no	no	yes	no	no	no	no	no	no	no
					Date Sampled	17-Aug-2012	17-Aug-2012	17-Aug-2012	17-Aug-2012	21-Aug-2012	21-Aug-2012	21-Aug-2012	19-Aug-2012	19-Aug-2012	19-Aug-2012
					Sample ID	6138.5-10	6138.5-11	6138.5-11_DUP	6138.5-12	6141.4-19	6141.4-20	6141.4-21	6141.4-10	6141.4-11	6141.4-12
	Volvocales	Chlamydomonadaceae	*Carteria*	*Carteria* sp.											
			Chlamydomonas	*Chlamydomonas* sp.		0.59	0.58								
	Zygnematales	Desmidiaceae	*Closterium*	*Closterium* sp.											
			Cosmarium	*Cosmarium* sp.					0.50	2.00	3.00				
			Euastrum	*Euastrum* sp.		0.59	0.58	0.68							
			Spondylosium	*Spondylosium* sp.											
			Staurastrum	*Staurastrum* sp.	0.57			0.68							
			Staurodesmus	*Staurodesmus* sp.	0.57	0.59	1.74	3.40		0.50					
			Teilingia	*Teilingia granulata*	4.00	8.32	2.32	3.40							
			Xanthidium	*Xanthidium* sp.		0.59	0.58	1.36							
		Mesotaeniaceae	*Gonatozygon*	*Gonatozygon* sp.				0.68							
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.	1.14			2.04							
Chrysophyceae	Chromulinales	Chromulinaceae	*Chromulina*	*Chromulina* sp.								112.20	51.00	15.30	
			Kephyrion	*Kephyrion* sp.								30.60	20.40	76.50	
		Chrysocapsaceae	*Chrysocapsa*	*Chrysocapsa planktonica*					52.00	5.50					
				Chrysocapsa sp.					16.00	16.00	105.00				
	Chrysomonadales	Dinobryaceae	*Chrysococcus*	*Chrysococcus* sp.											
			Chrysolykos	*Chrysolykos planctonicus*											
			Dinobryon	*Dinobryon bavaricum*						1.00					
				Dinobryon divergens								224.00	154.50	189.00	
				Dinobryon sertularia											
				Dinobryon sociale					1.00		3.50				
				Dinobryon sp.	7.43	5.95	5.80	7.49							
		Synuraceae	*Mallomonas*	*Mallomonas* sp.	3.43	4.16	4.06	4.76							
			Synura	*Synu* ra sp.							8.50				
	Hibberdiales	Stylococcaceae	*Diceras*	*Diceras* sp.											5.10
	Ochromonadales	Ochromonadaceae	*Ochromonas*	*Ochromonas* sp.					61.20	13.00	69.00	8.00	8.00	18.00	
	Prymnesiales	Prymnesiaceae	*Chrysochromulina*	*Chrysochromulina parva*					20.40	51.00		20.40	10.20		
Cryptophyceae	Cryptomonadales	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.	5.15	13.68	12.76	16.34							
				Cryptomonas spp.					5.00	1.50	4.00	14.00	2.00	0.50	
			Komma	*Komma caudata*				0.68							
	Pyrenomonadales	Pyrenomonadaceae	*Rhodomonas*	*Rhodomonas lacustris var. nannoplanctica*					13.00	8.00		14.00	9.00	22.00	
Cyanophyceae	Synechococcales	Synechococcaceae	*Cyanodictyon*	*Cyanodictyon* sp.											4400.00
Dinophyceae	Dinophysales	Amphisoleniaceae	*Dinophysis*	*Dinophysis* sp.											
	Gymnodiniales	Gymondiniaceae	*Gymnodinium*	*Gymnodinium* sp.					7.00	1.50	7.00	8.00	1.00		
	Peridiniales	Peridiniaceae	*Glenodinium*	*Glenodinium* sp.											
			Peridinium	*Peridinium* sp.	1.14	1.19	1.74	2.72							
Euglenophyceae	Euglenales	Euglenaceae	*Euglena*	*Euglena* sp.											
			Lepocinclis	*Lepocinclis* sp.											
			Phacus	*Phacus* sp.	2.86	0.59	1.16	2.04							
			Trachelomonas	*Trachelomonas* sp.		0.59	0.58								
Myxophyceae	Chroococcales	Chroococcaceae	*Chroococcus*	*Chroococcus limneticus*					32.00	16.00					
				Chroococcus minimus											
				Chroococcus prescottii											
				Chroococcus sp.	19.44	9.51	9.28	5.45							
		Merismopediaceae	*Aphanocapsa*	*Aphanocapsa conferta*					794.50	130.00					
				Aphanocapsa holsatica								1000.00	1100.00		
				Aphanocapsa incerta								3060.00	500.00		
				Aphanocapsa sp.		35.67	0.58				158.10		45.90	35.70	
			Coelomoron	*Coelomoron* sp.											
			Coelosphaerium	*Coelosphaerium* sp.	80.04	158.16	208.76	49.01							
			Merismopedia	*Merismopedia* sp.	187.52	107.02	115.98	182.43							
				Merismopedia tenuissima							48.00				
			Snowella	*Snowella lacustris*					8.00	64.00	32.00				

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	George	George	George	George	George	George
				Lake	Goose Central	Goose Central	Goose Central	Goose Central	Lower Long	Lower Long	Lower Long	Fold	Fold	Fold
				Replicate	1	2	2 DUP	3	1	2	3	1	2	3
				Lab Duplicate	no	no	yes	no	no	no	no	no	no	no
				Date Sampled	17-Aug-2012	17-Aug-2012	17-Aug-2012	17-Aug-2012	21-Aug-2012	21-Aug-2012	21-Aug-2012	19-Aug-2012	19-Aug-2012	19-Aug-2012
Class	Order	Family	Genus	Sample ID / Final Designation	6138.5-10	6138.5-11	6138.5-11_DUP	6138.5-12	6141.4-19	6141.4-20	6141.4-21	6141.4-10	6141.4-11	6141.4-12
			Woronichinia	*Woronichinia compacta*							72.00			
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa* sp.										
			Microcystis	*Microcystis aeruginosa*										
		Synechococcaceae	*Aphanothece*	*Aphanothece minutissima*										
				Aphanothece sp.										
			Rhabdoderma	*Rhabdoderma lineare*							7.00			
			Synechococcus	*Synechococcus* sp.					45.90					
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.	8.58	29.13	12.76	29.27						
			Nostoc	*Nostoc* sp.										
	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria* sp.		10.70	9.86							
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya* sp.	772.95	581.49	507.99	524.83						
			Planktolyngbya	*Planktolyngbya limnetica*										
			Pseudanabaena	*Pseudanabaena galeata*										
				Pseudanabaena sp.	21.15	8.32	12.76	21.78						
Trebouxiophyceae	Prasiolales	Koliellaceae	*Koliella*	*Koliella longiseta*										
Xanthophyceae	Heterococcales	Sciadaceae	*Centritractus*	*Centritractus* sp.		0.59	0.58							
	Mischococcales	Characiopsidaceae	*Characiopsis*	*Characiopsis* sp.										
Undetermined	Undetermined	Katablepharidaceae	*Katablepharis*	*Katablepharis ovalis*										
		Undetermined	Undetermined	unknown Chlorophyte coccoid										
				Total	**1745.99**	**1337.79**	**1344.19**	**1475.79**	**1107.50**	**400.90**	**595.10**	**4614.20**	**2074.70**	**5066.60**

Note: George Central Rep 3 (ID 6141.4-9) contained too much detritus and silt for taxonomists to enumerate.

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	George	George	George	George	George	George	George	George	George
				Lake	George Central	George Central	Lytle	Lytle	Lytle	Lytle	Occurrence	Occurrence	Occurrence
				Replicate	1	2	1	2	2 DUP	3	1	2	3
				Lab Duplicate	no	no	no	no	yes	no	no	no	no
				Date Sampled	18-Aug-2012	18-Aug-2012	23-Aug-2012	23-Aug-2012	23-Aug-2012	23-Aug-2012	21-Aug-2012	21-Aug-2012	21-Aug-2012
				Sample ID	6141.4-7	6141.4-8	6141.4-31	6141.4-32	6141.4-32_DUP	6141.4-33	6141.4-22	6141.4-23	6141.4-24
Class	**Order**	**Family**	**Genus**	**Final Designation**									
Bacillariophyceae	Centrales	Stephanodiscaceae	*Cyclotella*	*Cyclotella* sp.	96.00								
				Cyclotella sp. < 6µm	30.60	164.00							3.00
				Cyclotella sp. 6-10 µm									
			Stephanodiscus	*Stephanodiscus* sp.									
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.									
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.		2.00	5.00	3.00	4.00			5.10	
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.									
		Bacillariaceae	*Nitzschia*	*Nitzschia* sp.									
				Nitzschia spp.									
		Catenulaceae	*Amphora*	*Amphora* sp.		10.00							
		Cymbellaceae	*Cymbella*	*Cymbella* sp.							2.00		
		Diploneidaceae	*Diploneis*	*Diploneis* sp.									
		Eunotiaceae	*Eunotia*	*Eunotia* sp.									
		Fragilariaceae	*Fragilaria*	*Fragilaria* sp.									
			Synedra	*Synedra* sp.	1.50	2.50				0.50			
		Naviculaceae	*Navicula*	*Navicula* sp.						2.00			
		Pinnulariaceae	*Caloneis*	*Caloneis* sp.									
			Pinnularia	*Pinnularia biceps*									
				Pinnularia sp.									
		Pleurosigmataceae	*Pleurosigma*	*Pleurosigma* sp.									
		Rhopalodiaceae	*Epithemia*	*Epithemia* sp.									
		Stauroneidaceae	*Stauroneis*	*Stauroneis* sp.									
		Surirellaceae	*Surirella*	*Surirella* sp.									
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*									
				Tabellaria flocculosa							4.00		1.00
				Tabellaria sp.									
Chlorodendrophyceae	Chlorodendrales	Chlorodendraceae	*Tetraselmis*	*Tetraselmis* sp.									
Chlorophyceae	Chlorococcales	Chlorococcaceae	*Tetraedron*	*Tetraedron caudatum*									
				Tetraedron minimum									
				Tetraedron sp.	16.00	20.00	3.00	3.00	3.00				
		Hydrodictyaceae	*Pediastrum*	*Pediastrum* sp.									
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus* sp.									
			Botryococcus	*Botryococcus* sp.									
			Closteriopsis	*Closteriopsis acicularis*									
			Monoraphidium	*Monoraphidium arcuatum*									
				Monoraphidium contortum									
				Monoraphidium sp.									
				Monoraphidium tortile	1.00								
			Oocystis	*Oocystis* sp.		1.00							
			Quadrigula	*Quadrigula chodati*									
				Quadrigula closterioides									
		Scenedesmaceae	*Coelastrum*	*Coelastrum* sp.									
			Crucigenia	*Crucigenia* sp.									
			Crucigeniella	*Crucigeniella rectangularis*									
			Scenedesmus	*Scenedesmus bijuga*									
				Scenedesmus brasiliensis			4.00						
				Scenedesmus sp.									
	Sphaeropleales	Characiaceae	*Ankyra*	*Ankyra judayi*	1.00								
		Radiococcaceae	*Coenococcus*	*Coenococcus fottii*									
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*		1.50							
				Elakatothrix sp.									
		Palmellaceae	*Gloeocystis*	*Gloeocystis gigas*						0.50			
			Sphaerocystis	*Sphaerocystis planctonica*									
				Sphaerocystis sp.									

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	George	George	George	George	George	George	George	George	George
				Lake	George Central	George Central	Lytle	Lytle	Lytle	Lytle	Occurrence	Occurrence	Occurrence
				Replicate	1	2	1	2	2 DUP	3	1	2	3
				Lab Duplicate	no	no	no	no	yes	no	no	no	no
				Date Sampled	18-Aug-2012	18-Aug-2012	23-Aug-2012	23-Aug-2012	23-Aug-2012	23-Aug-2012	21-Aug-2012	21-Aug-2012	21-Aug-2012
				Sample ID	6141.4-7	6141.4-8	6141.4-31	6141.4-32	6141.4-32_DUP	6141.4-33	6141.4-22	6141.4-23	6141.4-24
Class	**Order**	**Family**	**Genus**	**Final Designation**									
	Volvocales	Chlamydomonadaceae	*Carteria*	*Carteria* sp.									
			Chlamydomonas	*Chlamydomonas* sp.									
	Zygnematales	Desmidiaceae	*Closterium*	*Closterium* sp.									
			Cosmarium	*Cosmarium* sp.						2.00			
			Euastrum	*Euastrum* sp.								1.00	
			Spondylosium	*Spondylosium* sp.									
			Staurastrum	*Staurastrum* sp.									
			Staurodesmus	*Staurodesmus* sp.									
			Teilingia	*Teilingia granulata*									
			Xanthidium	*Xanthidium* sp.									
		Mesotaeniaceae	*Gonatozygon*	*Gonatozygon* sp.									
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.									
Chrysophyceae	Chromulinales	Chromulinaceae	*Chromulina*	*Chromulina* sp.	20.40	45.90							
			Kephyrion	*Kephyrion* sp.		56.10	30.60	20.40	30.60	35.70	15.30	56.10	51.00
		Chrysocapsaceae	*Chrysocapsa*	*Chrysocapsa planktonica*									
				Chrysocapsa sp.									
	Chrysomonadales	Dinobryaceae	*Chrysococcus*	*Chrysococcus* sp.									
			Chrysolykos	*Chrysolykos planctonicus*		5.10							
			Dinobryon	*Dinobryon bavaricum*									
				Dinobryon divergens									
				Dinobryon sertularia	16.50	46.00							
				Dinobryon sociale			2.50	0.50	3.50	4.00			
				Dinobryon sp.									
		Synuraceae	*Mallomonas*	*Mallomonas* sp.									
			Synura	*Synu* ra sp.									
	Hibberdiales	Stylococcaceae	*Diceras*	*Diceras* sp.	1.00	5.00					4.00		
	Ochromonadales	Ochromonadaceae	*Ochromonas*	*Ochromonas* sp.	51.00	52.00					15.30		66.30
	Prymnesiales	Prymnesiaceae	*Chrysochromulina*	*Chrysochromulina parva*	10.20	25.50							10.20
Cryptophyceae	Cryptomonadales	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.									
				Cryptomonas spp.	1.00	12.00	4.50	9.00	10.50	7.00	9.50	12.00	12.50
			Komma	*Komma caudata*									
	Pyrenomonadales	Pyrenomonadaceae	*Rhodomonas*	*Rhodomonas lacustris var. nannoplanctica*	2.00	5.00	23.00	41.00	44.00	15.00	62.00	54.00	59.00
Cyanophyceae	Synechococcales	Synechococcaceae	*Cyanodictyon*	*Cyanodictyon* sp.									
Dinophyceae	Dinophysales	Amphisoleniaceae	*Dinophysis*	*Dinophysis* sp.									
	Gymnodiniales	Gymondiniaceae	*Gymnodinium*	*Gymnodinium* sp.	3.00	2.50						5.00	0.50
	Peridiniales	Peridiniaceae	*Glenodinium*	*Glenodinium* sp.	1.00		1.00	0.50	0.50	1.00	4.00		
			Peridinium	*Peridinium* sp.									
Euglenophyceae	Euglenales	Euglenaceae	*Euglena*	*Euglena* sp.									
			Lepocinclis	*Lepocinclis* sp.									
			Phacus	*Phacus* sp.									
			Trachelomonas	*Trachelomonas* sp.									
Myxophyceae	Chroococcales	Chroococcaceae	*Chroococcus*	*Chroococcus limneticus*									
				Chroococcus minimus								117.30	
				Chroococcus prescottii						24.00			
				Chroococcus sp.									
		Merismopediaceae	*Aphanocapsa*	*Aphanocapsa conferta*									
				Aphanocapsa holsatica		2399.00							
				Aphanocapsa incerta									
				Aphanocapsa sp.	357.00								
			Coelomoron	*Coelomoron* sp.	100.00								
			Coelosphaerium	*Coelosphaerium* sp.									
			Merismopedia	*Merismopedia* sp.								48.00	16.00
				Merismopedia tenuissima									
			Snowella	*Snowella lacustris*									

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	George	George	George	George	George	George	George	George	George
				Lake	George Central	George Central	Lytle	Lytle	Lytle	Lytle	Occurrence	Occurrence	Occurrence
				Replicate	1	2	1	2	2 DUP	3	1	2	3
				Lab Duplicate	no	no	no	no	yes	no	no	no	no
				Date Sampled	18-Aug-2012	18-Aug-2012	23-Aug-2012	23-Aug-2012	23-Aug-2012	23-Aug-2012	21-Aug-2012	21-Aug-2012	21-Aug-2012
Class	Order	Family	Genus	Sample ID / Final Designation	6141.4-7	6141.4-8	6141.4-31	6141.4-32	6141.4-32_DUP	6141.4-33	6141.4-22	6141.4-23	6141.4-24
			Woronichinia	*Woronichinia compacta*		98.00							
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa* sp.									
			Microcystis	*Microcystis aeruginosa*									
		Synechococcaceae	*Aphanothece*	*Aphanothece minutissima*	5500.00								
				Aphanothece sp.									
			Rhabdoderma	*Rhabdoderma lineare*									
			Synechococcus	*Synechococcus* sp.	56.10								
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.									
			Nostoc	*Nostoc* sp.									
	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria* sp.									
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya* sp.									
			Planktolyngbya	*Planktolyngbya limnetica*									
			Pseudanabaena	*Pseudanabaena galeata*								15.00	6.00
				Pseudanabaena sp.									
Trebouxiophyceae	Prasiolales	Koliellaceae	*Koliella*	*Koliella longiseta*									
Xanthophyceae	Heterococcales	Sciadaceae	*Centritractus*	*Centritractus* sp.									
	Mischococcales	Characiopsidaceae	*Characiopsis*	*Characiopsis* sp.									
Undetermined	Undetermined	Katablepharidaceae	*Katablepharis*	*Katablepharis ovalis*			3.00	3.00	5.00			6.00	11.00
		Undetermined	Undetermined	unknown Chlorophyte coccoid									
				Total	**6265.30**	**2953.10**	**76.60**	**80.40**	**101.10**	**91.70**	**116.10**	**319.50**	**236.50**

Note: George Central Rep 3 (ID 6141.4-9) contained too much detritus and silt for taxonomists to enumerate.

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification															
				Area	George	George	George	George	George	George	George	George	George	George
				Lake	Sleigh	Sleigh	Sleigh	Sleigh	Dragon	Dragon	Dragon	Komatic	Komatic	Komatic
				Replicate	1	1 DUP	2	3	1	2	3	1	2	3
				Lab Duplicate	no	yes	no	no	no	no	no	no	no	no
				Date Sampled	22-Aug-2012	22-Aug-2012	22-Aug-2012	22-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012
Class	Order	Family	Genus	Sample ID / Final Designation	6141.4-28	6141.4-28_DUP	6141.4-29	6141.4-30	6141.4-13	6141.4-14	6141.4-15	6141.4-16	6141.4-17	6141.4-18
Bacillariophyceae	Centrales	Stephanodiscaceae	*Cyclotella*	*Cyclotella* sp.					26.00					
				Cyclotella sp. < 6µm					153.00	87.00	119.00	12.00	15.00	15.30
				Cyclotella sp. 6-10 µm										
			Stephanodiscus	*Stephanodiscus* sp.										
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.										
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.			1.00	3.00			3.00	6.00		
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.										
		Bacillariaceae	*Nitzschia*	*Nitzschia* sp.										
				Nitzschia spp.				1.00						
		Catenulaceae	*Amphora*	*Amphora* sp.										
		Cymbellaceae	*Cymbella*	*Cymbella* sp.										
		Diploneidaceae	*Diploneis*	*Diploneis* sp.										
		Eunotiaceae	*Eunotia*	*Eunotia* sp.							5.00	2.00		
		Fragilariaceae	*Fragilaria*	*Fragilaria* sp.										
			Synedra	*Synedra* sp.					2.50	1.00	3.50		3.00	
		Naviculaceae	*Navicula*	*Navicula* sp.			1.00	2.00		1.00		1.00	1.00	0.50
		Pinnulariaceae	*Caloneis*	*Caloneis* sp.										
			Pinnularia	*Pinnularia biceps*										
				Pinnularia sp.										
		Pleurosigmataceae	*Pleurosigma*	*Pleurosigma* sp.										
		Rhopalodiaceae	*Epithemia*	*Epithemia* sp.										
		Stauroneidaceae	*Stauroneis*	*Stauroneis* sp.										
		Surirellaceae	*Surirella*	*Surirella* sp.										
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*										
				Tabellaria flocculosa				0.50		1.00		1.50	1.50	
				Tabellaria sp.										
Chlorodendrophyceae	Chlorodendrales	Chlorodendraceae	*Tetraselmis*	*Tetraselmis* sp.										
Chlorophyceae	Chlorococcales	Chlorococcaceae	*Tetraedron*	*Tetraedron caudatum*										
				Tetraedron minimum	2.00							5.10		
				Tetraedron sp.		2.00				5.00	4.00			
		Hydrodictyaceae	*Pediastrum*	*Pediastrum* sp.										
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus* sp.										
			Botryococcus	*Botryococcus* sp.										
			Closteriopsis	*Closteriopsis acicularis*										
			Monoraphidium	*Monoraphidium arcuatum*							2.00			
				Monoraphidium contortum	1.00									
				Monoraphidium sp.										
				Monoraphidium tortile					9.50	4.00	4.50	1.50		5.10
			Oocystis	*Oocystis* sp.								8.00	18.00	11.00
			Quadrigula	*Quadrigula chodati*										
				Quadrigula closterioides							6.00			17.00
		Scenedesmaceae	*Coelastrum*	*Coelastrum* sp.										
			Crucigenia	*Crucigenia* sp.										
			Crucigeniella	*Crucigeniella rectangularis*										
			Scenedesmus	*Scenedesmus bijuga*										
				Scenedesmus brasiliensis										
				Scenedesmus sp.										
	Sphaeropleales	Characiaceae	*Ankyra*	*Ankyra judayi*										
		Radiococcaceae	*Coenococcus*	*Coenococcus fottii*					250.00	800.00	250.00		44.00	
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*	5.00	6.00	3.00	1.00	3.50	3.50	11.50		13.50	
				Elakatothrix sp.										
		Palmellaceae	*Gloeocystis*	*Gloeocystis gigas*					2.00					2.00
			Sphaerocystis	*Sphaerocystis planctonica*										
				Sphaerocystis sp.										

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	George	George	George	George	George	George	George	George	George	George
				Lake	Sleigh	Sleigh	Sleigh	Sleigh	Dragon	Dragon	Dragon	Komatic	Komatic	Komatic
				Replicate	1	1 DUP	2	3	1	2	3	1	2	3
				Lab Duplicate	no	yes	no	no	no	no	no	no	no	no
				Date Sampled	22-Aug-2012	22-Aug-2012	22-Aug-2012	22-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012
				Sample ID	6141.4-28	6141.4-28_DUP	6141.4-29	6141.4-30	6141.4-13	6141.4-14	6141.4-15	6141.4-16	6141.4-17	6141.4-18
Class	**Order**	**Family**	**Genus**	**Final Designation**										
	Volvocales	Chlamydomonadaceae	*Carteria*	*Carteria* sp.										
			Chlamydomonas	*Chlamydomonas* sp.										
	Zygnematales	Desmidiaceae	*Closterium*	*Closterium* sp.										
			Cosmarium	*Cosmarium* sp.						0.50	0.50	1.50		
			Euastrum	*Euastrum* sp.										
			Spondylosium	*Spondylosium* sp.									2.00	
			Staurastrum	*Staurastrum* sp.										
			Staurodesmus	*Staurodesmus* sp.					1.00			1.50	3.00	6.00
			Teilingia	*Teilingia granulata*										
			Xanthidium	*Xanthidium* sp.										
		Mesotaeniaceae	*Gonatozygon*	*Gonatozygon* sp.										
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.										
Chrysophyceae	Chromulinales	Chromulinaceae	*Chromulina*	*Chromulina* sp.	15.30	20.40	5.10	15.30		25.50				
			Kephyrion	*Kephyrion* sp.	61.20	71.40	51.00	81.60	86.70	45.90	12.00	76.50	86.70	20.40
		Chrysocapsaceae	*Chrysocapsa*	*Chrysocapsa planktonica*									101.00	78.00
				Chrysocapsa sp.										
	Chrysomonadales	Dinobryaceae	*Chrysococcus*	*Chrysococcus* sp.					4.00					
			Chrysolykos	*Chrysolykos planctonicus*										
			Dinobryon	*Dinobryon bavaricum*							1.00	32.00	35.50	17.00
				Dinobryon divergens										
				Dinobryon sertularia								3.00	1.00	4.00
				Dinobryon sociale	5.00	2.00		1.00	3.50		16.00	32.00		
				Dinobryon sp.										
		Synuraceae	*Mallomonas*	*Mallomonas* sp.										
			Synura	*Synu* ra sp.								64.00		
	Hibberdiales	Stylococcaceae	*Diceras*	*Diceras* sp.										
	Ochromonadales	Ochromonadaceae	*Ochromonas*	*Ochromonas* sp.	10.20	35.70	10.20			13.00			11.00	1.00
	Prymnesiales	Prymnesiaceae	*Chrysochromulina*	*Chrysochromulina parva*						40.80	20.40			30.60
Cryptophyceae	Cryptomonadales	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.										
				Cryptomonas spp.	23.00	26.00	28.00	16.00	10.00	3.00	6.50	1.50	3.00	15.00
			Komma	*Komma caudata*										
	Pyrenomonadales	Pyrenomonadaceae	*Rhodomonas*	*Rhodomonas lacustris var. nannoplanctica*	40.00	46.00	37.00	16.00	15.30	3.00	13.00	4.00	18.00	9.00
Cyanophyceae	Synechococcales	Synechococcaceae	*Cyanodictyon*	*Cyanodictyon* sp.										
Dinophyceae	Dinophysales	Amphisoleniaceae	*Dinophysis*	*Dinophysis* sp.										
	Gymnodiniales	Gymondiniaceae	*Gymnodinium*	*Gymnodinium* sp.			10.20		2.00	1.50	5.50		5.00	3.00
	Peridiniales	Peridiniaceae	*Glenodinium*	*Glenodinium* sp.	0.50	0.50		1.00	2.00		0.50		1.00	
			Peridinium	*Peridinium* sp.									0.50	
Euglenophyceae	Euglenales	Euglenaceae	*Euglena*	*Euglena* sp.										
			Lepocinclis	*Lepocinclis* sp.										
			Phacus	*Phacus* sp.										
			Trachelomonas	*Trachelomonas* sp.										
Myxophyceae	Chroococcales	Chroococcaceae	*Chroococcus*	*Chroococcus limneticus*					12.00		16.50	224.00	4.00	66.00
				Chroococcus minimus				61.20			52.00	204.00	418.20	71.40
				Chroococcus prescottii				16.00						
				Chroococcus sp.										
		Merismopediaceae	*Aphanocapsa*	*Aphanocapsa conferta*								1000.00	900.00	
				Aphanocapsa holsatica									8094.00	4498.00
				Aphanocapsa incerta									400.00	
				Aphanocapsa sp.					51.00					
			Coelomoron	*Coelomoron* sp.										
			Coelosphaerium	*Coelosphaerium* sp.										
			Merismopedia	*Merismopedia* sp.										
				Merismopedia tenuissima										
			Snowella	*Snowella lacustris*										32.00

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL

Taxonomic Classification				Area	George	George	George	George	George	George	George	George	George	George
				Lake	Sleigh	Sleigh	Sleigh	Sleigh	Dragon	Dragon	Dragon	Komatic	Komatic	Komatic
				Replicate	1	1 DUP	2	3	1	2	3	1	2	3
				Lab Duplicate	no	yes	no	no	no	no	no	no	no	no
				Date Sampled	22-Aug-2012	22-Aug-2012	22-Aug-2012	22-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012	20-Aug-2012
				Sample ID	6141.4-28	6141.4-28_DUP	6141.4-29	6141.4-30	6141.4-13	6141.4-14	6141.4-15	6141.4-16	6141.4-17	6141.4-18
Class	**Order**	**Family**	**Genus**	**Final Designation**										
			Woronichinia	*Woronichinia compacta*				64.00						
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa* sp.			8.00							
			Microcystis	*Microcystis aeruginosa*										
		Synechococcaceae	*Aphanothece*	*Aphanothece minutissima*										
				Aphanothece sp.										
			Rhabdoderma	*Rhabdoderma lineare*										
			Synechococcus	*Synechococcus* sp.						10.20		10.20	66.30	15.30
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.										
			Nostoc	*Nostoc* sp.										
	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria* sp.										
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya* sp.										
			Planktolyngbya	*Planktolyngbya limnetica*										
			Pseudanabaena	*Pseudanabaena galeata*										
				Pseudanabaena sp.										
Trebouxiophyceae	Prasiolales	Koliellaceae	*Koliella*	*Koliella longiseta*	0.50	1.00								
Xanthophyceae	Heterococcales	Sciadaceae	*Centritractus*	*Centritractus* sp.										
	Mischococcales	Characiopsidaceae	*Characiopsis*	*Characiopsis* sp.										
Undetermined	Undetermined	Katablepharidaceae	*Katablepharis*	*Katablepharis ovalis*	5.00	8.00	6.00							15.30
		Undetermined	Undetermined	unknown Chlorophyte coccoid										
				Total	**168.70**	**219.00**	**160.50**	**279.60**	**634.00**	**1045.90**	**552.40**	**1691.30**	**10246.20**	**4932.90**

Note: George Central Rep 3 (ID 6141.4-9) contained too much detritus and silt for taxonomists to enumerate.

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL				Area	George	George	George	George
				Lake	Reference C	Reference C	Reference C	Reference C
				Replicate	1	1 DUP	2	3
				Lab Duplicate	no	yes	no	no
				Date Sampled	22-Aug-2012	22-Aug-2012	22-Aug-2012	22-Aug-2012
Taxonomic Classification				Sample ID	6141.4-25	6141.4-25_DUP	6141.4-26	6141.4-27
Class	**Order**	**Family**	**Genus**	**Final Designation**				
Bacillariophyceae	Centrales	Stephanodiscaceae	*Cyclotella*	*Cyclotella* sp.				
				Cyclotella sp. < 6µm	57.00	61.00	39.00	147.00
				Cyclotella sp. 6-10 µm				
			Stephanodiscus	*Stephanodiscus* sp.				
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.				
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.				2.00
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.				
		Bacillariaceae	*Nitzschia*	*Nitzschia* sp.				
				Nitzschia spp.			0.50	0.50
		Catenulaceae	*Amphora*	*Amphora* sp.				
		Cymbellaceae	*Cymbella*	*Cymbella* sp.				
		Diploneidaceae	*Diploneis*	*Diploneis* sp.				
		Eunotiaceae	*Eunotia*	*Eunotia* sp.				
		Fragilariaceae	*Fragilaria*	*Fragilaria* sp.				
			Synedra	*Synedra* sp.				
		Naviculaceae	*Navicula*	*Navicula* sp.				
		Pinnulariaceae	*Caloneis*	*Caloneis* sp.				
			Pinnularia	*Pinnularia biceps*				
				Pinnularia sp.				
		Pleurosigmataceae	*Pleurosigma*	*Pleurosigma* sp.				
		Rhopalodiaceae	*Epithemia*	*Epithemia* sp.				
		Stauroneidaceae	*Stauroneis*	*Stauroneis* sp.				
		Surirellaceae	*Surirella*	*Surirella* sp.				
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*				
				Tabellaria flocculosa				
				Tabellaria sp.				
Chlorodendrophyceae	Chlorodendrales	Chlorodendraceae	*Tetraselmis*	*Tetraselmis* sp.				
Chlorophyceae	Chlorococcales	Chlorococcaceae	*Tetraedron*	*Tetraedron caudatum*				
				Tetraedron minimum			2.00	
				Tetraedron sp.	11.00	18.00		2.00
		Hydrodictyaceae	*Pediastrum*	*Pediastrum* sp.				
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus* sp.				
			Botryococcus	*Botryococcus* sp.				
			Closteriopsis	*Closteriopsis acicularis*				
			Monoraphidium	*Monoraphidium arcuatum*				
				Monoraphidium contortum				
				Monoraphidium sp.				
				Monoraphidium tortile				
			Oocystis	*Oocystis* sp.			5.00	
			Quadrigula	*Quadrigula chodati*				
				Quadrigula closterioides				
		Scenedesmaceae	*Coelastrum*	*Coelastrum* sp.				
			Crucigenia	*Crucigenia* sp.				
			Crucigeniella	*Crucigeniella rectangularis*				
			Scenedesmus	*Scenedesmus bijuga*				
				Scenedesmus brasiliensis				
				Scenedesmus sp.				
	Sphaeropleales	Characiaceae	*Ankyra*	*Ankyra judayi*				
		Radiococcaceae	*Coenococcus*	*Coenococcus fottii*				
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*	4.00	6.00		4.00
				Elakatothrix sp.				
		Palmellaceae	*Gloeocystis*	*Gloeocystis gigas*				
			Sphaerocystis	*Sphaerocystis planctonica*				
				Sphaerocystis sp.				

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL				Area	George	George	George	George
				Lake	Reference C	Reference C	Reference C	Reference C
				Replicate	1	1 DUP	2	3
				Lab Duplicate	no	yes	no	no
				Date Sampled	22-Aug-2012	22-Aug-2012	22-Aug-2012	22-Aug-2012
Taxonomic Classification				Sample ID	6141.4-25	6141.4-25_DUP	6141.4-26	6141.4-27
Class	Order	Family	Genus	Final Designation				
	Volvocales	Chlamydomonadaceae	*Carteria*	*Carteria* sp.				
			Chlamydomonas	*Chlamydomonas* sp.				
	Zygnematales	Desmidiaceae	*Closterium*	*Closterium* sp.				
			Cosmarium	*Cosmarium* sp.	4.00	4.00	3.00	
			Euastrum	*Euastrum* sp.				
			Spondylosium	*Spondylosium* sp.				
			Staurastrum	*Staurastrum* sp.				4.00
			Staurodesmus	*Staurodesmus* sp.				
			Teilingia	*Teilingia granulata*				
			Xanthidium	*Xanthidium* sp.				
		Mesotaeniaceae	*Gonatozygon*	*Gonatozygon* sp.				
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.				
Chrysophyceae	Chromulinales	Chromulinaceae	*Chromulina*	*Chromulina* sp.				
			Kephyrion	*Kephyrion* sp.				
		Chrysocapsaceae	*Chrysocapsa*	*Chrysocapsa planktonica*				
				Chrysocapsa sp.				
	Chrysomonadales	Dinobryaceae	*Chrysococcus*	*Chrysococcus* sp.				
			Chrysolykos	*Chrysolykos planctonicus*				
			Dinobryon	*Dinobryon bavaricum*	4.50	4.00	8.50	13.00
				Dinobryon divergens				
				Dinobryon sertularia				
				Dinobryon sociale				
				Dinobryon sp.				
		Synuraceae	*Mallomonas*	*Mallomonas* sp.				
			Synura	*Synu* ra sp.				
	Hibberdiales	Stylococcaceae	*Diceras*	*Diceras* sp.			1.00	
	Ochromonadales	Ochromonadaceae	*Ochromonas*	*Ochromonas* sp.				
	Prymnesiales	Prymnesiaceae	*Chrysochromulina*	*Chrysochromulina parva*				
Cryptophyceae	Cryptomonadales	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.				
				Cryptomonas spp.	2.00	3.00	1.50	2.00
			Komma	*Komma caudata*				
	Pyrenomonadales	Pyrenomonadaceae	*Rhodomonas*	*Rhodomonas lacustris var. nannoplanctica*	7.00	10.00		11.00
Cyanophyceae	Synechococcales	Synechococcaceae	*Cyanodictyon*	*Cyanodictyon* sp.				
Dinophyceae	Dinophysales	Amphisoleniaceae	*Dinophysis*	*Dinophysis* sp.				
	Gymnodiniales	Gymondiniaceae	*Gymnodinium*	*Gymnodinium* sp.			1.50	4.00
	Peridiniales	Peridiniaceae	*Glenodinium*	*Glenodinium* sp.				
			Peridinium	*Peridinium* sp.				
Euglenophyceae	Euglenales	Euglenaceae	*Euglena*	*Euglena* sp.				
			Lepocinclis	*Lepocinclis* sp.				
			Phacus	*Phacus* sp.				
			Trachelomonas	*Trachelomonas* sp.				
Myxophyceae	Chroococcales	Chroococcaceae	*Chroococcus*	*Chroococcus limneticus*				
				Chroococcus minimus				
				Chroococcus prescottii				
				Chroococcus sp.				
		Merismopediaceae	*Aphanocapsa*	*Aphanocapsa conferta*	128.00	120.00		
				Aphanocapsa holsatica				
				Aphanocapsa incerta			192.00	128.00
				Aphanocapsa sp.				
			Coelomoron	*Coelomoron* sp.				
			Coelosphaerium	*Coelosphaerium* sp.				
			Merismopedia	*Merismopedia* sp.				
				Merismopedia tenuissima				
			Snowella	*Snowella lacustris*	32.00	30.00	128.00	

Appendix 3.6-2. Lake Phytoplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/mL				Area	George	George	George	George
				Lake	Reference C	Reference C	Reference C	Reference C
				Replicate	1	1 DUP	2	3
				Lab Duplicate	no	yes	no	no
				Date Sampled	22-Aug-2012	22-Aug-2012	22-Aug-2012	22-Aug-2012
Taxonomic Classification				Sample ID	6141.4-25	6141.4-25_DUP	6141.4-26	6141.4-27
Class	Order	Family	Genus	Final Designation				
			Woronichinia	*Woronichinia compacta*				
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa* sp.				
			Microcystis	*Microcystis aeruginosa*				
		Synechococcaceae	*Aphanothece*	*Aphanothece minutissima*				
				Aphanothece sp.				
			Rhabdoderma	*Rhabdoderma lineare*				
			Synechococcus	*Synechococcus* sp.				
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.				
			Nostoc	*Nostoc* sp.				
	Oscillatoriales	Oscillatoriaceae	*Oscillatoria*	*Oscillatoria* sp.				
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya* sp.				
			Planktolyngbya	*Planktolyngbya limnetica*	152.00	154.00	117.00	237.50
			Pseudanabaena	*Pseudanabaena galeata*	364.00	42.00		
				Pseudanabaena sp.				
Trebouxiophyceae	Prasiolales	Koliellaceae	*Koliella*	*Koliella longiseta*	2.00	3.00	7.00	6.00
Xanthophyceae	Heterococcales	Sciadaceae	*Centritractus*	*Centritractus* sp.				
	Mischococcales	Characiopsidaceae	*Characiopsis*	*Characiopsis* sp.				
Undetermined	Undetermined	Katablepharidaceae	*Katablepharis*	*Katablepharis ovalis*	4.00	6.00		5.00
		Undetermined	Undetermined	unknown Chlorophyte coccoid				
				Total	**771.50**	**461.00**	**506.00**	**566.00**

Note: George Central Rep 3 (ID 6141.4-9) contained too much detritus and silt for taxonomists to enumerate.

Appendix 3.6-3

Lake Phytoplankton Richness and Diversity Results, Back River Project, 2012

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Appendix 3.6-3. Lake Phytoplankton Richness and Diversity Results, Back River Project, 2012

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location	Moby	Gander	Gander	Gander	Gander	Big	Big	Big	Big	Rabbit	Rabbit	Rabbit	Fox	Fox	Fox	Fox	Rascal
Replicate	1	1	1	2	3	1	1	2	3	1	2	3	1	1	2	3	1
Date Sampled	10-Apr-12	10-Apr-12	18-Aug-12	18-Aug-12	18-Aug-12	10-Apr-12	16-Aug-12	16-Aug-12	16-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	10-Apr-12	20-Aug-12	20-Aug-12	20-Aug-12	11-Apr-12
Eco Analysts Sample ID	6138.4-7	6138.4-10	6138.5-13	6138.5-14	6138.5-15	6138.4-9	6138.5-7	6138.5-8	6138.5-9	6138.5-4	6138.5-5	6138.5-6	6138.4-8	6138.5-19	6138.5-20	6138.5-21	6138.4-2
Genus Richness (# genera)	15	26	28	28	25	13	30	27	25	17	19	21	13	25	21	20	8
Simpson's Diversity Index	0.50	0.72	0.82	0.88	0.84	0.49	0.58	0.65	0.61	0.65	0.77	0.72	0.66	0.72	0.79	0.86	0.46

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location	Giraffe North	Giraffe South	Giraffe South	Giraffe South	Giraffe South	Goose Neck	Goose Neck	Goose Neck	Goose Neck	Goose Central	Goose Central	Goose Central	Goose Central	Goose Tail	Propellor
Replicate	1	1	1	2	3	1	1	2	3	1	1	2	3	1	1
Date Sampled	11-Apr-12	11-Apr-12	19-Aug-12	19-Aug-12	19-Aug-12	11-Apr-12	14-Aug-12	14-Aug-12	14-Aug-12	11-Apr-12	17-Aug-12	17-Aug-12	17-Aug-12	11-Apr-12	12-Apr-12
Eco Analysts Sample ID	6138.4-3	6138.4-11	6138.5-16	6138.5-17	6138.5-18	6138.4-4	6138.5-1	6138.5-2	6138.5-3	6138.4-5	6138.5-10	6138.5-11	6138.5-12	6138.4-6	6138.4-1
Genus Richness (# genera)	16	13	21	29	26	23	27	25	29	10	25	29	30	15	12
Simpson's Diversity Index	0.84	0.63	0.75	0.84	0.79	0.87	0.84	0.84	0.80	0.59	0.72	0.77	0.78	0.66	0.40

Area	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George
Location	Lower Long	Lower Long	Lower Long	Lower Long	Fold	Fold	Fold	Fold	George Central	George Central	George Central	Lytle	Lytle	Lytle	Occurrence	Occurrence	Occurrence
Replicate	1	1	2	3	1	1	2	3	1	1	2	1	2	3	1	2	3
Date Sampled	13-Apr-12	21-Aug-12	21-Aug-12	21-Aug-12	15-Apr-12	19-Aug-12	19-Aug-12	19-Aug-12	13-Apr-12	18-Aug-12	18-Aug-12	23-Aug-12	23-Aug-12	23-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
Eco Analysts Sample ID	6141.4-3	6141.4-19	6141.4-20	6141.4-21	6141.4-5	6141.4-10	6141.4-11	6141.4-12	6141.4-1	6141.4-7	6141.4-8	6141.4-31	6141.4-32	6141.4-33	6141.4-22	6141.4-23	6141.4-24
Genus Richness (# genera)	11	20	18	20	6	12	16	15	5	18	19	9	8	10	8	10	11
Simpson's Diversity Index	0.47	0.47	0.83	0.85	0.73	0.22	0.36	0.24	0.32	0.23	0.33	0.74	0.66	0.74	0.67	0.78	0.80

Area	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George
Location	Sleigh	Sleigh	Sleigh	Dragon	Dragon	Dragon	Dragon	Komatic	Komatic	Komatic	Komatic	Reference C	Reference C	Reference C	Reference C
Replicate	1	2	3	1	1	2	3	1	1	2	3	1	1	2	3
Date Sampled	22-Aug-12	22-Aug-12	22-Aug-12	15-Apr-12	20-Aug-12	20-Aug-12	20-Aug-12	13-Apr-12	20-Aug-12	20-Aug-12	20-Aug-12	13-Apr-12	22-Aug-12	22-Aug-12	22-Aug-12
Eco Analysts Sample ID	6141.4-28	6141.4-29	6141.4-30	6141.4-6	6141.4-13	6141.4-14	6141.4-15	6141.4-4	6141.4-16	6141.4-17	6141.4-18	6141.4-2	6141.4-25	6141.4-26	6141.4-27
Genus Richness (# genera)	12	11	13	12	16	17	18	8	18	21	20	8	13	13	14
Simpson's Diversity Index	0.78	0.80	0.78	0.71	0.74	0.40	0.73	0.61	0.58	0.16	0.17	0.13	0.70	0.73	0.70

Note: George Central Rep 3 (ID 6141.4-9) contained too much detritus and silt for taxonomists to enumerate.

Appendix 3.6-4

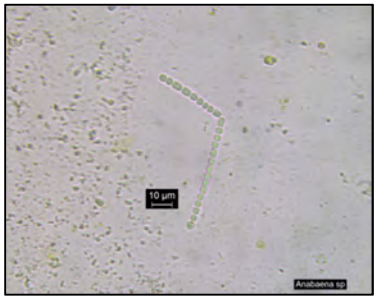
Lake Phytoplankton Reference Photographs, Back River Project, 2012

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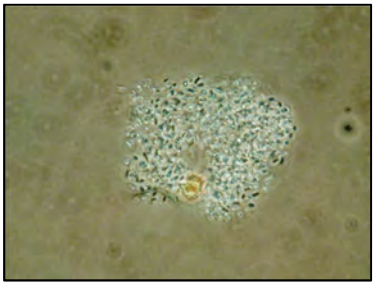
Appendix 3.6-4. Lake Phytoplankton Reference Photographs, Back River Project, 2012

Reference photographs of highly abundant genera are shown below, more information (species names, location, date) on these photographs are available by request. Photographs of less abundant taxa area also available by request.

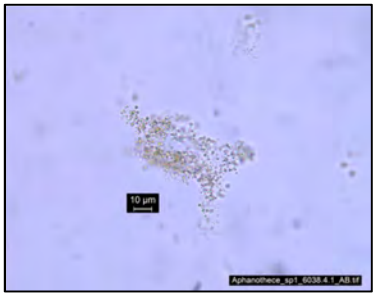
EcoAnalysts, Inc.



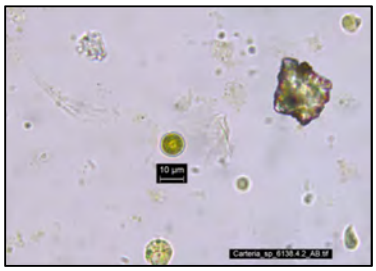
Anabaena (Myxophyceae)



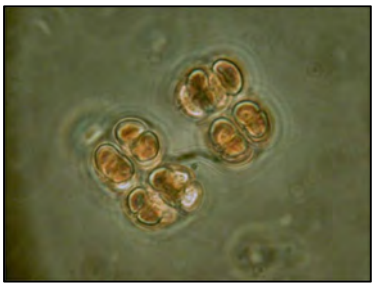
Aphanocapsa (Myxophyceae)



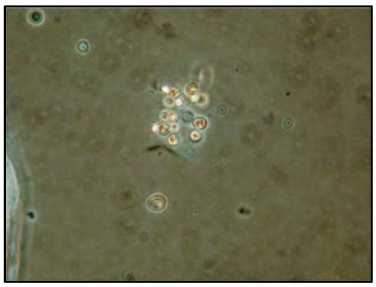
Aphanothece (Myxophyceae)



Carteria (Chlorophyceae)



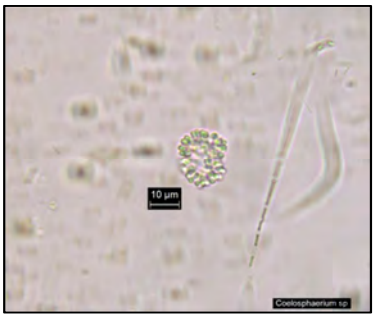
Chroococcus (Myxophyceae)



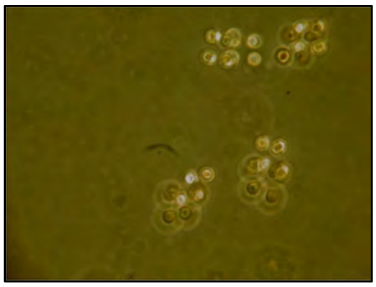
Chrysocapsa (Chrysophyceae)

No picture available

Chrysochromulina (Chrysophyceae)



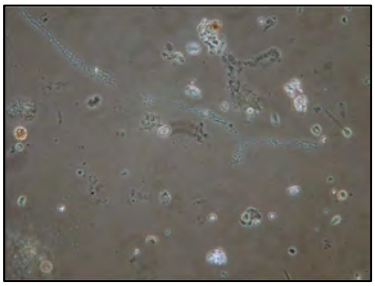
Coelosphaerium (Myxophyceae)



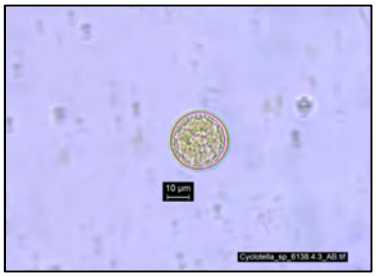
Coenococcus (Chlorophyceae)



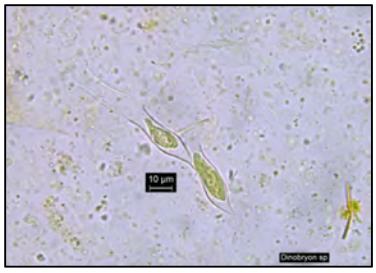
Cryptomonas (Cryptophyceae)



Cyanodictyon (Myxophyceae)



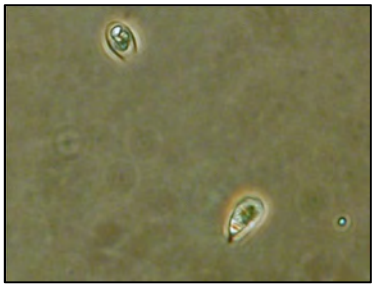
Cyclotella (Bacillariophyceae)



Dinobryon (Chrysophyceae)



Elakatothrix (Chlorophyceae)



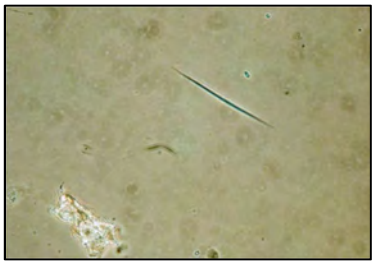
Kephyrion (Chrysophyceae)



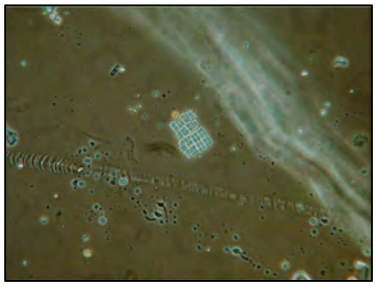
Komma (Cryptophyceae)



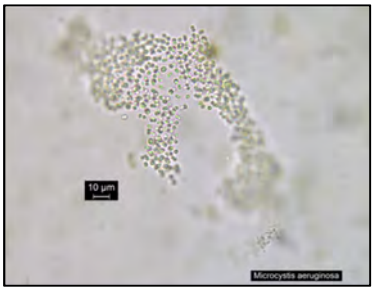
Leptolyngbya (Myxophyceae)



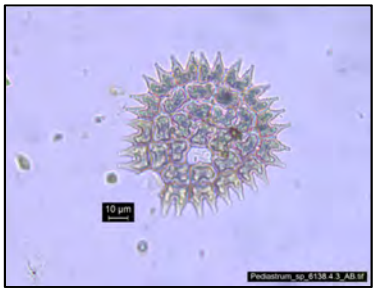
Monoraphidium (Chlorophyceae)



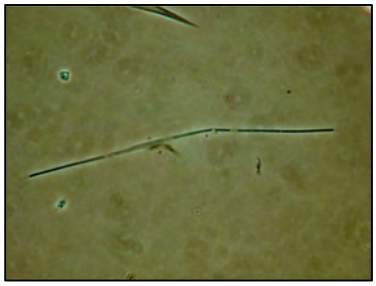
Merismopedia (Myxophyceae)



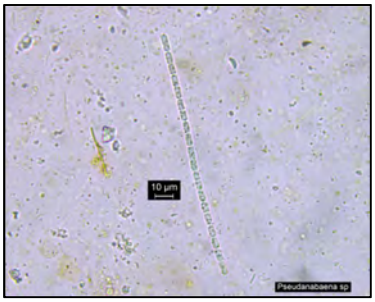
Microcystis (Myxophyceae)



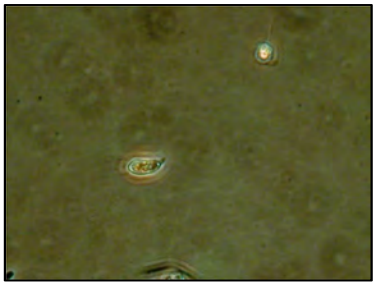
Pediastrum (Chlorophyceae)



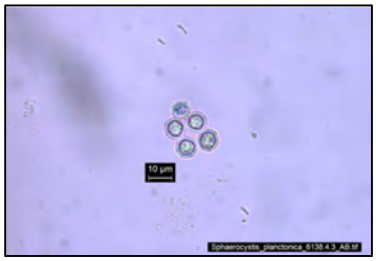
Planktolyngbya (Myxophyceae)



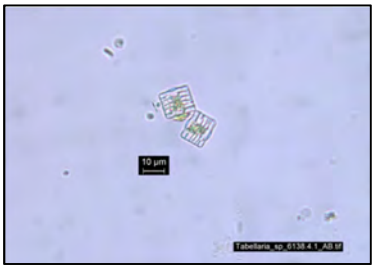
Pseudanabaena (Myxophyceae)



Rhodomonas (Cryptophyceae)



Sphaerocystis (Chlorophyceae)



Tabellaria (Bacillariophyceae)

Appendix 3.6-5

Lake Phytoplankton QA/QC Results, Back River Project, 2012

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Appendix 3.6-5. Lake Phytoplankton QA/QC Results, Back River Project, 2012

Duplication Report

EcoAnalysts, Inc.

6138.4-6	Taxonomic Identification Number (TIN)	Original Count (0.50% counted)	Relative Abundance	Dominance Rank	Duplication Count (0.50% counted)	Relative Abundance	Dominance Rank	Percent Similarity
Cryptomonas sp.	2177	157	51.82%	1	159	51.96%	1	51.82%
Komma caudata	2753	106	34.98%	2	105	34.31%	2	34.31%
Monoraphidium sp.	2250	12	3.96%	3	13	4.25%	3	3.96%
Peridinium sp.	2113	7	2.31%	4	7	2.29%	4	2.29%
Cyclotella sp.	334	5	1.65%	5	4	1.31%	5	1.31%
Nitzschia sp.	1470	2	0.66%		4	1.31%		0.66%
Carteria sp.	2571	3	0.99%		3	0.98%		0.98%
Elakatothrix sp.	2205	3	0.99%		2	0.65%		0.65%
Dinobryon sp.	2095	1	0.33%		2	0.65%		0.33%
Sphaerocystis planctonica	2723	1	0.33%		2	0.65%		0.33%
Achnanthes sp.	3	1	0.33%		1	0.33%		0.33%
Crucigenia sp.	2172	1	0.33%		1	0.33%		0.33%
Scenedesmus sp.	2055	1	0.33%		1	0.33%		0.33%
Teilingia granulata	2759	1	0.33%		1	0.33%		0.33%
Pediastrum sp.	2017	0	0.00%		1	0.33%		0.00%
Crucigeniella rectangularis	3145	2	0.66%		0	0.00%		0.00%
	TOTAL	**303**			**306**			**97.95%**

Appendix 3.6-6

Stream Periphyton Biomass Chl *a* Results, Back River Project, 2012

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Appendix 3.6-6. Stream Periphyton Biomass as Chl *a* Results, Back River Project, 2012

Area			Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location		Realised	Moby OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander IF	Gander US	Gander US	Gander US	Pond 19 OF	Pond 19 OF	Pond 19 OF
Replicate		Detection	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled		Limit	12-Aug-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	13-Aug-12	13-Aug-12	13-Aug-12
ALS Sample Name			MN-01-OF REP 1	MN-01-OF REP 2	MN-01-OF REP 3	MN-02-OF REP 1	MN-02-OF REP 2	MN-02-OF REP 3	MN-02-US REP 1	MN-02-US REP 2	MN-02-US REP 3	POND 19 OF REP 1	POND 19 OF REP 2	POND 19 OF REP 3
ALS Sample ID	Units	RDL	L1199755-25	L1199755-26	L1199755-27	L1199755-19	L1199755-20	L1199755-21	L1199755-22	L1199755-23	L1199755-24	L1199755-31	L1199755-32	L1199755-33
Area Sampled	cm^2		95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43
Final Volume	L		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chlorophyll a	ug/L		173	33.1	173	171	42.0	39.3	10.1	40.8	54.1	29.6	40.6	54.0
Chlorophyll a	ug/cm^2		0.91	0.17	0.91	0.90	0.22	0.21	0.05	0.21	0.28	0.16	0.21	0.28
RDL	ug/L	0.04 - 2.2	0.40	0.040	0.40	0.40	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040

Area			Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location		Realised	Chair OF	Chair OF	Chair OF	Llama OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Wolf OF
Replicate		Detection	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled		Limit	12-Aug-12	12-Aug-12	12-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12
ALS Sample Name			CHAIR OF REP 1	CHAIR OF REP 2	CHAIR OF REP 3	LLAMA OF REP 1	LLAMA OF REP 2	LLAMA OF REP 3	GIRAFFE OF REP 1	GIRAFFE OF REP 2	GIRAFFE OF REP 3	WOLF OF REP 1	WOLF OF REP 2	WOLF OF REP 3
ALS Sample ID	Units	RDL	L1199755-28	L1199755-29	L1199755-30	L1199755-1	L1199755-2	L1199755-3	L1199755-4	L1199755-5	L1199755-6	L1199755-7	L1199755-8	L1199755-9
Area Sampled	cm^2		95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43
Final Volume	L		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Chlorophyll a	ug/L		309	382	361	14.7	15.4	180	59.8	42.7	178	40.8	150	263
Chlorophyll a	ug/cm^2		1.62	2.00	1.89	0.08	0.08	0.94	0.31	0.22	0.93	0.21	0.79	1.38
RDL	ug/L	0.04 - 2.2	0.40	0.40	0.40	0.040	0.040	0.40	0.040	0.040	0.40	0.040	0.40	0.40

Area			Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	George	George	George
Location		Realised	Goose OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor OF	Reference B OF	Reference B OF	Reference B OF	George OF	George OF	George OF
Replicate		Detection	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled		Limit	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
ALS Sample Name			GOOSE OF REP 1	GOOSE OF REP 2	GOOSE OF REP 3	PROPELLOR OF REP 1	PROPELLOR OF REP 2	PROPELLOR OF REP 3	REF B OF REP 1	REF B OF REP 2	REF B OF REP 3	GEORGE LK OF -1	GEORGE LK OF -2	GEORGE LK OF -3
ALS Sample ID	Units	RDL	L1199755-13	L1199755-14	L1199755-15	L1199755-10	L1199755-11	L1199755-12	L1199755-16	L1199755-17	L1199755-18	L1207450-13	L1207450-14	L1207450-15
Area Sampled	cm^2	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43
Final Volume	L		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.174	0.167	0.237
Chlorophyll a	ug/L		223	44.2	34.1	126	168	38.3	200	166	17.3	195	206	415
Chlorophyll a	ug/cm^2		1.17	0.23	0.18	0.66	0.88	0.20	1.05	0.87	0.09	0.36	0.36	1.03
RDL	ug/L	0.04 - 2.2	0.40	0.040	0.040	0.40	0.40	0.040	0.40	0.40	0.040	1.3	1.2	1.3

Area			George	George	George	George	George	George	George	George	George	George	George	George
Location		Realised	Sleigh OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF	Dragon OF	Komatic IF*	Komatic IF*	Komatic IF*	Reference C OF	Reference C OF	Reference C OF
Replicate		Detection	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled		Limit	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12
ALS Sample Name			SLEIGH LK OF -1	SLEIGH LK OF -2	SLEIGH LK OF -3	DRAGON LK OF -1	DRAGON LK OF -2	DRAGON LK OF -3	KONATIC LK OF -1	KONATIC LK OF -2	KONATIC LK OF -3	REF LK C OF -1	REF LK C OF -2	REF LK C OF -3
ALS Sample ID	Units	RDL	L1207450-10	L1207450-11	L1207450-12	L1207450-7	L1207450-8	L1207450-9	L1207450-1	L1207450-2	L1207450-3	L1207450-4	L1207450-5	L1207450-6
Area Sampled	cm^2	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43	95.43
Final Volume	L		0.248	0.198	0.203	0.242	0.323	0.299	0.46	0.468	0.456	0.184	0.267	0.275
Chlorophyll a	ug/L		442	449	453	523	1040	337	102	189	160	219	36.3	251
Chlorophyll a	ug/cm^2		1.15	0.93	0.96	1.33	3.52	1.06	0.49	0.93	0.76	0.42	0.10	0.72
RDL	ug/L	0.04 - 2.2	2.2	2.0	1.7	1.4	1.5	1.1	0.28	0.41	0.35	0.87	0.10	1.2

Note Echo OF was dry during August sampling.

**Komatic IF had no rocks so periphyton was collected from sediment surface using modified methods.*

Appendix 3.6-7

Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

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Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Stream	Moby OF	Moby OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander IF	Gander US	Gander US	Gander US	Pond 19 OF	Pond 19 OF
				Replicate	1	2	2 Dup	3	1	2	3	1	2	3	1	2
				Lab Duplicate	no	no	yes	no	no	no	no	no	no	no	no	no
				Date Sampled	12-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	13-Aug-12	13-Aug-12
				Sample ID	6138.3-25	6138.3-26	6138.3-26_DUP	6138.3-27	6138.3-19	6138.3-20	6138.3-21	6138.3-22	6138.3-23	6138.3-24	6138.3-31	6138.3-32
Class	Order	Family	Genus	Final Designation												
Bacillariophyceae	**Centrales**	Aulacoseiraceae	*Aulacoseira*	*Aulacoseira* spp.					2631.989974	670.8994052			603.8094647	934.4670287		
		Melosiraceae	*Melosira*	*Melosira* spp.					464.468819	402.5396431						
		Stephanodiscaceae	*Cyclotella*	*Cyclotella meneghiniana*												
				Cyclotella sp.												
				Cyclotella spp.					1083.760578	2146.878097	880.5554693	23.67880254		143.7641583		
		Undetermined	Undetermined	unknown Centric diatom												
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.	8625.849495	445.7803357	425.9678763	8826.757025	9753.845199	4562.115955	3396.428239	47.35760507		1078.231187	34954.42279	4189.847964
			Cocconeis	*Cocconeis* spp.												
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.												
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.	1118.165675	594.3737809	709.9464605	526.9705686							1879.270043	1256.954389
				Frustulia spp.							125.7936385					
		Bacillariaceae	*Nitzschia*	*Nitzschia* spp.					9908.668138	7379.893457	6541.269201	390.7002419	1710.793483	1581.405741		
		Cymbellaceae	*Cymbella*	*Cymbella* sp.	638.9518145	148.5934452	141.9892921	526.9705686							751.708017	
				Cymbella spp.					464.468819		754.7618308	106.5546114		143.7641583		
		Encyonema	*Encyonema*	*Encyonema* spp.												
		Eunotiaceae	*Eunotia*	*Eunotia bilunaris*												
				Eunotia sp.				263.4852843		1878.518335	1886.904577	201.2698216	1106.984019	215.6462374		209.4923982
				Eunotia spp.												
		Fragilariaceae	*Diatoma*	*Diatoma* spp.												
			Fragilaria	*Fragilaria* sp.		891.5606714	283.9785842	1317.426422								
				Fragilaria spp.												
			Synedra	*Synedra* sp.											375.8540085	209.4923982
				Synedra spp.												
		Gomphonemataceae	*Gomphonema*	*Gomphonema* sp.												
				Gomphonema spp.												
		Naviculaceae	*Navicula*	*Navicula* sp.												39803.55566
				Navicula spp.	21564.62374	18574.18065	17464.68293	19893.13897	5418.802888	3891.21655	4402.777347	189.4304203	704.4443755	1150.113266	63895.18145	
		Neidiaceae	*Neidium*	*Neidium* spp.												
		Pinnulariaceae	*Caloneis*	*Caloneis* spp.												
			Pinnularia	*Pinnularia* sp.	4472.662701	445.7803357	567.9571684	4479.249833								
				Pinnularia spp.					309.6458793	402.5396431	251.5872769					
		Rhopalodiaceae	*Epithemia*	*Epithemia* spp.												
			Rhopalodia	*Rhopalodia gibba*												
				Rhopalodia spp.												
		Surirellaceae	*Surirella*	*Surirella* spp.												
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*	958.4277217							118.3940127				
				Tabellaria flocculosa	35461.8257	28529.94148	23570.22249	28983.38128	19352.86746	14625.60703	10440.87199	2142.93163	9057.14197	10997.95811	111628.6405	
				Tabellaria sp.												78978.63412
				Tabellaria spp.												
		Undetermined	Undetermined	unknown Pennate diatom												
Chlorophyceae	**Chaetophorales**	Chaetophoraceae	*Gongrosira*	*Gongrosira fluminensis*												
	Chlorococcales	Hydrodictyaceae	*Pediastrum*	*Pediastrum boryanum*					4954.334069							
				Pediastrum sp.						3220.317145						
				Pediastrum tetras												
		Microsporaceae	*Microspora*	*Microspora amoena*												
				Microspora crassior												
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus falcatus*				131.7426422	309.6458793	1073.439048	4276.983708		1610.158572	3019.047323		4189.847964
				Ankistrodesmus falcatus var. *acicularis*												
				Ankistrodesmus sp.												1675.939186
			Botryococcus	*Botryococcus braunii*									8050.792862			
			Dictyosphaerium	*Dictyosphaerium ehrenbergianum*									19321.90287			
				Dictyosphaerium pulchellum								378.8608406				
			Oocystis	*Oocystis* cf. *borgei*												
				Oocystis parva												
				Oocystis sp.	958.4277217	891.5606714	1845.860797	395.2279265							4510.248102	3351.878371
		Scenedesmaceae	*Scenedesmus*	*Scenedesmus* sp.	9584.277217	5646.550919	9655.271863	5796.676255	3096.458793	2683.597621	3019.047323		6440.63429	6900.679596	3006.832068	837.9695928
			Tetrastrum	*Tetrastrum staurogeniaeforme*												

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Stream	Moby OF	Moby OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander IF	Gander US	Gander US	Gander US	Pond 19 OF	Pond 19 OF
				Replicate	1	2	2 Dup	3	1	2	3	1	2	3	1	2
				Lab Duplicate	no	no	yes	no	no	no	no	no	no	no	no	no
				Date Sampled	12-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	13-Aug-12	13-Aug-12
Class	Order	Family	Genus	Final Designation	Sample ID	6138.3-25	6138.3-26	6138.3-26_DUP	6138.3-27	6138.3-19	6138.3-20	6138.3-21	6138.3-22	6138.3-23	6138.3-24	6138.3-31	6138.3-32
				Tetrastrum triangulare					619.2917586							
	Oedogoniales	Oedogoniaceae	*Bulbochaete*	*Bulbochaete rectangularis*												
				Bulbochaete sp.								59.19700634	805.0792862	143.7641583		1885.431584
			Oedogonium	*Oedogonium* sp.	2076.593397			658.7132108	1083.760578	670.8994052				646.9387122		837.9695928
				Oedogonium spp.												
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*		2377.495124	1135.914337									
	Ulotrichales	Ulotrichaceae	*Geminella*	*Geminella* sp.												5656.294751
	Volvocales	Chlamydomonadaceae	*Chlamydomonas*	*Chlamydomonas* sp.												
	Zygnematales	Desmidiaceae	*Actinotaenium*	*Actinotaenium diplosporum*												
			Closterium	*Closterium closterioides* var. *intermedium*		148.5934452	141.9892921				125.7936385					
				Closterium costatum		148.5934452	141.9892921									
				Closterium dianae												
				Closterium parvulum		148.5934452	141.9892921									
				Closterium sp.												
				Closterium spp.												
			Cosmarium	*Cosmarium bireme*												
				Cosmarium didymoprotupsum												
				Cosmarium garrolense												
				Cosmarium margaritatum fo. Minor												
				Cosmarium phaseolus	319.4759072	297.1868905	141.9892921	131.7426422				35.5182038				
				Cosmarium regnellii												
				Cosmarium sp.		445.7803357	283.9785842		774.1146983	1073.439048	125.7936385	82.87580888	2012.698216	503.1745539	1127.562026	1466.446787
				Cosmarium subcrenatum							377.3809154	23.67880254	2213.968037	71.88207913		
				Cosmarium subtumidum		148.5934452	141.9892921								375.8540085	
				Cosmarium subtumidum var. *minutum*											375.8540085	
				Cosmarium subundulatum									1408.888751	215.6462374		
				Cosmarium tinctum											375.8540085	
			Desmidium	*Desmidium* sp.												
			Euastrum	*Euastrum binale*												
				Euastrum obesum							125.7936385					
				Euastrum pulchellum		148.5934452	141.9892921		154.8229397	134.179881		35.5182038	100.6349108	575.056633		418.9847964
				Euastrum sp.							251.5872769	23.67880254	100.6349108			
				Euastrum validum				131.7426422		134.179881	377.3809154		402.5396431	143.7641583		
			Micrasterias	*Micrasterias papillifera*												
				Micrasterias sp.							125.7936385					
			Pleurotaenium	*Pleurotaenium ehrenbergii*												
			Staurastrum	*Staurastrum cingulum*												
				Staurastrum crenulatum								11.83940127		71.88207913		209.4923982
				Staurastrum furcigerum												
				Staurastrum furcigerum var. *[furcigerum] f. armiger*												
				Staurastrum margaritaceum												
				Staurastrum setigerum						134.179881				71.88207913		
				Staurastrum sp.					154.8229397	134.179881	377.3809154	11.83940127	100.6349108			
			Staurodesmus	*Staurodesmus dejectus*							251.5872769		301.9047323			
				Staurodesmus extensus	148.5934452	141.9892921										
				Staurodesmus extensus var. *joshuae*								11.83940127				
				Staurodesmus glaber										71.88207913		209.4923982
			Teilingia	*Teilingia granulata*						536.7195242			1509.523662	718.8207913	1503.416034	1466.446787
		Mesotaeniaceae	*Cylindrocystis*	*Cylindrocystis* sp.	445.7803357	425.9678763										209.4923982
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.						134.179881		59.19700634	905.714197		375.8540085	3980.355566
			Zygnema	*Zygnema* sp.										575.056633	6389.518145	
Chrysophyceae	**Chrysomonadales**	Dinobryaceae	*Dinobryon*	*Dinobryon sertularia*						268.3597621						
				Dinobryon sp.												1047.461991
		Synuraceae	*Mallomonas*	*Mallomonas caudata*												
Cryptophyceae	**Cryptomonadales**	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.					619.2917586					287.5283165		

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Stream	Moby OF	Moby OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander IF	Gander US	Gander US	Gander US	Pond 19 OF	Pond 19 OF
				Replicate	1	2	2 Dup	3	1	2	3	1	2	3	1	2
				Lab Duplicate	no	no	yes	no	no	no	no	no	no	no	no	no
				Date Sampled	12-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	13-Aug-12	13-Aug-12
				Sample ID	6138.3-25	6138.3-26	6138.3-26_DUP	6138.3-27	6138.3-19	6138.3-20	6138.3-21	6138.3-22	6138.3-23	6138.3-24	6138.3-31	6138.3-32
Class	**Order**	**Family**	**Genus**	**Final Designation**												
Dinophyceae	**Peridiniales**	Oxytoxaceae	*Ceratium*	*Ceratium carolinianum*												
		Peridiniaceae	*Peridinium*	*Peridinium* sp.												
Euglenophyceae	**Euglenales**	Euglenaceae	*Euglena*	*Euglena* sp.						134.179881						
Myxophyceae	**Chroococcales**	Chamaesiphonaceae	*Chamaesiphon*	*Chamaesiphon* spp.												
		Chroococcaceae	*Chroococcus*	*Chroococcus dispersus*												
				Chroococcus minutus	2555.807258									1725.169899		2513.908778
				Chroococcus pallidus												
				Chroococcus sp.												
				Chroococcus turgidus												
	Merismopediaceae	Aphanocapsa	*Aphanocapsa*	*Aphanocapsa delicatissima*												
				Aphanocapsa elachista							6918.650116					
				Aphanocapsa rivularis												5865.787149
			Merismopedia	*Merismopedia glauca*					16720.87748	17175.02477	32203.17145			2300.226532		
				Merismopedia punctata	5111.614516				55736.25828	37972.90633	81262.69045	189.4304203	30995.55252	29040.35997		10055.63511
				Merismopedia spp.												
			Woronichinia	*Woronichinia naegeliana*	95842.77217	188416.4885	196797.1589	17916.99933	35609.27612	45486.97967	118874.9884	520.9336558	27674.60046	43344.89371		13407.51348
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa aeruginosa*												
				Gloeocapsa rupestris												
				Gloeocapsa sanguinea												
				Gloeocapsa sp.						2683.597621			8050.792862			
				Gloeocapsa spp.												
			Microcystis	*Microcystis flosaquae*						48304.75717						
		Synechococcaceae	*Aphanothece*	*Aphanothece smithii*									2012.698216			
			Cyanothece	*Cyanothece aeruginosa*												
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.					5573.625828		4905.951901	142.0728152		790.7028704		
			Nostoc	*Nostoc linckia*												
				Nostoc paludosum												
				Nostoc sp.							5283.332816					
		Rivulariaceae	*Calothrix*	*Calothrix breviarticulata*												
				Calothrix fusca												
				Calothrix parietina												
				Calothrix sp.	4792.138609	17088.2462	27687.91196		774.1146983	4830.475717			20227.61707	8769.613654	30068.32068	61381.27267
			Dichothrix	*Dichothrix* sp.												
			Gloeotrichia	*Gloeotrichia* sp.									250580.9278	8985.259891		
			Rivularia	*Rivularia haematites*												
		Scytonemataceae	*Scytonema*	*Scytonema mirabile*												
				Scytonema sp.												
	Oscillatoriales	Borziaceae	*Komvophoron*	*Komvophoron* spp.												
		Oscillatoriaceae	*Homoeothrix*	*Homoeothrix janthina*												
			Oscillatoria	*Oscillatoria* sp.	8785.587449	181432.5966	171523.0649	3030.08077					13887.61769		24806.36456	16968.88425
				Oscillatoria ucrainica												
		Phormidiaceae	*Phormidium*	*Phormidium aerugineo-caeruleum*												
				Phormidium sp.												
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya foveolarum*									11472.37983			
				Leptolyngbya sp.												
				Leptolyngbya tenuis									2213.968037			
			Pseudanabaena	*Pseudanabaena* sp.												
	Stigonematales	Stigonemataceae	*Stigonema*	*Stigonema mamillosum*								5931.540035	61186.02575			9217.66552
				Total	**202867.2011**	**447563.457**	**453513.799**	**93010.30536**	**175569.2136**	**202745.8003**	**287564.2576**	**10738.33695**	**486771.0634**	**125218.5818**	**286400.7545**	**271502.1481**

Note Echo OF was dry during August sampling.

**Komatic IF had no rocks so periphyton was collected from sediment surface using modified methods.*

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Stream	Pond 19 OF	Chair OF	Chair OF	Chair OF	Llama OF	Llama OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Giraffe OF
				Replicate	3	1	2	3	1	2	2 Dup	3	1	2	3
				Lab Duplicate	no	no	no	no	no	no	yes	no	no	no	no
				Date Sampled	13-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12
				Sample ID	6138.3-33	6138.3-28	6138.3-29	6138.3-30	6138.3-1	6138.3-2	6138.3-2_DUP	6138.3-3	6138.3-7	6138.3-8	6138.3-9
Class	**Order**	**Family**	**Genus**	**Final Designation**											
Bacillariophyceae	**Centrales**	Aulacoseiraceae	*Aulacoseira*	*Aulacoseira* spp.					563.5555004						
		Melosiraceae	*Melosira*	*Melosira* spp.					2254.222001						
		Stephanodiscaceae	*Cyclotella*	*Cyclotella meneghiniana*											
				Cyclotella sp.	2072.276155										
				Cyclotella spp.											
		Undetermined	Undetermined	unknown Centric diatom											
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.	17268.96796	7357.626955	5508.205297	1047.461991	1207.618929	2817.777502	6279.618433		24152.37859	4919.928971	20126.98216
			Cocconeis	*Cocconeis* spp.											
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.											
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.	4144.55231	774.4870478	220.3282119								
				Frustulia spp.											
		Bacillariaceae	*Nitzschia*	*Nitzschia* spp.						1610.158572	1610.158572	268.3597621	15296.50644	36228.56788	61387.29558
		Cymbellaceae	*Cymbella*	*Cymbella* sp.		387.2435239		209.4923982							
				Cymbella spp.									805.0792862	1341.79881	
		Encyonema	*Encyonema*	*Encyonema* spp.											
		Eunotiaceae	*Eunotia*	*Eunotia bilunaris*											
				Eunotia sp.	3453.793592				966.0951435	3622.856788	4508.444003	49914.91575	13686.34787	1341.79881	5031.745539
				Eunotia spp.											
		Fragilariaceae	*Diatoma*	*Diatoma* spp.											
			Fragilaria	*Fragilaria* sp.	8979.863339		1321.969271		966.0951435	1878.518335					
				Fragilaria spp.											
			Synedra	*Synedra* sp.											
				Synedra spp.					483.0475717						
		Gomphonemataceae	*Gomphonema*	*Gomphonema* sp.											
				Gomphonema spp.											
		Naviculaceae	*Navicula*	*Navicula* sp.											
				Navicula spp.	58714.49106	49179.92754	28642.66755	9008.173122			483.0475717		18516.82358	12076.18929	2012.698216
		Neidiaceae	*Neidium*	*Neidium* spp.											
		Pinnulariaceae	*Caloneis*	*Caloneis* spp.											
			Pinnularia	*Pinnularia* sp.	690.7587184										
				Pinnularia spp.					80.50792862						
		Rhopalodiaceae	*Epithemia*	*Epithemia* spp.											
			Rhopalodia	*Rhopalodia gibba*											
				Rhopalodia spp.											
		Surirellaceae	*Surirella*	*Surirella* spp.											
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*	4144.55231						1288.126858				
				Tabellaria flocculosa	138151.7437	127015.8758	90775.2233	64104.67385	23186.28344	5098.83548	3864.380574	34618.40931	187583.4737	64853.60917	157996.8099
				Tabellaria sp.											
				Tabellaria spp.											
		Undetermined	Undetermined	unknown Pennate diatom											
Chlorophyceae	**Chaetophorales**	Chaetophoraceae	*Gongrosira*	*Gongrosira fluminensis*						14893.9668	25440.50545				
	Chlorococcales	Hydrodictyaceae	*Pediastrum*	*Pediastrum boryanum*											
				Pediastrum sp.		2323.461144	1321.969271	1675.939186							
				Pediastrum tetras		1548.974096									
		Microsporaceae	*Microspora*	*Microspora amoena*								16638.30525			
				Microspora crassior						536.7195242					
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus falcatus*											
				Ankistrodesmus falcatus var. *acicularis*		9293.844574	5287.877085	20739.74742							
				Ankistrodesmus sp.											
			Botryococcus	*Botryococcus braunii*											
			Dictyosphaerium	*Dictyosphaerium ehrenbergianum*											
				Dictyosphaerium pulchellum											
			Oocystis	*Oocystis* cf. *borgei*											
				Oocystis parva											
				Oocystis sp.	6907.587184	5808.652859	2643.938543	7122.741538							
		Scenedesmaceae	*Scenedesmus*	*Scenedesmus* sp.		85968.06231	50014.5041	54258.53113							
			Tetrastrum	*Tetrastrum staurogeniaeforme*											

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
				Stream	Pond 19 OF	Chair OF	Chair OF	Chair OF	Llama OF	Llama OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Giraffe OF
				Replicate	3	1	2	3	1	2	2 Dup	3	1	2	3
				Lab Duplicate	no	no	no	no	no	no	yes	no	no	no	no
				Date Sampled	13-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12
				Sample ID	6138.3-33	6138.3-28	6138.3-29	6138.3-30	6138.3-1	6138.3-2	6138.3-2_DUP	6138.3-3	6138.3-7	6138.3-8	6138.3-9
Class	**Order**	**Family**	**Genus**	**Final Designation**											
				Tetrastrum triangulare											
	Oedogoniales	Oedogoniaceae	*Bulbochaete*	*Bulbochaete rectangularis*					15215.99851						
				Bulbochaete sp.						73664.75469	76804.56391		19321.90287	13417.9881	68431.73933
			Oedogonium	*Oedogonium* sp.							3059.301288				
				Oedogonium spp.											
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*											
	Ulotrichales	Ulotrichaceae	*Geminella*	*Geminella* sp.	3453.793592										5031.745539
	Volvocales	Chlamydomonadaceae	*Chlamydomonas*	*Chlamydomonas* sp.		387.2435239									
	Zygnematales	Desmidiaceae	*Actinotaenium*	*Actinotaenium diplosporum*	345.3793592										
			Closterium	*Closterium closterioides* var. *intermedium*											
				Closterium costatum			220.3282119								
				Closterium dianae		1161.730572	440.6564238								
				Closterium parvulum			220.3282119	1675.939186							
				Closterium sp.			220.3282119								
				Closterium spp.											
			Cosmarium	*Cosmarium bireme*											
				Cosmarium didymoprotupsum											
				Cosmarium garrolense											
				Cosmarium margaritatum fo. Minor											
				Cosmarium phaseolus			220.3282119	209.4923982							
				Cosmarium regnellii			220.3282119								
				Cosmarium sp.	690.7587184	4259.678763	2643.938543	5237.309955					3220.317145		
				Cosmarium subcrenatum											
				Cosmarium subtumidum			220.3282119								
				Cosmarium subtumidum var. *minutum*											
				Cosmarium subundulatum										447.2662701	4025.396431
				Cosmarium tinctum				209.4923982					805.0792862		
			Desmidium	*Desmidium* sp.											
			Euastrum	*Euastrum binale*	690.7587184										
				Euastrum obesum			220.3282119								
				Euastrum pulchellum		1548.974096									
				Euastrum sp.				628.4771946							
				Euastrum validum			1101.641059	837.9695928							
			Micrasterias	*Micrasterias papillifera*											
				Micrasterias sp.											
			Pleurotaenium	*Pleurotaenium ehrenbergii*											
			Staurastrum	*Staurastrum cingulum*					80.50792862				1610.158572		
				Staurastrum crenulatum				209.4923982	80.50792862						
				Staurastrum furcigerum			660.9846357								
				Staurastrum furcigerum var. *[furcigerum] f. armiger*					80.50792862						
				Staurastrum margaritaceum											
				Staurastrum setigerum											
				Staurastrum sp.	690.7587184	387.2435239		418.9847964							
			Staurodesmus	*Staurodesmus dejectus*									2415.237859		
				Staurodesmus extensus											
				Staurodesmus extensus var. *joshuae*											
				Staurodesmus glaber				1256.954389							
			Teilingia	*Teilingia granulata*	1381.517437	3097.948191	881.3128476	3770.863167					1610.158572		8050.792862
		Mesotaeniaceae	*Cylindrocystis*	*Cylindrocystis* sp.											
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.	1036.138078	4646.922287	1762.625695	3142.385973			536.7195242		56355.55004	29966.8401	25158.72769
			Zygnema	*Zygnema* sp.							4293.756193				
Chrysophyceae	**Chrysomonadales**	Dinobryaceae	*Dinobryon*	*Dinobryon sertularia*											
				Dinobryon sp.											
		Synuraceae	*Mallomonas*	*Mallomonas caudata*											
Cryptophyceae	**Cryptomonadales**	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.											

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Stream	Pond 19 OF	Chair OF	Chair OF	Chair OF	Llama OF	Llama OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Giraffe OF
Replicate	3	1	2	3	1	2	2 Dup	3	1	2	3
Lab Duplicate	no	no	no	no	no	no	yes	no	no	no	no
Date Sampled	13-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12
Sample ID	6138.3-33	6138.3-28	6138.3-29	6138.3-30	6138.3-1	6138.3-2	6138.3-2_DUP	6138.3-3	6138.3-7	6138.3-8	6138.3-9
Taxonomic Classification											
Class	Order	Family	Genus	Final Designation											
Dinophyceae	Peridiniales	Oxytoxaceae	*Ceratium*	*Ceratium carolinianum*											
		Peridiniaceae	*Peridinium*	*Peridinium* sp.	690.7587184										
Euglenophyceae	Euglenales	Euglenaceae	*Euglena*	*Euglena* sp.											
Myxophyceae	Chroococcales	Chamaesiphonaceae	*Chamaesiphon*	*Chamaesiphon* spp.											
		Chroococcaceae	*Chroococcus*	*Chroococcus dispersus*								12881.26858		7156.260322	
				Chroococcus minutus	5526.069747	4646.922287	881.3128476	1675.939186							20126.98216
				Chroococcus pallidus											
				Chroococcus sp.											
				Chroococcus turgidus											
	Merismopediaceae	Aphanocapsa	*Aphanocapsa*	*Aphanocapsa delicatissima*											
				Aphanocapsa elachista											352222.1877
				Aphanocapsa rivularis	11052.13949										
			Merismopedia	*Merismopedia glauca*		9293.844574							77287.61148		119755.5438
				Merismopedia punctata		21685.63734	20270.19549	53211.06914							
				Merismopedia spp.											
			Woronichinia	*Woronichinia naegeliana*		102232.2903	12338.37987	37708.63167					89363.80077	28625.04129	452857.0985
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa aeruginosa*											
				Gloeocapsa rupestris									9660.951435		
				Gloeocapsa sanguinea											
				Gloeocapsa sp.										894.5325403	12076.18929
				Gloeocapsa spp.											
			Microcystis	*Microcystis flosaquae*											
		Synechococcaceae	*Aphanothece*	*Aphanothece smithii*											
			Cyanothece	*Cyanothece aeruginosa*									805.0792862		
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.		19362.1762									
			Nostoc	*Nostoc linckia*											
				Nostoc paludosum											
				Nostoc sp.											
		Rivulariaceae	*Calothrix*	*Calothrix breviarticulata*											
				Calothrix fusca											
				Calothrix parietina											
				Calothrix sp.	5526.069747	5808.652859	3304.923178	71436.90778			1127.111001				
			Dichothrix	*Dichothrix* sp.									66821.58076	24152.37859	146926.9697
			Gloeotrichia	*Gloeotrichia* sp.								52598.51337			
			Rivularia	*Rivularia haematites*											
		Scytonemataceae	*Scytonema*	*Scytonema mirabile*											
				Scytonema sp.											
	Oscillatoriales	Borziaceae	*Komvophoron*	*Komvophoron* spp.											
		Oscillatoriaceae	*Homoeothrix*	*Homoeothrix janthina*					151596.4296	35423.48859	6279.618433	146792.7899			
			Oscillatoria	*Oscillatoria* sp.	9325.242698	8519.357526	11677.39523	36451.67728							
				Oscillatoria ucrainica											
		Phormidiaceae	*Phormidium*	*Phormidium aerugineo-caeruleum*											
				Phormidium sp.											
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya foveolarum*									31398.09216	81849.72743	206301.5671
				Leptolyngbya sp.											
				Leptolyngbya tenuis						5501.375123	5313.523289				
			Pseudanabaena	*Pseudanabaena* sp.											38241.2661
	Stigonematales	Stigonemataceae	*Stigonema*	*Stigonema mamillosum*			8813.128476						91779.03863	125681.8219	218377.7564
				Total	**284937.9713**	**476696.778**	**252055.4744**	**376248.3471**	**196761.3776**	**145048.4514**	**136058.3994**	**318543.0376**	**712495.1683**	**432953.7495**	**1924139.494**

Note Echo OF was dry during August sampling.

**Komatic IF had no rocks so periphyton was collected from sediment surface using modified methods.*

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose Reference B	Goose Reference B
				Stream	Wolf OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor OF	Propellor OF	OF	OF
				Replicate	1	2	3	1	2	3	1	2	2 Dup	3	1	2
				Lab Duplicate	no	no	no	no	no	no	no	no	yes	no	no	no
				Date Sampled	8-Aug-12	8-Aug-12	8-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	10-Aug-12	10-Aug-12
				Sample ID	6138.3-4	6138.3-5	6138.3-6	6138.3-10	6138.3-11	6138.3-12	6138.3-13	6138.3-14	6138.3-14_DUP	6138.3-15	6138.3-16	6138.3-17
Class	**Order**	**Family**	**Genus**	**Final Designation**												
Bacillariophyceae	**Centrales**	Aulacoseiraceae	*Aulacoseira*	*Aulacoseira* spp.								16514.4469		7092.365141		
		Melosiraceae	*Melosira*	*Melosira* spp.			1006.349108									
		Stephanodiscaceae	*Cyclotella*	*Cyclotella meneghiniana*												
				Cyclotella sp.												
				Cyclotella spp.					1252.345556	766.7421774	1341.79881		309.6458793		751.4073338	
		Undetermined	Undetermined	unknown Centric diatom												
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.	3354.497026	8721.692268	17107.93483	7741.146983		4600.453064	4696.295836	2477.167035	928.937638		1502.814668	357.8130161
			Cocconeis	*Cocconeis* spp.												
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.												
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.												
				Frustulia spp.												
		Bacillariaceae	*Nitzschia*	*Nitzschia* spp.	9616.224808	14759.78691	7044.443755	14863.00221	7335.16683	16868.3279	12747.0887	4335.042311	774.1146983		2254.222001	2683.597621
		Cymbellaceae	*Cymbella*	*Cymbella* sp.												
				Cymbella spp.			251.5872769	928.937638	894.5325403	4600.453064		412.8611724	309.6458793			
		Encyonema	*Encyonema*	*Encyonema* spp.												
		Eunotiaceae	*Eunotia*	*Eunotia bilunaris*												
				Eunotia sp.	13194.35497	670.8994052	2012.698216	15172.64809	1789.065081	3066.968709	1006.349108	1857.875276	2322.344095		2790.941526	2146.878097
				Eunotia spp.												
		Fragilariaceae	*Diatoma*	*Diatoma* spp.												
			Fragilaria	*Fragilaria* sp.												
				Fragilaria spp.												
			Synedra	*Synedra* sp.												
				Synedra spp.												
		Gomphonemataceae	*Gomphonema*	*Gomphonema* sp.											2790.941526	
				Gomphonema spp.												
		Naviculaceae	*Navicula*	*Navicula* sp.												
				Navicula spp.	4249.029566	4025.396431	5786.50737	5883.271707	1967.971589	11884.50375	6373.544349	5573.625828	4489.86525		966.0951435	2504.691113
		Neidiaceae	*Neidium*	*Neidium* spp.												
		Pinnulariaceae	*Caloneis*	*Caloneis* spp.												
			Pinnularia	*Pinnularia* sp.												
				Pinnularia spp.	447.2662701		503.1745539	1857.875276								
		Rhopalodiaceae	*Epithemia*	*Epithemia* spp.												
			Rhopalodia	*Rhopalodia gibba*												
				Rhopalodia spp.												
		Surirellaceae	*Surirella*	*Surirella* spp.												
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*			1006.349108		536.7195242	16484.95681	5031.745539	825.7223449	1393.406457	13801.35919		
				Tabellaria flocculosa	30414.10637	55349.20093	36228.56788	48304.75717	30235.19986	50604.98371	52665.60331	34061.04673	24771.67035	41979.13421	7514.073338	8229.69937
				Tabellaria sp.												
				Tabellaria spp.												
		Undetermined	Undetermined	unknown Pennate diatom												
Chlorophyceae	**Chaetophorales**	Chaetophoraceae	*Gongrosira*	*Gongrosira fluminensis*												
	Chlorococcales	Hydrodictyaceae	*Pediastrum*	*Pediastrum boryanum*												
				Pediastrum sp.												
				Pediastrum tetras												
		Microsporaceae	*Microspora*	*Microspora amoena*												
				Microspora crassior												
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus falcatus*												
				Ankistrodesmus falcatus var. *acicularis*												
				Ankistrodesmus sp.												
			Botryococcus	*Botryococcus braunii*						18401.81226						
			Dictyosphaerium	*Dictyosphaerium ehrenbergianum*			22642.85493									
				Dictyosphaerium pulchellum											30915.04459	
			Oocystis	*Oocystis* cf. *borgei*	1789.065081		251.5872769									
				Oocystis parva												
				Oocystis sp.												
		Scenedesmaceae	*Scenedesmus*	*Scenedesmus* sp.			1006.349108					1651.44469	619.2917586	2300.226532		
			Tetrastrum	*Tetrastrum staurogeniaeforme*			1006.349108									

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose Reference B	Goose Reference B
Stream	Wolf OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor OF	Propellor OF	OF	OF
Replicate	1	2	3	1	2	3	1	2	2 Dup	3	1	2
Lab Duplicate	no	no	no	no	no	no	no	no	yes	no	no	no
Date Sampled	8-Aug-12	8-Aug-12	8-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	10-Aug-12	10-Aug-12
Sample ID	6138.3-4	6138.3-5	6138.3-6	6138.3-10	6138.3-11	6138.3-12	6138.3-13	6138.3-14	6138.3-14_DUP	6138.3-15	6138.3-16	6138.3-17
Taxonomic Classification												
Class	Order	Family	Genus	Final Designation												
				Tetrastrum triangulare												
	Oedogoniales	Oedogoniaceae	*Bulbochaete*	*Bulbochaete rectangularis*												
				Bulbochaete sp.		10734.39048	9308.729247	2477.167035	42937.56193	15718.21464	43273.01164	28693.85148	34061.04673	5367.195242	7084.697719	5367.195242
			Oedogonium	*Oedogonium* sp.	2012.698216										23937.69078	15922.67922
				Oedogonium spp.												
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*					357.8130161			412.8611724				
	Ulotrichales	Ulotrichaceae	*Geminella*	*Geminella* sp.								5780.056414		3450.339798		1073.439048
	Volvocales	Chlamydomonadaceae	*Chlamydomonas*	*Chlamydomonas* sp.												
	Zygnematales	Desmidiaceae	*Actinotaenium*	*Actinotaenium diplosporum*						383.3710887				191.6855443		
			Closterium	*Closterium closterioides* var. *intermedium*												
				Closterium costatum												
				Closterium dianae												
				Closterium parvulum		335.4497026										
				Closterium sp.												
				Closterium spp.												
			Cosmarium	*Cosmarium bireme*												
				Cosmarium didymoprotupsum						383.3710887						
				Cosmarium garrolense												
				Cosmarium margaritatum fo. Minor												
				Cosmarium phaseolus					536.7195242		1006.349108			383.3710887		89.45325403
				Cosmarium regnellii												
				Cosmarium sp.	223.6331351						670.8994052		154.8229397			89.45325403
				Cosmarium subcrenatum	1341.79881					383.3710887	335.4497026		154.8229397	575.056633	107.3439048	1073.439048
				Cosmarium subtumidum		1341.79881	251.5872769		178.9065081			206.4305862				357.8130161
				Cosmarium subtumidum var. *minutum*												
				Cosmarium subundulatum		670.8994052		619.2917586						1725.169899		
				Cosmarium tinctum		2348.147918	754.7618308		178.9065081							
			Desmidium	*Desmidium* sp.						6900.679596						
			Euastrum	*Euastrum binale*			251.5872769								107.3439048	89.45325403
				Euastrum obesum												
				Euastrum pulchellum					178.9065081		335.4497026			191.6855443		268.3597621
				Euastrum sp.	223.6331351						335.4497026					
				Euastrum validum	447.2662701		2012.698216		178.9065081	383.3710887					644.063429	
			Micrasterias	*Micrasterias papillifera*		335.4497026										
				Micrasterias sp.												
			Pleurotaenium	*Pleurotaenium ehrenbergii*												
			Staurastrum	*Staurastrum cingulum*			251.5872769			766.7421774						
				Staurastrum crenulatum								412.8611724				
				Staurastrum furcigerum												
				Staurastrum furcigerum var. *[furcigerum] f. armiger*												
				Staurastrum margaritaceum												
				Staurastrum setigerum												
				Staurastrum sp.			251.5872769	309.6458793		383.3710887	2683.597621		309.6458793		644.063429	
			Staurodesmus	*Staurodesmus dejectus*										575.056633		
				Staurodesmus extensus												
				Staurodesmus extensus var. *joshuae*												
				Staurodesmus glaber			1257.936385			383.3710887	335.4497026				107.3439048	
			Teilingia	*Teilingia granulata*				1857.875276			2683.597621					
		Mesotaeniaceae	*Cylindrocystis*	*Cylindrocystis* sp.												
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.	1118.165675			3096.458793	13954.70763	8434.163951	20797.88156	11972.974	7276.678164	12267.87484	8158.136767	2325.784605
			Zygnema	*Zygnema* sp.				3715.750552		5750.56633			8515.261681	1725.169899	13954.70763	4472.662701
Chrysophyceae	Chrysomonadales	Dinobryaceae	*Dinobryon*	*Dinobryon sertularia*												
				Dinobryon sp.												
		Synuraceae	*Mallomonas*	*Mallomonas caudata*		670.8994052	251.5872769									
Cryptophyceae	Cryptomonadales	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.												

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Taxonomic Classification				Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose Reference B	Goose Reference B
				Stream	Wolf OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor OF	Propellor OF	OF	OF
				Replicate	1	2	3	1	2	3	1	2	2 Dup	3	1	2
				Lab Duplicate	no	no	no	no	no	no	no	no	yes	no	no	no
				Date Sampled	8-Aug-12	8-Aug-12	8-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	10-Aug-12	10-Aug-12
				Sample ID	6138.3-4	6138.3-5	6138.3-6	6138.3-10	6138.3-11	6138.3-12	6138.3-13	6138.3-14	6138.3-14_DUP	6138.3-15	6138.3-16	6138.3-17
Class	**Order**	**Family**	**Genus**	**Final Designation**												
Dinophyceae	**Peridiniales**	Oxytoxaceae	*Ceratium*	*Ceratium carolinianum*												
		Peridiniaceae	*Peridinium*	*Peridinium* sp.		335.4497026		309.6458793								
Euglenophyceae	**Euglenales**	Euglenaceae	*Euglena*	*Euglena* sp.	223.6331351											
Myxophyceae	**Chroococcales**	Chamaesiphonaceae	*Chamaesiphon*	*Chamaesiphon* spp.												
		Chroococcaceae	*Chroococcus*	*Chroococcus dispersus*	1789.065081	2683.597621		4335.042311								
				Chroococcus minutus		18785.18335		9908.668138		6133.937419		2477.167035				357.8130161
				Chroococcus pallidus												
				Chroococcus sp.												
				Chroococcus turgidus												
	Merismopediaceae	Aphanocapsa	*Aphanocapsa*	*Aphanocapsa delicatissima*												
				Aphanocapsa elachista				235330.8683	64406.3429							
				Aphanocapsa rivularis						30669.68709						
			Merismopedia	*Merismopedia glauca*			34215.86967		2862.504129	12267.87484						
				Merismopedia punctata					178.9065081	18401.81226					21039.40535	21468.78097
				Merismopedia spp.												
			Woronichinia	*Woronichinia naegeliana*	29519.57383	134850.7804	89565.07059	60380.94647	71920.41624	62489.48746	45285.70985				53671.95242	33813.33002
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa aeruginosa*												
				Gloeocapsa rupestris			4025.396431	13934.06457	3041.410637						644.063429	715.6260322
				Gloeocapsa sanguinea												
				Gloeocapsa sp.		6038.094647	4025.396431					412.8611724	4799.51113		1717.502477	
				Gloeocapsa spp.												
			Microcystis	*Microcystis flosaquae*												10734.39048
		Synechococcaceae	*Aphanothece*	*Aphanothece smithii*		20126.98216										
			Cyanothece	*Cyanothece aeruginosa*												
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.												4830.475717
			Nostoc	*Nostoc linckia*												
				Nostoc paludosum												
				Nostoc sp.					40253.96431	22618.89423					2576.253716	7156.260322
		Rivulariaceae	*Calothrix*	*Calothrix breviarticulata*												
				Calothrix fusca												
				Calothrix parietina												
				Calothrix sp.					10376.57747	41787.44867	32874.07085	39634.67255	36693.0367	17443.38454	33383.9544	45263.34654
			Dichothrix	*Dichothrix* sp.	95938.61494	16437.03543	6038.094647	42731.13135	33097.70399	95842.77217	71115.33695	24358.80917	23068.61801	17826.75562		11002.75025
			Gloeotrichia	*Gloeotrichia* sp.	171973.8809								387057.3492			
			Rivularia	*Rivularia haematites*												
		Scytonemataceae	*Scytonema*	*Scytonema mirabile*												
				Scytonema sp.												
	Oscillatoriales	Borziaceae	*Komvophoron*	*Komvophoron* spp.												
		Oscillatoriaceae	*Homoeothrix*	*Homoeothrix janthina*		63399.99379										
			Oscillatoria	*Oscillatoria* sp.								51194.78538	24616.84741	32394.85699		
				Oscillatoria ucrainica			10818.25291									
		Phormidiaceae	*Phormidium*	*Phormidium aerugineo-caeruleum*												
				Phormidium sp.												
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya foveolarum*			10566.66563	93203.40968				18785.18335		15909.90018		3667.583415
				Leptolyngbya sp.												
				Leptolyngbya tenuis		6038.094647	14340.47479									
			Pseudanabaena	*Pseudanabaena* sp.		23146.02948	9811.903801	19198.04452								
	Stigonematales	Stigonemataceae	*Stigonema*	*Stigonema mamillosum*				44898.6525	14133.61414				3406.104673	14376.41583		10376.57747
				Total	**367876.5072**	**391805.2526**	**293853.9395**	**631058.3021**	**342784.8694**	**457361.7088**	**305594.6791**	**252051.7458**	**566032.6674**	**189577.0034**	**217264.0634**	**196439.3458**

Note Echo OF was dry during August sampling.

**Komatic IF had no rocks so periphyton was collected from sediment surface using modified methods.*

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Taxonomic Classification				Area	Goose Reference B	George	George	George	George	George	George	George	George	George	George
				Stream	OF	George OF	George OF	George OF	George OF	Sleigh OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF	Dragon OF
				Replicate	3	1	2	3	3 Dup	1	2	3	1	2	3
				Lab Duplicate	no	no	no	no	yes	no	no	no	no	no	no
				Date Sampled	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
				Sample ID	6138.3-18	6141.3-1	6141.3-2	6141.3-3	6141.3-3_DUP	6141.3-4	6141.3-5	6141.3-6	6141.3-7	6141.3-8	6141.3-9
Class	**Order**	**Family**	**Genus**	**Final Designation**											
Bacillariophyceae	**Centrales**	Aulacoseiraceae	*Aulacoseira*	*Aulacoseira* spp.											
		Melosiraceae	*Melosira*	*Melosira* spp.											
		Stephanodiscaceae	*Cyclotella*	*Cyclotella meneghiniana*										459.7007426	398.9469486
				Cyclotella sp.											
				Cyclotella spp.	452.8570985										
		Undetermined	Undetermined	unknown Centric diatom		222.8765829	121.5399339	459.9595102	379.4665959	203.6302408	72.87878752	98.49343942	276.7658716	459.7007426	398.9469486
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.	301.9047323										
			Cocconeis	*Cocconeis* spp.									415.1488075	459.7007426	598.4204229
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.		10920.95256	2714.391856	11383.99788	13660.79745	10486.9574	6486.212089	8273.448911	20342.29157	27122.34381	27926.2864
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.											
				Frustulia spp.			40.51331129	114.9898776					830.2976149	5286.558539	
		Bacillariaceae	*Nitzschia*	*Nitzschia* spp.	553.4920093	3491.733132	2552.338611	5289.534367	7083.376457	6414.352585	5247.272701	8864.409548	968.6805508	4137.306683	3391.049063
		Cymbellaceae	*Cymbella*	*Cymbella* sp.											
				Cymbella spp.	100.6349108										
		Encyonema	*Encyonema*	*Encyonema* spp.											
		Eunotiaceae	*Eunotia*	*Eunotia bilunaris*											398.9469486
				Eunotia sp.	1358.571296										
				Eunotia spp.		222.8765829	972.3194709	1379.878531	252.9777306	712.7058428		590.9606365	553.5317433	1379.102228	598.4204229
		Fragilariaceae	*Diatoma*	*Diatoma* spp.											
			Fragilaria	*Fragilaria* sp.											
				Fragilaria spp.		520.0453602	162.0532452	574.9493878		203.6302408		492.4671971	1245.446422	459.7007426	598.4204229
			Synedra	*Synedra* sp.											
				Synedra spp.			283.593179	114.9898776		203.6302408		196.9868788	1660.59523	689.5511138	1795.261269
		Gomphonemataceae	*Gomphonema*	*Gomphonema* sp.											
				Gomphonema spp.											
		Naviculaceae	*Navicula*	*Navicula* sp.											
				Navicula spp.	754.7618308	148.5843886	526.6730468	804.9291429	1011.910922	1527.226806	874.5454502	1181.921273	7887.827342	13561.17191	3391.049063
		Neidiaceae	*Neidium*	*Neidium* spp.											
		Pinnulariaceae	*Caloneis*	*Caloneis* spp.											
			Pinnularia	*Pinnularia* sp.											
				Pinnularia spp.	100.6349108										
		Rhopalodiaceae	*Epithemia*	*Epithemia* spp.										229.8503713	
			Rhopalodia	*Rhopalodia gibba*											
				Rhopalodia spp.											
		Surirellaceae	*Surirella*	*Surirella* spp.											
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*											
				Tabellaria flocculosa	6641.904111	4977.577019	4861.597355	10694.05861	9739.642629	6821.613067	2915.151501	5318.645729	3321.19046	2758.204455	3191.575589
				Tabellaria sp.											
				Tabellaria spp.											
		Undetermined	Undetermined	unknown Pennate diatom		594.3375545	202.5665564	459.9595102	505.9554612	712.7058428	437.2727251	590.9606365	968.6805508	229.8503713	797.8938972
Chlorophyceae	**Chaetophorales**	Chaetophoraceae	*Gongrosira*	*Gongrosira fluminensis*											
	Chlorococcales	Hydrodictyaceae	*Pediastrum*	*Pediastrum boryanum*						3258.083853					
				Pediastrum sp.											
				Pediastrum tetras											
		Microsporaceae	*Microspora*	*Microspora amoena*											
				Microspora crassior											
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus falcatus*											
				Ankistrodesmus falcatus var. *acicularis*											
				Ankistrodesmus sp.											
			Botryococcus	*Botryococcus braunii*											
			Dictyosphaerium	*Dictyosphaerium ehrenbergianum*	1610.158572										
				Dictyosphaerium pulchellum	7446.983398										
			Oocystis	*Oocystis* cf. *borgei*											
				Oocystis parva											
				Oocystis sp.											
		Scenedesmaceae	*Scenedesmus*	*Scenedesmus* sp.											
			Tetrastrum	*Tetrastrum staurogeniaeforme*											

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Area					Goose Reference B	George	George	George	George	George	George	George	George	George	George
Stream					OF	George OF	George OF	George OF	George OF	Sleigh OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF	Dragon OF
Replicate					3	1	2	3	3 Dup	1	2	3	1	2	3
Lab Duplicate					no	no	no	no	yes	no	no	no	no	no	no
Date Sampled					10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
Taxonomic Classification				Sample ID	6138.3-18	6141.3-1	6141.3-2	6141.3-3	6141.3-3_DUP	6141.3-4	6141.3-5	6141.3-6	6141.3-7	6141.3-8	6141.3-9
Class	Order	Family	Genus	Final Designation											
				Tetrastrum triangulare											
	Oedogoniales	Oedogoniaceae	*Bulbochaete*	*Bulbochaete rectangularis*											
				Bulbochaete sp.	1811.428394		526.6730468	574.9493878	758.9331918			886.4409548	7611.06147	8734.314108	1196.840846
			Oedogonium	*Oedogonium* sp.											
				Oedogonium spp.		222.8765829		574.9493878	632.4443265			393.9737577	1245.446422	1149.251856	997.3673715
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*	402.5396431		81.02662258						276.7658716		
	Ulotrichales	Ulotrichaceae	*Geminella*	*Geminella* sp.											
	Volvocales	Chlamydomonadaceae	*Chlamydomonas*	*Chlamydomonas* sp.											
	Zygnematales	Desmidiaceae	*Actinotaenium*	*Actinotaenium diplosporum*											
			Closterium	*Closterium closterioides* var. *intermedium*	50.31745539										
				Closterium costatum											
				Closterium dianae											
				Closterium parvulum											
				Closterium sp.											
				Closterium spp.											
			Cosmarium	*Cosmarium bireme*								196.9868788		229.8503713	199.4734743
				Cosmarium didymoprotupsum											
				Cosmarium garrolense		148.5843886	81.02662258		126.4888653	203.6302408					
				Cosmarium margaritatum fo. Minor									138.3829358		
				Cosmarium phaseolus				114.9898776					276.7658716		
				Cosmarium regnellii				344.9696327	126.4888653	101.8151204					
				Cosmarium sp.	50.31745539										
				Cosmarium subcrenatum	100.6349108										
				Cosmarium subtumidum											
				Cosmarium subtumidum var. *minutum*											
				Cosmarium subundulatum	50.31745539										
				Cosmarium tinctum											
			Desmidium	*Desmidium* sp.											
			Euastrum	*Euastrum binale*											
				Euastrum obesum	50.31745539										
				Euastrum pulchellum					126.4888653						199.4734743
				Euastrum sp.	50.31745539							98.49343942		229.8503713	
				Euastrum validum											
			Micrasterias	*Micrasterias papillifera*											
				Micrasterias sp.											
			Pleurotaenium	*Pleurotaenium ehrenbergii*											
			Staurastrum	*Staurastrum cingulum*											
				Staurastrum crenulatum											
				Staurastrum furcigerum											
				Staurastrum furcigerum var. *[furcigerum] f. armiger*											
				Staurastrum margaritaceum											398.9469486
				Staurastrum setigerum											
				Staurastrum sp.									276.7658716	229.8503713	
			Staurodesmus	*Staurodesmus dejectus*											
				Staurodesmus extensus											
				Staurodesmus extensus var. *joshuae*											
				Staurodesmus glaber											
			Teilingia	*Teilingia granulata*									4289.871011	459.7007426	
		Mesotaeniaceae	*Cylindrocystis*	*Cylindrocystis* sp.											
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.	654.1269201	1040.09072	729.2396032	689.9392653	632.4443265	1323.596565			1798.978166	4137.306683	4188.94296
			Zygnema	*Zygnema* sp.		1262.967303	810.2662258	804.9291429					4289.871011	5746.259282	1196.840846
Chrysophyceae	**Chrysomonadales**	Dinobryaceae	*Dinobryon*	*Dinobryon sertularia*											
				Dinobryon sp.											
		Synuraceae	*Mallomonas*	*Mallomonas caudata*											
Cryptophyceae	**Cryptomonadales**	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.	100.6349108										

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

				Area	Goose Reference B	George	George	George	George	George	George	George	George	George	George
				Stream	OF	George OF	George OF	George OF	George OF	Sleigh OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF	Dragon OF
				Replicate	3	1	2	3	3 Dup	1	2	3	1	2	3
				Lab Duplicate	no	no	no	no	yes	no	no	no	no	no	no
				Date Sampled	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
Taxonomic Classification				Sample ID	6138.3-18	6141.3-1	6141.3-2	6141.3-3	6141.3-3_DUP	6141.3-4	6141.3-5	6141.3-6	6141.3-7	6141.3-8	6141.3-9
Class	**Order**	**Family**	**Genus**	**Final Designation**											
Dinophyceae	**Peridiniales**	Oxytoxaceae	*Ceratium*	*Ceratium carolinianum*	50.31745539										
		Peridiniaceae	*Peridinium*	*Peridinium* sp.											
Euglenophyceae	**Euglenales**	Euglenaceae	*Euglena*	*Euglena* sp.											
Myxophyceae	**Chroococcales**	Chamaesiphonaceae	*Chamaesiphon*	*Chamaesiphon* spp.											
		Chroococcaceae	*Chroococcus*	*Chroococcus dispersus*				919.9190204							
				Chroococcus minutus											
				Chroococcus pallidus									276.7658716		
				Chroococcus sp.											398.9469486
				Chroococcus turgidus										919.4014851	
	Merismopediaceae	Aphanocapsa	*Aphanocapsa*	*Aphanocapsa delicatissima*											
				Aphanocapsa elachista					7589.331918						
				Aphanocapsa rivularis	2012.698216								8302.976149		
			Merismopedia	*Merismopedia glauca*	1610.158572										
				Merismopedia punctata	4830.475717										
				Merismopedia spp.						1629.041926	2332.121201	3151.790062	22141.26973		
			Woronichinia	*Woronichinia naegeliana*	22139.68037										
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa aeruginosa*											
				Gloeocapsa rupestris	19321.90287										
				Gloeocapsa sanguinea											
				Gloeocapsa sp.	18164.6014										
				Gloeocapsa spp.											
			Microcystis	*Microcystis flosaquae*											
		Synechococcaceae	*Aphanothece*	*Aphanothece smithii*											
			Cyanothece	*Cyanothece aeruginosa*											
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.	1912.063305										
			Nostoc	*Nostoc linckia*										18388.0297	
				Nostoc paludosum											
				Nostoc sp.											
		Rivulariaceae	*Calothrix*	*Calothrix breviarticulata*								1772.88191			
				Calothrix fusca			324.1064903	2299.797551	505.9554612	2239.932649	291.5151501	1575.895031		1379.102228	1994.734743
				Calothrix parietina		520.0453602	202.5665564	1724.848163	1644.355249	3868.974575	3206.666651		1660.59523		
				Calothrix sp.	25812.85462	1560.13608	1174.886027	919.9190204	885.4220572	2036.302408	2404.999988	4136.724456		2068.653341	1994.734743
			Dichothrix	*Dichothrix* sp.	9258.411792	18573.04858								50567.08168	
			Gloeotrichia	*Gloeotrichia* sp.											
			Rivularia	*Rivularia haematites*							14575.7575				
		Scytonemataceae	*Scytonema*	*Scytonema mirabile*											
				Scytonema sp.											
	Oscillatoriales	Borziaceae	*Komvophoron*	*Komvophoron* spp.					2656.266171						3590.522537
		Oscillatoriaceae	*Homoeothrix*	*Homoeothrix janthina*											
			Oscillatoria	*Oscillatoria* sp.											
				Oscillatoria ucrainica											
		Phormidiaceae	*Phormidium*	*Phormidium aerugineo-caeruleum*							1457.57575	787.9475154			4388.416435
				Phormidium sp.		3120.272161	1215.399339	4829.574857	3415.199363	5599.831622	5101.515126	2363.842546		1608.952599	6582.624652
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya foveolarum*											
				Leptolyngbya sp.		3268.85655	4091.84444	25067.79331	22388.52916	14559.56222	12972.42418	11228.25209	1522.212294	13561.17191	19149.45353
				Leptolyngbya tenuis											
			Pseudanabaena	*Pseudanabaena* sp.											
	Stigonematales	Stigonemataceae	*Stigonema*	*Stigonema mamillosum*		23773.50218	2835.93179		18973.3298						
				Total	**127756.0192**	**74589.36308**	**24510.55333**	**70143.82531**	**93095.80487**	**62107.22345**	**58375.9088**	**52201.52289**	**92578.18407**	**166641.5192**	**89962.53691**

Note Echo OF was dry during August sampling.

**Komatic IF had no rocks so periphyton was collected from sediment surface using modified methods.*

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Taxonomic Classification				Area	George	George	George	George	George	George	George
				Stream	Komatic IF*	Komatic IF*	Komatic IF*	Reference C OF	Reference C OF	Reference C OF	Reference C OF
				Replicate	1	2	3	1	2	2 Dup	3
				Lab Duplicate	no	no	no	no	no	yes	no
				Date Sampled	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12
				Sample ID	6141.3-13	6141.3-14	6141.3-15	6141.3-10	6141.3-11	6141.3-11_DUP	6141.3-12
Class	**Order**	**Family**	**Genus**	**Final Designation**							
Bacillariophyceae	**Centrales**	Aulacoseiraceae	*Aulacoseira*	*Aulacoseira* spp.				98.20232581	1246.875998		
		Melosiraceae	*Melosira*	*Melosira* spp.							
		Stephanodiscaceae	*Cyclotella*	*Cyclotella meneghiniana*							
				Cyclotella sp.							
				Cyclotella spp.							
		Undetermined	Undetermined	unknown Centric diatom	265.4116914	285.4576924	162.2473209	98.20232581	178.1251426		1258.026689
	Pennales	Achnanthaceae	*Achnanthes*	*Achnanthes* sp.							
			Cocconeis	*Cocconeis* spp.			162.2473209				
		Achnanthidiaceae	*Achnanthidium*	*Achnanthidium* sp.	17915.28917	10990.12116	27744.29187	10311.24421	10153.13313	11590.00928	51159.75203
		Amphipleuraceae	*Frustulia*	*Frustulia* sp.							
				Frustulia spp.	265.4116914	428.1865386	162.2473209	589.2139549		190.0001521	1258.026689
		Bacillariaceae	*Nitzschia*	*Nitzschia* spp.	4246.587062	9277.375003	2433.709814	687.4162807	712.5005704	950.0007605	2096.711149
		Cymbellaceae	*Cymbella*	*Cymbella* sp.							
				Cymbella spp.	1327.058457	570.9153848	324.4946418	98.20232581		190.0001521	3354.737838
		Encyonema	*Encyonema*	*Encyonema* spp.	398.1175371	713.644231					
		Eunotiaceae	*Eunotia*	*Eunotia bilunaris*			162.2473209				
				Eunotia sp.							
				Eunotia spp.	4379.292908	3282.763463	811.2366045	589.2139549	890.625713	570.0004563	2096.711149
		Fragilariaceae	*Diatoma*	*Diatoma* spp.							1677.368919
			Fragilaria	*Fragilaria* sp.							
				Fragilaria spp.	398.1175371	428.1865386	162.2473209				1258.026689
			Synedra	*Synedra* sp.							
				Synedra spp.		142.7288462	162.2473209	196.4046516	356.2502852	190.0001521	838.6844595
		Gomphonemataceae	*Gomphonema*	*Gomphonema* sp.							
				Gomphonema spp.					4631.253708	2280.001825	
		Naviculaceae	*Navicula*	*Navicula* sp.							
				Navicula spp.	3981.175371	3996.407694	5354.16159	3928.093032	4809.37885	6080.004867	25579.87602
		Neidiaceae	*Neidium*	*Neidium* spp.	132.7058457	713.644231	811.2366045				
		Pinnulariaceae	*Caloneis*	*Caloneis* spp.	796.2350741	713.644231	162.2473209			190.0001521	
			Pinnularia	*Pinnularia* sp.							
				Pinnularia spp.		285.4576924	648.9892836				
		Rhopalodiaceae	*Epithemia*	*Epithemia* spp.						380.0003042	8386.844595
			Rhopalodia	*Rhopalodia gibba*				196.4046516			
				Rhopalodia spp.				294.6069774			419.3422298
		Surirellaceae	*Surirella*	*Surirella* spp.	265.4116914						
		Tabellariaceae	*Tabellaria*	*Tabellaria fenestrata*							
				Tabellaria flocculosa			5191.914269				
				Tabellaria sp.							
				Tabellaria spp.	4113.881216	4567.323079	486.7419627		534.3754278	2090.001673	5451.448987
		Undetermined	Undetermined	unknown Pennate diatom	663.5292284	999.1019234	973.4839254	491.011629	356.2502852	380.0003042	2516.053379
Chlorophyceae	**Chaetophorales**	Chaetophoraceae	*Gongrosira*	*Gongrosira fluminensis*							
	Chlorococcales	Hydrodictyaceae	*Pediastrum*	*Pediastrum boryanum*							
				Pediastrum sp.							
				Pediastrum tetras							
		Microsporaceae	*Microspora*	*Microspora amoena*							
				Microspora crassior							
		Oocystaceae	*Ankistrodesmus*	*Ankistrodesmus falcatus*							
				Ankistrodesmus falcatus var. *acicularis*							
				Ankistrodesmus sp.							
			Botryococcus	*Botryococcus braunii*							
			Dictyosphaerium	*Dictyosphaerium ehrenbergianum*							
				Dictyosphaerium pulchellum							
			Oocystis	*Oocystis* cf. *borgei*							
				Oocystis parva					712.5005704		
				Oocystis sp.							
		Scenedesmaceae	*Scenedesmus*	*Scenedesmus* sp.							
			Tetrastrum	*Tetrastrum staurogeniaeforme*							

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2

Taxonomic Classification				Area	George	George	George	George	George	George	George
				Stream	Komatic IF*	Komatic IF*	Komatic IF*	Reference C OF	Reference C OF	Reference C OF	Reference C OF
				Replicate	1	2	3	1	2	2 Dup	3
				Lab Duplicate	no	no	no	no	no	yes	no
				Date Sampled	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12
				Sample ID	6141.3-13	6141.3-14	6141.3-15	6141.3-10	6141.3-11	6141.3-11_DUP	6141.3-12
Class	**Order**	**Family**	**Genus**	**Final Designation**							
				Tetrastrum triangulare							
	Oedogoniales	Oedogoniaceae	*Bulbochaete*	*Bulbochaete rectangularis*							
				Bulbochaete sp.							
			Oedogonium	*Oedogonium* sp.							
				Oedogonium spp.		1855.475001	811.2366045				
	Tetrasporales	Coccomyxaceae	*Elakatothrix*	*Elakatothrix gelatinosa*							
	Ulotrichales	Ulotrichaceae	*Geminella*	*Geminella* sp.							
	Volvocales	Chlamydomonadaceae	*Chlamydomonas*	*Chlamydomonas* sp.							
	Zygnematales	Desmidiaceae	*Actinotaenium*	*Actinotaenium diplosporum*							
			Closterium	*Closterium closterioides* var. *intermedium*							
				Closterium costatum							
				Closterium dianae							
				Closterium parvulum							
				Closterium sp.							
				Closterium spp.		285.4576924					
			Cosmarium	*Cosmarium bireme*					178.1251426		419.3422298
				Cosmarium didymoprotupsum							
				Cosmarium garrolense							419.3422298
				Cosmarium margaritatum fo. Minor							
				Cosmarium phaseolus							
				Cosmarium regnellii							
				Cosmarium sp.							
				Cosmarium subcrenatum							
				Cosmarium subtumidum							
				Cosmarium subtumidum var. *minutum*							
				Cosmarium subundulatum							
				Cosmarium tinctum							
			Desmidium	*Desmidium* sp.							
			Euastrum	*Euastrum binale*							
				Euastrum obesum							
				Euastrum pulchellum	132.7058457						
				Euastrum sp.							
				Euastrum validum							
			Micrasterias	*Micrasterias papillifera*							
				Micrasterias sp.							
			Pleurotaenium	*Pleurotaenium ehrenbergii*					178.1251426		
			Staurastrum	*Staurastrum cingulum*							
				Staurastrum crenulatum							
				Staurastrum furcigerum							
				Staurastrum furcigerum var. *[furcigerum] f. armiger*							
				Staurastrum margaritaceum	132.7058457						
				Staurastrum setigerum							
				Staurastrum sp.							
			Staurodesmus	*Staurodesmus dejectus*							
				Staurodesmus extensus							
				Staurodesmus extensus var. *joshuae*							
				Staurodesmus glaber							
			Teilingia	*Teilingia granulata*			162.2473209				
		Mesotaeniaceae	*Cylindrocystis*	*Cylindrocystis* sp.							
		Zygnemataceae	*Mougeotia*	*Mougeotia* sp.					178.1251426	570.0004563	
			Zygnema	*Zygnema* sp.							
Chrysophyceae	**Chrysomonadales**	Dinobryaceae	*Dinobryon*	*Dinobryon sertularia*							
				Dinobryon sp.							
		Synuraceae	*Mallomonas*	*Mallomonas caudata*							
Cryptophyceae	**Cryptomonadales**	Cryptomonadaceae	*Cryptomonas*	*Cryptomonas* sp.							

Appendix 3.6-7. Stream Periphyton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in cells/cm^2				Area	George	George	George	George	George	George	George
				Stream	Komatic IF*	Komatic IF*	Komatic IF*	Reference C OF	Reference C OF	Reference C OF	Reference C OF
				Replicate	1	2	3	1	2	2 Dup	3
				Lab Duplicate	no	no	no	no	no	yes	no
				Date Sampled	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12
Taxonomic Classification				Sample ID	6141.3-13	6141.3-14	6141.3-15	6141.3-10	6141.3-11	6141.3-11_DUP	6141.3-12
Class	**Order**	**Family**	**Genus**	**Final Designation**							
Dinophyceae	**Peridiniales**	Oxytoxaceae	*Ceratium*	*Ceratium carolinianum*							
		Peridiniaceae	*Peridinium*	*Peridinium* sp.							
Euglenophyceae	**Euglenales**	Euglenaceae	*Euglena*	*Euglena* sp.							
Myxophyceae	**Chroococcales**	Chamaesiphonaceae	*Chamaesiphon*	*Chamaesiphon* spp.					890.625713		
		Chroococcaceae	*Chroococcus*	*Chroococcus dispersus*		2283.661539	9085.84997	4320.902336	2850.002282	4560.003651	
				Chroococcus minutus							
				Chroococcus pallidus					356.2502852		
				Chroococcus sp.	265.4116914	856.3730772	648.9892836	2356.855819	1425.001141	2280.001825	1677.368919
				Chroococcus turgidus			648.9892836	392.8093032			
	Merismopediaceae	Aphanocapsa	*Aphanocapsa*	*Aphanocapsa delicatissima*				54011.27919	14250.01141		
				Aphanocapsa elachista				19640.46516	10687.50856	13300.01065	50321.06757
				Aphanocapsa rivularis							
			Merismopedia	*Merismopedia glauca*	2123.293531	9134.646157	28555.52848	3142.474426			
				Merismopedia punctata							
				Merismopedia spp.		2283.661539	3893.935702	3142.474426			
			Woronichinia	*Woronichinia naegeliana*							
		Microcystaceae	*Gloeocapsa*	*Gloeocapsa aeruginosa*				12766.30236	13537.51084	17100.01369	6709.475676
				Gloeocapsa rupestris							20967.11149
				Gloeocapsa sanguinea				8052.590716	4987.503993	2280.001825	1677.368919
				Gloeocapsa sp.							
				Gloeocapsa spp.				2553.260471	5700.004563	6840.005476	7548.160136
			Microcystis	*Microcystis flosaquae*							
		Synechococcaceae	*Aphanothece*	*Aphanothece smithii*							
			Cyanothece	*Cyanothece aeruginosa*							
	Nostocales	Nostocaceae	*Anabaena*	*Anabaena* sp.			9410.344612				
			Nostoc	*Nostoc linckia*				49101.1629			
				Nostoc paludosum				191494.5353	60562.54848	57000.04563	
				Nostoc sp.				7856.186065	12468.75998	190.0001521	
		Rivulariaceae	*Calothrix*	*Calothrix breviarticulata*				883.8209323			
				Calothrix fusca					1603.126283	2660.00213	8386.844595
				Calothrix parietina				14730.34887			6290.133447
				Calothrix sp.				1374.832561	3028.127424	3040.002434	3354.737838
			Dichothrix	*Dichothrix* sp.				7856.186065	89062.5713	161500.1293	46127.64527
			Gloeotrichia	*Gloeotrichia* sp.							
			Rivularia	*Rivularia haematites*							
		Scytonemataceae	*Scytonema*	*Scytonema mirabile*				44191.04661	14250.01141	13300.01065	46127.64527
				Scytonema sp.				40262.95358			62901.33447
	Oscillatoriales	Borziaceae	*Komvophoron*	*Komvophoron* spp.	2255.999377	3853.678848				2470.001977	21805.79595
		Oscillatoriaceae	*Homoeothrix*	*Homoeothrix janthina*							
			Oscillatoria	*Oscillatoria* sp.							
				Oscillatoria ucrainica							
		Phormidiaceae	*Phormidium*	*Phormidium aerugineo-caeruleum*					1959.376569	2280.001825	
				Phormidium sp.	796.2350741	1141.83077	486.7419627	1276.630236	3028.127424	2470.001977	4193.422298
		Pseudanabaenaceae	*Leptolyngbya*	*Leptolyngbya foveolarum*							
				Leptolyngbya sp.	4777.410445	15414.71539	7625.624082	9427.423278	42928.15937	57950.04639	45288.96082
				Leptolyngbya tenuis							
			Pseudanabaena	*Pseudanabaena* sp.							
	Stigonematales	Stigonemataceae	*Stigonema*	*Stigonema mamillosum*				11784.2791			
				Total	**49631.98629**	**74504.45772**	**107245.4791**	**508197.0361**	**308690.8721**	**374870.3001**	**441567.3679**

Note Echo OF was dry during August sampling.

**Komatic IF had no rocks so periphyton was collected from sediment surface using modified methods.*

Appendix 3.6-8

Stream Periphyton Richness and Diversity Results, Back River Project, 2012

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Appendix 3.6-8. Stream Periphyton Richness and Diversity Results, Back River Project, 2012

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location	Moby OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander IF	Gander US	Gander US	Gander US	Pond 19 OF	Pond 19 OF	Pond 19 OF
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	12-Aug-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12
Eco Analysts Sample ID	6138.3-25	6138.3-26	6138.3-27	6138.3-19	6138.3-20	6138.3-21	6138.3-22	6138.3-23	6138.3-24	6138.3-31	6138.3-32	6138.3-33
Genus Richness (# genera)	15	18	16	22	25	22	18	25	25	14	27	21
Simpson's Diversity Index	0.70	0.65	0.77	0.74	0.80	0.66	0.64	0.71	0.79	0.71	0.83	0.66

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location	Chair OF	Chair OF	Chair OF	Llama OF	Llama OF	Llama OF	Giraffe OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Wolf OF
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	12-Aug-12	12-Aug-12	12-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12
Eco Analysts Sample ID	6138.3-28	6138.3-29	6138.3-30	6138.3-1	6138.3-2	6138.3-3	6138.3-7	6138.3-8	6138.3-9	6138.3-4	6138.3-5	6138.3-6
Genus Richness (# genera)	22	21	20	11	10	9	19	15	19	16	19	25
Simpson's Diversity Index	0.83	0.80	0.87	0.38	0.66	0.72	0.86	0.83	0.86	0.69	0.81	0.84

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	George	George	George
Location	Goose OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor OF	Reference B OF	Reference B OF	Reference B OF	George OF	George OF	George OF
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
Eco Analysts Sample ID	6138.3-10	6138.3-11	6138.3-12	6138.3-13	6138.3-14	6138.3-15	6138.3-16	6138.3-17	6138.3-18	6141.3-1	6141.3-2	6141.3-3
Genus Richness (# genera)	22	19	24	16	20	16	21	23	24	15	17	17
Simpson's Diversity Index	0.81	0.87	0.89	0.84	0.88	0.85	0.86	0.88	0.83	0.80	0.88	0.80

Area	George	George	George	George	George	George	George	George	George	George	George	George
Location	Sleigh OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF	Dragon OF	Komatic IF*	Komatic IF*	Komatic IF*	Reference C OF	Reference C OF	Reference C OF
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12
Eco Analysts Sample ID	6141.3-4	6141.3-5	6141.3-6	6141.3-7	6141.3-8	6141.3-9	6141.3-13	6141.3-14	6141.3-15	6141.3-10	6141.3-11	6141.3-12
Genus Richness (# genera)	14	9	15	22	25	21	19	20	20	20	22	22
Simpson's Diversity Index	0.86	0.84	0.86	0.86	0.85	0.83	0.82	0.88	0.81	0.71	0.82	0.87

Note Echo OF was dry during August sampling.

**Komatic IF had no rocks so periphyton was collected from sediment surface using modified methods.*

Appendix 3.6-9

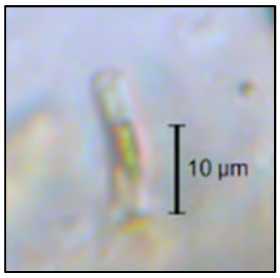
Stream Periphyton Reference Photographs, Back River Project, 2012

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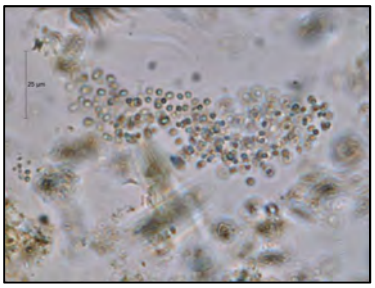
Appendix 3.6-9. Stream Periphyton Reference Photographs, Back River Project, 2012

Reference photographs of highly abundant genera are shown below, more information (species names, location, date) on these photographs are available by request. Photographs of less abundant taxa area also available by request.

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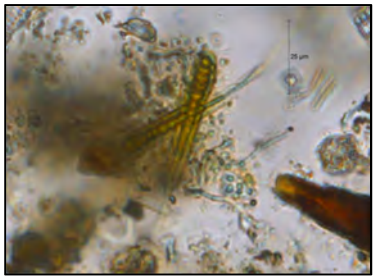
Achnanthidium (Bacillariophyceae)



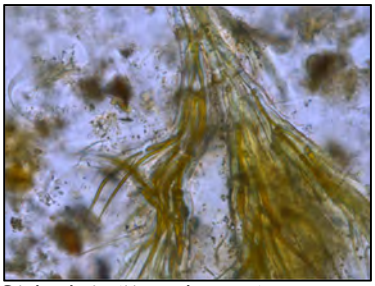
Aphanocapsa (Myxophyceae)



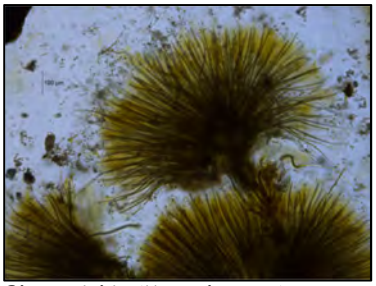
Bulbochaete (Chlorophyceae)



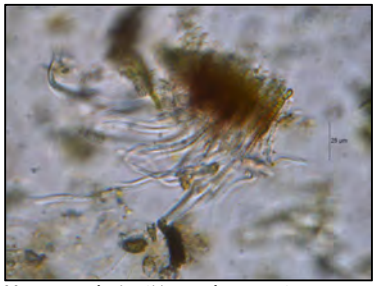
Calothrix (Myxophyceae)



Dichothrix (Myxophyceae)



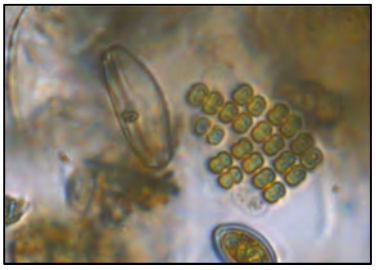
Gloeotrichia (Myxophyceae)



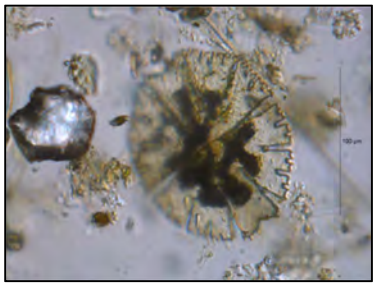
Homoeothrix (Myxophyceae)



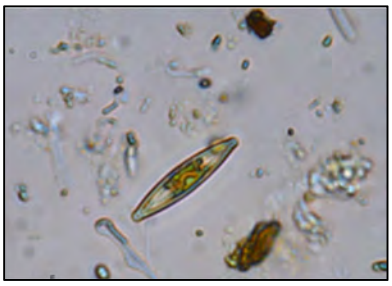
Leptolyngbya (Myxophyceae)



Merismopedia (Myxophyceae)



Microcystis (Myxophyceae)



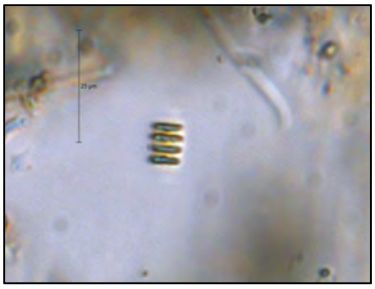
Navicula (Bacillariophyceae)



Nostoc (Myxophyceae)



Oscillatoria (Myxophyceae)



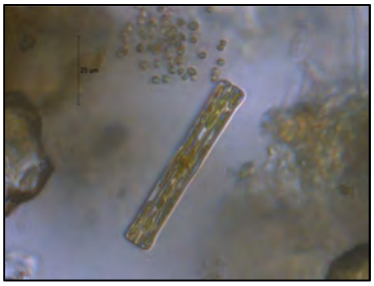
Scenedesmus (Chlorophyceae)



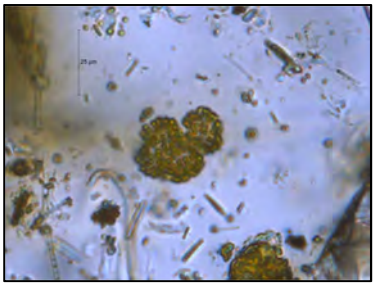
Scytonema (Myxophyceae)



Stigonema (Myxophyceae)



Tabellaria (Bacillariophyceae)



Woronichinia (Myxophyceae)

Appendix 3.6-10

Stream Periphyton QA/QC Results, Back River Project, 2012

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Appendix 3.6-10. Stream Periphyton QA/QC Results, Back River Project, 2012

SoftBody Taxonomy Duplicate Counts

EcoAnalysts, Inc.

6138.3-2_DUP	Taxonomic Identification Number (TIN)	Original Abundance (0.00887% Counted)	Relative Abundance	Dominance Rank	Duplicate Abundance (0.00740% Counted)	Relative Abundance	Dominance Rank	Percent Similarity
Achnanthes sp.	3	21	6.98%	4	39	13.00%	2	6.98%
Bulbochaete sp.	2046	171	56.81%	1	168	56.00%	1	56.00%
Calothrix sp.	2047	0	0.00%		1	0.33%		0.00%
Eunotia sp.	582	17	5.65%	5	28	9.33%	3	5.65%
Fragilaria sp.	654	4	1.33%		0	0.00%		0.00%
Gongrosira fluminensis	3355	13	4.32%		19	6.33%	5	4.32%
Homoeothrix janthina	3038	29	9.63%	3	2	0.67%		0.67%
Leptolyngbya tenuis	3356	4	1.33%		1	0.33%		0.33%
Microspora crassior	3208	1	0.33%		0	0.00%		0.00%
Navicula spp.	959	0	0.00%		3	1.00%		0.00%
Nitzschia spp.	1470	12	3.99%		10	3.33%		3.33%
Oedogonium sp.	2065	0	0.00%		3	1.00%		0.00%
Tabellaria fenestrata	1987	0	0.00%		2	0.67%		0.00%
Tabellaria flocculosa	1988	29	9.63%	2	24	8.00%	4	8.00%
		301			**300**			**85.28%**

6138.3-14_DUP	Taxonomic Identification Number (TIN)	Original Abundance (0.00590% Counted)	Relative Abundance	Dominance Rank	Duplicate Abundance (0.00769% Counted)	Relative Abundance	Dominance Rank	Percent Similarity
Tabellaria flocculosa	1988	96	31.89%	1	120	40.00%	1	31.89%
Achnanthes sp.	3	12	3.99%		6	2.00%		2.00%
Aulacoseira spp.	223	12	3.99%		0	0.00%		0.00%
Bulbochaete sp.	2046	36	11.96%	2	34	11.33%	2	11.33%
Calothrix sp.	2047	22	7.31%	5	5	1.67%		1.67%
Chroococcus minutus	2612	1	0.33%		0	0.00%		0.00%
Cosmarium sp.	2012	0	0.00%		1	0.33%		0.00%
Cosmarium subtumidum	3347	1	0.33%		1	0.33%		0.33%
Cyclotella spp.	334	0	0.00%		2	0.67%		0.00%
Cymbella spp.	379	2	0.66%		2	0.67%		0.66%
Dichothrix sp.	2062	4	1.33%		4	1.33%		1.33%
Elakatothrix gelatinosa	3022	1	0.33%		0	0.00%		0.00%
Eunotia sp.	582	9	2.99%		15	5.00%		2.99%
Geminella sp.	3076	4	1.33%		0	0.00%		0.00%
Gloeocapsa sp.	2049	2	0.66%		3	1.00%		0.66%
Gloeotrichia sp.	2093	0	0.00%		1	0.33%		0.00%
Leptolyngbya foveolarum	3244	9	2.99%		0	0.00%		0.00%

Appendix 3.6-10. Stream Periphyton QA/QC Results, Back River Project, 2012

SoftBody Taxonomy Duplicate Counts

EcoAnalysts, Inc.

6138.3-14_DUP	Taxonomic Identification Number (TIN)	Original Abundance (0.00590% Counted)	Relative Abundance	Dominance Rank	Duplicate Abundance (0.00769% Counted)	Relative Abundance	Dominance Rank	Percent Similarity
Mougeotia sp.	2053	24	7.97%	4	33	11.00%	3	7.97%
Navicula spp.	959	27	8.97%	3	29	9.67%	4	8.97%
Nitzschia spp.	1470	21	6.98%		5	1.67%		1.67%
Oscillatoria sp.	2016	12	3.99%		22	7.33%	5	3.99%
Scenedesmus sp.	2055	2	0.66%		1	0.33%		0.33%
Staurastrum crenulatum	2640	2	0.66%		0	0.00%		0.00%
Staurastrum sp.	2023	0	0.00%		2	0.67%		0.00%
Stigonema mamillosum	3313	0	0.00%		1	0.33%		0.00%
Tabellaria fenestrata	1987	2	0.66%		9	3.00%		0.66%
Zygnema sp.	2027	0	0.00%		4	1.33%		0.00%
		301			**300**			**76.47%**

6138.3-26_DUP	Taxonomic Identification Number (TIN)	Original Abundance (0.00801% Counted)	Relative Abundance	Dominance Rank	Duplicate Abundance (0.00839% Counted)	Relative Abundance	Dominance Rank	Percent Similarity
Navicula spp.	959	125	41.12%	1	123	40.07%	1	40.07%
Achnanthes sp.	3	3	0.99%		3	0.98%		0.98%
Calothrix sp.	2047	6	1.97%		9	2.93%		1.97%
Closterium closterioides var. intermedium	3342	1	0.33%		1	0.33%		0.33%
Closterium costatum	3343	1	0.33%		1	0.33%		0.33%
Closterium parvulum	3344	1	0.33%		1	0.33%		0.33%
Cosmarium phaseolus	3301	2	0.66%		1	0.33%		0.33%
Cosmarium sp.	2012	3	0.99%		2	0.65%		0.65%
Cosmarium subtumidum	3347	1	0.33%		1	0.33%		0.33%
Cylindrocystis sp.	3351	3	0.99%		3	0.98%		0.98%
Cymbella sp.	379	1	0.33%		1	0.33%		0.33%
Elakatothrix gelatinosa	3022	1	0.33%		1	0.33%		0.33%
Euastrum pulchellum	3303	1	0.33%		1	0.33%		0.33%
Fragilaria sp.	654	2	0.66%		1	0.33%		0.33%
Frustulia sp.	728	4	1.32%		5	1.63%		1.32%
Oocystis sp.	2015	4	1.32%		6	1.95%		1.32%
Oscillatoria sp.	2016	88	28.95%	2	89	28.99%	2	28.95%
Pinnularia sp.	1685	3	0.99%		4	1.30%		0.99%
Scenedesmus sp.	2055	13	4.28%	5	15	4.89%	5	4.28%
Staurodesmus extensus	3152	1	0.33%		1	0.33%		0.33%
Tabellaria flocculosa	1988	19	6.25%	4	16	5.21%	4	5.21%
Woronichinia naegeliana	2444	21	6.91%	3	22	7.17%	3	6.91%
		304			**307**			**96.86%**

Appendix 3.6-10. Stream Periphyton QA/QC Results, Back River Project, 2012

SoftBody Taxonomy Duplicate Counts

6141.3-3_DUP	Taxonomic Identification Number (TIN)	Original Abundance (0.00977% Counted)	Relative Abundance	Dominance Rank	Duplicate Abundance (0.00888% Counted)	Relative Abundance	Dominance Rank	Percent Similarity
Achnanthidium sp.	2259	99	32.57%	1	108	35.88%	1	32.57%
Aphanocapsa elachista	3016	0	0.00%		1	0.33%		0.00%
Bulbochaete sp.	2046	2	0.66%		1	0.33%		0.33%
Calothrix fusca	3298	2	0.66%		1	0.33%		0.33%
Calothrix parietina	3110	2	0.66%		3	1.00%		0.66%
Calothrix sp.	2047	3	0.99%		2	0.66%		0.66%
Chroococcus dispersus	2463	1	0.33%		0	0.00%		0.00%
Cosmarium garrolense	2471	0	0.00%		1	0.33%		0.00%
Cosmarium phaseolus	3301	1	0.33%		0	0.00%		0.00%
Cosmarium regnellii	3302	3	0.99%		1	0.33%		0.33%
Euastrum pulchellum	3303	0	0.00%		1	0.33%		0.00%
Eunotia spp.	582	7	2.30%		2	0.66%		0.66%
Fragilaria spp.	654	3	0.99%		0	0.00%		0.00%
Frustulia spp.	728	1	0.33%		0	0.00%		0.00%
Komvophoron spp.	2487	0	0.00%		2	0.66%		0.00%
Leptolyngbya sp.	2105	67	22.04%	2	62	20.60%	2	20.60%
Mougeotia sp.	2053	3	0.99%		4	1.33%		0.99%
Navicula spp.	959	7	2.30%		8	2.66%		2.30%
Nitzschia spp.	1470	46	15.13%	3	56	18.60%	3	15.13%
Oedogonium spp.	2065	1	0.33%		1	0.33%		0.33%
Phormidium sp.	2054	14	4.61%	5	10	3.32%	5	3.32%
Stigonema mamillosum	3313	0	0.00%		1	0.33%		0.00%
Synedra spp.	1930	1	0.33%		0	0.00%		0.00%
Tabellaria flocculosa	1988	32	10.53%	4	29	9.63%	4	9.63%
unknown Centric diatom	-30	4	1.32%		3	1.00%		1.00%
unknown Pennate diatom	-321	4	1.32%		4	1.33%		1.32%
Zygnema sp.	2027	1	0.33%		0	0.00%		0.00%
		304			**301**			**90.17%**

6141.3-11_DUP	TIN	Original Abundance (0.00588% Counted)	Relative Abundance	Dominance Rank	Duplicate Abundance (0.00552% Counted)	Relative Abundance	Dominance Rank	Percent Similarity
Achnanthidium sp.	2259	57	18.69%	2	61	20.20%	2	18.69%
Aphanocapsa delicatissima	2610	1	0.33%		0	0.00%		0.00%
Aphanocapsa elachista	3016	1	0.33%		1	0.33%		0.33%
Aulacoseira spp.	223	2	0.66%		0	0.00%		0.00%

Appendix 3.6-10. Stream Periphyton QA/QC Results, Back River Project, 2012

SoftBody Taxonomy Duplicate Counts

EcoAnalysts, Inc.

6141.3-11_DUP	Taxonomic Identification Number (TIN)	Original Abundance (0.00588% Counted)	Relative Abundance	Dominance Rank	Duplicate Abundance (0.00552% Counted)	Relative Abundance	Dominance Rank	Percent Similarity
Caloneis spp.	251	0	0.00%		1	0.33%		0.00%
Calothrix fusca	3298	2	0.66%		2	0.66%		0.66%
Calothrix sp.	2047	7	2.30%	5	5	1.66%		1.66%
Chamaesiphon spp.	2048	5	1.64%		0	0.00%		0.00%
Chroococcus dispersus	2463	1	0.33%		2	0.66%		0.33%
Chroococcus pallidus	3299	1	0.33%		0	0.00%		0.00%
Chroococcus sp.	2097	3	0.98%		4	1.32%		0.98%
Cosmarium bireme	2996	1	0.33%		0	0.00%		0.00%
Cymbella spp.	379	0	0.00%		1	0.33%		0.00%
Dichothrix sp.	2062	2	0.66%		3	0.99%		0.66%
Epithemia spp.	559	0	0.00%		2	0.66%		0.00%
Eunotia spp.	582	4	1.31%		3	0.99%		0.99%
Frustulia spp.	728	0	0.00%		1	0.33%		0.00%
Gloeocapsa aeruginosa	3304	5	1.64%		7	2.32%	5	1.64%
Gloeocapsa sanguinea	3306	2	0.66%		1	0.33%		0.33%
Gloeocapsa spp.	2049	5	1.64%		6	1.99%		1.64%
Gomphonema spp.	751	26	8.52%	4	12	3.97%	4	3.97%
Komvophoron spp.	2487	0	0.00%		1	0.33%		0.00%
Leptolyngbya sp.	2105	125	40.98%	1	136	45.03%	1	40.98%
Mougeotia sp.	2053	1	0.33%		2	0.66%		0.33%
Navicula spp.	959	27	8.85%	3	32	10.60%	3	8.85%
Nitzschia spp.	1470	4	1.31%		5	1.66%		1.31%
Nostoc paludosum	3308	3	0.98%		2	0.66%		0.66%
Nostoc sp.	2112	3	0.98%		1	0.33%		0.33%
Oocystis parva	2500	1	0.33%		0	0.00%		0.00%
Phormidium aerugineo-caeruleum	3039	2	0.66%		1	0.33%		0.33%
Phormidium sp.	2054	4	1.31%		3	0.99%		0.99%
Pleurotaenium ehrenbergii	3309	1	0.33%		0	0.00%		0.00%
Scytonema mirabile	3311	2	0.66%		1	0.33%		0.33%
Synedra spp.	1930	2	0.66%		1	0.33%		0.33%
Tabellaria spp.	1984	2	0.66%		3	0.99%		0.66%
unknown Centric diatom	-30	1	0.33%		0	0.00%		0.00%
unknown Pennate diatom	-321	2	0.66%		2	0.66%		0.66%
		305			**302**			**87.64%**

Appendix 3.7-1

Lake Zooplankton Density and Taxonomic Results, Back River Project, 2012

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Appendix 3.7-1. Lake Zooplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in zooplankton individuals/m^3

Taxonomic Classification:

					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Gander	Gander	Gander	Big	Big	Big	Rabbit	Rabbit	Rabbit	Fox	Fox	Fox
					Replicate	1	2	3	1	2	3	1	2	3	1	2	3
					Date Sampled	18-Aug-12	18-Aug-12	18-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12
					Volume Filtered (m^3)	0.606	0.634	0.667	0.539	0.798	0.726	0.543	0.541	0.547	0.648	0.682	0.617
					Tow Type	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique
					Tow Depth (m)	1.5	1.5	1.5	3.7	3.7	3.7	2.5	2.5	2.5	4.8	4.8	4.8
FINE FRACTION:	**Class**	**Order**	**Family**	**Genus**	**Final Designation**												
Crustacea	Branchiopoda	Diplostraca	Chydoridae	*Eurycercus*	*Eurycercus* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Daphniidae	*Daphnia*	*Daphnia longiremis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maxillopoda	Undetermined	Undetermined	Undetermined	Copepoda - nauplii	132.0	394.0	223.9	11029.3	7570.7	6394.5	1274.8	1226.5	3689.1	3129.8	2486.9	6810.1
Diptera-Chironomidae	Insecta	Diptera	Chironomidae	Undetermined	Chironomidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rotifera	Monogononta	Collothecacea	Collothecidae	*Collotheca*	*Collotheca* sp.	0.0	0.0	0.0	0.0	0.0	0.0	77.7	44.3	21.3	120.4	200.1	924.2
		Flosculariaceae	Conochilidae	*Conochilus*	*Conochilus unicornis*	32345.7	33493.7	62008.2	15292.8	10228.0	9702.0	139.9	34.5	29.9	1263.9	571.7	972.9
		Ploima	Asplanchnidae	*Asplanchna*	*Asplanchna priodonta*	924.2	985.1	1567.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Brachionidae	*Kellicottia*	*Kellicottia longispina*	23500.1	25415.8	61560.5	11539.1	11030.2	12237.7	2907.2	906.3	806.1	9900.9	5688.4	17998.0
				Keratella	*Keratella cochlearis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					Keratella serrulata	0.0	0.0	223.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Euchlanidae	*Euchlanis*	*Euchlanis alata*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					Euchlanis sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Synchaetidae	*Synchaeta*	*Synchaeta* sp.	1320.2	1379.2	2014.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Trichotriidae	*Trichotria*	*Trichotria tetractis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COARSE FRACTION:																	
Crustacea	Branchiopoda	Diplostraca	Bosminidae	*Bosmina*	*Bosmina longirostris*	224.4	761.3	1274.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Eubosmina	*Eubosmina longispina*	0.0	0.0	0.0	59.3	24.4	26.9	0.0	0.0	0.0	0.0	0.0	0.0
			Chydoridae	*Alonella*	*Alonella*	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Chydorus	*Chydorus* sp.	52.8	7.9	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Eurycercus	*Eurycercus* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Undetermined	Chydoridae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Daphniidae	Daphniidae	*Daphnia*	*Daphnia middendorffiana*	0.0	0.0	0.0	148.3	97.7	53.7	0.0	0.0	0.0	185.3	293.3	211.3
					Daphnia longiremis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Holopedidae	*Holpedium*	*Holopedium gibberum*	8.3	14.2	15.0	2402.4	1343.8	1773.0	7988.7	6188.0	4412.2	4137.4	6276.3	1009.5
			Macrothricidae	*Ophryoxus*	*Ophryoxus gracilis*	16.5	3.2	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maxillopoda	Calanoida	Diaptomidae	*Leptodiaptomus*	*Leptodiaptomus ashlandi*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					Leptodiaptomus pribilofensis	28.1	0.0	18.0	4804.7	4373.6	4110.2	5890.3	5125.9	5261.8	988.0	703.9	399.1
					Leptodiaptomus sicilis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Undetermined	Diaptomidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Temoridae	*Epischura*	*Epischura lacustris*	6.6	3.2	10.5	207.6	171.0	188.0	0.0	0.0	0.0	61.8	117.3	47.0
					Epischura sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Heterocope	*Heterocope septentrionalis*	0.0	0.0	0.0	29.7	24.4	26.9	147.3	461.8	246.6	432.3	469.3	140.9
			Undetermined	Undetermined	Calanoida - copepodites	0.0	39.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Cyclopoida	Cyclopidae	*Cyclops*	*Cyclops* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Undetermined	Undetermined	Cyclopoida	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					Cyclopoida - copepodites	104.0	63.0	36.0	2105.8	1734.8	1934.2	0.0	0.0	0.0	9571.7	9795.6	3967.4
		Undetermined	Undetermined	Undetermined	Copepoda - nauplii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diptera-Chironomidae	Insecta	Diptera	Chironomidae	Undetermined	Chironomidae	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rotifera	Monogononta	Flosculariaceae	Conochilidae	*Conochilus*	*Conochilus unicornis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					GRAND TOTAL	58664.5	62560.0	128968.9	47619.0	36598.8	36447.1	18425.9	13987.4	14467.0	29791.5	26602.7	32480.2

Note: L/R means organisims were observed in large/rare scans but not observed in subsample enumerated.

Density analyses does not include nauplii; composition, diversity and richness analyses does not include nauplii or copepodites.

Appendix 3.7-1. Lake Zooplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in zooplankton individuals/m^3

Taxonomic Classification:

					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	George	George	George
					Lake	Giraffe South	Giraffe South	Giraffe South	Goose Neck	Goose Neck	Goose Neck	Goose Central	Goose Central	Goose Central	Lower Long	Lower Long	Lower Long
					Replicate	1	2	3	1	2	3	1	2	3	1	2	3
					Date Sampled	19-Aug-12	19-Aug-12	19-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	17-Aug-12	17-Aug-12	17-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
					Volume Filtered (m^3)	0.657	0.503	0.615	0.608	0.728	0.705	0.697	0.545	0.657	1.370	0.741	0.579
					Tow Type	vertical	vertical	vertical	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique
					Tow Depth (m)	6.3	6.3	6.3	2	2	2	3.5	3.5	3.5	3	3	3
FINE FRACTION:	**Class**	**Order**	**Family**	**Genus**	**EcoAnalysts Sample ID**	**6138.6-16**	**6138.6-17**	**6138.6-18**	**6138.6-1**	**6138.6-2**	**6138.6-3**	**6138.6-9**	**6138.6-10**	**6138.6-11**	**6141.5-10**	**6141.5-11**	**6141.5-12**
					Final Designation												
Crustacea	Branchiopoda	Diplostraca	Chydoridae	*Eurycercus*	*Eurycercus* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Daphniidae	*Daphnia*	*Daphnia longiremis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maxillopoda	Undetermined	Undetermined	Undetermined	Copepoda - nauplii	4640.6	4758.7	5369.0	1504.5	1594.4	1170.1	5241.3	5574.8	5401.4	423.5	728.9	966.6
Diptera-Chironomidae	Insecta	Diptera	Chironomidae	Undetermined	Chironomidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rotifera	Monogononta	Collothecacea	Collothecidae	*Collotheca*	*Collotheca* sp.	874.9	679.8	518.1	0.0	0.0	0.0	206.9	179.8	76.1	0.0	0.0	0.0
		Flosculariaceae	Conochilidae	*Conochilus*	*Conochilus unicornis*	646.6	793.1	1130.3	3847.7	3518.8	3637.9	5172.3	15915.2	0.0	58.4	566.9	172.6
		Ploima	Asplanchnidae	*Asplanchna*	*Asplanchna priodonta*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Brachionidae	*Kellicottia*	*Kellicottia longispina*	9471.4	9517.4	10267.0	5722.2	5278.2	3382.6	9654.9	10969.8	7683.6	3548.6	7667.2	9976.5
				Keratella	*Keratella cochlearis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6	0.0	34.5
					Keratella serrulata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Euchlanidae	*Euchlanis*	*Euchlanis alata*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					Euchlanis sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Synchaetidae	*Synchaeta*	*Synchaeta* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Trichotriidae	*Trichotria*	*Trichotria tetractis*	0.0	0.0	0.0	24.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COARSE FRACTION:																	
Crustacea	Branchiopoda	Diplostraca	Bosminidae	*Bosmina*	*Bosmina longirostris*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Eubosmina	*Eubosmina longispina*	0.0	0.0	0.0	98.8	26.1	39.7	71.7	91.7	36.5	583.0	949.5	1148.5
			Chydoridae	*Alonella*	*Alonella*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	91.7	0.0	0.0	0.0	0.0
				Chydorus	*Chydorus* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.8
				Eurycercus	*Eurycercus* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Undetermined	Chydoridae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Daphniidae	Daphniidae	*Daphnia*	*Daphnia middendorffiana*	0.0	39.7	48.8	0.0	0.0	0.0	0.0	91.7	0.0	55.5	25.7	131.3
					Daphnia longiremis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.5	77.0	328.1
			Holopedidae	*Holpedium*	*Holopedium gibberum*	1386.5	1191.9	780.7	0.0	0.0	0.0	35.9	91.7	36.5	13.9	51.3	32.8
			Macrothricidae	*Ophryoxus*	*Ophryoxus gracilis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maxillopoda	Calanoida	Diaptomidae	*Leptodiaptomus*	*Leptodiaptomus ashlandi*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9	25.7	32.8
					Leptodiaptomus pribilofensis	8574.5	10926.2	8441.3	11017.0	7839.5	8466.2	10220.4	16508.7	10873.1	180.5	256.6	328.1
					Leptodiaptomus sicilis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.3	77.0	98.4
				Undetermined	Diaptomidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	777.4	461.9	1017.2
			Temoridae	*Epischura*	*Epischura lacustris*	218.9	516.5	292.8	0.0	0.0	159.0	107.6	458.6	145.9	0.0	0.0	0.0
					Epischura sp.	0.0	0.0	0.0	49.4	26.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Heterocope	*Heterocope septentrionalis*	36.5	39.7	48.8	49.4	52.3	79.5	35.9	91.7	36.5	13.9	25.7	32.8
			Undetermined	Undetermined	Calanoida - copepodites	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Cyclopoida	Cyclopidae	*Cyclops*	*Cyclops* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2540.3	3284.8	5512.8
			Undetermined	Undetermined	Cyclopoida	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					Cyclopoida - copepodites	1094.6	2344.2	1561.4	3606.4	2038.3	2702.8	2295.1	4677.5	3320.3	0.0	0.0	0.0
		Undetermined	Undetermined	Undetermined	Copepoda - nauplii	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diptera-Chironomidae	Insecta	Diptera	Chironomidae	Undetermined	Chironomidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rotifera	Monogononta	Flosculariaceae	Conochilidae	*Conochilus*	*Conochilus unicornis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5071.7	0.0	0.0	0.0
					GRAND TOTAL	26944.5	30807.3	28458.1	25920.1	20373.7	19637.8	33042.0	54742.9	32681.6	8362.1	14198.2	19846.1

Note: L/R means organisims were observed in large/rare scans but not observed in subsample enumerated.

Density analyses does not include nauplii; composition, diversity and richness analyses does not include nauplii or copepodites.

Appendix 3.7-1. Lake Zooplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in zooplankton individuals/m^3

Taxonomic Classification:

Area						George	George	George	George	George	George	George	George	George	George	George	George
Lake						Fold	Fold	Fold	George Central	George Central	George Central	Lytle	Lytle	Lytle	Occurrence	Occurrence	Occurrence
Replicate						1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled						19-Aug-12	19-Aug-12	19-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	23-Aug-12	23-Aug-12	23-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
Volume Filtered (m^3)						0.490	0.572	0.572	0.600	0.581	0.667	0.838	0.967	0.969	0.718	1.425	0.608
Tow Type						vertical	vertical	vertical	vertical	vertical	vertical	horizontal	horizontal	horizontal	horizontal	horizontal	horizontal
Tow Depth (m)						9	9	9	13	13	13	0.5	0.5	0.5	1	1	1
FINE FRACTION:	**Class**	**Order**	**Family**	**Genus**	**Final Designation**	**EcoAnalysts Sample ID**											
						6141.5-4	6141.5-5	6141.5-6	6141.5-1	6141.5-2	6141.5-3	6141.5-25	6141.5-26	6141.5-27	6141.5-16	6141.5-17	6141.5-18
Crustacea	Branchiopoda	Diplostraca	Chydoridae	*Eurycercus*	*Eurycercus* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Daphniidae	*Daphnia*	*Daphnia longiremis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maxillopoda	Undetermined	Undetermined	Undetermined	Copepoda - nauplii	7264.1	7345.7	7275.8	7814.2	0.0	0.0	0.0	0.0	0.0	55.7	40.0	79.0
Diptera-Chironomidae	Insecta	Diptera	Chironomidae	Undetermined	Chironomidae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	L/R	0.0	0.0
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rotifera	Monogononta	Collothecacea	Collothecidae	*Collotheca*	*Collotheca* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Flosculariaceae	Conochilidae	*Conochilus*	*Conochilus unicornis*	9794.3	10843.7	8325.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Ploima	Asplanchnidae	*Asplanchna*	*Asplanchna priodonta*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Brachionidae	*Kellicottia*	*Kellicottia longispina*	11916.4	12662.6	13082.4	3238.5	4209.5	4355.3	3.6	6.2	12.4	23.7	14.0	24.7
				Keratella	*Keratella cochlearis*	163.2	279.8	139.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					Keratella serrulata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Euchlanidae	*Euchlanis*	*Euchlanis alata*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	1.6
					Euchlanis sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0
			Synchaetidae	*Synchaeta*	*Synchaeta* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Trichotriidae	*Trichotria*	*Trichotria tetractis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COARSE FRACTION:																	
Crustacea	Branchiopoda	Diplostraca	Bosminidae	*Bosmina*	*Bosmina longirostris*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Eubosmina	*Eubosmina longispina*	1434.7	2596.1	1912.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Chydoridae	*Alonella*	*Alonella*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Chydorus	*Chydorus* sp.	0.0	68.3	68.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Eurycercus	*Eurycercus* sp.	0.0	0.0	0.0	0.0	0.0	0.0	11.9	10.3	10.3	1.4	0.7	0.0
				Undetermined	Chydoridae	0.0	0.0	0.0	0.0	0.0	0.0	11.9	10.3	20.6	0.0	0.7	3.3
		Daphniidae	Daphniidae	*Daphnia*	*Daphnia middendorffiana*	0.0	0.0	0.0	0.0	0.0	22.5	859.5	610.2	474.8	122.6	93.4	200.7
					Daphnia longiremis	7651.8	7925.1	6353.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Holopedidae	*Holpedium*	*Holopedium gibberum*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Macrothricidae	*Ophryoxus*	*Ophryoxus gracilis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maxillopoda	Calanoida	Diaptomidae	*Leptodiaptomus*	*Leptodiaptomus ashlandi*	0.0	0.0	0.0	0.0	0.0	0.0	95.5	124.1	92.9	242.3	269.5	467.2
					Leptodiaptomus pribilofensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	104.5	79.3	149.7
					Leptodiaptomus sicilis	1434.7	1434.7	1503.0	0.0	0.0	0.0	47.7	41.4	41.3	41.8	29.5	54.3
				Undetermined	Diaptomidae	8448.8	6695.3	7720.1	9305.3	10384.4	8297.4	0.0	0.0	0.0	34.8	19.7	18.1
			Temoridae	*Epischura*	*Epischura lacustris*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					Epischura sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Heterocope	*Heterocope septentrionalis*	0.0	0.0	0.0	50.0	51.7	22.5	0.0	0.0	10.3	5.6	8.4	4.9
			Undetermined	Undetermined	Calanoida - copepodites	0.0	0.0	0.0	0.0	0.0	0.0	1707.1	1572.1	1569.0	0.0	0.0	0.0
		Cyclopoida	Cyclopidae	*Cyclops*	*Cyclops* sp.	2550.6	888.2	1503.0	0.0	0.0	179.9	0.0	0.0	0.0	0.0	0.0	0.0
			Undetermined	Undetermined	Cyclopoida	0.0	0.0	0.0	1050.6	465.0	0.0	0.0	0.0	0.0	8.4	4.2	9.9
					Cyclopoida - copepodites	17615.0	13254.0	14347.1	0.0	0.0	359.8	59.7	31.0	0.0	0.0	0.0	0.0
		Undetermined	Undetermined	Undetermined	Copepoda - nauplii	0.0	0.0	0.0	0.0	9144.5	6071.3	393.9	320.6	351.0	0.0	0.0	0.0
Diptera-Chironomidae	Insecta	Diptera	Chironomidae	Undetermined	Chironomidae	0.0	0.0	0.0	0.0	0.0	0.0	L/R	L/R	L/R	L/R	L/R	L/R
Rotifera	Monogononta	Flosculariaceae	Conochilidae	*Conochilus*	*Conochilus unicornis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					GRAND TOTAL	68273.7	63993.5	62231.4	21458.7	24255.0	19308.7	3190.9	2727.4	2583.7	642.0	559.4	1013.4

Note: L/R means organisims were observed in large/rare scans but not observed in subsample enumerated.

Density analyses does not include nauplii; composition, diversity and richness analyses does not include nauplii or copepodites.

Appendix 3.7-1. Lake Zooplankton Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in zooplankton individuals/m^3

Taxonomic Classification:

Area						George	George	George	George	George	George	George	George	George	George
Lake						Sleigh	Sleigh	Sleigh	Dragon	Dragon	Dragon	Komatic	Komatic	Komatic	Reference C
Replicate						1	2	3	1	2	3	1	2	3	1
Date Sampled						22-Aug-12	22-Aug-12	22-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	22-Aug-12
Volume Filtered (m^3)						1.096	1.415	1.058	0.623	1.174	1.138	0.686	0.955	0.693	1.461
Tow Type						horizontal	horizontal	horizontal	oblique	oblique	oblique	vertical	vertical	vertical	vertical
Tow Depth (m)						0.5	0.5	0.5	2	2	2	6	6	6	30
EcoAnalysts Sample ID						6141.5-22	6141.5-23	6141.5-24	6141.5-7	6141.5-8	6141.5-9	6141.5-13	6141.5-14	6141.5-15	6141.5-19
FINE FRACTION:	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
Crustacea	Branchiopoda	Diplostraca	Chydoridae	*Eurycercus*	*Eurycercus* sp.	0.0	0.0	0.0	0.0	L/R	0.0	0.0	0.0	0.0	0.0
			Daphniidae	*Daphnia*	*Daphnia longiremis*	0.0	0.0	0.0	L/R	L/R	0.0	0.0	0.0	0.0	0.0
	Maxillopoda	Undetermined	Undetermined	Undetermined	Copepoda - nauplii	14.6	26.9	15.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Diptera-Chironomidae	Insecta	Diptera	Chironomidae	Undetermined	Chironomidae	L/R	0.0	L/R	L/R	L/R	0.0	0.0	L/R	0.0	0.0
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.	L/R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rotifera	Monogononta	Collothecacea	Collothecidae	*Collotheca*	*Collotheca* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Flosculariaceae	Conochilidae	*Conochilus*	*Conochilus unicornis*	0.0	0.0	0.0	0.0	0.0	0.0	129.2	162.2	113.6	1536.3
		Ploima	Asplanchnidae	*Asplanchna*	*Asplanchna priodonta*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Brachionidae	*Kellicottia*	*Kellicottia longispina*	184.3	14.1	12.3	1033.7	393.2	1183.5	733.3	889.6	1011.3	1320.6
				Keratella	*Keratella cochlearis*	0.0	0.0	0.0	5.0	2.0	0.0	0.0	0.0	0.0	0.0
					Keratella serrulata	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Euchlanidae	*Euchlanis*	*Euchlanis alata*	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					Euchlanis sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Synchaetidae	*Synchaeta*	*Synchaeta* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Trichotriidae	*Trichotria*	*Trichotria tetractis*	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0
COARSE FRACTION:															
Crustacea	Branchiopoda	Diplostraca	Bosminidae	*Bosmina*	*Bosmina longirostris*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Eubosmina	*Eubosmina longispina*	0.0	0.0	0.0	433.1	486.0	351.5	116.7	31.4	43.3	0.0
			Chydoridae	*Alonella*	*Alonella*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Chydorus	*Chydorus* sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Eurycercus	*Eurycercus* sp.	9.1	0.0	4.7	24.1	0.0	0.0	0.0	0.0	0.0	0.0
				Undetermined	Chydoridae	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Daphniidae	Daphniidae	*Daphnia*	*Daphnia middendorffiana*	27.4	4.7	9.5	1251.3	1867.4	2126.9	408.3	628.6	1212.8	0.0
					Daphnia longiremis	0.0	0.0	0.0	0.0	0.0	87.9	58.3	94.3	43.3	0.0
			Holopedidae	*Holpedium*	*Holopedium gibberum*	0.0	0.0	0.0	0.0	0.0	0.0	525.0	534.3	1169.4	0.0
			Macrothricidae	*Ophryoxus*	*Ophryoxus gracilis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maxillopoda	Calanoida	Diaptomidae	*Leptodiaptomus*	*Leptodiaptomus ashlandi*	273.7	207.3	269.4	0.0	0.0	0.0	0.0	31.4	0.0	0.0
					Leptodiaptomus pribilofensis	798.3	880.9	949.9	746.0	281.4	703.1	320.8	157.1	606.4	1311.8
					Leptodiaptomus sicilis	41.1	42.4	14.2	0.0	0.0	0.0	0.0	0.0	0.0	532.9
				Undetermined	Diaptomidae	41.1	23.6	42.5	0.0	0.0	0.0	233.3	125.7	0.0	6845.8
			Temoridae	*Epischura*	*Epischura lacustris*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					Epischura sp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				Heterocope	*Heterocope septentrionalis*	27.4	4.7	14.2	168.4	127.9	123.0	29.2	31.4	86.6	41.0
			Undetermined	Undetermined	Calanoida - copepodites	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Cyclopoida	Cyclopidae	*Cyclops*	*Cyclops* sp.	0.0	0.0	0.0	4114.8	3223.2	2988.2	350.0	282.9	866.3	82.0
			Undetermined	Undetermined	Cyclopoida	13.7	14.1	9.5	0.0	0.0	0.0	0.0	0.0	0.0	7788.6
					Cyclopoida - copepodites	0.0	0.0	0.0	0.0	0.0	0.0	4608.2	5845.9	5630.6	0.0
		Undetermined	Undetermined	Undetermined	Copepoda - nauplii	0.0	0.0	0.0	14317.5	13506.8	11495.6	22020.2	19737.8	21613.0	7091.8
Diptera-Chironomidae	Insecta	Diptera	Chironomidae	Undetermined	Chironomidae	L/R	L/R	0.0	L/R	0.0	0.0	0.0	0.0	0.0	0.0
Rotifera	Monogononta	Flosculariaceae	Conochilidae	*Conochilus*	*Conochilus unicornis*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					GRAND TOTAL	1431.5	1218.7	1341.2	22098.9	19887.9	19059.7	29532.5	28552.7	32396.5	26550.8

Area						George	George	George	George	George	George	George	George	George	George
Lake						Reference C	Reference C	Reference C							
Replicate						2	3								
Date Sampled						22-Aug-12	22-Aug-12								
Volume Filtered (m^3)						1.487	1.753								
Tow Type						vertical	vertical								
Tow Depth (m)						30	30								
EcoAnalysts Sample ID						6141.5-20	6141.5-21								
FINE FRACTION:	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
Crustacea	Branchiopoda	Diplostraca	Chydoridae	*Eurycercus*	*Eurycercus* sp.	0.0	0.0								
			Daphniidae	*Daphnia*	*Daphnia longiremis*	0.0	0.0								
	Maxillopoda	Undetermined	Undetermined	Undetermined	Copepoda - nauplii	0.0	0.0								
Diptera-Chironomidae	Insecta	Diptera	Chironomidae	Undetermined	Chironomidae	0.0	0.0								
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.	0.0	0.0								
Rotifera	Monogononta	Collothecacea	Collothecidae	*Collotheca*	*Collotheca* sp.	0.0	0.0								
		Flosculariaceae	Conochilidae	*Conochilus*	*Conochilus unicornis*	1062.9	0.0								
		Ploima	Asplanchnidae	*Asplanchna*	*Asplanchna priodonta*	0.0	0.0								
			Brachionidae	*Kellicottia*	*Kellicottia longispina*	585.0	493.9								
				Keratella	*Keratella cochlearis*	8.2	1379.3								
					Keratella serrulata	0.0	0.0								
			Euchlanidae	*Euchlanis*	*Euchlanis alata*	0.0	0.0								
					Euchlanis sp.	0.0	0.0								
			Synchaetidae	*Synchaeta*	*Synchaeta* sp.	0.0	0.0								
			Trichotriidae	*Trichotria*	*Trichotria tetractis*	0.0	0.0								
COARSE FRACTION:															
Crustacea	Branchiopoda	Diplostraca	Bosminidae	*Bosmina*	*Bosmina longirostris*	0.0	0.0								
				Eubosmina	*Eubosmina longispina*	0.0	0.0								
			Chydoridae	*Alonella*	*Alonella*	0.0	0.0								
				Chydorus	*Chydorus* sp.	0.0	0.0								
				Eurycercus	*Eurycercus* sp.	0.0	0.0								
				Undetermined	Chydoridae	0.0	0.0								
		Daphniidae	Daphniidae	*Daphnia*	*Daphnia middendorffiana*	0.0	0.0								
					Daphnia longiremis	0.0	0.0								
			Holopedidae	*Holpedium*	*Holopedium gibberum*	0.0	0.0								
			Macrothricidae	*Ophryoxus*	*Ophryoxus gracilis*	0.0	0.0								
	Maxillopoda	Calanoida	Diaptomidae	*Leptodiaptomus*	*Leptodiaptomus ashlandi*	0.0	0.0								
					Leptodiaptomus pribilofensis	1008.5	969.6								
					Leptodiaptomus sicilis	336.2	228.1								
				Undetermined	Diaptomidae	5412.3	4677.0								
			Temoridae	*Epischura*	*Epischura lacustris*	0.0	0.0								
					Epischura sp.	0.0	0.0								
				Heterocope	*Heterocope septentrionalis*	67.2	28.5								
			Undetermined	Undetermined	Calanoida - copepodites	0.0	0.0								
		Cyclopoida	Cyclopidae	*Cyclops*	*Cyclops* sp.	67.2	199.6								
			Undetermined	Undetermined	Cyclopoida	7664.7	5903.2								
					Cyclopoida - copepodites	0.0	0.0								
		Undetermined	Undetermined	Undetermined	Copepoda - nauplii	6051.1	3336.6								
Diptera-Chironomidae	Insecta	Diptera	Chironomidae	Undetermined	Chironomidae	0.0	0.0								
Rotifera	Monogononta	Flosculariaceae	Conochilidae	*Conochilus*	*Conochilus unicornis*	0.0	0.0								
					GRAND TOTAL	22263.4	17215.9								

Note: L/R means organisims were observed in large/rare scans but not observed in subsample enumerated.

Density analyses does not include nauplii; composition, diversity and richness analyses does not include nauplii or copepodites.

Appendix 3.7-2

Lake Zooplankton Richness and Diversity Results, Back River Project, 2012

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Appendix 3.7-2. Lake Zooplankton Richness and Diversity Results, Back River Project, 2012

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Lake	Gander	Gander	Gander	Big	Big	Big	Rabbit	Rabbit	Rabbit	Fox	Fox	Fox	Giraffe South	Giraffe South	Giraffe South	Goose Neck	Goose Neck	Goose Neck
Replicate	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	18-Aug-12	18-Aug-12	18-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12
Volume Filtered (m^3)	0.606	0.634	0.667	0.539	0.798	0.726	0.543	0.541	0.547	0.648	0.682	0.617	0.657	0.503	0.615	0.608	0.728	0.705
Tow Type	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique	oblique	vertical	vertical	vertical	oblique	oblique	oblique
Tow Depth (m)	1.5	1.5	1.5	3.7	3.7	3.7	2.5	2.5	2.5	4.8	4.8	4.8	6.3	6.3	6.3	2	2	2
EcoAnalysts Sample ID	6138.6-13	6138.6-14	6138.6-15	6138.6-7	6138.6-12	6138.6-8	6138.6-4	6138.6-5	6138.6-6	6138.6-19	6138.6-20	6138.6-21	6138.6-16	6138.6-17	6138.6-18	6138.6-1	6138.6-2	6138.6-3
Genus Richness (# genera)	11	9	11	8	8	8	6	6	6	8	8	8	7	8	8	7	6	6
Simpson's Diversity Index	0.53	0.54	0.54	0.67	0.67	0.67	0.64	0.60	0.59	0.60	0.64	0.31	0.63	0.62	0.61	0.61	0.64	0.61

Area	Goose	Goose	Goose	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George
Lake	Goose Central	Goose Central	Goose Central	Lower Long	Lower Long	Lower Long	Fold	Fold	Fold	George Central	George Central	George Central	Lytle	Lytle	Lytle	Occurrence	Occurrence	Occurrence
Replicate	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	17-Aug-12	17-Aug-12	17-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	23-Aug-12	23-Aug-12	23-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
Volume Filtered (m^3)	0.697	0.545	0.657	1.370	0.741	0.579	0.490	0.572	0.572	0.600	0.581	0.667	0.838	0.967	0.969	0.718	1.425	0.608
Tow Type	oblique	oblique	oblique	oblique	oblique	oblique	vertical	vertical	vertical	vertical	vertical	vertical	horizontal	horizontal	horizontal	horizontal	horizontal	horizontal
Tow Depth (m)	3.5	3.5	3.5	3	3	3	9	9	9	13	13	13	0.5	0.5	0.5	1	1	1
EcoAnalysts Sample ID	6138.6-9	6138.6-10	6138.6-11	6141.5-10	6141.5-11	6141.5-12	6141.5-4	6141.5-5	6141.5-6	6141.5-1	6141.5-2	6141.5-3	6141.5-25	6141.5-26	6141.5-27	6141.5-16	6141.5-17	6141.5-18
Genus Richness (# genera)	8	10	8	9	8	10	7	8	8	2	2	4	4	5	6	6	5	5
Simpson's Diversity Index	0.65	0.67	0.65	0.62	0.58	0.59	0.75	0.74	0.73	0.03	0.02	0.09	0.27	0.36	0.41	0.44	0.38	0.40

Area	George	George	George	George	George	George	George	George	George	George	George	George
Lake	Sleigh	Sleigh	Sleigh	Dragon	Dragon	Dragon	Komatic	Komatic	Komatic	Reference C	Reference C	Reference C
Replicate	1	2	3	1	2	3	1	2	3	1	2	3
Date Sampled	22-Aug-12	22-Aug-12	22-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12
Volume Filtered (m^3)	1.096	1.415	1.058	0.623	1.174	1.138	0.686	0.955	0.693	1.461	1.487	1.753
Tow Type	horizontal	horizontal	horizontal	oblique	oblique	oblique	vertical	vertical	vertical	vertical	vertical	vertical
Tow Depth (m)	0.5	0.5	0.5	2	2	2	6	6	6	30	30	30
EcoAnalysts Sample ID	6141.5-22	6141.5-23	6141.5-24	6141.5-7	6141.5-8	6141.5-9	6141.5-13	6141.5-14	6141.5-15	6141.5-19	6141.5-20	6141.5-21
Genus Richness (# genera)	6	4	5	9	7	6	8	8	8	5	6	5
Simpson's Diversity Index	0.31	0.04	0.06	0.66	0.65	0.72	0.82	0.78	0.81	0.68	0.67	0.67

Diversity and richness data does not include nauplii or copepodites or organisms not identified to the genus level.

Appendix 3.7-3

Lake Zooplankton Reference Photographs, Back River Project, 2012

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Appendix 3.7-3. Lake Zooplankton Reference Photographs, Back River Project, 2012

Reference photographs of highly abundant genera are shown below, more information (species names, location, date) on these photographs are available by request. Photographs of less abundant taxa area also available by request.

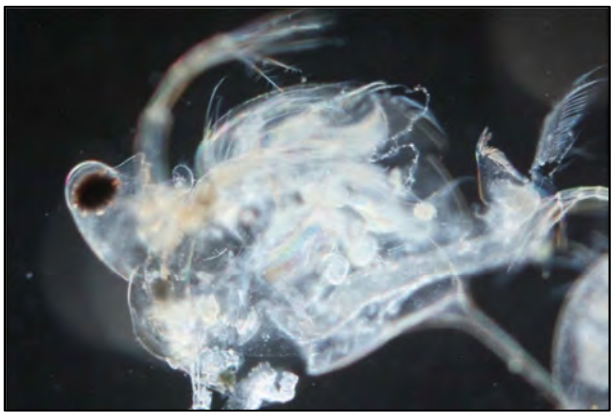
EcoAnalysts, Inc.



Conochilus (Rotifera - Conochilidae)



Cyclops (Crustacea - Cyclopidae)



Daphnia (Crustacea - Daphniidae)



Eubosmina (Crustacea - Bosminidae)



Eurycercus (Crustacea - Chydoridae)



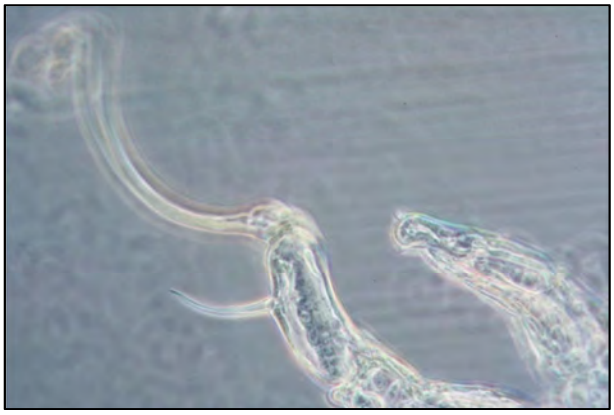
Heterocope (Crustacea - Temoridae)



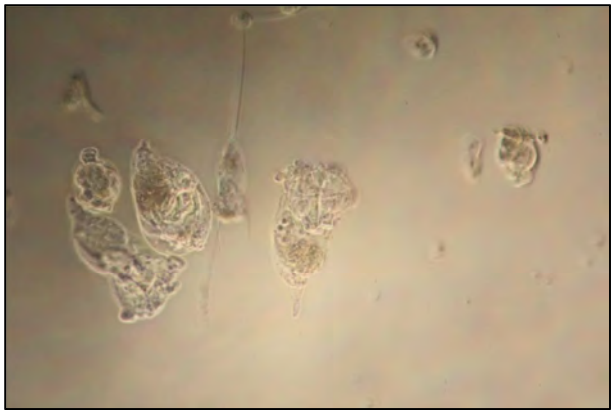
Holpedium (Crustacea - Holopedidae)



Kellicottia (Rotifera - Brachionidae)



Leptodiaptomus (Crustacea - Diaptomidae)



Synchaeta (Rotifera - Synchaetidae)

Appendix 3.7-4

Lake Zooplankton QA/QC Results, Back River Project, 2012

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EcoAnalysts, Inc.
1420 South Blaine Street, Suite 14
Moscow, Idaho 83843 U.S.A.
(208) 882 - 2588

Taxonomy ID QC Percent Similarity

6141.5-4

Comparison Date: 10/09/2012 02:58:42

Waterbody	Rep
Fold Lake	1

		Original Taxonomist - A Taxonomist					QC Taxonomist - Matthew Hill					
TIN	TAXON	NOTE	AB	L	P	A	AB	L	P	A	NOTE	DIFF.
4158	Conochilus unicornis		120	120	0	0	148	148	0	0		-28
4157	Copepoda - nauplii		89	89	0	0	82	82	0	0		7
4155	Cyclopoida - copepodites		221	221	0	0	204	204	0	0		17
4093	Cyclops		32	32	0	0	24	24	0	0		8
4075	Daphnia longiremis		96	96	0	0	88	88	0	0		8
3089	Diaptomidae		106	106	0	0	124	124	0	0		-18
8168	Eubosmina longispina		15	18	0	0	18	18	0	0		-3
4126	Kellicottia longispina		146	146	0	0	174	174	0	0		-28
4129	Keratella cochlearis		2	2	0	0	1	1	0	0		1
4414	Leptodiaptomus sicilis		16	18	0	0	16	16	0	0		0
			843				879				Difference =	-36
											Percent Similarity =	93.12

EcoAnalysts, Inc.
1420 South Blaine Street, Suite 14
Moscow, Idaho 83843 U.S.A.
(208) 882 - 2588

Taxonomy ID QC Percent Similarity

6141.5-17

Comparison Date: 10/09/2012 03:02:54

Waterbody	Rep
Occurance Lake	2

		Original Taxonomist - A Taxonomist					QC Taxonomist - Matthew Hill					
TIN	TAXON	NOTE	AB	L	P	A	AB	L	P	A	NOTE	DIFF.
765	Chironomidae		3	3	0	0	3	3	0	0		0
3318	Chydoridae		1	1	0	0	1	1	0	0		0
4157	Copepoda - nauplii		57	57	0	0	50	50	0	0		7
3298	Cyclopoida		6	6	0	0	0	0	0	0		6
4145	Daphnia middendorffiana		133	133	0	0	133	133	0	0		0
3089	Diaptomidae		28	28	0	0	10	10	0	0		18
4029	Eurycercus		1	1	0	0	1	1	0	0		0
4149	Heterocope septentrionalis		12	12	0	0	10	10	0	0		2
4126	Kellicottia longispina		20	20	0	0	10	10	0	0		10
4412	Leptodiaptomus ashlandi		384	384	0	0	399	399	0	0		-15
4150	Leptodiaptomus pribilofensis		113	113	0	0	154	154	0	0		-41
4414	Leptodiaptomus sicilis		42	42	0	0	45	45	0	0		-3
			800				816				Difference =	-16
											Percent Similarity =	94.09

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Taxonomy ID QC Percent Similarity

6141.5-23

Comparison Date: 10/09/2012 03:08:50

Waterbody	Rep
Sleigh Lake	2

		Original Taxonomist - A Taxonomist					QC Taxonomist - Matthew Hill					
TIN	TAXON	NOTE	AB	L	P	A	AB	L	P	A	NOTE	DIFF.
765	Chironomidae		1	1	0	0	1	1	0	0		0
4157	Copepoda - nauplii		38	38	0	0	26	26	0	0		12
3298	Cyclopoida		3	3	0	0	1	1	0	0		2
4145	Daphnia middendorffiana		1	1	0	0	1	1	0	0		0
3089	Diaptomidae		5	5	0	0	6	6	0	0		-1
4149	Heterocope septentrionalis		1	1	0	0	1	1	0	0		0
4126	Kellicottia longispina		20	20	0	0	14	14	0	0		6
4412	Leptodiaptomus ashlandi		44	44	0	0	50	50	0	0		-6
4150	Leptodiaptomus pribilofensis		187	187	0	0	154	154	0	0		33
4414	Leptodiaptomus sicilis		9	9	0	0	9	9	0	0		0
			309				263				Difference =	46
											Percent Similarity =	93.89

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Taxonomy ID QC Percent Similarity

6138.6-7

Comparison Date: 10/09/2012 02:53:54

Waterbody	Rep	Comments
Big Lake	1	

		Original Taxonomist - A Taxonomist					QC Taxonomist - Matthew Hill					
TIN	TAXON	NOTE	AB	L	P	A	AB	L	P	A	NOTE	DIFF.
4158	Conochilus unicornis		330	330	0	0	310	310	0	0		20
4157	Copepoda - nauplii		238	238	0	0	238	238	0	0		0
4155	Cyclopoida - copepodites		71	71	0	0	82	82	0	0		-11
4145	Daphnia middendorffiana		5	5	0	0	5	5	0	0		0
4411	Epischura lacustris		7	7	0	0	7	7	0	0		0
8168	Eubosmina longispina		2	2	0	0	2	2	0	0		0
4149	Heterocope septentrionalis		1	1	0	0	1	1	0	0		0
4058	Holopedium gibberum		81	81	0	0	86	86	0	0		-5
4126	Kellicottia longispina		249	249	0	0	240	240	0	0		9
4150	Leptodiaptomus pribilofensis		162	162	0	0	166	166	0	0		-4
			1146				1137				Difference =	9
											Percent Similarity =	97.85

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Taxonomy ID QC Percent Similarity

6138.6-18

Comparison Date: 10/09/2012 02:55:39

Waterbody	Rep	Comments
Giraffe Lake South - Deep	3	

		Original Taxonomist - A Taxonomist					QC Taxonomist - Matthew Hill					
TIN	TAXON	NOTE	AB	L	P	A	AB	L	P	A	NOTE	DIFF.
4114	Collotheca		11	11	0	0	0	0	0	0		11
4446	Collotheca mutabilis		0	0	0	0	11	11	0	0		-11
4158	Conochilus unicornis		24	24	0	0	24	24	0	0		0
4157	Copepoda - nauplii		114	114	0	0	96	96	0	0		18
4155	Cyclopoida - copepodites		32	32	0	0	34	34	0	0		-2
4145	Daphnia middendorffiana		1	1	0	0	1	1	0	0		0
4411	Epischura lacustris		6	6	0	0	6	6	0	0		0
4149	Heterocope septentrionalis		1	1	0	0	1	1	0	0		0
4058	Holopedium gibberum		16	16	0	0	10	10	0	0		6
4126	Kellicottia longispina		218	218	0	0	238	238	0	0		-20
4150	Leptodiaptomus pribilofensis		173	173	0	0	158	158	0	0		15
			596				579				Difference =	17
											Percent Similarity =	92.91

Appendix 3.7-5

Lake Benthos Density and Taxonomic Results, Back River Project, 2012

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Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Gander	Gander	Gander	Gander	Gander	Pond 19	Pond 19	Pond 19
					Replicate	1	2	3	4	5	1	2	3
					Date Sampled	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6138.2-26	6138.2-27	6138.2-28	6138.2-29	6138.2-30	6138.2-45	6138.2-46	6138.2-47
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**								
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.								
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.								
			Lebertiidae	*Lebertia*	*Lebertia* sp.	53.2		51.4		28.9			
			Oxidae	*Oxus*	*Oxus* sp.								
			Pionidae	Undetermined	Pionidae	17.7							
		Undetermined	Undetermined	Undetermined	Acari								
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae								
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	35.5	154.1	25.7			72.1	43.3	143.7
		Tubificida	Naididae	*Nais*	*Nais* sp.								24.0
				Specaria	*Specaria josinae*	53.2	51.4	25.7	86.6				
				Vejdovskyella	*Vejdovskyella comata*								
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*								
				Rhyacodrilus	*Rhyacodrilus coccineus*								
				Undetermined	Tubificidae w/ cap setae	567.9	282.5	487.9	634.8	288.6			143.7
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.	1739.1	1849.0	1926.1	3924.3	3837.7			
				Undetermined	Sphaeriidae	976.0	1027.2	487.9	2164.1	1760.2			
				Sphaerium	*Sphaerium* sp.	17.7	25.7		28.9	28.9			
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.								
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera								
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.								
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida								
		Cyclopoida	Undetermined	Undetermined	Cyclopoida			25.7					
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda	53.2						14.4	
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.								24.0
			Empididae	Undetermined	Empididae		25.7			28.9			
			Muscidae	Undetermined	Muscidae						43.3	28.9	71.9
			Tabanidae	*Chrysops*	*Chrysops* sp.								
			Tipulidae	*Tipula*	*Tipula* sp.								
			Undetermined	Undetermined	Diptera								
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.								
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.	35.5	359.5	179.8	115.4	57.7	14.4	14.4	47.9
				Ablabesmyia	*Ablabesmyia* sp.							202.0	886.2
				Undetermined	Chironomini						14.4		
				Chironomus	*Chironomus* sp.					28.9			
				Cladopelma	*Cladopelma* sp.								
				Cladotanytarsus	*Cladotanytarsus* sp.								
				Corynocera	*Corynocera* sp.								
				Corynoneura	*Corynoneura* sp.								
				Cricotopus	*Cricotopus* sp.	35.5	102.7	282.5	173.1	28.9			24.0
				Cryptochironomus	*Cryptochironomus* sp.	390.4	359.5	359.5	288.6	317.4	14.4		
				Demicryptochironomus	*Demicryptochironomus* sp.								
				Dicrotendipes	*Dicrotendipes fumidus*	816.3	2388.3	693.4	461.7	288.6	14.4	28.9	47.9
				Dicrotendipes	*Dicrotendipes* sp.			128.4		577.1			95.8
				Glyptotendipes	*Glyptotendipes* sp.								
				Heterotanytarsus	*Heterotanytarsus* sp.								
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*	71.0	154.1	179.8	404.0	144.3			
				Hydrobaenus	*Hydrobaenus* sp.								
				Micropsectra	*Micropsectra* sp.								
				Microtendipes	*Microtendipes pedellus gr.*								
				Monodiamesa	*Monodiamesa* sp.								

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2														
Taxonomic Classification:						Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
						Lake	Gander	Gander	Gander	Gander	Gander	Pond 19	Pond 19	Pond 19
						Replicate	1	2	3	4	5	1	2	3
						Date Sampled	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
						Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
						EcoAnalysts Sample ID	6138.2-26	6138.2-27	6138.2-28	6138.2-29	6138.2-30	6138.2-45	6138.2-46	6138.2-47
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**									
				Undetermined	Orthocladiinae									
				Orthocladius	Orthocladius Complex			25.7						
				Pagastiella	*Pagastiella sp.*									
				Parachironomus	*Parachironomus* sp.		88.7	231.1	205.4	86.6	115.4			
				Paracladius	*Paracladius sp.*									
				Parakiefferiella	*Parakiefferiella* sp.									
				Paratanytarsus	*Paratanytarsus* sp.			102.7				533.8	620.4	2179.5
				Polypedilum	*Polypedilum halterale gr.*		17.7		77.0	144.3	144.3			
				Polypedilum	*Polypedilum scalaenum gr.*									
				Polypedilum	*Polypedilum* sp.									
				Potthastia	*Potthastia longimana gr.*				25.7		28.9			
				Procladius	*Procladius* sp.		319.4	667.7	1104.3	577.1	548.2	86.6	144.3	598.8
				Protanypus	*Protanypus* sp.									
				Psectrocladius	*Psectrocladius* sp.		124.2	487.9	231.1	404.0	202.0	28.9	447.3	910.1
				Pseudosmittia	*Pseudosmittia* sp.									
				Sergentia	*Sergentia* sp.		17.7	51.4	308.2	259.7	173.1			
				Stempellinella	*Stempellinella* sp.									
				Stictochironomus	*Stictochironomus* sp.		124.2	77.0	51.4					
				Undetermined	Tanytarsini							14.4	14.4	
				Tanytarsus	*Tanytarsus* sp.		88.7	462.3	770.4	317.4	259.7		57.7	2275.3
				Thienemannimyia	*Thienemannimyia* gr. sp.									
				Zalutschia	*Zalutschia* sp.		17.7	25.7		28.9		14.4		
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*			205.4	77.0		230.8			
				Valvata	*Valvata* sp.		230.7	51.4		115.4	115.4			
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda			154.1	179.8			14.4		
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria									
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.		35.5				28.9			
			Limnephilidae	*Grensia*	*Grensia praeterita*									
				Undetermined	Limnephilidae									
				Limnephilus	*Limnephilus* sp.								14.4	
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.									
						TOTAL	**5927.2**	**9322.2**	**7884.0**	**10214.7**	**9262.5**	**865.7**	**1630.3**	**7472.4**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Pond 19	Pond 19	Big	Big	Big	Big	Big
					Replicate	4	5	1	2	3	4	5
					Date Sampled	21-Aug-12	21-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6138.2-48	6138.2-49	6138.2-16	6138.2-17	6138.2-18	6138.2-19	6138.2-20
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**							
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.							
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.							
			Lebertiidae	*Lebertia*	*Lebertia* sp.	14.4				28.9		
			Oxidae	*Oxus*	*Oxus* sp.							
			Pionidae	Undetermined	Pionidae					28.9	28.9	
		Undetermined	Undetermined	Undetermined	Acari							
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae							
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	72.1	173.1		173.1	86.6	43.3	28.9
		Tubificida	Naididae	*Nais*	*Nais* sp.							
				Specaria	*Specaria josinae*							
				Vejdovskyella	*Vejdovskyella comata*							
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*							
				Rhyacodrilus	*Rhyacodrilus coccineus*			38.5				
				Undetermined	Tubificidae w/ cap setae	28.9	14.4	154.1	115.4	115.4	57.7	230.8
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.			2388.5	1875.6	1673.6	1500.5	2193.0
				Undetermined	Sphaeriidae			693.4	952.2	735.8	476.1	750.2
				Sphaerium	*Sphaerium* sp.					28.9	43.3	
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.							
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera			77.0		14.4		57.7
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.							
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida							
		Cyclopoida	Undetermined	Undetermined	Cyclopoida			115.6				57.7
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda		28.9		86.6		115.4	28.9
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.	14.4						
			Empididae	Undetermined	Empididae							
			Muscidae	Undetermined	Muscidae	144.3	28.9					
			Tabanidae	*Chrysops*	*Chrysops* sp.		28.9					
			Tipulidae	*Tipula*	*Tipula* sp.							
			Undetermined	Undetermined	Diptera							
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.							
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.	14.4						
				Ablabesmyia	*Ablabesmyia* sp.	129.8	562.7	38.5	28.9	43.3		57.7
				Undetermined	Chironomini							
				Chironomus	*Chironomus* sp.			77.0		14.4		57.7
				Cladopelma	*Cladopelma* sp.			115.6	144.3	129.8	129.8	144.3
				Cladotanytarsus	*Cladotanytarsus* sp.			4931.2	3578.0	1659.2	1644.7	3433.7
				Corynocera	*Corynocera* sp.					14.4		
				Corynoneura	*Corynoneura* sp.							
				Cricotopus	*Cricotopus* sp.	28.9	72.1					
				Cryptochironomus	*Cryptochironomus* sp.			115.6	86.6	14.4	28.9	57.7
				Demicryptochironomus	*Demicryptochironomus* sp.							
				Dicrotendipes	*Dicrotendipes fumidus*	72.1	43.3		86.6	28.9		
				Dicrotendipes	*Dicrotendipes* sp.							
				Glyptotendipes	*Glyptotendipes* sp.							
				Heterotanytarsus	*Heterotanytarsus* sp.					14.4		
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*							
				Hydrobaenus	*Hydrobaenus* sp.							
				Micropsectra	*Micropsectra* sp.							
				Microtendipes	*Microtendipes pedellus gr.*			38.5	86.6	28.9	14.4	57.7
				Monodiamesa	*Monodiamesa* sp.							

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Pond 19	Pond 19	Big	Big	Big	Big	Big
					Replicate	4	5	1	2	3	4	5
					Date Sampled	21-Aug-12	21-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6138.2-48	6138.2-49	6138.2-16	6138.2-17	6138.2-18	6138.2-19	6138.2-20
Major Group	Class	Order	Family	Genus	Final Designation							
				Undetermined	Orthocladiinae							
				Orthocladius	Orthocladius Complex							
				Pagastiella	*Pagastiella sp.*							
				Parachironomus	*Parachironomus* sp.			38.5				
				Paracladius	*Paracladius sp.*							
				Parakiefferiella	*Parakiefferiella* sp.							
				Paratanytarsus	*Paratanytarsus* sp.	634.8	1659.2			28.9		
				Polypedilum	*Polypedilum halterale gr.*					57.7	28.9	115.4
				Polypedilum	*Polypedilum scalaenum gr.*							
				Polypedilum	*Polypedilum* sp.				28.9	28.9		57.7
				Potthastia	*Potthastia longimana gr.*							
				Procladius	*Procladius* sp.	288.6	303.0	1078.7	865.7	461.7	360.7	461.7
				Protanypus	*Protanypus* sp.							
				Psectrocladius	*Psectrocladius* sp.	173.1	548.2	115.6	317.4	173.1	115.4	86.6
				Pseudosmittia	*Pseudosmittia* sp.							
				Sergentia	*Sergentia* sp.			38.5	86.6		43.3	
				Stempellinella	*Stempellinella* sp.							
				Stictochironomus	*Stictochironomus* sp.							
				Undetermined	Tanytarsini				86.6	43.3	43.3	
				Tanytarsus	*Tanytarsus* sp.	43.3	591.5	2273.0	779.1	519.4	303.0	1615.9
				Thienemannimyia	*Thienemannimyia* gr. sp.						14.4	
				Zalutschia	*Zalutschia* sp.			423.8	115.4	202.0	303.0	173.1
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*							
				Valvata	*Valvata* sp.							
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda						14.4	
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria							
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.							
			Limnephilidae	*Grensia*	*Grensia praeterita*						14.4	28.9
				Undetermined	Limnephilidae							
				Limnephilus	*Limnephilus* sp.							
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.							
					TOTAL	**1659.2**	**4054.1**	**12751.7**	**9493.3**	**6175.0**	**5323.8**	**9695.3**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Rabbit	Rabbit	Rabbit	Rabbit	Rabbit	Fox	Fox	Fox
					Replicate	1	2	3	4	5	1	2	3
					Date Sampled	15-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6138.2-6	6138.2-7	6138.2-8	6138.2-9	6138.2-10	6138.2-40	6138.2-41	6138.2-42
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**								
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.	14.4							
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.								
			Lebertiidae	*Lebertia*	*Lebertia* sp.			72.1		14.4		14.4	
			Oxidae	*Oxus*	*Oxus* sp.		14.4	72.1	43.3	43.3			
			Pionidae	Undetermined	Pionidae		14.4	43.3	28.9	28.9	57.7	101.0	72.1
		Undetermined	Undetermined	Undetermined	Acari								
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae								
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	57.7	14.4	86.6	57.7	72.1	28.9	86.6	14.4
		Tubificida	Naididae	*Nais*	*Nais* sp.								
				Specaria	*Specaria josinae*								
				Vejdovskyella	*Vejdovskyella comata*								
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*								
				Rhyacodrilus	*Rhyacodrilus coccineus*								
				Undetermined	Tubificidae w/ cap setae		14.4			43.3	303.0	216.4	129.8
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.	173.1	72.1	115.4	101.0	288.6	1745.7	1471.6	1110.9
				Undetermined	Sphaeriidae	86.6	101.0	72.1	259.7	173.1	245.3	303.0	187.6
				Sphaerium	*Sphaerium* sp.	14.4			14.4	14.4	72.1		28.9
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.								
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera	72.1	43.3	57.7	202.0	173.1	28.9	14.4	14.4
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.								
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida				101.0	14.4			28.9
		Cyclopoida	Undetermined	Undetermined	Cyclopoida	14.4		14.4	14.4	14.4	28.9	43.3	14.4
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda	692.5	807.9	548.2	1125.3	505.0	101.0	360.7	101.0
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.								
			Empididae	Undetermined	Empididae								
			Muscidae	Undetermined	Muscidae								
			Tabanidae	*Chrysops*	*Chrysops* sp.								
			Tipulidae	*Tipula*	*Tipula* sp.								
			Undetermined	Undetermined	Diptera								
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.								
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.	129.8	57.7	28.9	158.7	129.8		28.9	
				Ablabesmyia	*Ablabesmyia* sp.	187.6	115.4	101.0	245.3	216.4	14.4	43.3	
				Undetermined	Chironomini			14.4					
				Chironomus	*Chironomus* sp.	28.9	57.7	14.4	72.1	28.9			
				Cladopelma	*Cladopelma* sp.						43.3	28.9	
				Cladotanytarsus	*Cladotanytarsus* sp.		14.4		57.7	14.4	346.3	43.3	72.1
				Corynocera	*Corynocera* sp.		14.4						
				Corynoneura	*Corynoneura* sp.								
				Cricotopus	*Cricotopus* sp.	43.3							
				Cryptochironomus	*Cryptochironomus* sp.			28.9	14.4	43.3	115.4	115.4	86.6
				Demicryptochironomus	*Demicryptochironomus* sp.								
				Dicrotendipes	*Dicrotendipes fumidus*				14.4				
				Dicrotendipes	*Dicrotendipes* sp.								
				Glyptotendipes	*Glyptotendipes* sp.								
				Heterotanytarsus	*Heterotanytarsus* sp.								28.9
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*								
				Hydrobaenus	*Hydrobaenus* sp.								
				Micropsectra	*Micropsectra* sp.								
				Microtendipes	*Microtendipes pedellus gr.*								
				Monodiamesa	*Monodiamesa* sp.								

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Rabbit	Rabbit	Rabbit	Rabbit	Rabbit	Fox	Fox	Fox
					Replicate	1	2	3	4	5	1	2	3
					Date Sampled	15-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6138.2-6	6138.2-7	6138.2-8	6138.2-9	6138.2-10	6138.2-40	6138.2-41	6138.2-42
Major Group	Class	Order	Family	Genus	Final Designation								
				Undetermined	Orthocladiinae								
				Orthocladius	Orthocladius Complex								
				Pagastiella	*Pagastiella sp.*	14.4		14.4				43.3	
				Parachironomus	*Parachironomus* sp.								
				Paracladius	*Paracladius sp.*								
				Parakiefferiella	*Parakiefferiella* sp.								
				Paratanytarsus	*Paratanytarsus* sp.	57.7	14.4	28.9		14.4			
				Polypedilum	*Polypedilum halterale gr.*				14.4		173.1	28.9	72.1
				Polypedilum	*Polypedilum scalaenum gr.*								
				Polypedilum	*Polypedilum* sp.								
				Potthastia	*Potthastia longimana gr.*								
				Procladius	*Procladius* sp.	548.2	346.3	360.7	591.5	649.2	331.8	490.5	129.8
				Protanypus	*Protanypus* sp.								
				Psectrocladius	*Psectrocladius* sp.	649.2	230.8	274.1	750.2	1168.6	158.7	245.3	43.3
				Pseudosmittia	*Pseudosmittia* sp.								
				Sergentia	*Sergentia* sp.								
				Stempellinella	*Stempellinella* sp.								
				Stictochironomus	*Stictochironomus* sp.	14.4			14.4				
				Undetermined	Tanytarsini								
				Tanytarsus	*Tanytarsus* sp.	245.3	115.4	259.7	245.3	706.9	115.4		43.3
				Thienemannimyia	*Thienemannimyia* gr. sp.	57.7		14.4	72.1	43.3			
				Zalutschia	*Zalutschia* sp.								
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*								
				Valvata	*Valvata* sp.								
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda	331.8	173.1	259.7	216.4	173.1		28.9	
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria					28.9		14.4	14.4
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.								
			Limnephilidae	*Grensia*	*Grensia praeterita*	14.4	14.4	14.4	43.3				
				Undetermined	Limnephilidae								
				Limnephilus	*Limnephilus* sp.								
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.								
					TOTAL	**3448.2**	**2236.3**	**2496.0**	**4458.1**	**4602.4**	**3909.9**	**3722.3**	**2193.0**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Fox	Fox	Rascal	Rascal	Rascal	Rascal	Rascal
					Replicate	4	5	1	2	3	4	5
					Date Sampled	20-Aug-12	20-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	8-Aug-12	15-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6138.2-43	6138.2-44	6138.2-11	6138.2-12	6138.2-13	6138.2-14	6138.2-15
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**							
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.							
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.							
			Lebertiidae	*Lebertia*	*Lebertia* sp.					28.9	43.3	14.4
			Oxidae	*Oxus*	*Oxus* sp.							
			Pionidae	Undetermined	Pionidae	28.9	14.4					
		Undetermined	Undetermined	Undetermined	Acari							
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae							
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	43.3	28.9	43.3	57.7	72.1	28.9	43.3
		Tubificida	Naididae	*Nais*	*Nais* sp.							
				Specaria	*Specaria josinae*							
				Vejdovskyella	*Vejdovskyella comata*							
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*							
				Rhyacodrilus	*Rhyacodrilus coccineus*							
				Undetermined	Tubificidae w/ cap setae	202.0	129.8	86.6	28.9	28.9	115.4	28.9
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.	1269.6	908.9	158.7	129.8	173.1	158.7	245.3
				Undetermined	Sphaeriidae	216.4	129.8	101.0	144.3	28.9	43.3	57.7
				Sphaerium	*Sphaerium* sp.	28.9			72.1	43.3	14.4	28.9
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.							
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera		14.4	14.4	14.4	86.6	86.6	86.6
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.							
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida		14.4					
		Cyclopoida	Undetermined	Undetermined	Cyclopoida	14.4			14.4		14.4	
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda	86.6	144.3	634.8	216.4	274.1	202.0	173.1
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.							
			Empididae	Undetermined	Empididae							
			Muscidae	Undetermined	Muscidae							
			Tabanidae	*Chrysops*	*Chrysops* sp.							
			Tipulidae	*Tipula*	*Tipula* sp.							
			Undetermined	Undetermined	Diptera							14.4
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.							
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.			259.7	158.7	202.0	375.1	360.7
				Ablabesmyia	*Ablabesmyia* sp.			43.3	14.4	28.9	158.7	101.0
				Undetermined	Chironomini							
				Chironomus	*Chironomus* sp.							
				Cladopelma	*Cladopelma* sp.	28.9	43.3		14.4		57.7	14.4
				Cladotanytarsus	*Cladotanytarsus* sp.	144.3	101.0	86.6	274.1	274.1	476.1	1240.8
				Corynocera	*Corynocera* sp.			1284.0	2077.6	1688.0	1298.5	1832.3
				Corynoneura	*Corynoneura* sp.							
				Cricotopus	*Cricotopus* sp.							
				Cryptochironomus	*Cryptochironomus* sp.	101.0	72.1	173.1	72.1	57.7	173.1	173.1
				Demicryptochironomus	*Demicryptochironomus* sp.							
				Dicrotendipes	*Dicrotendipes fumidus*			43.3	43.3	43.3	129.8	144.3
				Dicrotendipes	*Dicrotendipes* sp.						14.4	
				Glyptotendipes	*Glyptotendipes* sp.							
				Heterotanytarsus	*Heterotanytarsus* sp.	14.4	14.4					
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*							
				Hydrobaenus	*Hydrobaenus* sp.							
				Micropsectra	*Micropsectra* sp.							
				Microtendipes	*Microtendipes pedellus gr.*							
				Monodiamesa	*Monodiamesa* sp.							

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Fox	Fox	Rascal	Rascal	Rascal	Rascal	Rascal
					Replicate	4	5	1	2	3	4	5
					Date Sampled	20-Aug-12	20-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	8-Aug-12	15-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6138.2-43	6138.2-44	6138.2-11	6138.2-12	6138.2-13	6138.2-14	6138.2-15
Major Group	Class	Order	Family	Genus	Final Designation							
				Undetermined	Orthocladiinae							
				Orthocladius	Orthocladius Complex							
				Pagastiella	*Pagastiella sp.*							
				Parachironomus	*Parachironomus* sp.							
				Paracladius	*Paracladius sp.*							
				Parakiefferiella	*Parakiefferiella* sp.							14.4
				Paratanytarsus	*Paratanytarsus* sp.			533.8	620.4	375.1	259.7	202.0
				Polypedilum	*Polypedilum halterale gr.*	129.8	259.7	187.6	375.1	216.4	505.0	490.5
				Polypedilum	*Polypedilum scalaenum gr.*							
				Polypedilum	*Polypedilum* sp.			72.1	43.3	14.4		
				Potthastia	*Potthastia longimana gr.*							
				Procladius	*Procladius* sp.	274.1	230.8	158.7	115.4	57.7	259.7	101.0
				Protanypus	*Protanypus* sp.							
				Psectrocladius	*Psectrocladius* sp.	158.7	43.3	144.3	202.0	317.4	230.8	461.7
				Pseudosmittia	*Pseudosmittia* sp.							
				Sergentia	*Sergentia* sp.				14.4	14.4	72.1	
				Stempellinella	*Stempellinella* sp.							
				Stictochironomus	*Stictochironomus* sp.			57.7				
				Undetermined	Tanytarsini			14.4	14.4	43.3		14.4
				Tanytarsus	*Tanytarsus* sp.	43.3	28.9		101.0	43.3	158.7	101.0
				Thienemannimyia	*Thienemannimyia* gr. sp.							
				Zalutschia	*Zalutschia* sp.							
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*			57.7			28.9	
				Valvata	*Valvata* sp.				28.9			14.4
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda		14.4					
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria							
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.							
			Limnephilidae	*Grensia*	*Grensia praeterita*			14.4		28.9	14.4	
				Undetermined	Limnephilidae				14.4	14.4		57.7
				Limnephilus	*Limnephilus* sp.							
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.							
					TOTAL	**2798.9**	**2178.6**	**4169.6**	**4862.1**	**4155.1**	**4919.8**	**6016.3**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Giraffe North	Giraffe North	Giraffe North	Giraffe North	Giraffe North	Giraffe South	Giraffe South	Giraffe South
					Replicate	1	2	3	4	5	1	2	3
					Date Sampled	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6138.2-31	6138.2-32	6138.2-33	6138.2-34	6138.2-35	6138.2-36	6138.2-37	6138.2-38
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**								
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.							14.4	
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.								
			Lebertiidae	*Lebertia*	*Lebertia* sp.				14.4			43.3	
			Oxidae	*Oxus*	*Oxus* sp.								14.4
			Pionidae	Undetermined	Pionidae		72.1		14.4	43.3	43.3	14.4	14.4
		Undetermined	Undetermined	Undetermined	Acari								
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae								
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	86.6	86.6	115.4	101.0	72.1	28.9	14.4	
		Tubificida	Naididae	*Nais*	*Nais* sp.								
				Specaria	*Specaria josinae*								
				Vejdovskyella	*Vejdovskyella comata*								
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*								
				Rhyacodrilus	*Rhyacodrilus coccineus*			14.4					
				Undetermined	Tubificidae w/ cap setae	14.4	14.4	86.6	14.4	14.4		28.9	
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.	404.0	490.5	461.7	505.0	461.7	86.6	259.7	230.8
				Undetermined	Sphaeriidae	101.0	216.4	129.8	288.6	230.8	43.3	187.6	173.1
				Sphaerium	*Sphaerium* sp.	14.4	57.7	14.4	28.9	43.3			28.9
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.								
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera	880.1	432.8	476.1	303.0	317.4			14.4
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.								
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida	14.4							
		Cyclopoida	Undetermined	Undetermined	Cyclopoida	43.3						28.9	28.9
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda	86.6	43.3	86.6	115.4	28.9	158.7	72.1	86.6
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.								
			Empididae	Undetermined	Empididae								14.4
			Muscidae	Undetermined	Muscidae								
			Tabanidae	*Chrysops*	*Chrysops* sp.								
			Tipulidae	*Tipula*	*Tipula* sp.								
			Undetermined	Undetermined	Diptera							14.4	
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.								
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.				14.4			14.4	
				Ablabesmyia	*Ablabesmyia* sp.	28.9	72.1		57.7	43.3	14.4	28.9	14.4
				Undetermined	Chironomini								
				Chironomus	*Chironomus* sp.		14.4				14.4	28.9	14.4
				Cladopelma	*Cladopelma* sp.	101.0	230.8	86.6	245.3	28.9		14.4	43.3
				Cladotanytarsus	*Cladotanytarsus* sp.							14.4	
				Corynocera	*Corynocera* sp.	303.0	259.7	115.4	404.0	158.7			
				Corynoneura	*Corynoneura* sp.								
				Cricotopus	*Cricotopus* sp.								
				Cryptochironomus	*Cryptochironomus* sp.	57.7	28.9	14.4	43.3	43.3	14.4		14.4
				Demicryptochironomus	*Demicryptochironomus* sp.							43.3	
				Dicrotendipes	*Dicrotendipes fumidus*								14.4
				Dicrotendipes	*Dicrotendipes* sp.								
				Glyptotendipes	*Glyptotendipes* sp.								
				Heterotanytarsus	*Heterotanytarsus* sp.	72.1	43.3	28.9	14.4	57.7			
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*	14.4						28.9	
				Hydrobaenus	*Hydrobaenus* sp.								
				Micropsectra	*Micropsectra* sp.								
				Microtendipes	*Microtendipes pedellus gr.*								
				Monodiamesa	*Monodiamesa* sp.	14.4							

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Major Group	Class	Order	Family	Genus	Final Designation	Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
						Lake	Giraffe North	Giraffe North	Giraffe North	Giraffe North	Giraffe North	Giraffe South	Giraffe South	Giraffe South
						Replicate	1	2	3	4	5	1	2	3
						Date Sampled	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12
						Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
						EcoAnalysts Sample ID	6138.2-31	6138.2-32	6138.2-33	6138.2-34	6138.2-35	6138.2-36	6138.2-37	6138.2-38
				Undetermined	Orthocladiinae									
				Orthocladius	Orthocladius Complex									
				Pagastiella	*Pagastiella sp.*		216.4	548.2	274.1	533.8	230.8	72.1	144.3	86.6
				Parachironomus	*Parachironomus* sp.									
				Paracladius	*Paracladius sp.*									
				Parakiefferiella	*Parakiefferiella* sp.									
				Paratanytarsus	*Paratanytarsus* sp.						14.4		14.4	
				Polypedilum	*Polypedilum halterale gr.*		72.1		28.9	14.4	14.4			
				Polypedilum	*Polypedilum scalaenum gr.*									
				Polypedilum	*Polypedilum* sp.									
				Potthastia	*Potthastia longimana gr.*									
				Procladius	*Procladius* sp.		447.3	577.1	418.4	548.2	259.7	57.7	72.1	43.3
				Protanypus	*Protanypus* sp.									
				Psectrocladius	*Psectrocladius* sp.		28.9	86.6	144.3	43.3	28.9	14.4	72.1	
				Pseudosmittia	*Pseudosmittia* sp.									
				Sergentia	*Sergentia* sp.		14.4	14.4		57.7	28.9			
				Stempellinella	*Stempellinella* sp.									
				Stictochironomus	*Stictochironomus* sp.		288.6	288.6	375.1	259.7	101.0			
				Undetermined	Tanytarsini									
				Tanytarsus	*Tanytarsus* sp.		620.4	317.4	519.4	375.1	173.1		57.7	14.4
				Thienemannimyia	*Thienemannimyia* gr. sp.									
				Zalutschia	*Zalutschia* sp.		43.3	86.6	28.9	86.6	43.3	72.1	144.3	115.4
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*									
				Valvata	*Valvata* sp.									
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda					14.4	14.4			
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria		14.4			14.4				
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.									
			Limnephilidae	*Grensia*	*Grensia praeterita*		28.9		28.9					
				Undetermined	Limnephilidae									
				Limnephilus	*Limnephilus* sp.									
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.									
						TOTAL	**4010.8**	**3982.0**	**3448.2**	**4111.8**	**2452.7**	**620.4**	**1356.2**	**966.6**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Giraffe South	Goose Neck	Goose Neck	Goose Neck	Goose Neck	Goose Neck	Goose Central	Goose Central
					Replicate	4	1	2	3	4	5	1	2
					Date Sampled	19-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	17-Aug-12	17-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6138.2-39	6138.2-1	6138.2-2	6138.2-3	6138.2-4	6138.2-5	6138.2-21	6138.2-22
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**								
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.	14.4							
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.								
			Lebertiidae	*Lebertia*	*Lebertia* sp.	86.6	14.4	20.3			77.0	20.9	34.6
			Oxidae	*Oxus*	*Oxus* sp.	14.4	14.4					20.9	34.6
			Pionidae	Undetermined	Pionidae	57.7						20.9	
		Undetermined	Undetermined	Undetermined	Acari								
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae								
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	43.3	144.3	81.4	138.5	173.1	77.0	62.8	
		Tubificida	Naididae	*Nais*	*Nais* sp.								
				Specaria	*Specaria josinae*								
				Vejdovskyella	*Vejdovskyella comata*								
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*								
				Rhyacodrilus	*Rhyacodrilus coccineus*		14.4					62.8	34.6
				Undetermined	Tubificidae w/ cap setae	28.9	72.1	101.7	277.0	115.4	115.6	125.5	277.0
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.	72.1	389.5	773.0	369.3	1615.9	269.7	418.4	969.5
				Undetermined	Sphaeriidae	288.6	663.7	325.5	277.0	923.4	770.5	439.3	934.8
				Sphaerium	*Sphaerium* sp.		43.3	40.7	46.2	115.4	77.0	62.8	69.2
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.								
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera						38.5	20.9	103.9
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.								
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida								69.2
		Cyclopoida	Undetermined	Undetermined	Cyclopoida		14.4		23.1		154.1	104.6	1073.3
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda	303.0	187.6	427.2	115.4	750.2	423.8	502.0	1384.9
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.								
			Empididae	Undetermined	Empididae								
			Muscidae	Undetermined	Muscidae								
			Tabanidae	*Chrysops*	*Chrysops* sp.								
			Tipulidae	*Tipula*	*Tipula* sp.								
			Undetermined	Undetermined	Diptera		28.9		23.1				
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.								
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.			40.7	115.4			20.9	103.9
				Ablabesmyia	*Ablabesmyia* sp.		14.4			173.1	192.6	41.8	
				Undetermined	Chironomini								
				Chironomus	*Chironomus* sp.								
				Cladopelma	*Cladopelma* sp.	28.9						20.9	69.2
				Cladotanytarsus	*Cladotanytarsus* sp.			20.3	23.1				
				Corynocera	*Corynocera* sp.		14.4	61.0		115.4	154.1	439.3	900.2
				Corynoneura	*Corynoneura* sp.								
				Cricotopus	*Cricotopus* sp.							20.9	34.6
				Cryptochironomus	*Cryptochironomus* sp.								
				Demicryptochironomus	*Demicryptochironomus* sp.	14.4							
				Dicrotendipes	*Dicrotendipes fumidus*			40.7	23.1				
				Dicrotendipes	*Dicrotendipes* sp.								34.6
				Glyptotendipes	*Glyptotendipes* sp.								
				Heterotanytarsus	*Heterotanytarsus* sp.		14.4	40.7		115.4			
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*	14.4				57.7			
				Hydrobaenus	*Hydrobaenus* sp.								
				Micropsectra	*Micropsectra* sp.								
				Microtendipes	*Microtendipes pedellus gr.*		14.4		23.1		38.5	20.9	34.6
				Monodiamesa	*Monodiamesa* sp.		57.7	40.7		115.4			69.2

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Giraffe South	Goose Neck	Goose Neck	Goose Neck	Goose Neck	Goose Neck	Goose Central	Goose Central
					Replicate	4	1	2	3	4	5	1	2
					Date Sampled	19-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	17-Aug-12	17-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6138.2-39	6138.2-1	6138.2-2	6138.2-3	6138.2-4	6138.2-5	6138.2-21	6138.2-22
Major Group	Class	Order	Family	Genus	Final Designation								
				Undetermined	Orthocladiinae								
				Orthocladius	Orthocladius Complex								
				Pagastiella	*Pagastiella sp.*	43.3	2568.1	4617.9	4201.3	8771.9	5894.3	62.8	173.1
				Parachironomus	*Parachironomus* sp.								
				Paracladius	*Paracladius sp.*								
				Parakiefferiella	*Parakiefferiella* sp.								
				Paratanytarsus	*Paratanytarsus* sp.		303.0	122.1	92.3	346.3	154.1	376.5	450.1
				Polypedilum	*Polypedilum halterale gr.*								
				Polypedilum	*Polypedilum scalaenum gr.*				23.1				
				Polypedilum	*Polypedilum* sp.								
				Potthastia	*Potthastia longimana gr.*								
				Procladius	*Procladius* sp.	28.9	202.0	183.1	369.3	1789.0	616.4	502.0	1038.7
				Protanypus	*Protanypus* sp.	14.4	28.9				77.0		
				Psectrocladius	*Psectrocladius* sp.	28.9	216.4	305.2	415.5	1500.5	1232.8	251.0	415.5
				Pseudosmittia	*Pseudosmittia* sp.								
				Sergentia	*Sergentia* sp.	14.4							
				Stempellinella	*Stempellinella* sp.								
				Stictochironomus	*Stictochironomus* sp.		490.5	345.8	554.0	1327.3	809.0	1129.6	1177.2
				Undetermined	Tanytarsini								
				Tanytarsus	*Tanytarsus* sp.	72.1	14.4		138.5	57.7	192.6	962.3	1315.7
				Thienemannimyia	*Thienemannimyia* gr. sp.		274.1	325.5	253.9	1154.2	654.9	167.3	173.1
				Zalutschia	*Zalutschia* sp.	72.1					38.5	188.3	346.2
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*		14.4				77.0		173.1
				Valvata	*Valvata* sp.				46.2	173.1	77.0	523.0	415.5
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda	28.9	57.7	40.7	115.4	230.8	192.6	376.5	138.5
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria						38.5		
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.								
			Limnephilidae	*Grensia*	*Grensia praeterita*								
				Undetermined	Limnephilidae		14.4						
				Limnephilus	*Limnephilus* sp.								
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.								
					TOTAL	**1269.6**	**5886.4**	**7954.3**	**7663.9**	**19621.4**	**12443.5**	**6965.9**	**12048.9**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Lake	Goose Central	Goose Central	Goose Central	Propellor	Propellor	Propellor	Propellor	Propellor
					Replicate	3	4	5	1	2	3	4	5
					Date Sampled	17-Aug-12	17-Aug-12	17-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6138.2-23	6138.2-24	6138.2-25	6138.2-50	6138.2-51	6138.2-52	6138.2-53	6138.2-54
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**								
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.								
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.							28.9	
			Lebertiidae	*Lebertia*	*Lebertia* sp.		38.5	38.5	28.9	19.2		28.9	
			Oxidae	*Oxus*	*Oxus* sp.								
			Pionidae	Undetermined	Pionidae								
		Undetermined	Undetermined	Undetermined	Acari								
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae	25.7							
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	25.7	115.6	231.1	86.6	19.2		115.4	14.4
		Tubificida	Naididae	*Nais*	*Nais* sp.								
				Specaria	*Specaria josinae*								
				Vejdovskyella	*Vejdovskyella comata*					38.4			
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*								
				Rhyacodrilus	*Rhyacodrilus coccineus*			77.0				28.9	14.4
				Undetermined	Tubificidae w/ cap setae	256.8	38.5	385.2	86.6	95.9	173.1	115.4	28.9
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.	462.3	963.1	1001.6	375.1	498.9	519.4	750.2	259.7
				Undetermined	Sphaeriidae	487.9	1040.2	847.5	346.3	95.9	86.6	288.6	72.1
				Sphaerium	*Sphaerium* sp.	77.0	308.2	231.1	28.9	38.4		86.6	
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.								
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera								
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.								
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida								
		Cyclopoida	Undetermined	Undetermined	Cyclopoida				28.9				
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda	719.1	1695.1	654.9					
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.								
			Empididae	Undetermined	Empididae								
			Muscidae	Undetermined	Muscidae								
			Tabanidae	*Chrysops*	*Chrysops* sp.								
			Tipulidae	*Tipula*	*Tipula* sp.								
			Undetermined	Undetermined	Diptera					19.2			
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.								
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.	25.7	231.1	231.1					
				Ablabesmyia	*Ablabesmyia* sp.	51.4				76.8	259.7	259.7	14.4
				Undetermined	Chironomini								
				Chironomus	*Chironomus* sp.								
				Cladopelma	*Cladopelma* sp.	51.4	38.5	154.1					
				Cladotanytarsus	*Cladotanytarsus* sp.								
				Corynocera	*Corynocera* sp.	1592.2	1579.5		750.2	172.7	317.4	432.8	187.6
				Corynoneura	*Corynoneura* sp.								
				Cricotopus	*Cricotopus* sp.			115.6					
				Cryptochironomus	*Cryptochironomus* sp.					19.2	28.9		
				Demicryptochironomus	*Demicryptochironomus* sp.								
				Dicrotendipes	*Dicrotendipes fumidus*					153.5		115.4	
				Dicrotendipes	*Dicrotendipes* sp.					19.2			
				Glyptotendipes	*Glyptotendipes* sp.								
				Heterotanytarsus	*Heterotanytarsus* sp.								
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*	25.7				38.4			
				Hydrobaenus	*Hydrobaenus* sp.								
				Micropsectra	*Micropsectra* sp.								
				Microtendipes	*Microtendipes pedellus gr.*	128.4	38.5	154.1	519.4	268.6	317.4	230.8	28.9
				Monodiamesa	*Monodiamesa* sp.	25.7		38.5	57.7	95.9	57.7		101.0

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2														
Taxonomic Classification:						Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
						Lake	Goose Central	Goose Central	Goose Central	Propellor	Propellor	Propellor	Propellor	Propellor
						Replicate	3	4	5	1	2	3	4	5
						Date Sampled	17-Aug-12	17-Aug-12	17-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
						Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
						EcoAnalysts Sample ID	6138.2-23	6138.2-24	6138.2-25	6138.2-50	6138.2-51	6138.2-52	6138.2-53	6138.2-54
Major Group	Class	Order	Family	Genus	Final Designation									
				Undetermined	Orthocladiinae									
				Orthocladius	Orthocladius Complex									
				Pagastiella	*Pagastiella sp.*		231.1	77.0						
				Parachironomus	*Parachironomus* sp.							28.9	28.9	
				Paracladius	*Paracladius sp.*									
				Parakiefferiella	*Parakiefferiella* sp.									
				Paratanytarsus	*Paratanytarsus* sp.		282.5	500.8	1040.2	404.0	307.0	548.2	432.8	115.4
				Polypedilum	*Polypedilum halterale gr.*					28.9				
				Polypedilum	*Polypedilum scalaenum gr.*									
				Polypedilum	*Polypedilum* sp.									
				Potthastia	*Potthastia longimana gr.*									
				Procladius	*Procladius* sp.		873.1	963.1	886.1	144.3	326.2	404.0	461.7	144.3
				Protanypus	*Protanypus* sp.		25.7	38.5	115.6	57.7	38.4		28.9	
				Psectrocladius	*Psectrocladius* sp.		385.2	1194.3	539.3		153.5	86.6	202.0	14.4
				Pseudosmittia	*Pseudosmittia* sp.									
				Sergentia	*Sergentia* sp.			38.5						
				Stempellinella	*Stempellinella* sp.									
				Stictochironomus	*Stictochironomus* sp.		1566.5	1810.7	2311.5	346.3	153.5	317.4	173.1	72.1
				Undetermined	Tanytarsini							28.9		14.4
				Tanytarsus	*Tanytarsus* sp.		565.0	1078.7	2773.8	202.0	230.3	230.8	115.4	
				Thienemannimyia	*Thienemannimyia* gr. sp.		154.1	115.6	154.1		19.2	28.9	28.9	
				Zalutschia	*Zalutschia* sp.		102.7	346.7	346.7	6348.1	3300.3	5626.7	5280.5	3000.9
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*		205.4	269.7	192.6					
				Valvata	*Valvata* sp.		282.5	577.9	192.6		19.2	57.7	57.7	28.9
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda		128.4	77.0	154.1	28.9	38.4		86.6	28.9
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria									
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.									
			Limnephilidae	*Grensia*	*Grensia praeterita*									
				Undetermined	Limnephilidae									
				Limnephilus	*Limnephilus* sp.									
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.									
						TOTAL	**8757.2**	**13175.5**	**12867.3**	**9868.4**	**6255.3**	**9118.2**	**9377.9**	**4140.7**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George	George	George	George	George	George	George	George
					Lake	Lower Long	Lower Long	Lower Long	Lower Long	Lower Long	Fold	Fold	Fold
					Replicate	1	2	3	4	5	1	2	3
					Date Sampled	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6141.2-26	6141.2-27	6141.2-28	6141.2-29	6141.2-30	6141.2-11	6141.2-12	6141.2-13
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**								
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.								
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.							16.4	28.9
			Lebertiidae	*Lebertia*	*Lebertia* sp.			57.7			28.9		43.3
			Oxidae	*Oxus*	*Oxus* sp.				14.4		28.9	16.4	
			Pionidae	Undetermined	Pionidae								
		Undetermined	Undetermined	Undetermined	Acari								
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae								
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	14.4	14.4	86.6	43.3		43.3	32.9	
		Tubificida	Naididae	*Nais*	*Nais* sp.								
				Specaria	*Specaria josinae*								
				Vejdovskyella	*Vejdovskyella comata*								
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*								
				Rhyacodrilus	*Rhyacodrilus coccineus*							16.4	14.4
				Undetermined	Tubificidae w/ cap setae								
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.	663.7	735.8	505.0	562.7	678.1	490.5	361.8	432.8
				Undetermined	Sphaeriidae	519.4	606.0	216.4	288.6	389.5	317.4	197.4	187.6
				Sphaerium	*Sphaerium* sp.		43.3	28.9		14.4	28.9		14.4
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.								
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera	43.3	43.3	72.1	144.3	28.9			
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.	14.4		14.4	28.9				
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida						57.7		28.9
		Cyclopoida	Undetermined	Undetermined	Cyclopoida					14.4			72.1
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda	274.1	418.4	72.1	86.6	303.0	706.9	1628.3	620.4
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.								
			Empididae	Undetermined	Empididae								
			Muscidae	Undetermined	Muscidae								
			Tabanidae	*Chrysops*	*Chrysops* sp.								
			Tipulidae	*Tipula*	*Tipula* sp.								
			Undetermined	Undetermined	Diptera								
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.								
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.							16.4	14.4
				Ablabesmyia	*Ablabesmyia* sp.		28.9			14.4	14.4	49.3	14.4
				Undetermined	Chironomini								
				Chironomus	*Chironomus* sp.							16.4	
				Cladopelma	*Cladopelma* sp.								
				Cladotanytarsus	*Cladotanytarsus* sp.								
				Corynocera	*Corynocera* sp.	14.4							
				Corynoneura	*Corynoneura* sp.								14.4
				Cricotopus	*Cricotopus* sp.								
				Cryptochironomus	*Cryptochironomus* sp.								
				Demicryptochironomus	*Demicryptochironomus* sp.								
				Dicrotendipes	*Dicrotendipes fumidus*							16.4	14.4
				Dicrotendipes	*Dicrotendipes* sp.								
				Glyptotendipes	*Glyptotendipes* sp.								
				Heterotanytarsus	*Heterotanytarsus* sp.								
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*								14.4
				Hydrobaenus	*Hydrobaenus* sp.								
				Micropsectra	*Micropsectra* sp.			28.9	57.7		129.8		375.1
				Microtendipes	*Microtendipes pedellus gr.*	202.0	418.4	86.6	360.7	144.3		16.4	72.1
				Monodiamesa	*Monodiamesa* sp.	14.4		14.4	14.4	28.9	14.4	16.4	28.9

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2													
Taxonomic Classification:						Area	George	George	George	George	George	George	George	George
						Lake	Lower Long	Lower Long	Lower Long	Lower Long	Lower Long	Fold	Fold	Fold
						Replicate	1	2	3	4	5	1	2	3
						Date Sampled	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12
						Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
						EcoAnalysts Sample ID	6141.2-26	6141.2-27	6141.2-28	6141.2-29	6141.2-30	6141.2-11	6141.2-12	6141.2-13
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**									
				Undetermined	Orthocladiinae									
				Orthocladius	Orthocladius Complex									
				Pagastiella	*Pagastiella sp.*									
				Parachironomus	*Parachironomus* sp.								32.9	101.0
				Paracladius	*Paracladius sp.*									
				Parakiefferiella	*Parakiefferiella* sp.									
				Paratanytarsus	*Paratanytarsus* sp.		230.8	1197.5		158.7	360.7	28.9	98.7	115.4
				Polypedilum	*Polypedilum halterale gr.*									
				Polypedilum	*Polypedilum scalaenum gr.*									
				Polypedilum	*Polypedilum* sp.									
				Potthastia	*Potthastia longimana gr.*									
				Procladius	*Procladius* sp.		86.6	86.6	158.7	230.8	158.7	216.4	164.5	259.7
				Protanypus	*Protanypus* sp.		14.4	14.4	14.4	14.4		43.3	115.1	72.1
				Psectrocladius	*Psectrocladius* sp.		14.4	129.8	28.9	14.4	57.7	43.3	32.9	14.4
				Pseudosmittia	*Pseudosmittia* sp.									
				Sergentia	*Sergentia* sp.									
				Stempellinella	*Stempellinella* sp.							28.9		14.4
				Stictochironomus	*Stictochironomus* sp.		86.6	115.4	331.8	187.6	230.8	692.5	1891.4	1832.3
				Undetermined	Tanytarsini									
				Tanytarsus	*Tanytarsus* sp.		14.4			14.4	28.9		559.2	28.9
				Thienemannimyia	*Thienemannimyia* gr. sp.			173.1		28.9	28.9		16.4	43.3
				Zalutschia	*Zalutschia* sp.									14.4
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*									
				Valvata	*Valvata* sp.									
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda		28.9		28.9	14.4	28.9		16.4	14.4
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria				28.9	14.4				14.4
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.									
			Limnephilidae	*Grensia*	*Grensia praeterita*							14.4		14.4
				Undetermined	Limnephilidae							14.4		
				Limnephilus	*Limnephilus* sp.									
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.									
					TOTAL		**2236.3**	**4025.3**	**1774.6**	**2279.5**	**2510.4**	**2943.2**	**5328.9**	**4530.2**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George	George	George	George	George	George	George
					Lake	Fold	Fold	George South	George South	George South	George South	George South
					Replicate	4	5	1	2	3	4	5
					Date Sampled	19-Aug-12	19-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6141.2-14	6141.2-15	6141.2-1	6141.2-2	6141.2-3	6141.2-4	6141.2-5
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**							
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.							
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.							
			Lebertiidae	*Lebertia*	*Lebertia* sp.	43.3		28.9	14.4	14.4		
			Oxidae	*Oxus*	*Oxus* sp.	101.0	14.4	14.4				14.4
			Pionidae	Undetermined	Pionidae							
		Undetermined	Undetermined	Undetermined	Acari	14.4						
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae					28.9	14.4	
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae		43.3	72.1	57.7		28.9	43.3
		Tubificida	Naididae	*Nais*	*Nais* sp.							
				Specaria	*Specaria josinae*							
				Vejdovskyella	*Vejdovskyella comata*							
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*							
				Rhyacodrilus	*Rhyacodrilus coccineus*					28.9		
				Undetermined	Tubificidae w/ cap setae	28.9	14.4	28.9	14.4			
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.	1543.7	1817.9	2106.4	1226.3	1240.8	2120.8	634.8
				Undetermined	Sphaeriidae	836.8	649.2	1385.0	1327.3	793.5	1168.6	663.7
				Sphaerium	*Sphaerium* sp.	28.9	14.4	28.9				14.4
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.							
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera							
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.						14.4	
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida					28.9	14.4	28.9
		Cyclopoida	Undetermined	Undetermined	Cyclopoida	57.7	28.9			14.4		
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda	1413.9	1096.5	14.4	14.4	43.3	28.9	
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.							
			Empididae	Undetermined	Empididae						14.4	14.4
			Muscidae	Undetermined	Muscidae							
			Tabanidae	*Chrysops*	*Chrysops* sp.							
			Tipulidae	*Tipula*	*Tipula* sp.							
			Undetermined	Undetermined	Diptera				14.4			14.4
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.							
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.	14.4						
				Ablabesmyia	*Ablabesmyia* sp.		14.4	43.3	43.3	14.4	101.0	
				Undetermined	Chironomini							
				Chironomus	*Chironomus* sp.							
				Cladopelma	*Cladopelma* sp.							
				Cladotanytarsus	*Cladotanytarsus* sp.							
				Corynocera	*Corynocera* sp.			43.3	129.8	230.8	245.3	72.1
				Corynoneura	*Corynoneura* sp.							
				Cricotopus	*Cricotopus* sp.							
				Cryptochironomus	*Cryptochironomus* sp.							
				Demicryptochironomus	*Demicryptochironomus* sp.							
				Dicrotendipes	*Dicrotendipes fumidus*							14.4
				Dicrotendipes	*Dicrotendipes* sp.							
				Glyptotendipes	*Glyptotendipes* sp.							
				Heterotanytarsus	*Heterotanytarsus* sp.							
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*				28.9	43.3		
				Hydrobaenus	*Hydrobaenus* sp.							
				Micropsectra	*Micropsectra* sp.		519.4				14.4	
				Microtendipes	*Microtendipes pedellus gr.*		14.4	14.4	43.3	86.6	101.0	28.9
				Monodiamesa	*Monodiamesa* sp.			86.6	57.7	28.9		14.4

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George	George	George	George	George	George	George
					Lake	Fold	Fold	George South	George South	George South	George South	George South
					Replicate	4	5	1	2	3	4	5
					Date Sampled	19-Aug-12	19-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6141.2-14	6141.2-15	6141.2-1	6141.2-2	6141.2-3	6141.2-4	6141.2-5
Major Group	Class	Order	Family	Genus	Final Designation							
				Undetermined	Orthocladiinae				14.4			
				Orthocladius	Orthocladius Complex							
				Pagastiella	*Pagastiella sp.*							
				Parachironomus	*Parachironomus* sp.	14.4						
				Paracladius	*Paracladius sp.*		101.0					
				Parakiefferiella	*Parakiefferiella* sp.							
				Paratanytarsus	*Paratanytarsus* sp.	43.3	28.9	72.1	43.3	43.3	72.1	14.4
				Polypedilum	*Polypedilum halterale gr.*							
				Polypedilum	*Polypedilum scalaenum gr.*							
				Polypedilum	*Polypedilum* sp.							
				Potthastia	*Potthastia longimana gr.*							
				Procladius	*Procladius* sp.	245.3	404.0	346.3	360.7	317.4	144.3	144.3
				Protanypus	*Protanypus* sp.	72.1	115.4	57.7	14.4	28.9	28.9	28.9
				Psectrocladius	*Psectrocladius* sp.	245.3	72.1	14.4	57.7		43.3	28.9
				Pseudosmittia	*Pseudosmittia* sp.							
				Sergentia	*Sergentia* sp.							
				Stempellinella	*Stempellinella* sp.		28.9					
				Stictochironomus	*Stictochironomus* sp.	404.0	101.0	57.7		14.4		
				Undetermined	Tanytarsini		14.4					
				Tanytarsus	*Tanytarsus* sp.		86.6				14.4	
				Thienemannimyia	*Thienemannimyia* gr. sp.	72.1		202.0	173.1	144.3	216.4	57.7
				Zalutschia	*Zalutschia* sp.		28.9					
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*					14.4		
				Valvata	*Valvata* sp.						14.4	28.9
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda	28.9	173.1	28.9	72.1			28.9
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria					14.4		
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.							
			Limnephilidae	*Grensia*	*Grensia praeterita*						28.9	
				Undetermined	Limnephilidae				28.9	14.4		
				Limnephilus	*Limnephilus* sp.							
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.							
					TOTAL	**5208.3**	**5381.5**	**4645.7**	**3736.7**	**3188.5**	**4429.2**	**1890.0**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George	George	George	George	George	George	George	George
					Lake	George Central	George Central	George Central	George Central	George Central	Lytle	Lytle	Lytle
					Replicate	1	2	3	4	5	1	2	3
					Date Sampled	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	23-Aug-12	23-Aug-12	23-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6141.2-6	6141.2-7	6141.2-8	6141.2-9	6141.2-10	6141.2-46	6141.2-47	6141.2-48
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**								
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.								
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.	28.9			14.4				
			Lebertiidae	*Lebertia*	*Lebertia* sp.	14.4	43.3	14.4	14.4				
			Oxidae	*Oxus*	*Oxus* sp.								
			Pionidae	Undetermined	Pionidae								
		Undetermined	Undetermined	Undetermined	Acari								
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae	274.1	303.0	303.0	158.7	216.4			
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	28.9	101.0	115.4	187.6	72.1	577.9	462.3	577.1
		Tubificida	Naididae	*Nais*	*Nais* sp.								
				Specaria	*Specaria josinae*								
				Vejdovskyella	*Vejdovskyella comata*								
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*								
				Rhyacodrilus	*Rhyacodrilus coccineus*								
				Undetermined	Tubificidae w/ cap setae						154.1	115.6	404.0
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.	981.1	894.5	865.7	807.9	721.4	38.5	115.6	
				Undetermined	Sphaeriidae	447.3	1486.0	793.5	908.9	447.3			
				Sphaerium	*Sphaerium* sp.					14.4			
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.								
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera				14.4				57.7
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.								
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida			14.4					
		Cyclopoida	Undetermined	Undetermined	Cyclopoida								
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda						192.6		346.3
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.								
			Empididae	Undetermined	Empididae	43.3			14.4		38.5	38.5	
			Muscidae	Undetermined	Muscidae								
			Tabanidae	*Chrysops*	*Chrysops* sp.								
			Tipulidae	*Tipula*	*Tipula* sp.								
			Undetermined	Undetermined	Diptera								
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.								
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.								
				Ablabesmyia	*Ablabesmyia* sp.						77.0	38.5	
				Undetermined	Chironomini								
				Chironomus	*Chironomus* sp.								57.7
				Cladopelma	*Cladopelma* sp.								115.4
				Cladotanytarsus	*Cladotanytarsus* sp.								
				Corynocera	*Corynocera* sp.								
				Corynoneura	*Corynoneura* sp.								
				Cricotopus	*Cricotopus* sp.								
				Cryptochironomus	*Cryptochironomus* sp.						77.0	115.6	461.7
				Demicryptochironomus	*Demicryptochironomus* sp.								
				Dicrotendipes	*Dicrotendipes fumidus*	28.9							
				Dicrotendipes	*Dicrotendipes* sp.								
				Glyptotendipes	*Glyptotendipes* sp.								
				Heterotanytarsus	*Heterotanytarsus* sp.								
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*	72.1	14.4	14.4					
				Hydrobaenus	*Hydrobaenus* sp.								
				Micropsectra	*Micropsectra* sp.								
				Microtendipes	*Microtendipes pedellus gr.*								
				Monodiamesa	*Monodiamesa* sp.	28.9	14.4	14.4	28.9				

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George	George	George	George	George	George	George	George
					Lake	George Central	George Central	George Central	George Central	George Central	Lytle	Lytle	Lytle
					Replicate	1	2	3	4	5	1	2	3
					Date Sampled	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	23-Aug-12	23-Aug-12	23-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6141.2-6	6141.2-7	6141.2-8	6141.2-9	6141.2-10	6141.2-46	6141.2-47	6141.2-48
Major Group	Class	Order	Family	Genus	Final Designation								
				Undetermined	Orthocladiinae								
				Orthocladius	Orthocladius Complex								
				Pagastiella	*Pagastiella sp.*								
				Parachironomus	*Parachironomus* sp.								
				Paracladius	*Paracladius sp.*								
				Parakiefferiella	*Parakiefferiella* sp.		14.4	28.9	14.4				
				Paratanytarsus	*Paratanytarsus* sp.						13984.5	11364.8	16909.0
				Polypedilum	*Polypedilum halterale gr.*								
				Polypedilum	*Polypedilum scalaenum gr.*								
				Polypedilum	*Polypedilum* sp.								
				Potthastia	*Potthastia longimana gr.*	28.9	14.4		14.4				
				Procladius	*Procladius* sp.	57.7	389.5	259.7	562.7	404.0	886.1	346.7	519.4
				Protanypus	*Protanypus* sp.								
				Psectrocladius	*Psectrocladius* sp.	57.7	187.6	43.3	144.3	173.1	154.1	38.5	865.7
				Pseudosmittia	*Pseudosmittia* sp.		72.1	101.0		14.4			
				Sergentia	*Sergentia* sp.						38.5		
				Stempellinella	*Stempellinella* sp.								
				Stictochironomus	*Stictochironomus* sp.						38.5	38.5	57.7
				Undetermined	Tanytarsini						269.7		288.6
				Tanytarsus	*Tanytarsus* sp.						154.1		577.1
				Thienemannimyia	*Thienemannimyia* gr. sp.			43.3	28.9	28.9			
				Zalutschia	*Zalutschia* sp.				14.4				
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*		14.4		14.4				
				Valvata	*Valvata* sp.	28.9	28.9	43.3	101.0	28.9			
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda		28.9	28.9	14.4	14.4			
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria								
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.								
			Limnephilidae	*Grensia*	*Grensia praeterita*								
				Undetermined	Limnephilidae	14.4	43.3	14.4		14.4			
				Limnephilus	*Limnephilus* sp.								
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.						38.5	38.5	
					TOTAL	**1962.1**	**3794.4**	**2697.9**	**3058.6**	**2178.6**	**16719.7**	**12713.2**	**21237.3**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George	George	George	George	George	George	George
					Lake	Lytle	Lytle	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence
					Replicate	4	5	1	2	3	4	5
					Date Sampled	23-Aug-12	23-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6141.2-49	6141.2-50	6141.2-31	6141.2-32	6141.2-33	6141.2-34	6141.2-35
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**							
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.							
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.							
			Lebertiidae	*Lebertia*	*Lebertia* sp.		57.7					
			Oxidae	*Oxus*	*Oxus* sp.							
			Pionidae	Undetermined	Pionidae							
		Undetermined	Undetermined	Undetermined	Acari							
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae							
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	807.9	230.8	72.1		101.0	259.7	57.7
		Tubificida	Naididae	*Nais*	*Nais* sp.							
				Specaria	*Specaria josinae*							
				Vejdovskyella	*Vejdovskyella comata*							
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*						14.4	
				Rhyacodrilus	*Rhyacodrilus coccineus*							
				Undetermined	Tubificidae w/ cap setae	1038.8	57.7	230.8	72.1	144.3	432.8	86.6
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.			389.5	158.7	447.3	158.7	158.7
				Undetermined	Sphaeriidae			375.1	115.4	173.1	86.6	245.3
				Sphaerium	*Sphaerium* sp.					14.4		
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.					14.4		
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera			43.3		14.4	14.4	14.4
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.							
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida							
		Cyclopoida	Undetermined	Undetermined	Cyclopoida			14.4				
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda	807.9	577.1	28.9	14.4	14.4	14.4	
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.							
			Empididae	Undetermined	Empididae							
			Muscidae	Undetermined	Muscidae							
			Tabanidae	*Chrysops*	*Chrysops* sp.							
			Tipulidae	*Tipula*	*Tipula* sp.							
			Undetermined	Undetermined	Diptera		57.7					
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.							
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.			14.4		14.4	14.4	57.7
				Ablabesmyia	*Ablabesmyia* sp.	115.4						
				Undetermined	Chironomini							
				Chironomus	*Chironomus* sp.		57.7					
				Cladopelma	*Cladopelma* sp.		57.7	86.6		43.3	14.4	57.7
				Cladotanytarsus	*Cladotanytarsus* sp.							
				Corynocera	*Corynocera* sp.							
				Corynoneura	*Corynoneura* sp.							
				Cricotopus	*Cricotopus* sp.							
				Cryptochironomus	*Cryptochironomus* sp.	115.4	404.0	14.4	14.4	86.6	14.4	28.9
				Demicryptochironomus	*Demicryptochironomus* sp.							
				Dicrotendipes	*Dicrotendipes fumidus*	115.4		101.0	28.9	57.7		57.7
				Dicrotendipes	*Dicrotendipes* sp.			28.9				14.4
				Glyptotendipes	*Glyptotendipes* sp.			14.4				
				Heterotanytarsus	*Heterotanytarsus* sp.							
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*							
				Hydrobaenus	*Hydrobaenus* sp.			14.4				
				Micropsectra	*Micropsectra* sp.							
				Microtendipes	*Microtendipes pedellus gr.*							28.9
				Monodiamesa	*Monodiamesa* sp.							

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George	George	George	George	George	George	George
					Lake	Lytle	Lytle	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence
					Replicate	4	5	1	2	3	4	5
					Date Sampled	23-Aug-12	23-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6141.2-49	6141.2-50	6141.2-31	6141.2-32	6141.2-33	6141.2-34	6141.2-35
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**							
				Undetermined	Orthocladiinae							
				Orthocladius	Orthocladius Complex							
				Pagastiella	*Pagastiella sp.*							
				Parachironomus	*Parachironomus* sp.							
				Paracladius	*Paracladius sp.*							
				Parakiefferiella	*Parakiefferiella* sp.							
				Paratanytarsus	*Paratanytarsus* sp.	29432.1	20371.7	634.8	72.1	331.8	129.8	245.3
				Polypedilum	*Polypedilum halterale gr.*							
				Polypedilum	*Polypedilum scalaenum gr.*							
				Polypedilum	*Polypedilum* sp.							
				Potthastia	*Potthastia longimana gr.*							
				Procladius	*Procladius* sp.	1962.1	577.1	129.8	72.1	115.4	72.1	173.1
				Protanypus	*Protanypus* sp.							
				Psectrocladius	*Psectrocladius* sp.	1154.2	115.4	144.3	14.4	28.9	43.3	57.7
				Pseudosmittia	*Pseudosmittia* sp.							
				Sergentia	*Sergentia* sp.							
				Stempellinella	*Stempellinella* sp.							
				Stictochironomus	*Stictochironomus* sp.	115.4						14.4
				Undetermined	Tanytarsini	115.4	230.8					
				Tanytarsus	*Tanytarsus* sp.	807.9	346.3	43.3		14.4	101.0	101.0
				Thienemannimyia	*Thienemannimyia* gr. sp.							
				Zalutschia	*Zalutschia* sp.			14.4				
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*			28.9		43.3		28.9
				Valvata	*Valvata* sp.					43.3		14.4
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda		57.7	43.3	28.9		158.7	43.3
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria		57.7					
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.							
			Limnephilidae	*Grensia*	*Grensia praeterita*							
				Undetermined	Limnephilidae							
				Limnephilus	*Limnephilus* sp.							
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.							
					TOTAL	**36588.2**	**23257.2**	**2467.1**	**591.5**	**1702.4**	**1529.3**	**1486.0**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George	George	George	George	George	George	George	George
					Lake	Sleigh	Sleigh	Sleigh	Sleigh	Sleigh	Dragon	Dragon	Dragon
					Replicate	1	2	3	4	5	1	2	3
					Date Sampled	22-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6141.2-41	6141.2-42	6141.2-43	6141.2-44	6141.2-45	6141.2-16	6141.2-17	6141.2-18
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**								
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.				14.4				
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.								
			Lebertiidae	*Lebertia*	*Lebertia* sp.		14.4	14.4			76.8	72.1	101.0
			Oxidae	*Oxus*	*Oxus* sp.						19.2		
			Pionidae	Undetermined	Pionidae								
		Undetermined	Undetermined	Undetermined	Acari							14.4	28.9
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae		14.4						
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	28.9	72.1	57.7	28.9	28.9	76.8	43.3	43.3
		Tubificida	Naididae	*Nais*	*Nais* sp.								
				Specaria	*Specaria josinae*								
				Vejdovskyella	*Vejdovskyella comata*								
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*								
				Rhyacodrilus	*Rhyacodrilus coccineus*								
				Undetermined	Tubificidae w/ cap setae	43.3	14.4	28.9	187.6	14.4	19.2		57.7
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.						1151.3	822.4	1154.2
				Undetermined	Sphaeriidae						1074.5	793.5	476.1
				Sphaerium	*Sphaerium* sp.						38.4	14.4	14.4
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.								
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera	28.9	14.4	14.4			844.3	331.8	562.7
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.								
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida								
		Cyclopoida	Undetermined	Undetermined	Cyclopoida	14.4	43.3				153.5	86.6	28.9
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda	28.9		14.4		288.6	1573.4	1399.5	1197.5
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.			14.4	14.4				
			Empididae	Undetermined	Empididae	28.9	28.9	158.7		14.4			
			Muscidae	Undetermined	Muscidae								
			Tabanidae	*Chrysops*	*Chrysops* sp.								
			Tipulidae	*Tipula*	*Tipula* sp.		14.4	14.4		28.9			
			Undetermined	Undetermined	Diptera								14.4
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.								
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.	28.9	28.9	14.4				14.4	
				Ablabesmyia	*Ablabesmyia* sp.						191.9	245.3	259.7
				Undetermined	Chironomini			14.4					
				Chironomus	*Chironomus* sp.								
				Cladopelma	*Cladopelma* sp.			14.4			153.5	115.4	158.7
				Cladotanytarsus	*Cladotanytarsus* sp.		28.9			43.3			
				Corynocera	*Corynocera* sp.						115.1	57.7	57.7
				Corynoneura	*Corynoneura* sp.								
				Cricotopus	*Cricotopus* sp.	14.4	28.9	28.9	57.7	28.9			
				Cryptochironomus	*Cryptochironomus* sp.	57.7	43.3	14.4	14.4	28.9		72.1	43.3
				Demicryptochironomus	*Demicryptochironomus* sp.					28.9			
				Dicrotendipes	*Dicrotendipes fumidus*	28.9		14.4					
				Dicrotendipes	*Dicrotendipes* sp.		28.9			43.3			
				Glyptotendipes	*Glyptotendipes* sp.								
				Heterotanytarsus	*Heterotanytarsus* sp.								
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*								
				Hydrobaenus	*Hydrobaenus* sp.				14.4				
				Micropsectra	*Micropsectra* sp.	14.4							
				Microtendipes	*Microtendipes pedellus gr.*								
				Monodiamesa	*Monodiamesa* sp.						19.2	28.9	28.9

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2													
Taxonomic Classification:						Area	George	George	George	George	George	George	George	George
						Lake	Sleigh	Sleigh	Sleigh	Sleigh	Sleigh	Dragon	Dragon	Dragon
						Replicate	1	2	3	4	5	1	2	3
						Date Sampled	22-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12
						Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
						EcoAnalysts Sample ID	6141.2-41	6141.2-42	6141.2-43	6141.2-44	6141.2-45	6141.2-16	6141.2-17	6141.2-18
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**									
				Undetermined	Orthocladiinae									
				Orthocladius	Orthocladius Complex									
				Pagastiella	*Pagastiella sp.*							153.5	86.6	72.1
				Parachironomus	*Parachironomus* sp.			14.4						
				Paracladius	*Paracladius sp.*									
				Parakiefferiella	*Parakiefferiella* sp.			14.4		57.7	28.9			
				Paratanytarsus	*Paratanytarsus* sp.		1673.6	1500.5	2611.4	1413.9	1139.8		57.7	57.7
				Polypedilum	*Polypedilum halterale gr.*									
				Polypedilum	*Polypedilum scalaenum gr.*									
				Polypedilum	*Polypedilum* sp.									
				Potthastia	*Potthastia longimana gr.*						14.4			
				Procladius	*Procladius* sp.		28.9	57.7	101.0	43.3	245.3	901.8	1053.2	851.2
				Protanypus	*Protanypus* sp.									
				Psectrocladius	*Psectrocladius* sp.		86.6	57.7	144.3	43.3	14.4	95.9	28.9	28.9
				Pseudosmittia	*Pseudosmittia* sp.									
				Sergentia	*Sergentia* sp.									
				Stempellinella	*Stempellinella* sp.									
				Stictochironomus	*Stictochironomus* sp.		28.9	28.9		101.0	490.5	537.3	230.8	389.5
				Undetermined	Tanytarsini					14.4				
				Tanytarsus	*Tanytarsus* sp.		115.4	72.1	86.6	404.0	158.7			
				Thienemannimyia	*Thienemannimyia* gr. sp.		14.4				14.4	19.2		14.4
				Zalutschia	*Zalutschia* sp.		72.1	202.0	72.1	43.3	14.4			
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*			72.1	14.4	14.4				
				Valvata	*Valvata* sp.			14.4	14.4			19.2		
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda						14.4	19.2		57.7
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria					14.4				14.4
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.									
			Limnephilidae	*Grensia*	*Grensia praeterita*									28.9
				Undetermined	Limnephilidae							19.2	14.4	
				Limnephilus	*Limnephilus* sp.									
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.									
						TOTAL	**2337.3**	**2409.4**	**3462.6**	**2481.5**	**2683.5**	**7272.3**	**5583.4**	**5742.2**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George	George	George	George	George	George	George
					Lake	Dragon	Dragon	Komatic	Komatic	Komatic	Komatic	Komatic
					Replicate	4	5	1	2	3	4	5
					Date Sampled	20-Aug-12	20-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6141.2-19	6141.2-20	6141.2-21	6141.2-22	6141.2-23	6141.2-24	6141.2-25
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**							
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.							
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.							
			Lebertiidae	*Lebertia*	*Lebertia* sp.	49.3	202.0	115.4	173.1			38.5
			Oxidae	*Oxus*	*Oxus* sp.	16.4						
			Pionidae	Undetermined	Pionidae							
		Undetermined	Undetermined	Undetermined	Acari							
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae							
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	32.9	144.3		28.9		192.6	38.5
		Tubificida	Naididae	*Nais*	*Nais* sp.							
				Specaria	*Specaria josinae*							
				Vejdovskyella	*Vejdovskyella comata*							
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*							
				Rhyacodrilus	*Rhyacodrilus coccineus*				28.9			
				Undetermined	Tubificidae w/ cap setae	49.3	28.9					38.5
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.	1299.3	2250.7	1356.2	1183.1	2157.4	1964.8	577.9
				Undetermined	Sphaeriidae	526.3	923.4	865.7	1298.5	577.9	1040.2	77.0
				Sphaerium	*Sphaerium* sp.	65.8			86.6	38.5	38.5	38.5
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.							
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera	937.5	1067.6		57.7		38.5	38.5
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.							
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida							
		Cyclopoida	Undetermined	Undetermined	Cyclopoida	115.1	28.9				38.5	
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda	1348.7	2164.1	432.8	865.7	732.0	847.5	154.1
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.							
			Empididae	Undetermined	Empididae					38.5	38.5	
			Muscidae	Undetermined	Muscidae							
			Tabanidae	*Chrysops*	*Chrysops* sp.							
			Tipulidae	*Tipula*	*Tipula* sp.							
			Undetermined	Undetermined	Diptera							
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.			375.1	259.7	346.7	346.7	154.1
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.	32.9	28.9					
				Ablabesmyia	*Ablabesmyia* sp.	82.2	375.1	57.7		115.6	154.1	
				Undetermined	Chironomini							
				Chironomus	*Chironomus* sp.							
				Cladopelma	*Cladopelma* sp.	98.7	202.0	28.9		38.5	38.5	
				Cladotanytarsus	*Cladotanytarsus* sp.	16.4	57.7					38.5
				Corynocera	*Corynocera* sp.	213.8	894.5	2366.1	663.7	2311.5	4122.1	4507.4
				Corynoneura	*Corynoneura* sp.							
				Cricotopus	*Cricotopus* sp.	16.4	86.6	28.9	28.9	38.5		77.0
				Cryptochironomus	*Cryptochironomus* sp.	32.9	202.0		115.4		154.1	38.5
				Demicryptochironomus	*Demicryptochironomus* sp.							
				Dicrotendipes	*Dicrotendipes fumidus*							
				Dicrotendipes	*Dicrotendipes* sp.			28.9				
				Glyptotendipes	*Glyptotendipes* sp.							
				Heterotanytarsus	*Heterotanytarsus* sp.							
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*			86.6			38.5	38.5
				Hydrobaenus	*Hydrobaenus* sp.							
				Micropsectra	*Micropsectra* sp.			1731.3	144.3	2080.3	2850.8	2966.4
				Microtendipes	*Microtendipes pedellus gr.*			1125.3	2337.3	1772.1	924.6	1810.7
				Monodiamesa	*Monodiamesa* sp.		28.9			77.0		

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2													
Taxonomic Classification:						Area	George	George	George	George	George	George	George
						Lake	Dragon	Dragon	Komatic	Komatic	Komatic	Komatic	Komatic
						Replicate	4	5	1	2	3	4	5
						Date Sampled	20-Aug-12	20-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12
						Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
						EcoAnalysts Sample ID	6141.2-19	6141.2-20	6141.2-21	6141.2-22	6141.2-23	6141.2-24	6141.2-25
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**								
				Undetermined	Orthocladiinae								
				Orthocladius	Orthocladius Complex								
				Pagastiella	*Pagastiella sp.*		32.9	86.6	28.9	57.7			
				Parachironomus	*Parachironomus* sp.				28.9				
				Paracladius	*Paracladius sp.*								
				Parakiefferiella	*Parakiefferiella* sp.								
				Paratanytarsus	*Paratanytarsus* sp.		65.8	115.4					
				Polypedilum	*Polypedilum halterale gr.*								
				Polypedilum	*Polypedilum scalaenum gr.*				28.9	28.9		38.5	38.5
				Polypedilum	*Polypedilum* sp.								
				Potthastia	*Potthastia longimana gr.*								
				Procladius	*Procladius* sp.		871.7	1009.9	202.0	202.0	231.1	231.1	346.7
				Protanypus	*Protanypus* sp.				115.4	173.1	77.0	77.0	
				Psectrocladius	*Psectrocladius* sp.		49.3	86.6	115.4	86.6		115.6	115.6
				Pseudosmittia	*Pseudosmittia* sp.								
				Sergentia	*Sergentia* sp.								
				Stempellinella	*Stempellinella* sp.								
				Stictochironomus	*Stictochironomus* sp.		756.6	692.5	1038.8	1327.3	1579.5	886.1	1001.6
				Undetermined	Tanytarsini				404.0	461.7	192.6	192.6	
				Tanytarsus	*Tanytarsus* sp.			28.9			231.1	192.6	154.1
				Thienemannimyia	*Thienemannimyia* gr. sp.			28.9					38.5
				Zalutschia	*Zalutschia* sp.				86.6	173.1	77.0	38.5	77.0
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*			28.9				38.5	
				Valvata	*Valvata* sp.				28.9				
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda			28.9	28.9				38.5
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria				28.9	144.3	38.5	77.0	
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.								
			Limnephilidae	*Grensia*	*Grensia praeterita*								
				Undetermined	Limnephilidae								
				Limnephilus	*Limnephilus* sp.								
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.								
						TOTAL	**6710.5**	**10791.8**	**10734.1**	**9926.1**	**12751.7**	**14716.5**	**12443.5**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George	George	George	George	George
					Lake	Reference C	Reference C	Reference C	Reference C	Reference C
					Replicate	1	2	3	4	5
					Date Sampled	22-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12
					Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07
Taxonomic Classification:					EcoAnalysts Sample ID	6141.2-36	6141.2-37	6141.2-38	6141.2-39	6141.2-40
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**					
Acari	Arachnida	Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.					
			Hygrobatidae	*Hygrobates*	*Hygrobates* sp.					
			Lebertiidae	*Lebertia*	*Lebertia* sp.	14.4				
			Oxidae	*Oxus*	*Oxus* sp.					
			Pionidae	Undetermined	Pionidae					
		Undetermined	Undetermined	Undetermined	Acari					
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae					
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae					
		Tubificida	Naididae	*Nais*	*Nais* sp.					
				Specaria	*Specaria josinae*					
				Vejdovskyella	*Vejdovskyella comata*					
			Tubificidae	*Psammoryctides*	*Psammoryctides californianus*					
				Rhyacodrilus	*Rhyacodrilus coccineus*	14.4				
				Undetermined	Tubificidae w/ cap setae	43.3		43.3		14.4
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.	303.0	129.8	144.3	57.7	158.7
				Undetermined	Sphaeriidae	317.4	303.0	72.1	57.7	144.3
				Sphaerium	*Sphaerium* sp.					
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Stictotarsus*	*Stictotarsus* sp.					
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera	14.4				
	Malacostraca	Amphipoda	Gammaridae	*Gammarus*	*Gammarus* sp.					
	Maxillopoda	Calanoida	Undetermined	Undetermined	Calanoida					
		Cyclopoida	Undetermined	Undetermined	Cyclopoida				14.4	28.9
	Ostracoda	Ostracoda	Undetermined	Undetermined	Ostracoda				43.3	
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.					
			Empididae	Undetermined	Empididae					
			Muscidae	Undetermined	Muscidae					
			Tabanidae	*Chrysops*	*Chrysops* sp.					
			Tipulidae	*Tipula*	*Tipula* sp.					
			Undetermined	Undetermined	Diptera					
			Chironomidae	*Abiskomyia*	*Abiskomyia* sp.	28.9	14.4		14.4	
				Ablabesmyia	*Ablabesmyia* (Karelia) sp.					
				Ablabesmyia	*Ablabesmyia* sp.					
				Undetermined	Chironomini					
				Chironomus	*Chironomus* sp.					
				Cladopelma	*Cladopelma* sp.					
				Cladotanytarsus	*Cladotanytarsus* sp.					
				Corynocera	*Corynocera* sp.					
				Corynoneura	*Corynoneura* sp.					
				Cricotopus	*Cricotopus* sp.					
				Cryptochironomus	*Cryptochironomus* sp.					
				Demicryptochironomus	*Demicryptochironomus* sp.					
				Dicrotendipes	*Dicrotendipes fumidus*					
				Dicrotendipes	*Dicrotendipes* sp.					
				Glyptotendipes	*Glyptotendipes* sp.					
				Heterotanytarsus	*Heterotanytarsus* sp.					
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*					
				Hydrobaenus	*Hydrobaenus* sp.					
				Micropsectra	*Micropsectra* sp.		14.4		14.4	
				Microtendipes	*Microtendipes pedellus gr.*					
				Monodiamesa	*Monodiamesa* sp.	28.9		14.4	57.7	

Appendix 3.7-5. Lake Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2										
Taxonomic Classification:										
Area						**George**	**George**	**George**	**George**	**George**
Lake						**Reference C**	**Reference C**	**Reference C**	**Reference C**	**Reference C**
Replicate						**1**	**2**	**3**	**4**	**5**
Date Sampled						**22-Aug-12**	**22-Aug-12**	**22-Aug-12**	**22-Aug-12**	**22-Aug-12**
Surface Area Sampled (m^2)						**0.07**	**0.07**	**0.07**	**0.07**	**0.07**
EcoAnalysts Sample ID						**6141.2-36**	**6141.2-37**	**6141.2-38**	**6141.2-39**	**6141.2-40**
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**					
				Undetermined	Orthocladiinae					
				Orthocladius	Orthocladius Complex					
				Pagastiella	*Pagastiella sp.*					
				Parachironomus	*Parachironomus* sp.					
				Paracladius	*Paracladius sp.*					
				Parakiefferiella	*Parakiefferiella* sp.					
				Paratanytarsus	*Paratanytarsus* sp.					
				Polypedilum	*Polypedilum halterale gr.*					
				Polypedilum	*Polypedilum scalaenum gr.*					
				Polypedilum	*Polypedilum* sp.					
				Potthastia	*Potthastia longimana gr.*					
				Procladius	*Procladius* sp.	14.4		57.7	28.9	43.3
				Protanypus	*Protanypus* sp.					28.9
				Psectrocladius	*Psectrocladius* sp.					
				Pseudosmittia	*Pseudosmittia* sp.					
				Sergentia	*Sergentia* sp.					
				Stempellinella	*Stempellinella* sp.					
				Stictochironomus	*Stictochironomus* sp.	86.6	57.7	202.0	317.4	28.9
				Undetermined	Tanytarsini					
				Tanytarsus	*Tanytarsus* sp.	14.4		14.4		
				Thienemannimyia	*Thienemannimyia* gr. sp.					
				Zalutschia	*Zalutschia* sp.				14.4	
Gastropoda	Gastropoda	Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*					
				Valvata	*Valvata* sp.					
Other Organisms	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda		57.7		28.9	43.3	57.7
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria					
Trichoptera	Insecta	Trichoptera	Hydroptilidae	*Agraylea*	*Agraylea* sp.					
			Limnephilidae	*Grensia*	*Grensia praeterita*					
				Undetermined	Limnephilidae					
				Limnephilus	*Limnephilus* sp.					
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.					
					TOTAL	**937.8**	**519.4**	**577.1**	**663.7**	**505.0**

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.
Nematodes, copepods or cladocerans were excluded from analyses.
Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-6

Lake Benthos Richness and Diversity Results, Back River Project, 2012

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Appendix 3.7-6. Lake Benthos Richness and Diversity Results, Back River Project, 2012

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location	Gander	Gander	Gander	Gander	Gander	Pond 19	Pond 19	Pond 19	Pond 19	Pond 19	Big	Big	Big	Big	Big	Rabbit	Rabbit	Rabbit	Rabbit	Rabbit	Fox	Fox	Fox	Fox	Fox
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Date Sampled	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12	16-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	15-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12
Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Eco Analysts Sample ID	6138.2-26	6138.2-27	6138.2-28	6138.2-29	6138.2-30	6138.2-45	6138.2-46	6138.2-47	6138.2-48	6138.2-49	6138.2-16	6138.2-17	6138.2-18	6138.2-19	6138.2-20	6138.2-6	6138.2-7	6138.2-8	6138.2-9	6138.2-10	6138.2-40	6138.2-41	6138.2-42	6138.2-43	6138.2-44
Family Richness (# families)	9	7	7	5	7	3	4	6	6	5	3	4	6	6	5	5	7	7	6	7	5	6	5	5	5
Simpson's Diversity Index	0.64	0.54	0.54	0.54	0.53	0.24	0.10	0.11	0.29	0.12	0.39	0.46	0.53	0.51	0.47	0.26	0.34	0.48	0.33	0.32	0.57	0.59	0.51	0.56	0.57

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Location	Rascal	Rascal	Rascal	Rascal	Rascal	Giraffe North	Giraffe North	Giraffe North	Giraffe North	Giraffe North	Giraffe South	Giraffe South	Giraffe South	Giraffe South	Neck	Neck	Neck	Neck	Neck	Central	Central	Central	Central	Central	
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	1	2	3	4	5	1	2	3	4	5	
Date Sampled	15-Aug-12	15-Aug-12	15-Aug-12	8-Aug-12	15-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	14-Aug-12	17-Aug-12	17-Aug-12	17-Aug-12	17-Aug-12	17-Aug-12	
Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	
Eco Analysts Sample ID	6138.2-11	6138.2-12	6138.2-13	6138.2-14	6138.2-15	6138.2-31	6138.2-32	6138.2-33	6138.2-34	6138.2-35	6138.2-36	6138.2-37	6138.2-38	6138.2-39	6138.2-1	6138.2-2	6138.2-3	6138.2-4	6138.2-5	6138.2-21	6138.2-22	6138.2-23	6138.2-24	6138.2-25	
Family Richness (# families)	6	6	6	7	7	5	5	5	6	5	4	7	5	8	8	5	5	5	6	8	6	6	6	6	
Simpson's Diversity Index	0.24	0.19	0.20	0.18	0.16	0.36	0.41	0.46	0.41	0.53	0.59	0.56	0.55	0.70	0.39	0.30	0.28	0.29	0.24	0.47	0.48	0.39	0.45	0.43	

Area	Goose	Goose	Goose	Goose	Goose	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George
Location	Propellor	Propellor	Propellor	Propellor	Propellor	Lower Long	Lower Long	Lower Long	Lower Long	Lower Long	Fold	Fold	Fold	Fold	Fold	George South	George South	George South	George South	George South	George Central	George Central	George Central	George Central	George Central
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Date Sampled	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	19-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12	18-Aug-12
Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Eco Analysts Sample ID	6138.2-50	6138.2-51	6138.2-52	6138.2-53	6138.2-54	6141.2-26	6141.2-27	6141.2-28	6141.2-29	6141.2-30	6141.2-11	6141.2-12	6141.2-13	6141.2-14	6141.2-15	6141.2-1	6141.2-2	6141.2-3	6141.2-4	6141.2-5	6141.2-6	6141.2-7	6141.2-8	6141.2-9	6141.2-10
Family Richness (# families)	5	7	4	7	5	4	3	5	5	2	6	6	6	5	5	6	6	7	8	6	8	8	7	8	6
Simpson's Diversity Index	0.18	0.24	0.17	0.28	0.19	0.48	0.48	0.59	0.53	0.50	0.54	0.29	0.32	0.48	0.49	0.37	0.44	0.47	0.39	0.43	0.44	0.55	0.56	0.60	0.60

Area	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George
Location	Lytle	Lytle	Lytle	Lytle	Lytle	Occurrence	Occurrence	Occurrence	Occurrence	Occurrence	Sleigh	Sleigh	Sleigh	Sleigh	Sleigh	Dragon	Dragon	Dragon	Dragon	Dragon
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Date Sampled	23-Aug-12	23-Aug-12	23-Aug-12	23-Aug-12	23-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12	20-Aug-12
Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Eco Analysts Sample ID	6141.2-46	6141.2-47	6141.2-48	6141.2-49	6141.2-50	6141.2-31	6141.2-32	6141.2-33	6141.2-34	6141.2-35	6141.2-41	6141.2-42	6141.2-43	6141.2-44	6141.2-45	6141.2-16	6141.2-17	6141.2-18	6141.2-19	6141.2-20
Family Richness (# families)	6	6	3	3	4	5	3	6	4	5	4	8	8	6	5	8	5	6	6	6
Simpson's Diversity Index	0.10	0.12	0.09	0.10	0.03	0.60	0.60	0.67	0.73	0.57	0.09	0.20	0.17	0.18	0.07	0.55	0.53	0.55	0.53	0.55

Area	George	George	George	George	George	George	George	George	George	George
Location	Komatic	Komatic	Komatic	Komatic	Komatic	Reference C	Reference C	Reference C	Reference C	Reference C
Replicate	1	2	3	4	5	1	2	3	4	5
Date Sampled	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12	22-Aug-12
Surface Area Sampled (m^2)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Eco Analysts Sample ID	6141.2-21	6141.2-22	6141.2-23	6141.2-24	6141.2-25	6141.2-36	6141.2-37	6141.2-38	6141.2-39	6141.2-40
Family Richness (# families)	4	5	3	5	5	4	2	3	2	3
Simpson's Diversity Index	0.36	0.45	0.36	0.38	0.12	0.44	0.28	0.56	0.33	0.42

Note: Only four replicates were collected at Giraffe South as substrate made it difficult to get complete Ekman grabs.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-7

Lake Benthos QA/QC Results, Back River Project, 2012

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Appendix 3.7-7. Lake Benthos QA/QC Results, Back River Project, 2012

EcoA ANALYSTS, INC.

EcoA Sample ID	Sample ID	Replicate	Collection Date	Sorter	Sort Date	Primary Matrix	Estimated Pre-Rinse Volume (L)	Estimated Post-Rinse Volume (L)	QC Sorter	QC Date	Estimated % Recovery 1	Estimated % Recovery 2	Estimated % Recovery3
6138.2-1	Goose Lake Neck	1	14-Aug-12	Laurie Flaherty	09/24/12	Fine Organic	0.06	0.04	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-2	Goose Lake Neck	2	14-Aug-12	Laura Mills	09/24/12	Coarse Organic	0.21	0.05	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-3	Goose Lake Neck	3	14-Aug-12	Angela Eagleston	09/24/12	Fine Organic	0.15	0.15	Nora Williams	09/27/12	89.84	N/A	N/A
6138.2-4	Goose Lake Neck	4	14-Aug-12	Nora Williams	09/24/12	Inorganic	0.13	0.05	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-5	Goose Lake Neck	5	14-Aug-12	Nora Williams	09/24/12	Filamentous Algae	0.10	0.04	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-6	Rabbit Lake	1	15-Aug-12	Ben Alexander	09/25/12	Coarse Organic	0.13	0.06	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-7	Rabbit Lake	2	15-Aug-12	Angela Eagleston	09/24/12	Fine Organic	0.11	0.11	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-8	Rabbit Lake	3	15-Aug-12	Laurie Flaherty	09/24/12	Fine Organic	0.05	0.04	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-9	Rabbit Lake	4	15-Aug-12	Angela Eagleston	09/25/12	Fine Organic	0.13	0.13	Zach Meier	09/26/12	99.00	N/A	N/A
6138.2-10	Rabbit Lake	5	15-Aug-12	Nora Williams	09/25/12	Filamentous Algae	0.25	0.10	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-11	Rascal Lake	1	15-Aug-12	Allie Pfeiffer	09/26/12	Vegetation	0.23	0.05	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-12	Rascal Lake	2	15-Aug-12	Ben Alexander	09/25/12	Coarse Organic	0.33	0.10	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-13	Rascal Lake	3	15-Aug-12	Laura Mills	09/25/12	Coarse Organic	0.25	0.02	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-14	Rascal Lake	4	15-Aug-12	Laura Mills	09/25/12	Coarse Organic	0.32	0.02	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-15	Rascal Lake	5	15-Aug-12	Laura Mills	09/25/12	Coarse Organic	0.40	0.03	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-16	Big Lake	1	16-Aug-12	Angela Eagleston	09/25/12	Fine Organic	0.25	0.25	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-17	Big Lake	2	16-Aug-12	Laura Mills	09/25/12	Coarse Organic	0.20	0.03	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-18	Big Lake	3	16-Aug-12	Amanda Thompson	09/26/12	Fine Organic	0.08	0.03	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-19	Big Lake	4	16-Aug-12	Nora Williams	09/25/12	Fine Organic	0.20	0.01	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-20	Big Lake	5	16-Aug-12	Angela Eagleston	09/26/12	Fine Organic	0.12	0.12	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-21	Goose Lake Central	1	17-Aug-12	Nora Williams	09/27/12	Filamentous Algae	0.25	0.10	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-22	Goose Lake Central	2	17-Aug-12	Angela Eagleston	09/27/12	Fine Organic	0.30	0.30	Zach Meier	09/27/12	96.33	N/A	N/A
6138.2-23	Goose Lake Central	3	17-Aug-12	Laura Mills	09/26/12	Coarse Organic	0.25	0.05	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-24	Goose Lake Central	4	17-Aug-12	Steven Little	09/26/12	Coarse Organic	0.08	0.04	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-25	Goose Lake Central	5	17-Aug-12	Laura Mills	09/26/12	Coarse Organic	0.25	0.05	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-26	Gander Lake	1	18-Aug-12	Steven Little	09/26/12	Coarse Organic	0.08	0.02	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-27	Gander Lake	2	18-Aug-12	Laura Mills	09/26/12	Coarse Organic	0.35	0.10	Zach Meier	09/26/12	100.00	N/A	N/A
6138.2-28	Gander Lake	3	18-Aug-12	Amanda Thompson	09/28/12	Vegetation	0.08	0.05	Megan Payne	09/28/12	93.91	N/A	N/A
6138.2-29	Gander Lake	4	18-Aug-12	Steven Little	09/26/12	Coarse Organic	0.08	0.01	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-30	Gander Lake	5	18-Aug-12	Steven Little	09/27/12	Coarse Organic	0.08	0.04	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-31	Giraffe Lake North - shallow	1	19-Aug-12	Angela Eagleston	09/27/12	Fine Organic	0.20	0.20	Zach Meier	09/27/12	98.50	N/A	N/A
6138.2-32	Giraffe Lake North - shallow	2	19-Aug-12	Steven Little	09/27/12	Coarse Organic	0.10	0.01	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-33	Giraffe Lake North - shallow	3	19-Aug-12	Steven Little	09/27/12	Coarse Organic	0.08	0.01	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-34	Giraffe Lake North - shallow	4	19-Aug-12	Steven Little	09/27/12	Coarse Organic	0.10	0.01	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-35	Giraffe Lake North - shallow	5	19-Aug-12	Steven Little	09/27/12	Coarse Organic	0.13	0.01	Zach Meier	09/27/12	100.00	N/A	N/A
6138.2-36	Giraffe Lake South - Deep	1	19-Aug-12	Steven Little	09/28/12	Coarse Organic	0.35	0.05	Zach Meier	09/28/12	100.00	N/A	N/A
6138.2-37	Giraffe Lake South - Deep	2	19-Aug-12	Angela Eagleston	10/02/12	Fine Organic	0.55	0.55	Zach Meier	10/03/12	100.00	N/A	N/A
6138.2-38	Giraffe Lake South - Deep	3	19-Aug-12	Nicole Huddleston	10/03/12	Coarse Organic	0.15	0.10	Ben Alexander	10/03/12	100.00	N/A	N/A
6138.2-39	Giraffe Lake South - Deep	4	19-Aug-12	Steven Little	09/28/12	Coarse Organic	0.38	0.10	Megan Payne	09/28/12	95.72	N/A	N/A
6138.2-40	Fox Lake	1	20-Aug-12	Zach Meier	09/28/12	Inorganic	0.15	0.02	Megan Payne	09/28/12	100.00	N/A	N/A
6138.2-41	Fox Lake	2	20-Aug-12	Steven Little	09/28/12	Inorganic	0.05	0.01	Megan Payne	09/28/12	100.00	N/A	N/A
6138.2-42	Fox Lake	3	20-Aug-12	Steven Little	09/28/12	Inorganic	0.03	0.01	Megan Payne	09/28/12	100.00	N/A	N/A
6138.2-43	Fox Lake	4	20-Aug-12	Zach Meier	09/28/12	Inorganic	0.12	0.02	Megan Payne	09/28/12	100.00	N/A	N/A
6138.2-44	Fox Lake	5	20-Aug-12	Ben Alexander	09/28/12	Fine Organic	0.25	0.01	Megan Payne	09/28/12	100.00	N/A	N/A
6138.2-45	Pond 19	1	21-Aug-12	Steven Little	09/28/12	Inorganic	0.93	0.03	Megan Payne	09/28/12	100.00	N/A	N/A
6138.2-46	Pond 19	2	21-Aug-12	Ben Alexander	09/29/12	Filamentous Algae	0.50	0.26	Zach Meier	09/30/12	93.85	N/A	N/A
6138.2-47	Pond 19	3	21-Aug-12	Amanda Thompson	09/29/12	Fine Organic	0.50	0.33	Zach Meier	09/30/12	95.52	N/A	N/A
6138.2-48	Pond 19	4	21-Aug-12	Steven Little	09/28/12	Coarse Organic	0.40	0.08	Zach Meier	09/30/12	88.55	97.71	N/A
6138.2-49	Pond 19	5	21-Aug-12	Allie Pfeiffer	09/30/12	Vegetation	0.67	0.30	Zach Meier	10/01/12	92.54	N/A	N/A
6138.2-50	Propellor Lake	1	21-Aug-12	Ben Alexander	09/29/12	Fine Organic	0.13	0.01	Zach Meier	10/01/12	100.00	N/A	N/A
6138.2-51	Propellor Lake	2	21-Aug-12	Amanda Thompson	10/01/12	Fine Organic	0.08	0.03	Zach Meier	10/01/12	100.00	N/A	N/A
6138.2-52	Propellor Lake	3	21-Aug-12	Ben Alexander	09/30/12	Fine Organic	0.23	0.02	Zach Meier	09/30/12	100.00	N/A	N/A
6138.2-53	Propellor Lake	4	21-Aug-12	Allie Pfeiffer	10/01/12	Fine Organic	0.14	0.02	Zach Meier	10/02/12	100.00	N/A	N/A
6138.2-54	Propellor Lake	5	21-Aug-12	Steven Little	10/01/12	Coarse Organic	0.10	0.04	Zach Meier	10/01/12	100.00	N/A	N/A

Appendix 3.7-7. Lake Benthos QA/QC Results, Back River Project, 2012

EcoA ANALYSTS, INC.

EcoA Sample ID	Sample ID	Replicate	Collection Date	Sorter	Sort Date	Primary Matrix	Estimated Pre-Rinse Volume (L)	Estimated Post-Rinse Volume (L)	QC Sorter	QC Date	Estimated % Recovery 1	Estimated % Recovery 2	Estimated % Recovery3
6141.2-1	George Lake Shallow	1	18-Aug-12	Ben Alexander	10/01/12	Inorganic	0.23	0.01	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-2	George Lake Shallow	2	18-Aug-12	Ben Alexander	10/01/12	Inorganic	0.33	0.01	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-3	George Lake Shallow	3	18-Aug-12	Ben Alexander	10/01/12	Inorganic	0.32	0.01	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-4	George Lake Shallow	4	18-Aug-12	Ben Alexander	10/01/12	Inorganic	0.35	0.01	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-5	George Lake Shallow	5	18-Aug-12	Ben Alexander	10/01/12	Inorganic	0.23	0.01	Nora Williams	10/03/12	100.00	N/A	N/A
6141.2-6	George Lake Deep	1	18-Aug-12	Steven Little	10/01/12	Inorganic	0.10	0.05	Ben Alexander	10/03/12	100.00	N/A	N/A
6141.2-7	George Lake Deep	2	18-Aug-12	Steven Little	10/02/12	Inorganic	0.15	0.05	Ben Alexander	10/03/12	98.84	N/A	N/A
6141.2-8	George Lake Deep	3	18-Aug-12	Ben Alexander	10/01/12	Inorganic	0.16	0.01	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-9	George Lake Deep	4	18-Aug-12	Amanda Thompson	10/01/12	Inorganic	0.05	0.01	Ben Alexander	10/03/12	100.00	N/A	N/A
6141.2-10	George Lake Deep	5	18-Aug-12	Ben Alexander	10/01/12	Inorganic	0.19	0.01	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-11	Fold Lake	1	19-Aug-12	Amanda Thompson	10/01/12	Inorganic	0.05	0.01	Ben Alexander	10/03/12	100.00	N/A	N/A
6141.2-12	Fold Lake	2	19-Aug-12	Tiffany Miller	10/02/12	Vegetation	0.10	0.08	Ben Alexander	10/03/12	93.98	N/A	N/A
6141.2-13	Fold Lake	3	19-Aug-12	Amanda Thompson	10/02/12	Coarse Organic	0.15	0.10	Ben Alexander	10/03/12	78.57	98.21	N/A
6141.2-14	Fold Lake	4	19-Aug-12	Allie Pfeiffer	10/01/12	Inorganic	0.09	0.02	Ben Alexander	10/03/12	100.00	N/A	N/A
6141.2-15	Fold Lake	5	19-Aug-12	Ben Alexander	10/02/12	Inorganic	0.03	0.01	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-16	Dragon Lake	1	20-Aug-12	Ben Alexander	10/02/12	Filamentous Algae	0.20	0.10	Nora Williams	10/03/12	99.10	N/A	N/A
6141.2-17	Dragon Lake	2	20-Aug-12	Tiffany Miller	10/02/12	Inorganic	0.10	0.05	Ben Alexander	10/04/12	100.00	N/A	N/A
6141.2-18	Dragon Lake	3	20-Aug-12	Steven Little	10/02/12	Coarse Organic	0.13	0.01	Ben Alexander	10/03/12	100.00	N/A	N/A
6141.2-19	Dragon Lake	4	20-Aug-12	Steven Little	10/02/12	Coarse Organic	0.15	0.01	Ben Alexander	10/03/12	100.00	N/A	N/A
6141.2-20	Dragon Lake	5	20-Aug-12	Angela Eagleston	10/03/12	Fine Organic	0.20	0.20	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-21	Komatic Lake	1	21-Aug-12	Tiffany Miller	10/02/12	Inorganic	0.08	0.05	Ben Alexander	10/03/12	100.00	N/A	N/A
6141.2-22	Komatic Lake	2	21-Aug-12	Steven Little	10/03/12	Inorganic	0.03	0.01	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-23	Komatic Lake	3	21-Aug-12	Tiffany Miller	10/02/12	Inorganic	0.05	0.05	Ben Alexander	10/03/12	100.00	N/A	N/A
6141.2-24	Komatic Lake	4	21-Aug-12	Tiffany Miller	10/02/12	Inorganic	0.08	0.05	Ben Alexander	10/03/12	100.00	N/A	N/A
6141.2-25	Komatic Lake	5	21-Aug-12	Amanda Thompson	10/03/12	Fine Organic	0.05	0.03	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-26	Lower Long Lake	1	21-Aug-12	Tiffany Miller	10/02/12	Vegetation	0.03	0.03	Zach Meier	10/03/12	100.00	N/A	N/A
6141.2-27	Lower Long Lake	2	21-Aug-12	Allie Pfeiffer	10/02/12	Inorganic	0.02	0.00	Zach Meier	10/03/12	100.00	N/A	N/A
6141.2-28	Lower Long Lake	3	21-Aug-12	Tiffany Miller	10/02/12	Bugs	0.01	0.01	Zach Meier	10/03/12	100.00	N/A	N/A
6141.2-29	Lower Long Lake	4	21-Aug-12	Allie Pfeiffer	10/03/12	Fine Organic	0.00	0.00	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-30	Lower Long Lake	5	21-Aug-12	Tiffany Miller	10/03/12	Fine Organic	0.05	0.03	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-31	Occurrence Lake	1	21-Aug-12	Ben Alexander	10/03/12	Coarse Organic	0.16	0.10	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-32	Occurrence Lake	2	21-Aug-12	Steven Little	10/03/12	Vegetation	0.01	0.01	Ben Alexander	10/04/12	100.00	N/A	N/A
6141.2-33	Occurrence Lake	3	21-Aug-12	Steven Little	10/03/12	Vegetation	0.01	0.01	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-34	Occurrence Lake	4	21-Aug-12	Angela Eagleston	10/03/12	Fine Organic	0.09	0.09	Ben Alexander	10/04/12	100.00	N/A	N/A
6141.2-35	Occurrence Lake	5	21-Aug-12	Zach Meier	10/03/12	Vegetation	0.03	0.03	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-36	Ref C Lake	1	22-Aug-12	Steven Little	10/03/12	Coarse Organic	0.10	0.08	Ben Alexander	10/04/12	91.89	N/A	N/A
6141.2-37	Ref C Lake	2	22-Aug-12	Laurie Flaherty	10/03/12	Fine Organic	0.25	0.10	Ben Alexander	10/04/12	92.11	N/A	N/A
6141.2-38	Ref C Lake	3	22-Aug-12	Amanda Thompson	10/03/12	Fine Organic	0.05	0.03	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-39	Ref C Lake	4	22-Aug-12	Tiffany Miller	10/03/12	Inorganic	0.10	0.05	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-40	Ref C Lake	5	22-Aug-12	Amanda Thompson	10/03/12	Fine Organic	0.05	0.03	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-41	Sleigh Lake	1	22-Aug-12	Zach Meier	10/05/12	Filamentous Algae	0.10	0.08	Megan Payne	10/05/12	92.98	N/A	N/A
6141.2-42	Sleigh Lake	2	22-Aug-12	Angela Eagleston	10/03/12	Fine Organic	0.20	0.20	Ben Alexander	10/04/12	100.00	N/A	N/A
6141.2-43	Sleigh Lake	3	22-Aug-12	Amanda Thompson	10/03/12	Fine Organic	0.05	0.03	Ben Alexander	10/04/12	100.00	N/A	N/A
6141.2-44	Sleigh Lake	4	22-Aug-12	Steven Little	10/03/12	Coarse Organic	0.05	0.01	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-45	Sleigh Lake	5	22-Aug-12	Tiffany Miller	10/03/12	Inorganic	0.35	0.05	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-46	Lytle Lake	1	23-Aug-12	Allie Pfeiffer	10/03/12	Fine Organic	0.05	0.01	Ben Alexander	10/04/12	100.00	N/A	N/A
6141.2-47	Lytle Lake	2	23-Aug-12	Steven Little	10/04/12	Inorganic	0.05	0.02	Ben Alexander	10/04/12	100.00	N/A	N/A
6141.2-48	Lytle Lake	3	23-Aug-12	Allie Pfeiffer	10/03/12	Inorganic	0.10	0.02	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-49	Lytle Lake	4	23-Aug-12	Tiffany Miller	10/04/12	Inorganic	0.05	0.05	Megan Payne	10/04/12	100.00	N/A	N/A
6141.2-50	Lytle Lake	5	23-Aug-12	Allie Pfeiffer	10/04/12	Inorganic	0.05	0.01	Megan Payne	10/05/12	100.00	N/A	N/A

Appendix 3.7-8

Stream Benthos Density and Taxonomic Results, Back River Project, 2012

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Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2																
Taxonomic Classification:																
Area						**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**
Stream						**Moby OF**	**Moby OF**	**Moby OF**	**Moby OF**	**Moby OF**	**Gander IF**	**Gander IF**	**Gander IF**	**Gander IF**	**Gander IF**
Replicate						**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Date Sampled						**12-Aug-12**	**12-Aug-12**	**12-Aug-12**	**12-Aug-12**	**12-Aug-12**	**11-Aug-12**	**11-Aug-12**	**11-Aug-12**	**11-Aug-12**	**11-Aug-12**
Surface Area Sampled (m^2)						**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**
EcoAnalysts Sample ID						**6138.1-36**	**6138.1-37**	**6138.1-38**	**6138.1-39**	**6138.1-40**	**6138.1-26**	**6138.1-27**	**6138.1-28**	**6138.1-29**	**6138.1-30**
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
Acari	Arachnida	Sarcoptiformes	Undetermined	Undetermined	Oribatei										
		Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.										
			Hydryphantidae	Undetermined	Hydryphantidae										
			Hygrobatidae	*Atractides*	*Atractides* sp.										
				Hygrobates	*Hygrobates* sp.	27.72	41.58	103.94	124.73	23.70	16.63	25.98	3.46	17.32	20.79
			Lebertiidae	*Lebertia*	*Lebertia* sp.	58.90	142.05	90.08	153.83	148.11	55.43	25.98	20.79	38.11	3.46
			Oxidae	*Oxus*	*Oxus* sp.									3.46	
			Pionidae	Undetermined	Pionidae	3.46									
			Sperchontidae	*Sperchon*	*Sperchon* sp.	3.46	3.46	38.11	74.84	183.66					
			Unionicolidae	*Neumania*	*Neumania* sp.										
		Undetermined	Undetermined	Undetermined	Acari										
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae			6.93	4.16	23.70					
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	17.32	41.58	48.50	33.26	47.40	5.54				3.46
		Tubificida	Naididae	*Chaetogaster*	*Chaetogaster diastrophus*										
				Nais	*Nais* sp.										
				Uncinais	*Uncinais uncinata*										
			Tubificidae	*Rhyacodrilus*	*Rhyacodrilus* sp.										
				Undetermined	Tubificidae w/ cap setae	3.46	6.93	6.93	8.32	5.92	5.54	5.20			
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.						133.04	62.36	10.39		6.93
				Sphaerium	*Sphaerium* sp.										
				Undetermined	Sphaeriidae	3.46				5.92	288.25	83.15			3.46
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Agabus*	*Agabus* sp.										
				Hydroporus	*Hydroporus* sp.										
				Oreodytes	*Oreodytes* sp.	3.46	3.46	6.93	4.16						6.93
			Haliplidae	*Haliplus*	*Haliplus* sp.										
				Undetermined	Haliplidae										
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera							20.79			
	Maxillopoda	Cyclopoida	Undetermined	Undetermined	Cyclopoida		20.79								
	Ostracoda	Undetermined	Undetermined	Undetermined	Ostracoda	3.46	17.32	3.46		5.92	66.52	36.38		3.46	
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.						5.54				
				Probezzia	*Probezzia* sp.								3.46		
				Undetermined	Ceratopogoninae										
			Chironomidae	*Ablabesmyia*	*Ablabesmyia* (Karelia) sp.										
				Ablabesmyia	*Ablabesmyia* sp.	6.93					16.63	20.79	3.46		3.46
				Acamptocladius	*Acamptocladius* sp.										
				Acricotopus	*Acricotopus* sp.										
				Chaetocladius	*Chaetocladius* sp.										
				Chironomus	*Chironomus* sp.										
				Cladotanytarsus	*Cladotanytarsus* sp.	148.98	97.01	10.39	74.84	5.92	315.97	550.84		131.65	20.79
				Constempellina	*Constempellina* sp.										
				Corynoneura	*Corynoneura* sp.		3.46								
				Cricotopus	*Cricotopus bicinctus gr.*										
				Cricotopus	*Cricotopus* sp.										
				Cryptochironomus	*Cryptochironomus* sp.	3.46			4.16		27.72	5.20			
				Demicryptochironomus	*Demicryptochironomus* sp.						5.54	5.20			
				Dicrotendipes	*Dicrotendipes fumidus*	62.36	128.19	38.11	8.32	17.77	11.09	5.20		58.90	6.93
				Dicrotendipes	*Dicrotendipes* sp.	10.39	20.79	6.93						3.46	
				Eukiefferiella	*Eukiefferiella gracei gr.*			3.46							
				Euryhapsis	*Euryhapsis* sp.	13.86	6.93			11.85					
				Glyptotendipes	*Glyptotendipes* sp.										
				Heterotanytarsus	*Heterotanytarsus* sp.										
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*	3.46			4.16		11.09				
				Lipiniella	*Lipiniella* sp.	3.46	3.46				55.43	36.38		13.86	3.46

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Stream	Moby OF	Moby OF	Moby OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander IF	Gander IF	Gander IF
Replicate	1	2	3	4	5	1	2	3	4	5
Date Sampled	12-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12
Surface Area Sampled (m^2)	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID	6138.1-36	6138.1-37	6138.1-38	6138.1-39	6138.1-40	6138.1-26	6138.1-27	6138.1-28	6138.1-29	6138.1-30

Major Group	Class	Order	Family	Genus	Final Designation									
				Mesosmittia	*Mesosmittia* sp.									
				Micropsectra	*Micropsectra* sp.									
				Nanocladius	*Nanocladius* sp.									
				Natarsia	*Natarsia* sp.									
				Orthocladius	*Orthocladius (Pogonocladius)* sp.									
				Orthocladius	*Orthocladius* Complex									
				Orthocladius	*Orthocladius* sp.									
				Parachironomus	*Parachironomus* sp.									
				Paracladopelma	*Paracladopelma* sp.						83.15	46.77		17.32	
				Parakiefferiella	*Parakiefferiella* sp.	3.46	10.39								
				Paramerina	*Paramerina* sp.										
				Parametriocnemus	*Parametriocnemus* sp.										
				Paratanytarsus	*Paratanytarsus* sp.	3.46	3.46		4.16	11.85					
				Paratendipes	*Paratendipes* sp.										
				Phaenopsectra	*Phaenopsectra* sp.	10.39									
				Polypedilum	*Polypedilum halterale gr.*	3.46	3.46		4.16						
				Polypedilum	*Polypedilum scalaenum gr.*	93.54	20.79	31.18	74.84	5.92	138.58	530.06	17.32	162.84	34.65
				Polypedilum	*Polypedilum sordens*										
				Polypedilum	*Polypedilum* sp.	31.18			4.16		5.54				
				Potthastia	*Potthastia longimana gr.*				4.16		5.54				
				Procladius	*Procladius* sp.	69.29	17.32		33.26		127.50	239.05	51.97	107.40	65.83
				Protanypus	*Protanypus* sp.										
				Psectrocladius	*Psectrocladius* sp.						266.08	51.97		13.86	
				Pseudochironomus	*Pseudochironomus* sp.										
				Pseudokiefferiella	*Pseudokiefferiella* sp.										
				Pseudosmittia	*Pseudosmittia* sp.	13.86	13.86	20.79	12.47					3.46	3.46
				Rheocricotopus	*Rheocricotopus* sp.					11.85					
				Rheotanytarsus	*Rheotanytarsus exiguus gr.*	6.93		17.32		195.51					
				Saetheria	*Saetheria tylus*	3.46	17.32	51.97	41.58	112.56	33.26	98.74			3.46
				Sergentia	*Sergentia* sp.	58.90	13.86		16.63	11.85	133.04	67.56	10.39	10.39	
				Stempellina	*Stempellina* sp.	24.25			4.16		238.36	478.09			
				Stictochironomus	*Stictochironomus* sp.	3.46	3.46	3.46	4.16		49.89	15.59	3.46	10.39	6.93
				Synorthocladius	*Synorthocladius* sp.										
				Tanytarsus	*Tanytarsus* sp.	13.86	20.79	13.86	20.79	23.70					
				Thienemanniella	*Thienemanniella* sp.										
				Thienemannimyia	*Thienemannimyia* gr. sp.	90.08	124.73	90.08	174.62	53.32	55.43	129.92		48.50	6.93
				Tokunagaia	*Tokunagaia* sp.										
				Tvetenia	*Tvetenia bavarica gr.*				20.79	17.77					
				Undetermined	Chironomini										
				Undetermined	Pentaneurini										
				Undetermined	Tanytarsini	58.90									
				Zalutschia	*Zalutschia* sp.						33.26	10.39			
			Dolichopodidae	Undetermined	Dolichopodidae										
			Empididae	*Clinocera*	*Clinocera* sp.		3.46								
				Trichoclinocera	*Trichoclinocera* sp.										
				Undetermined	Empididae			3.46			11.09	25.98		27.72	10.39
			Muscidae	Undetermined	Muscidae						16.63	20.79			
			Simuliidae	*Simulium*	*Simulium* sp.				33.26	94.79					
				Undetermined	Simuliidae			10.39	20.79	23.70					
			Tipulidae	*Dicranota*	*Dicranota* sp.			24.25	33.26	71.09					
				Limnophila	*Limnophila* sp.										
				Prionocera	*Prionocera* sp.										
				Tipula	*Tipula* sp.	76.22	107.40	76.22	49.89	53.32	5.54	5.20		6.93	

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Area						Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Stream						Moby OF	Moby OF	Moby OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander IF	Gander IF	Gander IF
Replicate						1	2	3	4	5	1	2	3	4	5
Date Sampled						12-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12
Surface Area Sampled (m^2)						0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID						6138.1-36	6138.1-37	6138.1-38	6138.1-39	6138.1-40	6138.1-26	6138.1-27	6138.1-28	6138.1-29	6138.1-30
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
			Undetermined	Undetermined	Diptera		3.46	3.46	8.32	5.92				3.46	
Ephemeroptera	Insecta	Ephemeroptera	Baetidae	*Acentrella*	*Acentrella lapponica*										
				Baetis	*Baetis flavistriga*										
				Baetis	*Baetis* sp.			6.93	8.32	5.92					
			Ephemerellidae	*Ephemerella*	*Ephemerella* sp.										
			Metretopodidae	*Metretopus*	*Metretopus* sp.		3.46								
				Undetermined	Metretopodidae	3.46	6.93	3.46							
			Undetermined	Undetermined	Ephemeroptera										
Gastropoda	Gastropoda	Basommatophora	Lymnaeidae	*Stagnicola*	*Stagnicola* sp.										
				Undetermined	Lymnaeidae										
			Physidae	*Physa*	*Physa* sp.										
		Gastropoda (class)	Undetermined	Undetermined	Gastropoda										
		Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*						5.54		3.46		
				Valvata	*Valvata* sp.										
Hemiptera	Insecta	Hemiptera	Undetermined	Undetermined	Auchenorrhyncha										
				Undetermined	Hemiptera										
Ichthyoplankton	Actinopterygii	Gasterosteiformes	Gasterosteidae	Undetermined	Gasterosteidae										
Other Insecta	Insecta	Collembola	Undetermined	Undetermined	Collembola										
		Hymenoptera	Undetermined	Undetermined	Hymenoptera										
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.										
	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda	20.79	121.26	214.81	157.99	1131.56	16.63	88.34	17.32	13.86	
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria										
Plecoptera	Insecta	Plecoptera	Nemouridae	*Nemoura*	*Nemoura* sp.	13.86	55.43	17.32	29.10	5.92					
				Undetermined	Nemouridae	3.46	3.46	3.46	16.63						
			Perlodidae	*Arcynopteryx*	*Arcynopteryx compacta*										
			Undetermined	Undetermined	Perlodidae										
Trichoptera	Insecta	Trichoptera	Brachycentridae	*Brachycentrus*	*Brachycentrus americanus*	3.46			8.32	5.92					
				Micrasema	*Micrasema* sp.	3.46	3.46		24.95	5.92					
			Hydropsychidae	*Arctopsyche*	*Arctopsyche* sp.										
			Hydroptilidae	*Agraylea*	*Agraylea* sp.										
				Oxyethira	*Oxyethira* sp.			17.32	166.31	35.55					
			Leptoceridae	*Ceraclea*	*Ceraclea* sp.										
				Mystacides	*Mystacides sepulchralis*									10.39	
				Mystacides	*Mystacides* sp.							15.59		10.39	3.46
				Undetermined	Leptoceridae										
			Limnephilidae	*Asynarchus*	*Asynarchus* sp.										
				Grensia	*Grensia praeterita*										
				Undetermined	Limnephilidae								3.46		
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.										
			Rhyacophilidae	*Rhyacophila*	*Rhyacophila brunnea*										
				Rhyacophila	*Rhyacophila mongolica*										
				Rhyacophila	*Rhyacophila* sp.										
			Undetermined	Undetermined	Trichoptera										
					TOTAL	**990.87**	**1094.81**	**973.55**	**1471.82**	**2363.84**	**2245.06**	**2707.45**	**148.98**	**717.17**	**214.81**

Note: Benthos samples were not collected from Echo OF, which was dry during sampling, or Llama Lake where substrate size and water levels prevented sampling.
Only two samples were collected at Pond 19 OF due to low water levels.
Nematodes, copepods or cladocerans were excluded from analyses.
Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2															
Taxonomic Classification:						**Area**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**
						Stream	**Gander US**	**Gander US**	**Gander US**	**Gander US**	**Gander US**	**Pond 19 OF**	**Pond 19 OF**	**Chair OF**	**Chair OF**	**Chair OF**
						Replicate	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**1**	**2**	**3**
						Date Sampled	**11-Aug-12**	**11-Aug-12**	**11-Aug-12**	**11-Aug-12**	**11-Aug-12**	**13-Aug-12**	**13-Aug-12**	**13-Aug-12**	**13-Aug-12**	**13-Aug-12**
						Surface Area Sampled (m^2)	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**
						EcoAnalysts Sample ID	**6138.1-31**	**6138.1-32**	**6138.1-33**	**6138.1-34**	**6138.1-35**	**6138.1-41**	**6138.1-42**	**6138.1-43**	**6138.1-44**	**6138.1-45**
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**											
Acari	Arachnida	Sarcoptiformes	Undetermined	Undetermined	Oribatei							12.13				
		Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.											
			Hydryphantidae	Undetermined	Hydryphantidae											
			Hygrobatidae	*Atractides*	*Atractides* sp.											
				Hygrobates	*Hygrobates* sp.		103.94	103.94	131.65	190.55	273.70			148.02	41.58	471.81
			Lebertiidae	*Lebertia*	*Lebertia* sp.		13.86	17.32	6.93	10.39	45.04		6.17	194.28	31.18	148.02
			Oxidae	*Oxus*	*Oxus* sp.											
			Pionidae	Undetermined	Pionidae		6.93									
			Sperchontidae	*Sperchon*	*Sperchon* sp.		27.72	51.97	48.50	24.25	6.93		6.17	27.75	20.79	92.51
			Unionicolidae	*Neumania*	*Neumania* sp.											
		Undetermined	Undetermined	Undetermined	Acari											
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae		13.86	13.86	83.15					37.01	10.39	9.25
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae			6.93				339.55	92.50	18.50	3.46	64.76
		Tubificida	Naididae	*Chaetogaster*	*Chaetogaster diastrophus*											
				Nais	*Nais* sp.				6.93			48.51				
				Uncinais	*Uncinais uncinata*											
			Tubificidae	*Rhyacodrilus*	*Rhyacodrilus* sp.											
				Undetermined	Tubificidae w/ cap setae							12.13	6.17	18.50	27.72	185.03
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.											
				Sphaerium	*Sphaerium* sp.											
				Undetermined	Sphaeriidae					3.46						
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Agabus*	*Agabus* sp.								6.17			
				Hydroporus	*Hydroporus* sp.								6.17			
				Oreodytes	*Oreodytes* sp.									27.75		18.50
			Haliplidae	*Haliplus*	*Haliplus* sp.											
				Undetermined	Haliplidae											
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera								6.17	55.51	6.93	120.27
	Maxillopoda	Cyclopoida	Undetermined	Undetermined	Cyclopoida							84.89		212.78	17.32	101.76
	Ostracoda	Undetermined	Undetermined	Undetermined	Ostracoda		13.86		13.86	6.93	6.93	133.39	18.50	74.01	17.32	148.02
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.											18.50
				Probezzia	*Probezzia* sp.											
				Undetermined	Ceratopogoninae											
			Chironomidae	*Ablabesmyia*	*Ablabesmyia* (Karelia) sp.											
				Ablabesmyia	*Ablabesmyia* sp.									9.25		
				Acamptocladius	*Acamptocladius* sp.											
				Acricotopus	*Acricotopus* sp.											
				Chaetocladius	*Chaetocladius* sp.											
				Chironomus	*Chironomus* sp.											
				Cladotanytarsus	*Cladotanytarsus* sp.		6.93			3.46	3.46	36.38	43.17	212.78	27.72	120.27
				Constempellina	*Constempellina* sp.											
				Corynoneura	*Corynoneura* sp.		6.93		6.93				6.17			
				Cricotopus	*Cricotopus bicinctus gr.*			3.46								
				Cricotopus	*Cricotopus* sp.		13.86		13.86	3.46		48.51	24.67	120.27	6.93	37.01
				Cryptochironomus	*Cryptochironomus* sp.											
				Demicryptochironomus	*Demicryptochironomus* sp.		20.79	6.93			10.39					
				Dicrotendipes	*Dicrotendipes fumidus*					3.46				37.01		27.75
				Dicrotendipes	*Dicrotendipes* sp.											18.50
				Eukiefferiella	*Eukiefferiella gracei gr.*											
				Euryhapsis	*Euryhapsis* sp.		367.25	263.31	256.38	197.48	228.66			18.50	6.93	27.75
				Glyptotendipes	*Glyptotendipes* sp.											
				Heterotanytarsus	*Heterotanytarsus* sp.							48.51	74.00	18.50		
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*									9.25		
				Lipiniella	*Lipiniella* sp.											

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Stream	Gander US	Gander US	Gander US	Gander US	Gander US	Pond 19 OF	Pond 19 OF	Chair OF	Chair OF	Chair OF
Replicate	1	2	3	4	5	1	2	1	2	3
Date Sampled	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	13-Aug-12	13-Aug-12	13-Aug-12	13-Aug-12	13-Aug-12
Surface Area Sampled (m^2)	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID	6138.1-31	6138.1-32	6138.1-33	6138.1-34	6138.1-35	6138.1-41	6138.1-42	6138.1-43	6138.1-44	6138.1-45

Major Group	Class	Order	Family	Genus	Final Designation									
				Mesosmittia	*Mesosmittia* sp.									
				Micropsectra	*Micropsectra* sp.									
				Nanocladius	*Nanocladius* sp.									
				Natarsia	*Natarsia* sp.							12.33		
				Orthocladius	*Orthocladius (Pogonocladius)* sp.									
				Orthocladius	*Orthocladius* Complex									
				Orthocladius	*Orthocladius* sp.								3.46	27.75
				Parachironomus	*Parachironomus* sp.									
				Paracladopelma	*Paracladopelma* sp.					3.46				
				Parakiefferiella	*Parakiefferiella* sp.						12.13	67.84		
				Paramerina	*Paramerina* sp.									
				Parametriocnemus	*Parametriocnemus* sp.	6.93	17.32			3.46				9.25
				Paratanytarsus	*Paratanytarsus* sp.						1503.71	419.35		9.25
				Paratendipes	*Paratendipes* sp.									
				Phaenopsectra	*Phaenopsectra* sp.									
				Polypedilum	*Polypedilum halterale gr.*	83.15	27.72	131.65	3.46	41.58				9.25
				Polypedilum	*Polypedilum scalaenum gr.*							6.17	647.59	3.46
				Polypedilum	*Polypedilum sordens*									
				Polypedilum	*Polypedilum* sp.								18.50	
				Potthastia	*Potthastia longimana gr.*									
				Procladius	*Procladius* sp.					3.46	388.05	117.17	37.01	
				Protanypus	*Protanypus* sp.									
				Psectrocladius	*Psectrocladius* sp.						1103.53	339.18		
				Pseudochironomus	*Pseudochironomus* sp.									
				Pseudokiefferiella	*Pseudokiefferiella* sp.		3.46	6.93						
				Pseudosmittia	*Pseudosmittia* sp.			13.86			169.77	530.36	9.25	3.46
				Rheocricotopus	*Rheocricotopus* sp.									
				Rheotanytarsus	*Rheotanytarsus exiguus gr.*	769.14	142.05	374.18	135.12	41.58			27.75	38.11	111.02
				Saetheria	*Saetheria tylus*	27.72	13.86	27.72	17.32	31.18		6.17		
				Sergentia	*Sergentia* sp.									
				Stempellina	*Stempellina* sp.					3.46			9.25	3.46	83.26
				Stictochironomus	*Stictochironomus* sp.						218.28	74.00		
				Synorthocladius	*Synorthocladius* sp.				3.46					
				Tanytarsus	*Tanytarsus* sp.	13.86					72.76	246.68	157.27	69.29	83.26
				Thienemanniella	*Thienemanniella* sp.									
				Thienemannimyia	*Thienemannimyia* gr. sp.	200.95	55.43	214.81	41.58	38.11	84.89	203.51	1073.15	76.22	508.82
				Tokunagaia	*Tokunagaia* sp.		3.46	62.36	3.46					20.79	55.51
				Tvetenia	*Tvetenia bavarica gr.*	277.17	280.63	367.25	103.94	86.61				20.79	55.51
				Undetermined	Chironomini						12.13				
				Undetermined	Pentaneurini	6.93									
				Undetermined	Tanytarsini								37.01		
				Zalutschia	*Zalutschia* sp.						897.38	43.17			9.25
			Dolichopodidae	Undetermined	Dolichopodidae										
			Empididae	*Clinocera*	*Clinocera* sp.							18.50		3.46	
				Trichoclinocera	*Trichoclinocera* sp.								9.25		
				Undetermined	Empididae				3.46						18.50
			Muscidae	Undetermined	Muscidae				3.46			6.17	9.25		
			Simuliidae	*Simulium*	*Simulium* sp.	34.65	83.15	55.43	24.25	3.46					
				Undetermined	Simuliidae	6.93	38.11	55.43	20.79						9.25
			Tipulidae	*Dicranota*	*Dicranota* sp.						12.13				
				Limnophila	*Limnophila* sp.										
				Prionocera	*Prionocera* sp.										
				Tipula	*Tipula* sp.	6.93	6.93	13.86		6.93	60.63	92.50	194.28	3.46	203.53

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2															
Taxonomic Classification:															
Area						**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**
Stream						**Gander US**	**Gander US**	**Gander US**	**Gander US**	**Gander US**	**Pond 19 OF**	**Pond 19 OF**	**Chair OF**	**Chair OF**	**Chair OF**
Replicate						**1**	**2**	**3**	**4**	**5**	**1**	**2**	**1**	**2**	**3**
Date Sampled						**11-Aug-12**	**11-Aug-12**	**11-Aug-12**	**11-Aug-12**	**11-Aug-12**	**13-Aug-12**	**13-Aug-12**	**13-Aug-12**	**13-Aug-12**	**13-Aug-12**
Surface Area Sampled (m^2)						**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**
EcoAnalysts Sample ID						**6138.1-31**	**6138.1-32**	**6138.1-33**	**6138.1-34**	**6138.1-35**	**6138.1-41**	**6138.1-42**	**6138.1-43**	**6138.1-44**	**6138.1-45**
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
			Undetermined	Undetermined	Diptera			13.86	13.86	6.93	12.13			17.32	27.75
Ephemeroptera	Insecta	Ephemeroptera	Baetidae	*Acentrella*	*Acentrella lapponica*		3.46								
				Baetis	*Baetis flavistriga*										
				Baetis	*Baetis* sp.		3.46	13.86	3.46	3.46					
			Ephemerellidae	*Ephemerella*	*Ephemerella* sp.	6.93	6.93	13.86	6.93					3.46	64.76
			Metretopodidae	*Metretopus*	*Metretopus* sp.										
				Undetermined	Metretopodidae										
			Undetermined	Undetermined	Ephemeroptera				3.46						
Gastropoda	Gastropoda	Basommatophora	Lymnaeidae	*Stagnicola*	*Stagnicola* sp.										
				Undetermined	Lymnaeidae										
			Physidae	*Physa*	*Physa* sp.										
		Gastropoda (class)	Undetermined	Undetermined	Gastropoda										
		Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*										
				Valvata	*Valvata* sp.				3.46						
Hemiptera	Insecta	Hemiptera	Undetermined	Undetermined	Auchenorrhyncha					3.46			9.25		9.25
				Undetermined	Hemiptera										
Ichthyoplankton	Actinopterygii	Gasterosteiformes	Gasterosteidae	Undetermined	Gasterosteidae										
Other Insecta	Insecta	Collembola	Undetermined	Undetermined	Collembola										
		Hymenoptera	Undetermined	Undetermined	Hymenoptera				3.46						
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.				6.93						
	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda	48.50	17.32	110.87	69.29	24.25	133.39	80.17	166.52	55.43	351.55
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria										
Plecoptera	Insecta	Plecoptera	Nemouridae	*Nemoura*	*Nemoura* sp.	76.22	45.04	34.65	41.58	10.39		43.17	9.25	6.93	18.50
				Undetermined	Nemouridae				3.46					41.58	37.01
			Perlodidae	*Arcynopteryx*	*Arcynopteryx compacta*										
				Undetermined	Perlodidae										
Trichoptera	Insecta	Trichoptera	Brachycentridae	*Brachycentrus*	*Brachycentrus americanus*	6.93	34.65	117.80	10.39	13.86				20.79	83.26
				Micrasema	*Micrasema* sp.										
			Hydropsychidae	*Arctopsyche*	*Arctopsyche* sp.		3.46								
			Hydroptilidae	*Agraylea*	*Agraylea* sp.										
				Oxyethira	*Oxyethira* sp.	6.93								13.86	18.50
			Leptoceridae	*Ceraclea*	*Ceraclea* sp.		3.46								9.25
				Mystacides	*Mystacides sepulchralis*							6.17			
				Mystacides	*Mystacides* sp.								74.01		
				Undetermined	Leptoceridae										
			Limnephilidae	*Asynarchus*	*Asynarchus* sp.										9.25
				Grensia	*Grensia praeterita*										
				Undetermined	Limnephilidae										
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.										
			Rhyacophilidae	*Rhyacophila*	*Rhyacophila brunnea*										
				Rhyacophila	*Rhyacophila mongolica*										
				Rhyacophila	*Rhyacophila* sp.			6.93							
			Undetermined	Undetermined	Trichoptera										
					TOTAL	**2175.77**	**1257.65**	**2203.48**	**970.09**	**900.80**	**5444.89**	**2608.62**	**3728.26**	**623.63**	**3432.22**

Note: Benthos samples were not collected from Echo OF, which was dry during sampling, or Llama Lake where substrate size and water levels prevented sampling.
Only two samples were collected at Pond 19 OF due to low water levels.
Nematodes, copepods or cladocerans were excluded from analyses.
Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2															
Taxonomic Classification:															
Area						**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**
Stream						**Chair OF**	**Chair OF**	**Giraffe OF**	**Giraffe OF**	**Giraffe OF**	**Giraffe OF**	**Giraffe OF**	**Wolf OF**	**Wolf OF**	**Wolf OF**
Replicate						**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
Date Sampled						**13-Aug-12**	**13-Aug-12**	**8-Aug-12**	**8-Aug-12**	**8-Aug-12**	**8-Aug-12**	**8-Aug-12**	**7-Aug-12**	**7-Aug-12**	**7-Aug-12**
Surface Area Sampled (m^2)						**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**
EcoAnalysts Sample ID						**6138.1-46**	**6138.1-47**	**6138.1-11**	**6138.1-12**	**6138.1-13**	**6138.1-14**	**6138.1-15**	**6138.1-1**	**6138.1-2**	**6138.1-3**
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
Acari	Arachnida	Sarcoptiformes	Undetermined	Undetermined	Oribatei									79.51	
		Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.										
			Hydryphantidae	Undetermined	Hydryphantidae										
			Hygrobatidae	*Atractides*	*Atractides* sp.									5.30	
				Hygrobates	*Hygrobates* sp.	346.46	27.72		3.46					5.30	
			Lebertiidae	*Lebertia*	*Lebertia* sp.	159.37	103.94		3.46	27.72	20.79	6.93	6.93	74.21	31.18
			Oxidae	*Oxus*	*Oxus* sp.										
			Pionidae	Undetermined	Pionidae			27.72	6.93	13.86		17.32		5.30	
			Sperchontidae	*Sperchon*	*Sperchon* sp.	76.22									
			Unionicolidae	*Neumania*	*Neumania* sp.										
		Undetermined	Undetermined	Undetermined	Acari										
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae	34.65		3.46			3.46			10.60	6.93
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	83.15	41.58	17.32		27.72	34.65	13.86		5.30	3.46
		Tubificida	Naididae	*Chaetogaster*	*Chaetogaster diastrophus*										
				Nais	*Nais* sp.			6.93		3.46	27.72		6.93	15.90	
				Uncinais	*Uncinais uncinata*										
			Tubificidae	*Rhyacodrilus*	*Rhyacodrilus* sp.										
				Undetermined	Tubificidae w/ cap setae	27.72	117.80								
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.										
				Sphaerium	*Sphaerium* sp.										
				Undetermined	Sphaeriidae										
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Agabus*	*Agabus* sp.										
				Hydroporus	*Hydroporus* sp.										
				Oreodytes	*Oreodytes* sp.	55.43				3.46				21.20	
			Haliplidae	*Haliplus*	*Haliplus* sp.										
				Undetermined	Haliplidae										
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera	55.43		117.80	3.46	142.05	58.90	17.32	3.46	180.23	
	Maxillopoda	Cyclopoida	Undetermined	Undetermined	Cyclopoida	166.30		51.97	10.39		69.29	187.09	10.39	31.80	
	Ostracoda	Undetermined	Undetermined	Undetermined	Ostracoda	55.43		48.50	6.93	62.36	58.90	13.86	17.32	37.11	6.93
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.	6.93								5.30	
				Probezzia	*Probezzia* sp.										
				Undetermined	Ceratopogoninae										
			Chironomidae	*Ablabesmyia*	*Ablabesmyia* (Karelia) sp.										
				Ablabesmyia	*Ablabesmyia* sp.					3.46					
				Acamptocladius	*Acamptocladius* sp.										
				Acricotopus	*Acricotopus* sp.										
				Chaetocladius	*Chaetocladius* sp.										
				Chironomus	*Chironomus* sp.				3.46						
				Cladotanytarsus	*Cladotanytarsus* sp.	194.02	159.37							21.20	
				Constempellina	*Constempellina* sp.										
				Corynoneura	*Corynoneura* sp.			3.46				3.46			
				Cricotopus	*Cricotopus bicinctus gr.*										
				Cricotopus	*Cricotopus* sp.	41.58	13.86	13.86			51.97	17.32	3.46	265.04	10.39
				Cryptochironomus	*Cryptochironomus* sp.	6.93	48.50					3.46	3.46	10.60	3.46
				Demicryptochironomus	*Demicryptochironomus* sp.			3.46		6.93	3.46	3.46			
				Dicrotendipes	*Dicrotendipes fumidus*	69.29		45.04			6.93	17.32		74.21	45.04
				Dicrotendipes	*Dicrotendipes* sp.			72.76	3.46	24.25	27.72	24.25	45.04	68.91	10.39
				Eukiefferiella	*Eukiefferiella gracei gr.*										
				Euryhapsis	*Euryhapsis* sp.									106.02	
				Glyptotendipes	*Glyptotendipes* sp.										
				Heterotanytarsus	*Heterotanytarsus* sp.		6.93	3.46				3.46		5.30	
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*					3.46	3.46				
				Lipiniella	*Lipiniella* sp.										

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Stream	Chair OF	Chair OF	Giraffe OF	Giraffe OF	Giraffe OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Wolf OF
Replicate	4	5	1	2	3	4	5	1	2	3
Date Sampled	13-Aug-12	13-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12
Surface Area Sampled (m^2)	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID	6138.1-46	6138.1-47	6138.1-11	6138.1-12	6138.1-13	6138.1-14	6138.1-15	6138.1-1	6138.1-2	6138.1-3

Major Group	Class	Order	Family	Genus	Final Designation									
				Mesosmittia	*Mesosmittia* sp.									
				Micropsectra	*Micropsectra* sp.									
				Nanocladius	*Nanocladius* sp.								5.30	
				Natarsia	*Natarsia* sp.									
				Orthocladius	*Orthocladius (Pogonocladius)* sp.									
				Orthocladius	*Orthocladius* Complex								10.60	
				Orthocladius	*Orthocladius* sp.	41.58							5.30	3.46
				Parachironomus	*Parachironomus* sp.			3.46						
				Paracladopelma	*Paracladopelma* sp.									
				Parakiefferiella	*Parakiefferiella* sp.								47.71	27.72
				Paramerina	*Paramerina* sp.									
				Parametriocnemus	*Parametriocnemus* sp.									
				Paratanytarsus	*Paratanytarsus* sp.			121.26	13.86	183.62	349.92	398.43	90.11	10.39
				Paratendipes	*Paratendipes* sp.									
				Phaenopsectra	*Phaenopsectra* sp.									
				Polypedilum	*Polypedilum halterale gr.*									
				Polypedilum	*Polypedilum scalaenum gr.*	242.52	1358.12						84.81	13.86
				Polypedilum	*Polypedilum sordens*						3.46			3.46
				Polypedilum	*Polypedilum* sp.		13.86						3.46	3.46
				Potthastia	*Potthastia longimana gr.*	6.93					3.46		15.90	
				Procladius	*Procladius* sp.	27.72	103.94	6.93	45.04	55.43	20.79	20.79		
				Protanypus	*Protanypus* sp.									
				Psectrocladius	*Psectrocladius* sp.	6.93	13.86	34.65	31.18	69.29	76.22	103.94	47.71	3.46
				Pseudochironomus	*Pseudochironomus* sp.									
				Pseudokiefferiella	*Pseudokiefferiella* sp.									
				Pseudosmittia	*Pseudosmittia* sp.	13.86	13.86	3.46					31.80	31.18
				Rheocricotopus	*Rheocricotopus* sp.									
				Rheotanytarsus	*Rheotanytarsus exiguus gr.*								5.30	
				Saetheria	*Saetheria tylus*		6.93						47.71	
				Sergentia	*Sergentia* sp.									
				Stempellina	*Stempellina* sp.	48.50	69.29						31.80	
				Stictochironomus	*Stictochironomus* sp.		13.86	6.93	3.46	3.46	65.83	3.46	3.46	84.81	24.25
				Synorthocladius	*Synorthocladius* sp.									
				Tanytarsus	*Tanytarsus* sp.	13.86	304.88	3.46	3.46	6.93	31.18	6.93		217.33
				Thienemanniella	*Thienemanniella* sp.									
				Thienemannimyia	*Thienemannimyia* gr. sp.	478.11	263.31	34.65	10.39	34.65	41.58	31.18	34.65	355.15	65.83
				Tokunagaia	*Tokunagaia* sp.	13.86								
				Tvetenia	*Tvetenia bavarica gr.*									5.30
				Undetermined	Chironomini									
				Undetermined	Pentaneurini									
				Undetermined	Tanytarsini		48.50							3.46
				Zalutschia	*Zalutschia* sp.			3.46	3.46		10.39	20.79		
			Dolichopodidae	Undetermined	Dolichopodidae	6.93								
			Empididae	*Clinocera*	*Clinocera* sp.									
				Trichoclinocera	*Trichoclinocera* sp.					13.86			5.30	
				Undetermined	Empididae					3.46	10.39			
			Muscidae	Undetermined	Muscidae					6.93		3.46		
			Simuliidae	*Simulium*	*Simulium* sp.									
				Undetermined	Simuliidae									
			Tipulidae	*Dicranota*	*Dicranota* sp.	6.93								
				Limnophila	*Limnophila* sp.									
				Prionocera	*Prionocera* sp.									
				Tipula	*Tipula* sp.	110.87	159.37	6.93			3.46	6.93	6.93	47.71	31.18

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2															
Taxonomic Classification:															
Area						**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**
Stream						**Chair OF**	**Chair OF**	**Giraffe OF**	**Giraffe OF**	**Giraffe OF**	**Giraffe OF**	**Giraffe OF**	**Wolf OF**	**Wolf OF**	**Wolf OF**
Replicate						**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
Date Sampled						**13-Aug-12**	**13-Aug-12**	**8-Aug-12**	**8-Aug-12**	**8-Aug-12**	**8-Aug-12**	**8-Aug-12**	**7-Aug-12**	**7-Aug-12**	**7-Aug-12**
Surface Area Sampled (m^2)						**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**
EcoAnalysts Sample ID						**6138.1-46**	**6138.1-47**	**6138.1-11**	**6138.1-12**	**6138.1-13**	**6138.1-14**	**6138.1-15**	**6138.1-1**	**6138.1-2**	**6138.1-3**
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
			Undetermined	Undetermined	Diptera	6.93	13.86						17.32	84.81	3.46
Ephemeroptera	Insecta	Ephemeroptera	Baetidae	*Acentrella*	*Acentrella lapponica*										
				Baetis	*Baetis flavistriga*										
				Baetis	*Baetis* sp.										
			Ephemerellidae	*Ephemerella*	*Ephemerella* sp.	6.93								5.30	
			Metretopodidae	*Metretopus*	*Metretopus* sp.										
				Undetermined	Metretopodidae										
			Undetermined	Undetermined	Ephemeroptera										
Gastropoda	Gastropoda	Basommatophora	Lymnaeidae	*Stagnicola*	*Stagnicola* sp.										
				Undetermined	Lymnaeidae										
			Physidae	*Physa*	*Physa* sp.			3.46		10.39	13.86				
		Gastropoda (class)	Undetermined	Undetermined	Gastropoda						3.46				
		Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*										
				Valvata	*Valvata* sp.										
Hemiptera	Insecta	Hemiptera	Undetermined	Undetermined	Auchenorrhyncha								3.46		
				Undetermined	Hemiptera										
Ichthyoplankton	Actinopterygii	Gasterosteiformes	Gasterosteidae	Undetermined	Gasterosteidae								6.93	5.30	
Other Insecta	Insecta	Collembola	Undetermined	Undetermined	Collembola								3.46		
		Hymenoptera	Undetermined	Undetermined	Hymenoptera									10.60	
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.										
	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda	152.44	200.95	17.32	13.86	27.72	3.46		10.39	312.75	69.29
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria						3.46				
Plecoptera	Insecta	Plecoptera	Nemouridae	*Nemoura*	*Nemoura* sp.	20.79					10.39			5.30	
				Undetermined	Nemouridae										
			Perlodidae	*Arcynopteryx*	*Arcynopteryx compacta*										
			Undetermined	Undetermined	Perlodidae										
Trichoptera	Insecta	Trichoptera	Brachycentridae	*Brachycentrus*	*Brachycentrus americanus*	34.65									
				Micrasema	*Micrasema* sp.										
			Hydropsychidae	*Arctopsyche*	*Arctopsyche* sp.										
			Hydroptilidae	*Agraylea*	*Agraylea* sp.			17.32					3.46		
				Oxyethira	*Oxyethira* sp.	27.72								5.30	
			Leptoceridae	*Ceraclea*	*Ceraclea* sp.										
				Mystacides	*Mystacides sepulchralis*						3.46			21.20	
				Mystacides	*Mystacides* sp.										
				Undetermined	Leptoceridae										
			Limnephilidae	*Asynarchus*	*Asynarchus* sp.										
				Grensia	*Grensia praeterita*										
				Undetermined	Limnephilidae	6.93				6.93		3.46			
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.		6.93	3.46			6.93				
			Rhyacophilidae	*Rhyacophila*	*Rhyacophila brunnea*		6.93								
				Rhyacophila	*Rhyacophila mongolica*										
				Rhyacophila	*Rhyacophila* sp.										
			Undetermined	Undetermined	Trichoptera										
					TOTAL	**2653.88**	**3118.14**	**682.53**	**166.30**	**741.42**	**1028.99**	**928.51**	**200.95**	**2618.59**	**412.29**

Note: Benthos samples were not collected from Echo OF, which was dry during sampling, or Llama Lake where substrate size and water levels prevented sampling.
Only two samples were collected at Pond 19 OF due to low water levels.
Nematodes, copepods or cladocerans were excluded from analyses.
Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2															
Taxonomic Classification:															
Area						**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**
Stream						**Wolf OF**	**Wolf OF**	**Goose OF**	**Goose OF**	**Goose OF**	**Goose OF**	**Goose OF**	**Propellor OF**	**Propellor OF**	**Propellor OF**
Replicate						**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
Date Sampled						**7-Aug-12**	**7-Aug-12**	**7-Aug-12**	**7-Aug-12**	**7-Aug-12**	**7-Aug-12**	**7-Aug-12**	**9-Aug-12**	**9-Aug-12**	**9-Aug-12**
Surface Area Sampled (m^2)						**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**
EcoAnalysts Sample ID						**6138.1-4**	**6138.1-5**	**6138.1-6**	**6138.1-7**	**6138.1-8**	**6138.1-9**	**6138.1-10**	**6138.1-16**	**6138.1-17**	**6138.1-18**
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
Acari	Arachnida	Sarcoptiformes	Undetermined	Undetermined	Oribatei										
		Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.										
			Hydryphantidae	Undetermined	Hydryphantidae										
			Hygrobatidae	*Atractides*	*Atractides* sp.										
				Hygrobates	*Hygrobates* sp.			15.80	6.93	10.39					
			Lebertiidae	*Lebertia*	*Lebertia* sp.	17.32	20.79	15.80	6.93	13.86	23.28	33.27	6.93	9.25	99.80
			Oxidae	*Oxus*	*Oxus* sp.										
			Pionidae	Undetermined	Pionidae	3.46		3.95		3.46			27.72	148.02	
			Sperchontidae	*Sperchon*	*Sperchon* sp.				3.46	10.39	5.82	99.80			
			Unionicolidae	*Neumania*	*Neumania* sp.										
		Undetermined	Undetermined	Undetermined	Acari	3.46									
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae	17.32	110.87	59.24	145.51	24.25	5.82	16.63		9.25	116.43
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae			31.60	24.25	31.18	87.31	33.27	10.39		16.63
		Tubificida	Naididae	*Chaetogaster*	*Chaetogaster diastrophus*										
				Nais	*Nais* sp.	3.46	17.32	55.29	6.93	86.61	151.34	1463.68		27.75	33.27
				Uncinais	*Uncinais uncinata*			23.70	6.93	10.39	58.21				
			Tubificidae	*Rhyacodrilus*	*Rhyacodrilus* sp.										
				Undetermined	Tubificidae w/ cap setae					6.93			3.46	9.25	
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.										
				Sphaerium	*Sphaerium* sp.										
				Undetermined	Sphaeriidae										
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Agabus*	*Agabus* sp.		3.46								
				Hydroporus	*Hydroporus* sp.										
				Oreodytes	*Oreodytes* sp.	10.39	6.93			3.46			6.93		16.63
			Haliplidae	*Haliplus*	*Haliplus* sp.										
				Undetermined	Haliplidae	3.46			3.46	20.79					
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera	20.79		126.39	24.25	200.95	40.75		166.30	3237.94	382.55
	Maxillopoda	Cyclopoida	Undetermined	Undetermined	Cyclopoida	13.86		3.95	20.79	114.33			3.46	64.76	
	Ostracoda	Undetermined	Undetermined	Undetermined	Ostracoda	10.39	3.46	252.78	114.33	65.83	244.48	166.33	128.19	157.27	365.92
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.			11.85	62.36	114.33	5.82				
				Probezzia	*Probezzia* sp.										
				Undetermined	Ceratopogoninae										
			Chironomidae	*Ablabesmyia*	*Ablabesmyia* (Karelia) sp.										
				Ablabesmyia	*Ablabesmyia* sp.			19.75	6.93	3.46	17.46				
				Acamptocladius	*Acamptocladius* sp.										
				Acricotopus	*Acricotopus* sp.										
				Chaetocladius	*Chaetocladius* sp.		3.46								
				Chironomus	*Chironomus* sp.				3.46						
				Cladotanytarsus	*Cladotanytarsus* sp.										
				Constempellina	*Constempellina* sp.										
				Corynoneura	*Corynoneura* sp.			7.90			17.46				33.27
				Cricotopus	*Cricotopus bicinctus gr.*					3.46		1230.82			
				Cricotopus	*Cricotopus* sp.		62.36	78.99	62.36	51.97	52.39	482.35		64.76	1896.13
				Cryptochironomus	*Cryptochironomus* sp.			7.90	3.46	3.46	5.82				
				Demicryptochironomus	*Demicryptochironomus* sp.			7.90	34.65	6.93	29.10				
				Dicrotendipes	*Dicrotendipes fumidus*	76.22	183.62	19.75					31.18		49.90
				Dicrotendipes	*Dicrotendipes* sp.	17.32	10.39	27.65	41.58	6.93	5.82	83.16		64.76	83.16
				Eukiefferiella	*Eukiefferiella gracei gr.*										
				Euryhapsis	*Euryhapsis* sp.	6.93	13.86				5.82	49.90			
				Glyptotendipes	*Glyptotendipes* sp.										
				Heterotanytarsus	*Heterotanytarsus* sp.	6.93		3.95	3.46				51.97	249.78	33.27
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*	3.46				6.93					
				Lipiniella	*Lipiniella* sp.										

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2														
Taxonomic Classification:					Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
					Stream	Wolf OF	Wolf OF	Goose OF	Goose OF	Goose OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor OF
					Replicate	4	5	1	2	3	4	5	1	2	3
					Date Sampled	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12
					Surface Area Sampled (m^2)	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
					EcoAnalysts Sample ID	6138.1-4	6138.1-5	6138.1-6	6138.1-7	6138.1-8	6138.1-9	6138.1-10	6138.1-16	6138.1-17	6138.1-18
Major Group	Class	Order	Family	Genus	Final Designation										
				Mesosmittia	*Mesosmittia* sp.										
				Micropsectra	*Micropsectra* sp.									9.25	16.63
				Nanocladius	*Nanocladius* sp.				3.46						
				Natarsia	*Natarsia* sp.										
				Orthocladius	*Orthocladius (Pogonocladius)* sp.							133.06			
				Orthocladius	*Orthocladius* Complex							133.06			16.63
				Orthocladius	*Orthocladius* sp.			3.95			5.82	49.90	6.93	46.26	299.39
				Parachironomus	*Parachironomus* sp.			3.95		10.39	29.10	182.96		9.25	
				Paracladopelma	*Paracladopelma* sp.							16.63			
				Parakiefferiella	*Parakiefferiella* sp.		10.39		3.46		17.46				
				Paramerina	*Paramerina* sp.									37.01	16.63
				Parametriocnemus	*Parametriocnemus* sp.										
				Paratanytarsus	*Paratanytarsus* sp.	20.79	38.11	339.67	76.22	65.83	174.63	49.90	114.33	157.27	332.65
				Paratendipes	*Paratendipes* sp.										
				Phaenopsectra	*Phaenopsectra* sp.										
				Polypedilum	*Polypedilum halterale gr.*										
				Polypedilum	*Polypedilum scalaenum gr.*	20.79	10.39								
				Polypedilum	*Polypedilum sordens*										
				Polypedilum	*Polypedilum* sp.										
				Potthastia	*Potthastia longimana gr.*	6.93	6.93			3.46					
				Procladius	*Procladius* sp.	3.46	3.46	94.79	13.86		11.64		31.18	18.50	
				Protanypus	*Protanypus* sp.										
				Psectrocladius	*Psectrocladius* sp.	6.93	24.25	35.55	10.39	17.32	75.67	49.90	100.47	286.79	33.27
				Pseudochironomus	*Pseudochironomus* sp.										
				Pseudokiefferiella	*Pseudokiefferiella* sp.										33.27
				Pseudosmittia	*Pseudosmittia* sp.	31.18	138.58		24.25	3.46					49.90
				Rheocricotopus	*Rheocricotopus* sp.										
				Rheotanytarsus	*Rheotanytarsus exiguus gr.*							99.80			
				Saetheria	*Saetheria tylus*	3.46	17.32								
				Sergentia	*Sergentia* sp.										
				Stempellina	*Stempellina* sp.										
				Stictochironomus	*Stictochironomus* sp.	3.46	20.79	110.59	65.83	24.25	34.93	16.63		9.25	
				Synorthocladius	*Synorthocladius* sp.										
				Tanytarsus	*Tanytarsus* sp.	3.46	6.93	55.29	10.39	13.86	5.82	49.90	10.39	9.25	182.96
				Thienemanniella	*Thienemanniella* sp.									18.50	
				Thienemannimyia	*Thienemannimyia* gr. sp.	65.83	76.22	27.65	51.97	48.50	52.39	515.61	31.18	9.25	16.63
				Tokunagaia	*Tokunagaia* sp.										16.63
				Tvetenia	*Tvetenia bavarica gr.*							33.27			133.06
				Undetermined	Chironomini								3.46		
				Undetermined	Pentaneurini										
				Undetermined	Tanytarsini				3.46				3.46		
				Zalutschia	*Zalutschia* sp.		3.46	63.19	3.46	3.46	11.64	33.27	110.87	1184.16	482.35
			Dolichopodidae	Undetermined	Dolichopodidae										
			Empididae	*Clinocera*	*Clinocera* sp.										
				Trichoclinocera	*Trichoclinocera* sp.	3.46									
				Undetermined	Empididae				10.39						
			Muscidae	Undetermined	Muscidae					3.46	5.82				
			Simuliidae	*Simulium*	*Simulium* sp.										
				Undetermined	Simuliidae										
			Tipulidae	*Dicranota*	*Dicranota* sp.										
				Limnophila	*Limnophila* sp.					3.46					
				Prionocera	*Prionocera* sp.										
				Tipula	*Tipula* sp.	24.25	38.11	102.69	86.61	58.90	139.70	49.90			16.63

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Area						Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Stream						Wolf OF	Wolf OF	Goose OF	Goose OF	Goose OF	Goose OF	Goose OF	Propellor OF	Propellor OF	Propellor OF
Replicate						4	5	1	2	3	4	5	1	2	3
Date Sampled						7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12
Surface Area Sampled (m^2)						0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID						6138.1-4	6138.1-5	6138.1-6	6138.1-7	6138.1-8	6138.1-9	6138.1-10	6138.1-16	6138.1-17	6138.1-18
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
			Undetermined	Undetermined	Diptera	58.90	211.34	3.95	31.18	65.83	17.46		17.32		
Ephemeroptera	Insecta	Ephemeroptera	Baetidae	*Acentrella*	*Acentrella lapponica*										
				Baetis	*Baetis flavistriga*										
				Baetis	*Baetis* sp.										33.27
			Ephemerellidae	*Ephemerella*	*Ephemerella* sp.	3.46	10.39			10.39		166.33	10.39		49.90
			Metretopodidae	*Metretopus*	*Metretopus* sp.	3.46									
				Undetermined	Metretopodidae										
			Undetermined	Undetermined	Ephemeroptera									9.25	
Gastropoda	Gastropoda	Basommatophora	Lymnaeidae	*Stagnicola*	*Stagnicola* sp.										
				Undetermined	Lymnaeidae										
			Physidae	*Physa*	*Physa* sp.			23.70			29.10				
		Gastropoda (class)	Undetermined	Undetermined	Gastropoda										
		Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*								31.18		
				Valvata	*Valvata* sp.								117.80	46.26	66.53
Hemiptera	Insecta	Hemiptera	Undetermined	Undetermined	Auchenorrhyncha										
				Undetermined	Hemiptera										
Ichthyoplankton	Actinopterygii	Gasterosteiformes	Gasterosteidae	Undetermined	Gasterosteidae	6.93	3.46								
Other Insecta	Insecta	Collembola	Undetermined	Undetermined	Collembola		3.46								
		Hymenoptera	Undetermined	Undetermined	Hymenoptera										
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.				31.18	20.79	17.46	748.47	3.46	9.25	
	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda	45.04	65.83	59.24	55.43	76.22	390.00	615.41	27.72	166.52	182.96
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria						5.82	33.27		9.25	
Plecoptera	Insecta	Plecoptera	Nemouridae	*Nemoura*	*Nemoura* sp.	13.86		86.89	76.22	169.77	110.60	282.76	13.86	9.25	
				Undetermined	Nemouridae			15.80	6.93	124.73	52.39	249.49	10.39	9.25	
			Perlodidae	*Arcynopteryx*	*Arcynopteryx compacta*				3.46	3.46					
				Undetermined	Perlodidae					3.46					
Trichoptera	Insecta	Trichoptera	Brachycentridae	*Brachycentrus*	*Brachycentrus americanus*								3.46	18.50	316.02
				Micrasema	*Micrasema* sp.										
			Hydropsychidae	*Arctopsyche*	*Arctopsyche* sp.										
			Hydroptilidae	*Agraylea*	*Agraylea* sp.	20.79	10.39					16.63	48.50	55.51	365.92
				Oxyethira	*Oxyethira* sp.		3.46								
			Leptoceridae	*Ceraclea*	*Ceraclea* sp.										
				Mystacides	*Mystacides sepulchralis*	3.46	6.93		10.39						
				Mystacides	*Mystacides* sp.										
				Undetermined	Leptoceridae										
			Limnephilidae	*Asynarchus*	*Asynarchus* sp.										
				Grensia	*Grensia praeterita*										
				Undetermined	Limnephilidae			7.90	3.46						
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.										
			Rhyacophilidae	*Rhyacophila*	*Rhyacophila brunnea*										
				Rhyacophila	*Rhyacophila mongolica*										
				Rhyacophila	*Rhyacophila* sp.	3.46	3.46		3.46	3.46					
			Undetermined	Undetermined	Trichoptera										
					TOTAL	**568.19**	**1150.25**	**1808.92**	**1167.57**	**1534.82**	**1944.18**	**7185.34**	**1132.92**	**6170.59**	**5788.19**

Note: Benthos samples were not collected from Echo OF, which was dry during sampling, or Llama Lake where substrate size and water levels prevented sampling.
Only two samples were collected at Pond 19 OF due to low water levels.
Nematodes, copepods or cladocerans were excluded from analyses.
Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2															
Taxonomic Classification:					**Area**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**Goose**	**George**	**George**	**George**
					Stream	**Propellor OF**	**Propellor OF**	**Reference B OF**	**Reference B OF**	**Reference B OF**	**Reference B OF**	**Reference B OF**	**George OF**	**George OF**	**George OF**
					Replicate	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
					Date Sampled	**9-Aug-12**	**9-Aug-12**	**10-Aug-12**	**10-Aug-12**	**10-Aug-12**	**10-Aug-12**	**10-Aug-12**	**5-Aug-12**	**5-Aug-12**	**5-Aug-12**
					Surface Area Sampled (m^2)	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**
					EcoAnalysts Sample ID	**6138.1-19**	**6138.1-20**	**6138.1-21**	**6138.1-22**	**6138.1-23**	**6138.1-24**	**6138.1-25**	**6141.1-6**	**6141.1-7**	**6141.1-8**
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
Acari	Arachnida	Sarcoptiformes	Undetermined	Undetermined	Oribatei										6.41
		Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.										
			Hydryphantidae	Undetermined	Hydryphantidae										
			Hygrobatidae	*Atractides*	*Atractides* sp.										
				Hygrobates	*Hygrobates* sp.										6.41
			Lebertiidae	*Lebertia*	*Lebertia* sp.	51.97			17.32	10.39	3.46	3.46	71.09		57.69
			Oxidae	*Oxus*	*Oxus* sp.								11.85		
			Pionidae	Undetermined	Pionidae					6.93					
			Sperchontidae	*Sperchon*	*Sperchon* sp.	31.18							35.55		19.23
			Unionicolidae	*Neumania*	*Neumania* sp.										
		Undetermined	Undetermined	Undetermined	Acari										
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae		124.70			6.93			35.55	75.53	76.92
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae			51.97	45.04	93.54	20.79	65.83		166.17	32.05
		Tubificida	Naididae	*Chaetogaster*	*Chaetogaster diastrophus*		20.78								
				Nais	*Nais* sp.		62.35							60.42	6.41
				Uncinais	*Uncinais uncinata*								11.85		
			Tubificidae	*Rhyacodrilus*	*Rhyacodrilus* sp.									15.11	
				Undetermined	Tubificidae w/ cap setae			6.93		13.86		3.46		60.42	19.23
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.										
				Sphaerium	*Sphaerium* sp.										
				Undetermined	Sphaeriidae										
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Agabus*	*Agabus* sp.										
				Hydroporus	*Hydroporus* sp.										
				Oreodytes	*Oreodytes* sp.	3.46									
			Haliplidae	*Haliplus*	*Haliplus* sp.				6.93			3.46			
				Undetermined	Haliplidae							6.93		7.55	
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera				3.46		31.18	3.46		22.66	
	Maxillopoda	Cyclopoida	Undetermined	Undetermined	Cyclopoida					24.25	6.93	41.58	17.77	15.11	6.41
	Ostracoda	Undetermined	Undetermined	Undetermined	Ostracoda	27.72	374.10	6.93	3.46		51.97	103.94	118.49	626.91	121.79
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.			10.39	20.79	13.86	6.93	13.86	5.92		19.23
				Probezzia	*Probezzia* sp.										
				Undetermined	Ceratopogoninae										
			Chironomidae	*Ablabesmyia*	*Ablabesmyia* (Karelia) sp.						6.93				
				Ablabesmyia	*Ablabesmyia* sp.										
				Acamptocladius	*Acamptocladius* sp.										
				Acricotopus	*Acricotopus* sp.				3.46			17.32		7.55	6.41
				Chaetocladius	*Chaetocladius* sp.										
				Chironomus	*Chironomus* sp.			17.32		3.46	13.86	3.46			
				Cladotanytarsus	*Cladotanytarsus* sp.				3.46			3.46		15.11	6.41
				Constempellina	*Constempellina* sp.										
				Corynoneura	*Corynoneura* sp.		41.57								6.41
				Cricotopus	*Cricotopus bicinctus gr.*								88.87		32.05
				Cricotopus	*Cricotopus* sp.	58.90	2223.83	45.04	3.46	34.65			177.73	45.32	243.58
				Cryptochironomus	*Cryptochironomus* sp.				3.46	3.46	3.46	10.39		7.55	12.82
				Demicryptochironomus	*Demicryptochironomus* sp.						3.46		5.92		6.41
				Dicrotendipes	*Dicrotendipes fumidus*	3.46	103.92	38.11	51.97			6.93	23.70	83.08	25.64
				Dicrotendipes	*Dicrotendipes* sp.		20.78		6.93	24.25				15.11	
				Eukiefferiella	*Eukiefferiella gracei gr.*										
				Euryhapsis	*Euryhapsis* sp.	3.46									
				Glyptotendipes	*Glyptotendipes* sp.			3.46							
				Heterotanytarsus	*Heterotanytarsus* sp.									113.30	32.05
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*										6.41
				Lipiniella	*Lipiniella* sp.										

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	George	George	George
Stream	Propellor OF	Propellor OF	Reference B OF	Reference B OF	Reference B OF	Reference B OF	Reference B OF	George OF	George OF	George OF
Replicate	4	5	1	2	3	4	5	1	2	3
Date Sampled	9-Aug-12	9-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
Surface Area Sampled (m^2)	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID	6138.1-19	6138.1-20	6138.1-21	6138.1-22	6138.1-23	6138.1-24	6138.1-25	6141.1-6	6141.1-7	6141.1-8

Major Group	Class	Order	Family	Genus	Final Designation									
				Mesosmittia	*Mesosmittia* sp.									6.41
				Micropsectra	*Micropsectra* sp.		20.78						5.92	
				Nanocladius	*Nanocladius* sp.									
				Natarsia	*Natarsia* sp.									
				Orthocladius	*Orthocladius (Pogonocladius)* sp.									
				Orthocladius	*Orthocladius* Complex								7.55	
				Orthocladius	*Orthocladius* sp.	17.32	207.83							
				Parachironomus	*Parachironomus* sp.								82.94	60.42	307.68
				Paracladopelma	*Paracladopelma* sp.										
				Parakiefferiella	*Parakiefferiella* sp.				6.93		3.46	13.86	41.47	98.19	12.82
				Paramerina	*Paramerina* sp.										
				Parametriocnemus	*Parametriocnemus* sp.										
				Paratanytarsus	*Paratanytarsus* sp.	17.32	935.25	145.51	83.15	38.11	13.86	6.93		90.64	96.15
				Paratendipes	*Paratendipes* sp.						3.46	6.93			
				Phaenopsectra	*Phaenopsectra* sp.										
				Polypedilum	*Polypedilum halterale gr.*										
				Polypedilum	*Polypedilum scalaenum gr.*										
				Polypedilum	*Polypedilum sordens*					3.46					
				Polypedilum	*Polypedilum* sp.										
				Potthastia	*Potthastia longimana gr.*								35.55	45.32	25.64
				Procladius	*Procladius* sp.			51.97	173.23	103.94	384.57	498.90	5.92		6.41
				Protanypus	*Protanypus* sp.										6.41
				Psectrocladius	*Psectrocladius* sp.		353.32	31.18	159.37	135.12	297.96	221.73	11.85	22.66	25.64
				Pseudochironomus	*Pseudochironomus* sp.				3.46			10.39			
				Pseudokiefferiella	*Pseudokiefferiella* sp.	17.32							82.94		6.41
				Pseudosmittia	*Pseudosmittia* sp.			3.46	10.39				5.92	7.55	6.41
				Rheocricotopus	*Rheocricotopus* sp.										
				Rheotanytarsus	*Rheotanytarsus exiguus gr.*	3.46							17.77	15.11	
				Saetheria	*Saetheria tylus*										
				Sergentia	*Sergentia* sp.										
				Stempellina	*Stempellina* sp.										
				Stictochironomus	*Stictochironomus* sp.			6.93	10.39	6.93	13.86	6.93		60.42	
				Synorthocladius	*Synorthocladius* sp.										
				Tanytarsus	*Tanytarsus* sp.		270.18		13.86	10.39	162.84	114.33	5.92	37.77	19.23
				Thienemanniella	*Thienemanniella* sp.										
				Thienemannimyia	*Thienemannimyia* gr. sp.		124.70	48.50	17.32	17.32	6.93	27.72	355.46	324.78	339.73
				Tokunagaia	*Tokunagaia* sp.	27.72									
				Tvetenia	*Tvetenia bavarica gr.*	13.86	20.78						118.49	7.55	
				Undetermined	Chironomini										6.41
				Undetermined	Pentaneurini										
				Undetermined	Tanytarsini		20.78	107.40	103.94	79.69	58.90	138.58			
				Zalutschia	*Zalutschia* sp.	3.46	748.20								
			Dolichopodidae	Undetermined	Dolichopodidae										
			Empididae	*Clinocera*	*Clinocera* sp.										
				Trichoclinocera	*Trichoclinocera* sp.										
				Undetermined	Empididae				3.46						
			Muscidae	Undetermined	Muscidae			10.39	27.72	13.86	10.39	3.46			
			Simuliidae	*Simulium*	*Simulium* sp.										
				Undetermined	Simuliidae										6.41
			Tipulidae	*Dicranota*	*Dicranota* sp.										
				Limnophila	*Limnophila* sp.										
				Prionocera	*Prionocera* sp.										
				Tipula	*Tipula* sp.	3.46							35.55	90.64	115.38

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Area						Goose	Goose	Goose	Goose	Goose	Goose	Goose	George	George	George
Stream						Propellor OF	Propellor OF	Reference B OF	Reference B OF	Reference B OF	Reference B OF	Reference B OF	George OF	George OF	George OF
Replicate						4	5	1	2	3	4	5	1	2	3
Date Sampled						9-Aug-12	9-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
Surface Area Sampled (m^2)						0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID						6138.1-19	6138.1-20	6138.1-21	6138.1-22	6138.1-23	6138.1-24	6138.1-25	6141.1-6	6141.1-7	6141.1-8
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
			Undetermined	Undetermined	Diptera	6.93									
Ephemeroptera	Insecta	Ephemeroptera	Baetidae	*Acentrella*	*Acentrella lapponica*										
				Baetis	*Baetis flavistriga*										
				Baetis	*Baetis* sp.	3.46	20.78								
			Ephemerellidae	*Ephemerella*	*Ephemerella* sp.	17.32	41.57						82.94	22.66	
			Metretopodidae	*Metretopus*	*Metretopus* sp.										
				Undetermined	Metretopodidae										
			Undetermined	Undetermined	Ephemeroptera										
Gastropoda	Gastropoda	Basommatophora	Lymnaeidae	*Stagnicola*	*Stagnicola* sp.										
				Undetermined	Lymnaeidae										
			Physidae	*Physa*	*Physa* sp.						3.46				
		Gastropoda (class)	Undetermined	Undetermined	Gastropoda										
		Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*								47.40	75.53	83.33
				Valvata	*Valvata* sp.	6.93	145.48						59.24	75.53	
Hemiptera	Insecta	Hemiptera	Undetermined	Undetermined	Auchenorrhyncha										
				Undetermined	Hemiptera										
Ichthyoplankton	Actinopterygii	Gasterosteiformes	Gasterosteidae	Undetermined	Gasterosteidae										
Other Insecta	Insecta	Collembola	Undetermined	Undetermined	Collembola										
		Hymenoptera	Undetermined	Undetermined	Hymenoptera										
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.										6.41
	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda	3.46	311.75	62.36	24.25	17.32		17.32	308.07	105.74	108.97
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria	3.46		10.39	10.39						
Plecoptera	Insecta	Plecoptera	Nemouridae	*Nemoura*	*Nemoura* sp.								11.85	15.11	
				Undetermined	Nemouridae	6.93							17.77	15.11	
			Perlodidae	*Arcynopteryx*	*Arcynopteryx compacta*										
				Undetermined	Perlodidae										
Trichoptera	Insecta	Trichoptera	Brachycentridae	*Brachycentrus*	*Brachycentrus americanus*	55.43									
				Micrasema	*Micrasema* sp.										
			Hydropsychidae	*Arctopsyche*	*Arctopsyche* sp.										
			Hydroptilidae	*Agraylea*	*Agraylea* sp.	41.58	228.62								
				Oxyethira	*Oxyethira* sp.										
			Leptoceridae	*Ceraclea*	*Ceraclea* sp.										
				Mystacides	*Mystacides sepulchralis*										
				Mystacides	*Mystacides* sp.										
				Undetermined	Leptoceridae									7.55	
			Limnephilidae	*Asynarchus*	*Asynarchus* sp.										
				Grensia	*Grensia praeterita*										70.51
				Undetermined	Limnephilidae					3.46					
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.				3.46			10.39			
			Rhyacophilidae	*Rhyacophila*	*Rhyacophila brunnea*										
				Rhyacophila	*Rhyacophila mongolica*										
				Rhyacophila	*Rhyacophila* sp.										
			Undetermined	Undetermined	Trichoptera										
					TOTAL	**429.61**	**6422.08**	**658.27**	**821.11**	**665.20**	**1108.67**	**1365.05**	**1937.28**	**2522.73**	**2006.33**

Note: Benthos samples were not collected from Echo OF, which was dry during sampling, or Llama Lake where substrate size and water levels prevented sampling.
Only two samples were collected at Pond 19 OF due to low water levels.
Nematodes, copepods or cladocerans were excluded from analyses.
Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2															
Taxonomic Classification:															
Area						**George**	**George**	**George**	**George**	**George**	**George**	**George**	**George**	**George**	**George**
Stream						**George OF**	**George OF**	**Sleigh OF**	**Sleigh OF**	**Sleigh OF**	**Sleigh OF**	**Sleigh OF**	**Dragon OF**	**Dragon OF**	**Dragon OF**
Replicate						**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
Date Sampled						**5-Aug-12**	**5-Aug-12**	**5-Aug-12**	**5-Aug-12**	**5-Aug-12**	**5-Aug-12**	**5-Aug-12**	**5-Aug-12**	**5-Aug-12**	**5-Aug-12**
Surface Area Sampled (m^2)						**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**
EcoAnalysts Sample ID						**6141.1-9**	**6141.1-10**	**6141.1-11**	**6141.1-12**	**6141.1-13**	**6141.1-14**	**6141.1-15**	**6141.1-1**	**6141.1-2**	**6141.1-3**
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
Acari	Arachnida	Sarcoptiformes	Undetermined	Undetermined	Oribatei										
		Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.			13.86					6.93		
			Hydryphantidae	Undetermined	Hydryphantidae						20.78				
			Hygrobatidae	*Atractides*	*Atractides* sp.										
				Hygrobates	*Hygrobates* sp.								6.93	13.86	
			Lebertiidae	*Lebertia*	*Lebertia* sp.	47.54	14.76				20.78		90.08	27.72	55.43
			Oxidae	*Oxus*	*Oxus* sp.		4.92								
			Pionidae	Undetermined	Pionidae										
			Sperchontidae	*Sperchon*	*Sperchon* sp.	71.31	83.64	13.86	1953.64	1462.98	1766.59	169.98	117.80	526.62	291.03
			Unionicolidae	*Neumania*	*Neumania* sp.		4.92								
		Undetermined	Undetermined	Undetermined	Acari			13.86	20.78						13.86
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae	23.77	44.28	124.73	187.05	166.25	270.18	7.73	55.43		41.58
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae		14.76						34.65	284.10	152.44
		Tubificida	Naididae	*Chaetogaster*	*Chaetogaster diastrophus*										
				Nais	*Nais* sp.	463.53	44.28	13.86		66.50			20.79		97.01
				Uncinais	*Uncinais uncinata*										
			Tubificidae	*Rhyacodrilus*	*Rhyacodrilus* sp.										
				Undetermined	Tubificidae w/ cap setae										
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.										
				Sphaerium	*Sphaerium* sp.										
				Undetermined	Sphaeriidae										
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Agabus*	*Agabus* sp.										
				Hydroporus	*Hydroporus* sp.										
				Oreodytes	*Oreodytes* sp.										
			Haliplidae	*Haliplus*	*Haliplus* sp.								13.86	83.15	138.58
				Undetermined	Haliplidae										
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera			13.86	166.27	33.25		15.45	90.08		55.43
	Maxillopoda	Cyclopoida	Undetermined	Undetermined	Cyclopoida		24.60						97.01	34.65	69.29
	Ostracoda	Undetermined	Undetermined	Undetermined	Ostracoda	47.54	127.92	291.03		232.75	20.78		325.67	6.93	568.19
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.								34.65	13.86	13.86
				Probezzia	*Probezzia* sp.										
				Undetermined	Ceratopogoninae								6.93		
			Chironomidae	*Ablabesmyia*	*Ablabesmyia* (Karelia) sp.			41.58							
				Ablabesmyia	*Ablabesmyia* sp.										
				Acamptocladius	*Acamptocladius* sp.										
				Acricotopus	*Acricotopus* sp.										
				Chaetocladius	*Chaetocladius* sp.										
				Chironomus	*Chironomus* sp.										
				Cladotanytarsus	*Cladotanytarsus* sp.			83.15					6.93		
				Constempellina	*Constempellina* sp.										69.29
				Corynoneura	*Corynoneura* sp.			277.17	41.57	33.25					13.86
				Cricotopus	*Cricotopus bicinctus gr.*	130.74									27.72
				Cricotopus	*Cricotopus* sp.	641.81	314.87		166.27	266.00	519.59	92.72	41.58		27.72
				Cryptochironomus	*Cryptochironomus* sp.	11.89							6.93		
				Demicryptochironomus	*Demicryptochironomus* sp.					66.50			6.93		
				Dicrotendipes	*Dicrotendipes fumidus*		9.84						13.86	20.79	
				Dicrotendipes	*Dicrotendipes* sp.				20.78	66.50	20.78		34.65		13.86
				Eukiefferiella	*Eukiefferiella gracei gr.*										
				Euryhapsis	*Euryhapsis* sp.				1558.76	1396.48	956.04	363.15	6.93		
				Glyptotendipes	*Glyptotendipes* sp.										
				Heterotanytarsus	*Heterotanytarsus* sp.										
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*										
				Lipiniella	*Lipiniella* sp.										

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Area					George	George	George	George	George	George	George	George	George	George
Stream					George OF	George OF	Sleigh OF	Sleigh OF	Sleigh OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF	Dragon OF
Replicate					4	5	1	2	3	4	5	1	2	3
Date Sampled					5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
Surface Area Sampled (m^2)					0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID					6141.1-9	6141.1-10	6141.1-11	6141.1-12	6141.1-13	6141.1-14	6141.1-15	6141.1-1	6141.1-2	6141.1-3
Major Group	Class	Order	Family	Genus	Final Designation									
				Mesosmittia	*Mesosmittia* sp.									
				Micropsectra	*Micropsectra* sp.									
				Nanocladius	*Nanocladius* sp.		9.84							
				Natarsia	*Natarsia* sp.									
				Orthocladius	*Orthocladius (Pogonocladius)* sp.									
				Orthocladius	*Orthocladius* Complex		4.92							13.86
				Orthocladius	*Orthocladius* sp.							13.86	48.50	55.43
				Parachironomus	*Parachironomus* sp.	59.43	54.12	13.86	145.48	99.75	124.70	38.63	76.22	13.86	138.58
				Paracladopelma	*Paracladopelma* sp.										
				Parakiefferiella	*Parakiefferiella* sp.								6.93		
				Paramerina	*Paramerina* sp.										
				Parametriocnemus	*Parametriocnemus* sp.										
				Paratanytarsus	*Paratanytarsus* sp.	47.54	4.92	41.58		33.25	20.78		124.73	13.86	55.43
				Paratendipes	*Paratendipes* sp.						20.78				
				Phaenopsectra	*Phaenopsectra* sp.										
				Polypedilum	*Polypedilum halterale gr.*										
				Polypedilum	*Polypedilum scalaenum gr.*										
				Polypedilum	*Polypedilum sordens*										
				Polypedilum	*Polypedilum* sp.										
				Potthastia	*Potthastia longimana gr.*	23.77	24.60				20.78	15.45			
				Procladius	*Procladius* sp.			13.86					27.72		
				Protanypus	*Protanypus* sp.										
				Psectrocladius	*Psectrocladius* sp.	11.89	4.92						20.79	6.93	
				Pseudochironomus	*Pseudochironomus* sp.										
				Pseudokiefferiella	*Pseudokiefferiella* sp.	23.77	9.84								
				Pseudosmittia	*Pseudosmittia* sp.	71.31				33.25	62.35	15.45	48.50	6.93	27.72
				Rheocricotopus	*Rheocricotopus* sp.										
				Rheotanytarsus	*Rheotanytarsus exiguus gr.*	106.97	4.92		103.92			7.73			
				Saetheria	*Saetheria tylus*			692.92	415.67	365.74	311.75	69.54	6.93		
				Sergentia	*Sergentia* sp.										
				Stempellina	*Stempellina* sp.										
				Stictochironomus	*Stictochironomus* sp.			97.01					20.79	6.93	13.86
				Synorthocladius	*Synorthocladius* sp.		4.92				20.78				
				Tanytarsus	*Tanytarsus* sp.	11.89		27.72			20.78		20.79		235.59
				Thienemanniella	*Thienemanniella* sp.										13.86
				Thienemannimyia	*Thienemannimyia* gr. sp.	118.85	167.28	124.73	103.92	133.00	249.40	115.90	457.33	457.33	582.05
				Tokunagaia	*Tokunagaia* sp.							7.73			
				Tvetenia	*Tvetenia bavarica gr.*	142.62	93.48		145.48		249.40	38.63			
				Undetermined	Chironomini										
				Undetermined	Pentaneurini										
				Undetermined	Tanytarsini										
				Zalutschia	*Zalutschia* sp.	11.89		41.58	20.78		20.78				
			Dolichopodidae	Undetermined	Dolichopodidae										
			Empididae	*Clinocera*	*Clinocera* sp.										13.86
				Trichoclinocera	*Trichoclinocera* sp.					33.25			6.93	6.93	
				Undetermined	Empididae								13.86	34.65	41.58
			Muscidae	Undetermined	Muscidae		4.92					7.73	6.93	6.93	
			Simuliidae	*Simulium*	*Simulium* sp.	332.79	19.68	13.86	810.55			363.15		6.93	
				Undetermined	Simuliidae	23.77			20.78			38.63			
			Tipulidae	*Dicranota*	*Dicranota* sp.										
				Limnophila	*Limnophila* sp.				20.78			7.73			
				Prionocera	*Prionocera* sp.				20.78						
				Tipula	*Tipula* sp.	35.66	54.12	485.04	103.92	166.25	145.48	54.09	152.44	187.09	374.18

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Area						George	George	George	George	George	George	George	George	George	George
Stream						George OF	George OF	Sleigh OF	Sleigh OF	Sleigh OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF	Dragon OF
Replicate						4	5	1	2	3	4	5	1	2	3
Date Sampled						5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
Surface Area Sampled (m^2)						0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID						6141.1-9	6141.1-10	6141.1-11	6141.1-12	6141.1-13	6141.1-14	6141.1-15	6141.1-1	6141.1-2	6141.1-3
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
			Undetermined	Undetermined	Diptera	11.89				33.25		15.45			13.86
Ephemeroptera	Insecta	Ephemeroptera	Baetidae	*Acentrella*	*Acentrella lapponica*										
				Baetis	*Baetis flavistriga*										
				Baetis	*Baetis* sp.				20.78						
			Ephemerellidae	*Ephemerella*	*Ephemerella* sp.	142.62	73.80	41.58	207.83	631.74	394.89	84.99	20.79	41.58	27.72
			Metretopodidae	*Metretopus*	*Metretopus* sp.										
				Undetermined	Metretopodidae										
			Undetermined	Undetermined	Ephemeroptera										
Gastropoda	Gastropoda	Basommatophora	Lymnaeidae	*Stagnicola*	*Stagnicola* sp.										
				Undetermined	Lymnaeidae										
			Physidae	*Physa*	*Physa* sp.						103.92		117.80	20.79	83.15
		Gastropoda (class)	Undetermined	Undetermined	Gastropoda						83.13		6.93	27.72	
		Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*		63.96								
				Valvata	*Valvata* sp.	71.31	14.76								
Hemiptera	Insecta	Hemiptera	Undetermined	Undetermined	Auchenorrhyncha										
				Undetermined	Hemiptera								6.93		
Ichthyoplankton	Actinopterygii	Gasterosteiformes	Gasterosteidae	Undetermined	Gasterosteidae										
Other Insecta	Insecta	Collembola	Undetermined	Undetermined	Collembola										
		Hymenoptera	Undetermined	Undetermined	Hymenoptera										
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.	1604.53	285.35		83.13	631.74		934.92	20.79		457.33
	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda	130.74	73.80	1676.87	665.07	4455.43	1143.09	193.16	187.09	55.43	720.64
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria										
Plecoptera	Insecta	Plecoptera	Nemouridae	*Nemoura*	*Nemoura* sp.	23.77	49.20	97.01	478.02	398.99	207.83	38.63	27.72	55.43	69.29
				Undetermined	Nemouridae	11.89	24.60	27.72		166.25	20.78	7.73			83.15
			Perlodidae	*Arcynopteryx*	*Arcynopteryx compacta*								6.93	13.86	
				Undetermined	Perlodidae										
Trichoptera	Insecta	Trichoptera	Brachycentridae	*Brachycentrus*	*Brachycentrus americanus*										
				Micrasema	*Micrasema* sp.										
			Hydropsychidae	*Arctopsyche*	*Arctopsyche* sp.										
			Hydroptilidae	*Agraylea*	*Agraylea* sp.									55.43	83.15
				Oxyethira	*Oxyethira* sp.										
			Leptoceridae	*Ceraclea*	*Ceraclea* sp.										
				Mystacides	*Mystacides sepulchralis*										
				Mystacides	*Mystacides* sp.										
				Undetermined	Leptoceridae										
			Limnephilidae	*Asynarchus*	*Asynarchus* sp.										
				Grensia	*Grensia praeterita*	23.77	19.68						20.79		
				Undetermined	Limnephilidae	11.89								13.86	
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.										
			Rhyacophilidae	*Rhyacophila*	*Rhyacophila brunnea*										
				Rhyacophila	*Rhyacophila mongolica*										
				Rhyacophila	*Rhyacophila* sp.									6.93	
			Undetermined	Undetermined	Trichoptera								6.93		
					TOTAL	**4492.69**	**1756.41**	**4282.24**	**7482.03**	**10972.33**	**6816.96**	**2704.30**	**2446.01**	**2099.55**	**4753.43**

Note: Benthos samples were not collected from Echo OF, which was dry during sampling, or Llama Lake where substrate size and water levels prevented sampling.
Only two samples were collected at Pond 19 OF due to low water levels.
Nematodes, copepods or cladocerans were excluded from analyses.
Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2															
Taxonomic Classification:															
Area						**George**	**George**	**George**	**George**	**George**	**George**	**George**	**George Reference C**	**George Reference C**	**George Reference C**
Stream						**Dragon OF**	**Dragon OF**	**Komatic IF**	**Komatic IF**	**Komatic IF**	**Komatic IF**	**Komatic IF**	**OF**	**OF**	**OF**
Replicate						**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**
Date Sampled						**5-Aug-12**	**5-Aug-12**	**6-Aug-12**	**6-Aug-12**	**6-Aug-12**	**6-Aug-12**	**6-Aug-12**	**6-Aug-12**	**6-Aug-12**	**6-Aug-12**
Surface Area Sampled (m^2)						**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**	**0.289**
EcoAnalysts Sample ID						**6141.1-4**	**6141.1-5**	**6141.1-16**	**6141.1-17**	**6141.1-18**	**6141.1-19**	**6141.1-20**	**6141.1-21**	**6141.1-22**	**6141.1-23**
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**										
Acari	Arachnida	Sarcoptiformes	Undetermined	Undetermined	Oribatei								3.46		3.78
		Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.										
			Hydryphantidae	Undetermined	Hydryphantidae										
			Hygrobatidae	*Atractides*	*Atractides* sp.										
				Hygrobates	*Hygrobates* sp.	41.57		23.70	20.79	10.39	6.17				
			Lebertiidae	*Lebertia*	*Lebertia* sp.	124.70	34.65	59.24	57.16	31.18	61.67			3.46	15.11
			Oxidae	*Oxus*	*Oxus* sp.										
			Pionidae	Undetermined	Pionidae										7.55
			Sperchontidae	*Sperchon*	*Sperchon* sp.	872.90	159.37						3.46		
			Unionicolidae	*Neumania*	*Neumania* sp.										
		Undetermined	Undetermined	Undetermined	Acari										3.78
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae	187.05	13.86						17.32	24.25	
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	623.50	332.60	5.92	15.59		12.33	13.51	62.36	97.01	26.44
		Tubificida	Naididae	*Chaetogaster*	*Chaetogaster diastrophus*										
				Nais	*Nais* sp.	83.13	13.86						27.72	24.25	3.78
				Uncinais	*Uncinais uncinata*			23.70		45.04	12.33	18.02			
			Tubificidae	*Rhyacodrilus*	*Rhyacodrilus* sp.	20.78									3.78
				Undetermined	Tubificidae w/ cap setae	62.35	20.79								7.55
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.			5.92	10.39		30.83	4.50			
				Sphaerium	*Sphaerium* sp.								3.46		
				Undetermined	Sphaeriidae			23.70	93.54	24.25	24.67	22.52			
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Agabus*	*Agabus* sp.										
				Hydroporus	*Hydroporus* sp.									6.93	
				Oreodytes	*Oreodytes* sp.			5.92		3.46	6.17				
			Haliplidae	*Haliplus*	*Haliplus* sp.	62.35	34.65								
				Undetermined	Haliplidae			5.92							
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera	41.57		35.55	10.39	24.25		54.05	3.46		
	Maxillopoda	Cyclopoida	Undetermined	Undetermined	Cyclopoida	207.83	13.86	17.77	25.98	10.39			3.46	3.46	
	Ostracoda	Undetermined	Undetermined	Undetermined	Ostracoda	1080.74	311.81	77.02	77.95	27.72	6.17	22.52	13.86	34.65	3.78
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.	83.13	6.93				6.17		34.65	27.72	22.66
				Probezzia	*Probezzia* sp.										
				Undetermined	Ceratopogoninae										
			Chironomidae	*Ablabesmyia*	*Ablabesmyia* (Karelia) sp.					3.46					
				Ablabesmyia	*Ablabesmyia* sp.										
				Acamptocladius	*Acamptocladius* sp.			5.92		3.46					
				Acricotopus	*Acricotopus* sp.										
				Chaetocladius	*Chaetocladius* sp.										
				Chironomus	*Chironomus* sp.										
				Cladotanytarsus	*Cladotanytarsus* sp.	20.78		509.50	41.57	10.39	6.17	135.12			
				Constempellina	*Constempellina* sp.		6.93	35.55	5.20	3.46		9.01			
				Corynoneura	*Corynoneura* sp.		6.93								3.78
				Cricotopus	*Cricotopus bicinctus gr.*	20.78									
				Cricotopus	*Cricotopus* sp.	20.78	6.93			3.46			3.46	24.25	11.33
				Cryptochironomus	*Cryptochironomus* sp.			11.85	15.59				6.93	6.93	11.33
				Demicryptochironomus	*Demicryptochironomus* sp.			29.62		3.46	18.50	4.50			
				Dicrotendipes	*Dicrotendipes fumidus*			5.92		3.46		22.52		3.46	
				Dicrotendipes	*Dicrotendipes* sp.				20.79		6.17				
				Eukiefferiella	*Eukiefferiella gracei gr.*										
				Euryhapsis	*Euryhapsis* sp.	20.78	6.93		10.39	10.39					
				Glyptotendipes	*Glyptotendipes* sp.										
				Heterotanytarsus	*Heterotanytarsus* sp.										
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*										
				Lipiniella	*Lipiniella* sp.			82.94	88.34	10.39	333.02	45.04			

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Area	George	George	George	George	George	George	George	George	George	George
Stream	Dragon OF	Dragon OF	Komatic IF	Komatic IF	Komatic IF	Komatic IF	Komatic IF	George Reference C OF	George Reference C OF	George Reference C OF
Replicate	4	5	1	2	3	4	5	1	2	3
Date Sampled	5-Aug-12	5-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12
Surface Area Sampled (m^2)	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID	6141.1-4	6141.1-5	6141.1-16	6141.1-17	6141.1-18	6141.1-19	6141.1-20	6141.1-21	6141.1-22	6141.1-23

Major Group	Class	Order	Family	Genus	Final Designation									
				Mesosmittia	*Mesosmittia* sp.									
				Micropsectra	*Micropsectra* sp.									
				Nanocladius	*Nanocladius* sp.									
				Natarsia	*Natarsia* sp.									
				Orthocladius	*Orthocladius (Pogonocladius)* sp.									
				Orthocladius	*Orthocladius* Complex									
				Orthocladius	*Orthocladius* sp.	124.70								
				Parachironomus	*Parachironomus* sp.	103.92	34.65						3.46	
				Paracladopelma	*Paracladopelma* sp.									
				Parakiefferiella	*Parakiefferiella* sp.			35.55	5.20					
				Paramerina	*Paramerina* sp.									
				Parametriocnemus	*Parametriocnemus* sp.									
				Paratanytarsus	*Paratanytarsus* sp.	145.48	27.72						62.36	41.58	173.72
				Paratendipes	*Paratendipes* sp.									
				Phaenopsectra	*Phaenopsectra* sp.									
				Polypedilum	*Polypedilum halterale gr.*									
				Polypedilum	*Polypedilum scalaenum gr.*		55.43	325.84	291.01	86.61	585.86	157.65			3.78
				Polypedilum	*Polypedilum sordens*									
				Polypedilum	*Polypedilum* sp.									
				Potthastia	*Potthastia longimana gr.*			5.92						
				Procladius	*Procladius* sp.			331.77	223.46	173.23	499.52	261.24	38.11	41.58	30.21
				Protanypus	*Protanypus* sp.										
				Psectrocladius	*Psectrocladius* sp.				5.20	6.93		58.55			
				Pseudochironomus	*Pseudochironomus* sp.			5.92							
				Pseudokiefferiella	*Pseudokiefferiella* sp.										
				Pseudosmittia	*Pseudosmittia* sp.	62.35	20.79						10.39	10.39	
				Rheocricotopus	*Rheocricotopus* sp.										
				Rheotanytarsus	*Rheotanytarsus exiguus gr.*	20.78	6.93								
				Saetheria	*Saetheria tylus*			272.52	166.29	197.48	166.51	364.84	10.39	3.46	
				Sergentia	*Sergentia* sp.							4.50			
				Stempellina	*Stempellina* sp.										
				Stictochironomus	*Stictochironomus* sp.		6.93			10.39	6.17		13.86	31.18	30.21
				Synorthocladius	*Synorthocladius* sp.										
				Tanytarsus	*Tanytarsus* sp.	83.13	69.29	118.49				4.50	10.39	3.46	
				Thienemanniella	*Thienemanniella* sp.										
				Thienemannimyia	*Thienemannimyia* gr. sp.	1143.09	471.19	171.81	155.90	27.72	92.50	85.58	131.65	173.23	222.82
				Tokunagaia	*Tokunagaia* sp.										
				Tvetenia	*Tvetenia bavarica gr.*	20.78									3.78
				Undetermined	Chironomini										
				Undetermined	Pentaneurini										
				Undetermined	Tanytarsini	20.78		29.62	25.98			4.50	65.83	24.25	135.96
				Zalutschia	*Zalutschia* sp.										
			Dolichopodidae	Undetermined	Dolichopodidae										
			Empididae	*Clinocera*	*Clinocera* sp.	20.78									
				Trichoclinocera	*Trichoclinocera* sp.		6.93							3.46	56.65
				Undetermined	Empididae	41.57								6.93	3.78
			Muscidae	Undetermined	Muscidae	41.57	13.86	130.34	192.28	135.12	135.67	117.11	3.46		
			Simuliidae	*Simulium*	*Simulium* sp.										
				Undetermined	Simuliidae										
			Tipulidae	*Dicranota*	*Dicranota* sp.										
				Limnophila	*Limnophila* sp.										
				Prionocera	*Prionocera* sp.										
				Tipula	*Tipula* sp.	478.02	200.95	53.32	36.38	41.58	49.34	49.55	135.12	86.61	132.18

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2

Taxonomic Classification:

Major Group	Class	Order	Family	Genus	Final Designation									
Area						George	George	George	George	George	George	George	George Reference C OF	George Reference C OF	George Reference C OF
Stream						Dragon OF	Dragon OF	Komatic IF	Komatic IF	Komatic IF	Komatic IF	Komatic IF			
Replicate						4	5	1	2	3	4	5	1	2	3
Date Sampled						5-Aug-12	5-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12
Surface Area Sampled (m^2)						0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID						6141.1-4	6141.1-5	6141.1-16	6141.1-17	6141.1-18	6141.1-19	6141.1-20	6141.1-21	6141.1-22	6141.1-23
			Undetermined	Undetermined	Diptera			59.24	51.97	72.76	49.34	22.52	20.79		
Ephemeroptera	Insecta	Ephemeroptera	Baetidae	*Acentrella*	*Acentrella lapponica*										
				Baetis	*Baetis flavistriga*	20.78									
				Baetis	*Baetis* sp.										
			Ephemerellidae	*Ephemerella*	*Ephemerella* sp.	83.13									
			Metretopodidae	*Metretopus*	*Metretopus* sp.										
				Undetermined	Metretopodidae										
			Undetermined	Undetermined	Ephemeroptera										
Gastropoda	Gastropoda	Basommatophora	Lymnaeidae	*Stagnicola*	*Stagnicola* sp.								62.36	41.58	45.32
				Undetermined	Lymnaeidae								194.02	76.22	67.98
			Physidae	*Physa*	*Physa* sp.	228.62	41.58						3.46	13.86	11.33
		Gastropoda (class)	Undetermined	Undetermined	Gastropoda	41.57	20.79								
		Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*			59.24	31.18	24.25	18.50	45.04	194.02	69.29	64.20
				Valvata	*Valvata* sp.			47.40	77.95	45.04	55.50	9.01	138.58	34.65	30.21
Hemiptera	Insecta	Hemiptera	Undetermined	Undetermined	Auchenorrhyncha										
				Undetermined	Hemiptera										
Ichthyoplankton	Actinopterygii	Gasterosteiformes	Gasterosteidae	Undetermined	Gasterosteidae										
Other Insecta	Insecta	Collembola	Undetermined	Undetermined	Collembola										
		Hymenoptera	Undetermined	Undetermined	Hymenoptera										
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.	332.53	90.08								
	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda	935.25	325.67	77.02	5.20		6.17	4.50	93.54	69.29	67.98
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria										
Plecoptera	Insecta	Plecoptera	Nemouridae	*Nemoura*	*Nemoura* sp.	41.57							10.39		
				Undetermined	Nemouridae	41.57	6.93								
			Perlodidae	*Arcynopteryx*	*Arcynopteryx compacta*										
				Undetermined	Perlodidae										
Trichoptera	Insecta	Trichoptera	Brachycentridae	*Brachycentrus*	*Brachycentrus americanus*										
				Micrasema	*Micrasema* sp.										
			Hydropsychidae	*Arctopsyche*	*Arctopsyche* sp.										
			Hydroptilidae	*Agraylea*	*Agraylea* sp.	145.48	27.72								
				Oxyethira	*Oxyethira* sp.										
			Leptoceridae	*Ceraclea*	*Ceraclea* sp.										
				Mystacides	*Mystacides sepulchralis*										
				Mystacides	*Mystacides* sp.										
				Undetermined	Leptoceridae			5.92							
			Limnephilidae	*Asynarchus*	*Asynarchus* sp.										
				Grensia	*Grensia praeterita*							9.01			3.78
				Undetermined	Limnephilidae			5.92		3.46	6.17		3.46		
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.										
			Rhyacophilidae	*Rhyacophila*	*Rhyacophila brunnea*										
				Rhyacophila	*Rhyacophila mongolica*	20.78									
				Rhyacophila	*Rhyacophila* sp.										
			Undetermined	Undetermined	Trichoptera		6.93								
					TOTAL	**7773.00**	**2404.43**	**2701.53**	**1761.66**	**1053.24**	**2201.60**	**1549.43**	**1389.30**	**987.41**	**1208.49**

Note: Benthos samples were not collected from Echo OF, which was dry during sampling, or Llama Lake where substrate size and water levels prevented sampling.
Only two samples were collected at Pond 19 OF due to low water levels.
Nematodes, copepods or cladocerans were excluded from analyses.
Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George Reference C	George Reference C
					Stream	OF	OF
					Replicate	4	5
					Date Sampled	6-Aug-12	6-Aug-12
					Surface Area Sampled (m^2)	0.289	0.289
Taxonomic Classification:					EcoAnalysts Sample ID	6141.1-24	6141.1-25
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**		
Acari	Arachnida	Sarcoptiformes	Undetermined	Undetermined	Oribatei	4.95	3.46
		Trombidiformes	Arrenuridae	*Arrenurus*	*Arrenurus* sp.		3.46
			Hydryphantidae	Undetermined	Hydryphantidae	4.95	
			Hygrobatidae	*Atractides*	*Atractides* sp.		
				Hygrobates	*Hygrobates* sp.		
			Lebertiidae	*Lebertia*	*Lebertia* sp.	14.86	3.46
			Oxidae	*Oxus*	*Oxus* sp.		
			Pionidae	Undetermined	Pionidae		3.46
			Sperchontidae	*Sperchon*	*Sperchon* sp.		
			Unionicolidae	*Neumania*	*Neumania* sp.		
		Undetermined	Undetermined	Undetermined	Acari		3.46
Annelida	Clitellata	Enchytraeida	Enchytraeidae	Undetermined	Enchytraeidae		
		Lumbriculida	Lumbriculidae	Undetermined	Lumbriculidae	4.95	45.04
		Tubificida	Naididae	*Chaetogaster*	*Chaetogaster diastrophus*		
				Nais	*Nais* sp.	19.82	
				Uncinais	*Uncinais uncinata*		
			Tubificidae	*Rhyacodrilus*	*Rhyacodrilus* sp.		
				Undetermined	Tubificidae w/ cap setae		31.18
Bivalvia	Bivalvia	Veneroida	Sphaeriidae	*Pisidium*	*Pisidium* sp.		
				Sphaerium	*Sphaerium* sp.		
				Undetermined	Sphaeriidae		
Coleoptera	Insecta	Coleoptera	Dytiscidae	*Agabus*	*Agabus* sp.		
				Hydroporus	*Hydroporus* sp.		6.93
				Oreodytes	*Oreodytes* sp.		
			Haliplidae	*Haliplus*	*Haliplus* sp.		
				Undetermined	Haliplidae		
Crustacea	Branchiopoda	Diplostraca	Undetermined	Undetermined	Cladocera		
	Maxillopoda	Cyclopoida	Undetermined	Undetermined	Cyclopoida	9.91	3.46
	Ostracoda	Undetermined	Undetermined	Undetermined	Ostracoda	9.91	24.25
Diptera	Insecta	Diptera	Ceratopogonidae	*Bezzia/Palpomyia*	*Bezzia/Palpomyia* sp.	19.82	17.32
				Probezzia	*Probezzia* sp.		
				Undetermined	Ceratopogoninae		
			Chironomidae	*Ablabesmyia*	*Ablabesmyia* (Karelia) sp.		
				Ablabesmyia	*Ablabesmyia* sp.		
				Acamptocladius	*Acamptocladius* sp.		
				Acricotopus	*Acricotopus* sp.		
				Chaetocladius	*Chaetocladius* sp.		
				Chironomus	*Chironomus* sp.		
				Cladotanytarsus	*Cladotanytarsus* sp.		
				Constempellina	*Constempellina* sp.		
				Corynoneura	*Corynoneura* sp.		
				Cricotopus	*Cricotopus bicinctus gr.*		
				Cricotopus	*Cricotopus* sp.	29.73	17.32
				Cryptochironomus	*Cryptochironomus* sp.		
				Demicryptochironomus	*Demicryptochironomus* sp.		
				Dicrotendipes	*Dicrotendipes fumidus*		24.25
				Dicrotendipes	*Dicrotendipes* sp.		
				Eukiefferiella	*Eukiefferiella gracei gr.*		
				Euryhapsis	*Euryhapsis* sp.		
				Glyptotendipes	*Glyptotendipes* sp.		
				Heterotanytarsus	*Heterotanytarsus* sp.		
				Heterotrissocladius	*Heterotrissocladius marcidus gr.*		
				Lipiniella	*Lipiniella* sp.		

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2				Area	George Reference C	George Reference C
				Stream	OF	OF
				Replicate	4	5
				Date Sampled	6-Aug-12	6-Aug-12
				Surface Area Sampled (m^2)	0.289	0.289
Taxonomic Classification:				EcoAnalysts Sample ID	6141.1-24	6141.1-25
Major Group	Class	Order	Family	Genus	Final Designation		
				Mesosmittia	*Mesosmittia* sp.		
				Micropsectra	*Micropsectra* sp.		
				Nanocladius	*Nanocladius* sp.		
				Natarsia	*Natarsia* sp.		
				Orthocladius	*Orthocladius (Pogonocladius)* sp.		
				Orthocladius	*Orthocladius* Complex		
				Orthocladius	*Orthocladius* sp.		
				Parachironomus	*Parachironomus* sp.		
				Paracladopelma	*Paracladopelma* sp.		
				Parakiefferiella	*Parakiefferiella* sp.		
				Paramerina	*Paramerina* sp.		
				Parametriocnemus	*Parametriocnemus* sp.		
				Paratanytarsus	*Paratanytarsus* sp.	535.07	148.98
				Paratendipes	*Paratendipes* sp.		
				Phaenopsectra	*Phaenopsectra* sp.		
				Polypedilum	*Polypedilum halterale gr.*		
				Polypedilum	*Polypedilum scalaenum gr.*		
				Polypedilum	*Polypedilum sordens*		
				Polypedilum	*Polypedilum* sp.		
				Potthastia	*Potthastia longimana gr.*		
				Procladius	*Procladius* sp.	24.77	31.18
				Protanypus	*Protanypus* sp.		
				Psectrocladius	*Psectrocladius* sp.	4.95	3.46
				Pseudochironomus	*Pseudochironomus* sp.		
				Pseudokiefferiella	*Pseudokiefferiella* sp.		
				Pseudosmittia	*Pseudosmittia* sp.		6.93
				Rheocricotopus	*Rheocricotopus* sp.		
				Rheotanytarsus	*Rheotanytarsus exiguus gr.*		
				Saetheria	*Saetheria tylus*		
				Sergentia	*Sergentia* sp.		
				Stempellina	*Stempellina* sp.		
				Stictochironomus	*Stictochironomus* sp.	54.50	38.11
				Synorthocladius	*Synorthocladius* sp.		
				Tanytarsus	*Tanytarsus* sp.	4.95	
				Thienemanniella	*Thienemanniella* sp.		
				Thienemannimyia	*Thienemannimyia* gr. sp.	178.36	124.73
				Tokunagaia	*Tokunagaia* sp.		
				Tvetenia	*Tvetenia bavarica gr.*		
				Undetermined	Chironomini		
				Undetermined	Pentaneurini		
				Undetermined	Tanytarsini	14.86	45.04
				Zalutschia	*Zalutschia* sp.		
			Dolichopodidae	Undetermined	Dolichopodidae		
			Empididae	*Clinocera*	*Clinocera* sp.		
				Trichoclinocera	*Trichoclinocera* sp.	29.73	20.79
				Undetermined	Empididae		
			Muscidae	Undetermined	Muscidae		
			Simuliidae	*Simulium*	*Simulium* sp.		
				Undetermined	Simuliidae		
			Tipulidae	*Dicranota*	*Dicranota* sp.		
				Limnophila	*Limnophila* sp.	4.95	
				Prionocera	*Prionocera* sp.		
				Tipula	*Tipula* sp.	54.50	51.97

Appendix 3.7-8. Stream Benthos Density and Taxonomic Results, Back River Project, 2012

EcoAnalysts, Inc.

Data in organisms/m^2					Area	George Reference C	George Reference C
					Stream	OF	OF
					Replicate	4	5
					Date Sampled	6-Aug-12	6-Aug-12
					Surface Area Sampled (m^2)	0.289	0.289
Taxonomic Classification:					EcoAnalysts Sample ID	6141.1-24	6141.1-25
Major Group	**Class**	**Order**	**Family**	**Genus**	**Final Designation**		
			Undetermined	Undetermined	Diptera	9.91	
Ephemeroptera	Insecta	Ephemeroptera	Baetidae	*Acentrella*	*Acentrella lapponica*		
				Baetis	*Baetis flavistriga*		
				Baetis	*Baetis* sp.		
			Ephemerellidae	*Ephemerella*	*Ephemerella* sp.		
			Metretopodidae	*Metretopus*	*Metretopus* sp.		
				Undetermined	Metretopodidae		
			Undetermined	Undetermined	Ephemeroptera		
Gastropoda	Gastropoda	Basommatophora	Lymnaeidae	*Stagnicola*	*Stagnicola* sp.	19.82	24.25
				Undetermined	Lymnaeidae	475.62	41.58
			Physidae	*Physa*	*Physa* sp.	24.77	10.39
		Gastropoda (class)	Undetermined	Undetermined	Gastropoda		
		Heterostropha	Valvatidae	*Valvata*	*Valvata lewisi*	4.95	31.18
				Valvata	*Valvata* sp.	24.77	121.26
Hemiptera	Insecta	Hemiptera	Undetermined	Undetermined	Auchenorrhyncha		
				Undetermined	Hemiptera		
Ichthyoplankton	Actinopterygii	Gasterosteiformes	Gasterosteidae	Undetermined	Gasterosteidae		
Other Insecta	Insecta	Collembola	Undetermined	Undetermined	Collembola		
		Hymenoptera	Undetermined	Undetermined	Hymenoptera		
Other Organisms	Hydrozoa	Hydroida	Hydridae	*Hydra*	*Hydra* sp.		
	Nematoda (phylum)	Undetermined	Undetermined	Undetermined	Nematoda	49.54	62.36
	Turbellaria	Undetermined	Undetermined	Undetermined	Turbellaria		
Plecoptera	Insecta	Plecoptera	Nemouridae	*Nemoura*	*Nemoura* sp.		
				Undetermined	Nemouridae		
			Perlodidae	*Arcynopteryx*	*Arcynopteryx compacta*		
				Undetermined	Perlodidae		
Trichoptera	Insecta	Trichoptera	Brachycentridae	*Brachycentrus*	*Brachycentrus americanus*		
				Micrasema	*Micrasema* sp.		
			Hydropsychidae	*Arctopsyche*	*Arctopsyche* sp.		
			Hydroptilidae	*Agraylea*	*Agraylea* sp.		3.46
				Oxyethira	*Oxyethira* sp.		
			Leptoceridae	*Ceraclea*	*Ceraclea* sp.		
				Mystacides	*Mystacides sepulchralis*		
				Mystacides	*Mystacides* sp.		
				Undetermined	Leptoceridae		
			Limnephilidae	*Asynarchus*	*Asynarchus* sp.		
				Grensia	*Grensia praeterita*		
				Undetermined	Limnephilidae	9.91	
			Phryganeidae	*Agrypnia*	*Agrypnia* sp.		
			Rhyacophilidae	*Rhyacophila*	*Rhyacophila brunnea*		
				Rhyacophila	*Rhyacophila mongolica*		
				Rhyacophila	*Rhyacophila* sp.		
			Undetermined	Undetermined	Trichoptera		
					TOTAL	**1644.85**	**952.76**

Note: Benthos samples were not collected from Echo OF, which was dry during sampling, or Llama Lake where substrate size and water levels prevented sampling.
Only two samples were collected at Pond 19 OF due to low water levels.
Nematodes, copepods or cladocerans were excluded from analyses.
Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-9

Stream Benthos Richness and Diversity Results, Back River Project, 2012

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Appendix 3.7-9. Stream Benthos Richness and Diversity Results, Back River Project, 2012

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose
Stream	Moby OF	Moby OF	Moby OF	Moby OF	Moby OF	Gander IF	Gander IF	Gander IF	Gander IF	Gander IF	Gander US	Gander US	Gander US	Gander US	Gander US	Pond 19 OF	Pond 19 OF	Chair OF	Chair OF	Chair OF	Chair OF	Chair OF
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	1	2	3	4	5
Date Sampled	12-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	12-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	11-Aug-12	13-Aug-12	13-Aug-12	13-Aug-12	13-Aug-12	13-Aug-12	13-Aug-12	13-Aug-12
Surface Area Sampled (m^2)	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID	6138.1-36	6138.1-37	6138.1-38	6138.1-39	6138.1-40	6138.1-26	6138.1-27	6138.1-28	6138.1-29	6138.1-30	6138.1-31	6138.1-32	6138.1-33	6138.1-34	6138.1-35	6138.1-41	6138.1-42	6138.1-43	6138.1-44	6138.1-45	6138.1-46	6138.1-47
Family Richness (# families)	13	12	15	14	14	11	9	7	7	8	12	14	13	14	9	5	11	13	13	18	16	8
Simpson's Diversity Index	0.40	0.66	0.79	0.80	0.78	0.40	0.20	0.53	0.30	0.46	0.27	0.54	0.48	0.60	0.56	0.17	0.21	0.41	0.67	0.75	0.67	0.29

Area	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose	Goose Propellor	Goose Propellor	Goose Propellor	Goose Propellor	Goose Propellor
Stream	Giraffe OF	Giraffe OF	Giraffe OF	Giraffe OF	Giraffe OF	Wolf OF	Wolf OF	Wolf OF	Wolf OF	Wolf OF	Goose OF	Goose OF	Goose OF	Goose OF	Goose OF	OF	OF	OF	OF	OF
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Date Sampled	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	8-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	7-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12	9-Aug-12
Surface Area Sampled (m^2)	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID	6138.1-11	6138.1-12	6138.1-13	6138.1-14	6138.1-15	6138.1-1	6138.1-2	6138.1-3	6138.1-4	6138.1-5	6138.1-6	6138.1-7	6138.1-8	6138.1-9	6138.1-10	6138.1-16	6138.1-17	6138.1-18	6138.1-19	6138.1-20
Family Richness (# families)	9	4	10	11	7	5	15	5	15	10	12	17	19	12	11	12	11	12	11	7
Simpson's Diversity Index	0.34	0.20	0.40	0.29	0.14	0.33	0.24	0.37	0.53	0.45	0.54	0.74	0.81	0.74	0.67	0.56	0.25	0.40	0.76	0.21

Area	Goose Reference	Goose Reference	Goose Reference	Goose Reference	Goose Reference	George	George	George	George	George	George	George	George	George	George	George	George	George	George	George
Stream	B OF	B OF	B OF	B OF	B OF	George OF	George OF	George OF	George OF	George OF	Sleigh OF	Sleigh OF	Sleigh OF	Sleigh OF	Sleigh OF	Dragon OF	Dragon OF	Dragon OF	Dragon OF	Dragon OF
Replicate	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Date Sampled	10-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	10-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12	5-Aug-12
Surface Area Sampled (m^2)	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID	6138.1-21	6138.1-22	6138.1-23	6138.1-24	6138.1-25	6141.1-6	6141.1-7	6141.1-8	6141.1-9	6141.1-10	6141.1-11	6141.1-12	6141.1-13	6141.1-14	6141.1-15	6141.1-1	6141.1-2	6141.1-3	6141.1-4	6141.1-5
Family Richness (# families)	5	8	9	6	8	11	11	14	12	16	9	9	9	9	9	19	18	15	20	16
Simpson's Diversity Index	0.25	0.29	0.43	0.09	0.17	0.48	0.61	0.49	0.73	0.74	0.54	0.72	0.75	0.67	0.73	0.68	0.81	0.80	0.83	0.76

Area	George	George	George	George	George	George Reference	George Reference	George Reference	George Reference	George Reference
Stream	Komatic IF	Komatic IF	Komatic IF	Komatic IF	Komatic IF	C OF	C OF	C OF	C OF	C OF
Replicate	1	2	3	4	5	1	2	3	4	5
Date Sampled	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12	6-Aug-12
Surface Area Sampled (m^2)	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289	0.289
EcoAnalysts Sample ID	6141.1-16	6141.1-17	6141.1-18	6141.1-19	6141.1-20	6141.1-21	6141.1-22	6141.1-23	6141.1-24	6141.1-25
Family Richness (# families)	13	8	10	12	8	14	12	13	12	14
Simpson's Diversity Index	0.33	0.53	0.60	0.35	0.35	0.79	0.77	0.66	0.60	0.69

Note: Benthos samples were not collected from Echo OF, which was dry during sampling, or Llama Lake where substrate size and water levels prevented sampling.

Only two samples were collected at Pond 19 OF due to low water levels.

Nematodes, copepods or cladocerans were excluded from analyses.

Diversity and richness analyses excluded individuals not identified to the family level.

Appendix 3.7-10

Stream Benthos QA/QC Results, Back River Project, 2012

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Appendix 3.7-10. Stream Benthos QA/QC Results, Back River Project, 2012

EcoA Sample ID | Sample ID | Replicate | Collection Date | Sorter | Sort Date | Primary Matrix | Estimated Pre-Rinse Volume (L) | Estimated Post-Rinse Volume (L) | QC Sorter | QC Date | Estimated % Recovery 1 | Estimated % Recovery 2 | Estimated % Recovery 3

EcoA Sample ID	Sample ID	Replicate	Collection Date	Sorter	Sort Date	Primary Matrix	Estimated Pre-Rinse Volume (L)	Estimated Post-Rinse Volume (L)	QC Sorter	QC Date	Estimated % Recovery 1	Estimated % Recovery 2	Estimated % Recovery 3
6138.1-1	Wolf OF	1	7-Aug-12	Laura Mills	09/12/12	Coarse Organic	0.10	0.10	Megan Payne	09/19/12	100.00	N/A	N/A
6138.1-2	Wolf OF	2	7-Aug-12	Laura Mills	09/18/12	Coarse Organic	1.60	1.30	Megan Payne	09/28/12	100.00	N/A	N/A
6138.1-3	Wolf OF	3	7-Aug-12	Steven Little	09/17/12	Fine Organic	0.25	0.23	Zach Meier	09/20/12	66.07	100.00	N/A
6138.1-4	Wolf OF	4	7-Aug-12	Nicole Huddleston	09/17/12	Coarse Organic	0.20	0.10	Zach Meier	09/19/12	91.37	96.23	N/A
6138.1-5	Wolf OF	5	7-Aug-12	Amanda Thompson	09/14/12	Fine Organic	0.13	0.08	Zach Meier	09/21/12	86.72	92.23	N/A
6138.1-6	Goose OF	1	7-Aug-12	Allie Pfeiffer	09/17/12	Vegetation	0.13	0.10	Zach Meier	09/20/12	85.22	94.56	N/A
6138.1-7	Goose OF	2	7-Aug-12	Zach Meier	09/17/12	Coarse Organic	0.38	0.33	Megan Payne	09/21/12	89.08	94.60	N/A
6138.1-8	Goose OF	3	7-Aug-12	Laurie Flaherty	09/18/12	Vegetation	0.35	0.25	Zach Meier	09/19/12	81.90	97.83	N/A
6138.1-9	Goose OF	4	7-Aug-12	Steven Little	09/17/12	Fine Organic	0.05	0.04	Megan Payne	09/19/12	96.63	N/A	N/A
6138.1-10	Goose OF	5	7-Aug-12	Amanda Thompson	09/17/12	Coarse Organic	0.13	0.10	Megan Payne	09/18/12	100.00	N/A	N/A
6138.1-11	Giraffe OF	1	8-Aug-12	Zach Meier	09/17/12	Coarse Organic	0.14	0.14	Megan Payne	09/18/12	100.00	N/A	N/A
6138.1-12	Giraffe OF	2	8-Aug-12	Zach Meier	09/17/12	Coarse Organic	0.12	0.12	Megan Payne	09/21/12	93.18	N/A	N/A
6138.1-13	Giraffe OF	3	8-Aug-12	Allie Pfeiffer	09/18/12	Inorganic	0.07	0.06	Zach Meier	09/19/12	84.66	98.25	N/A
6138.1-14	Giraffe OF	4	8-Aug-12	Zach Meier	09/18/12	Coarse Organic	0.33	0.31	Megan Payne	09/24/12	93.54	N/A	N/A
6138.1-15	Giraffe OF	5	8-Aug-12	Nicole Huddleston	09/25/12	Coarse Organic	0.20	0.15	Nora Williams	09/27/12	92.34	N/A	N/A
6138.1-16	Propellor OF	1	9-Aug-12	Laurie Flaherty	09/18/12	Vegetation	0.15	0.10	Zach Meier	09/21/12	92.78	N/A	N/A
6138.1-17	Propellor OF	2	9-Aug-12	Zach Meier	09/18/12	Coarse Organic	0.10	0.10	Megan Payne	09/21/12	100.00	N/A	N/A
6138.1-18	Propellor OF	3	9-Aug-12	Allie Pfeiffer	09/22/12	Vegetation	0.26	0.25	Zach Meier	09/22/12	93.31	N/A	N/A
6138.1-19	Propellor OF	4	9-Aug-12	Steven Little	09/19/12	Coarse Organic	0.10	0.04	Zach Meier	09/21/12	93.33	N/A	N/A
6138.1-20	Propellor OF	5	9-Aug-12	Ben Alexander	09/20/12	Filamentous Algae	6.50	5.25	Zach Meier	09/21/12	100.00	N/A	N/A
6138.1-21	Ref B OF	1	10-Aug-12	Steven Little	09/19/12	Coarse Organic	0.30	0.10	Zach Meier	09/21/12	98.05	N/A	N/A
6138.1-22	Ref B OF	2	10-Aug-12	Steven Little	09/20/12	Coarse Organic	0.70	0.05	Zach Meier	09/20/12	82.14	95.08	N/A
6138.1-23	Ref B OF	3	10-Aug-12	Steven Little	09/21/12	Coarse Organic	1.43	0.25	Zach Meier	09/21/12	85.82	100.00	N/A
6138.1-24	Ref B OF	4	10-Aug-12	Tiffany Miller	09/29/12	Vegetation	3.30	1.10	Megan Payne	10/03/12	100.00	N/A	N/A
6138.1-25	Ref B OF	5	10-Aug-12	Zach Meier	09/30/12	Coarse Organic	2.90	0.75	Nora Williams	10/02/12	100.00	N/A	N/A
6138.1-26	MN-02-OF	1	11-Aug-12	Tiffany Miller	10/01/12	Inorganic	1.00	0.10	Zach Meier	10/02/12	100.00	N/A	N/A
6138.1-27	MN-02-OF	2	11-Aug-12	Zach Meier	09/29/12	Inorganic	2.08	0.23	Nora Williams	10/01/12	76.16	100.00	N/A
6138.1-28	MN-02-OF	3	11-Aug-12	Megan Payne	09/25/12	Vegetation	3.40	0.70	Zach Meier	09/26/12	83.33	91.52	N/A
6138.1-29	MN-02-OF	4	11-Aug-12	Amanda Thompson	09/20/12	Fine Organic	0.08	0.03	Zach Meier	09/22/12	100.00	N/A	N/A
6138.1-30	MN-02-OF	5	11-Aug-12	Laura Mills	09/20/12	Coarse Organic	0.15	0.05	Zach Meier	09/21/12	100.00	N/A	N/A
6138.1-31	MN-02-US	1	11-Aug-12	Ben Alexander	09/20/12	Coarse Organic	0.23	0.13	Zach Meier	09/21/12	100.00	N/A	N/A
6138.1-32	MN-02-US	2	11-Aug-12	Laura Mills	09/20/12	Coarse Organic	0.15	0.02	Zach Meier	09/21/12	100.00	N/A	N/A
6138.1-33	MN-02-US	3	11-Aug-12	Angela Eagleston	09/20/12	Fine Organic	0.20	0.15	Zach Meier	09/21/12	97.36	N/A	N/A
6138.1-34	MN-02-US	4	11-Aug-12	Laurie Flaherty	09/20/12	Vegetation	0.15	0.11	Zach Meier	09/21/12	88.30	98.93	N/A
6138.1-35	MN-02-US	5	11-Aug-12	Amanda Thompson	09/20/12	Fine Organic	0.13	0.03	Zach Meier	09/22/12	100.00	N/A	N/A
6138.1-36	MN-01-OF	1	12-Aug-12	Ben Alexander	09/22/12	Coarse Organic	0.60	0.53	Zach Meier	09/22/12	88.97	94.19	N/A
6138.1-37	MN-01-OF	2	12-Aug-12	Amanda Thompson	09/21/12	Fine Organic	0.23	0.10	Zach Meier	09/21/12	72.16	100.00	N/A
6138.1-38	MN-01-OF	3	12-Aug-12	Nora Williams	09/24/12	Filamentous Algae	0.20	0.10	Zach Meier	09/27/12	86.55	96.14	N/A
6138.1-39	MN-01-OF	4	12-Aug-12	Laurie Flaherty	09/22/12	Vegetation	0.55	0.35	Zach Meier	09/22/12	96.96	N/A	N/A
6138.1-40	MN-01-OF	5	12-Aug-12	Amanda Thompson	09/21/12	Coarse Organic	0.33	0.18	Zach Meier	09/22/12	85.04	95.08	N/A
6138.1-41	Pond 19 OF	1	13-Aug-12	Zach Meier	09/24/12	Coarse Organic	1.25	1.25	Megan Payne	09/25/12	100.00	N/A	N/A
6138.1-42	Pond 19 OF	2	13-Aug-12	Allie Pfeiffer	09/24/12	Fine Organic	0.24	0.22	Megan Payne	09/26/12	89.52	95.99	N/A
6138.1-43	Chair OF	1	13-Aug-12	Amanda Thompson	09/25/12	Fine Organic	0.30	0.08	Megan Payne	09/26/12	87.31	100.00	N/A
6138.1-44	Chair OF	2	13-Aug-12	Angela Eagleston	09/21/12	Fine Organic	0.15	0.15	Zach Meier	09/21/12	100.00	N/A	N/A
6138.1-45	Chair OF	3	13-Aug-12	Ben Alexander	09/23/12	Coarse Organic	0.13	0.10	Megan Payne	09/26/12	100.00	N/A	N/A
6138.1-46	Chair OF	4	13-Aug-12	Ben Alexander	09/24/12	Coarse Organic	0.20	0.10	Zach Meier	09/24/12	99.13	N/A	N/A
6138.1-47	Chair OF	5	13-Aug-12	Steven Little	09/25/12	Fine Organic	1.08	0.15	Megan Payne	09/26/12	74.90	94.09	N/A
6141.1-1	Dragon Lake OF	1	5-Aug-12	Tiffany Miller	10/04/12	Fine Organic	0.45	0.25	Megan Payne	10/10/12	100.00	N/A	N/A
6141.1-2	Dragon Lake OF	2	5-Aug-12	Nicole Huddleston	10/05/12	Coarse Organic	0.02	0.01	Megan Payne	10/08/12	100.00	N/A	N/A
6141.1-3	Dragon Lake OF	3	5-Aug-12	Laurie Flaherty	10/04/12	Fine Organic	0.20	0.10	Megan Payne	10/04/12	100.00	N/A	N/A
6141.1-4	Dragon Lake OF	4	5-Aug-12	Angela Eagleston	10/04/12	Fine Organic	0.15	0.15	Megan Payne	10/04/12	100.00	N/A	N/A
6141.1-5	Dragon Lake OF	5	5-Aug-12	Amanda Thompson	10/04/12	Fine Organic	0.13	0.10	Megan Payne	10/04/12	100.00	N/A	N/A
6141.1-6	George Lake OF	1	5-Aug-12	Ben Alexander	10/05/12	Coarse Organic	0.63	0.45	Zach Meier	10/09/12	98.86	N/A	N/A
6141.1-7	George Lake OF	2	5-Aug-12	Angela Eagleston	10/08/12	Fine Organic	0.50	0.50	Ben Alexander	10/08/12	92.23	N/A	N/A

Appendix 3.7-10. Stream Benthos QA/QC Results, Back River Project, 2012

EcoA ANALYSTS, INC.

EcoA Sample ID	Sample ID	Replicate	Collection Date	Sorter	Sort Date	Primary Matrix	Estimated Pre-Rinse Volume (L)	Estimated Post-Rinse Volume (L)	QC Sorter	QC Date	Estimated % Recovery 1	Estimated % Recovery 2	Estimated % Recovery 3
6141.1-8	George Lake OF	3	5-Aug-12	Amanda Thompson	10/10/12	Fine Organic	0.50	0.15	Megan Payne	10/11/12	96.43	N/A	N/A
6141.1-9	George Lake OF	4	5-Aug-12	Laurie Flaherty	10/05/12	Fine Organic	0.25	0.25	Megan Payne	10/09/12	94.29	N/A	N/A
6141.1-10	George Lake OF	5	5-Aug-12	Allie Pfeiffer	10/05/12	Filamentous Algae	0.15	0.10	Ben Alexander	10/08/12	100.00	N/A	N/A
6141.1-11	Sleigh Lake OF	1	5-Aug-12	Nora Williams	10/05/12	Fine Organic	0.35	0.23	Ben Alexander	10/08/12	98.13	N/A	N/A
6141.1-12	Sleigh Lake OF	2	5-Aug-12	Ben Alexander	10/08/12	Coarse Organic	0.79	0.46	Megan Payne	10/08/12	100.00	N/A	N/A
6141.1-13	Sleigh Lake OF	3	5-Aug-12	Laurie Flaherty	10/08/12	Vegetation	0.60	0.40	Ben Alexander	10/10/12	100.00	N/A	N/A
6141.1-14	Sleigh Lake OF	4	5-Aug-12	Nora Williams	10/09/12	Fine Organic	0.55	0.45	Zach Meier	10/11/12	100.00	N/A	N/A
6141.1-15	Sleigh Lake OF	5	5-Aug-12	Allie Pfeiffer	10/07/12	Vegetation	0.14	0.10	Megan Payne	10/08/12	100.00	N/A	N/A
6141.1-16	Komatic Lake IF	1	6-Aug-12	Allie Pfeiffer	10/08/12	Fine Organic	0.45	0.15	Megan Payne	10/11/12	100.00	N/A	N/A
6141.1-17	Komatic Lake IF	2	6-Aug-12	Angela Eagleston	10/09/12	Fine Organic	0.70	0.25	Zach Meier	10/11/12	95.66	N/A	N/A
6141.1-18	Komatic Lake IF	3	6-Aug-12	Laurie Flaherty	10/09/12	Fine Organic	0.30	0.10	Megan Payne	10/09/12	100.00	N/A	N/A
6141.1-19	Komatic Lake IF	4	6-Aug-12	Zach Meier	10/08/12	Inorganic	0.27	0.02	Ben Alexander	10/09/12	100.00	N/A	N/A
6141.1-20	Komatic Lake IF	5	6-Aug-12	Allie Pfeiffer	10/10/12	Fine Organic	0.40	0.15	Zach Meier	10/11/12	92.44	N/A	N/A
6141.1-21	Ref C OF	1	6-Aug-12	Tiffany Miller	10/07/12	Fine Organic	1.60	0.45	Ben Alexander	10/09/12	72.20	93.30	N/A
6141.1-22	Ref C OF	2	6-Aug-12	Zach Meier	10/08/12	Filamentous Algae	1.83	0.75	Ben Alexander	10/10/12	100.00	N/A	N/A
6141.1-23	Ref C OF	3	6-Aug-12	Tiffany Miller	10/08/12	Fine Organic	1.80	0.35	Zach Meier	10/11/12	93.29	N/A	N/A
6141.1-24	Ref C OF	4	6-Aug-12	Laurie Flaherty	10/10/12	Filamentous Algae	1.15	1.00	Zach Meier	10/11/12	92.41	N/A	N/A
6141.1-25	Ref C OF	5	6-Aug-12	Zach Meier	10/10/12	Filamentous Algae	2.37	0.40	Megan Payne	10/11/12	100.00	N/A	N/A

Appendix 4-1

Summary of 2012 Freshwater Baseline Results for Lakes

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Appendix 4-1. Summary of 2012 Freshwater Baseline Results for Lakes

Lake	Summer Sampling Max Depth (m)	Dissolved Oxygen: Seasons and Depths that Exceed CCME Guidelines*	Water Quality: General Description	Water Quality: Nutrient Status	Water Quality: CCME Guideline Exceedances*	Sediment Quality: CCME Guideline Exceedances*	Primary producers: Phytoplankton	Aquatic Macroinvertebrates: Zooplankton	Aquatic Macroinvertebrates: Benthos
Goose Area									
Moby	14.8	none	near neutral, soft, low TDS	ultraoligotrophic	Cd	nc	moderate chl a biomass, low densities, more than 60% chlorophytes	nc	nc
Gander	2.4	all life stages: Apr, all depths	near neutral, soft, low TDS	oligotrophic - mesotrophic	Cd, Cu	ISQG: As, Cr	euglenophytes present; highest richness	highest densities; vast majority rotifers; highest richness	high densities; high richness and diverstiy
Pond 19	1.5	none	slightly basic, soft, low TDS	ultraoligotrophic	Cu	PEL: As	nc	nc	low densities; vast majority dipteran; low richness and diversity
Big	5.0	all life stages: Apr, bottom depths	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	Cd	ISQG: As, Cu; PEL: As	moderate chl *a* biomass and densities, highest richness in Aug	rotifer dominated; high richness	high densities; over half dipteran; low richness; moderate diversity
Rabbit	3.6	none	slightly acidic, soft, low TDS	ultraoligotrophic	pH, Al, Cd and Cu	ISQG: As, Cu; PEL: As	low chl a biomass; almost 80% myxophyte (cyanobacteria)	moderate densities; crustacean dominated; moderate richness; high diversity	low densities; over half dipteran; high richness
Fox	5.8	early life stages: Apr, bottom depths	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	Cd and Pb	ISQG: As, Cu; PEL: As	low densities, only Goose area lake with significant chrysophyte component	highest copepodite densities; rotifer dominated; high richness	low densities; over half bivalves
Echo	0.4	none	near neutral, soft, low TDS	mesoeutrophic	Cu and Fe	ISQG: As, Cu	nc	nc	nc
Rascal	2.8	all life stages: Apr, all depths	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	pH, Al, Cd and Cu	ISQG: Cu	relatively high chl *a* biomass, low density, more than 90% cryptophytes, lowest richness and low diversity	nc	vast majority dipteran; moderate richness; low diversity
Giraffe North	3.7	none	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	Cd and Cu	ISQG: As, Cu	low chl *a* biomass, low densities, moderate richness and high diversity	nc	low densities; over half dipteran
Giraffe South	7.7	all life stages: Apr, bottom depths; Early life stages: Apr, bottom depths	near neutral, soft, low TDS	ultraoligotrophic	Cd and Cu	ISQG: As, Cu	low Apr biomass and densities, over 80% cryptophyte in Apr; greatest genera richness in Aug, high diversity	moderate densities; moderate richness and diversity	low densities; high diversity
Goose Neck	3.0	none	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	Cu	ISQG: As, Cu; PEL: As	low Apr densities; greatest genera richness in Aug; high diversity	moderate densities; high richness and diversity	high densities; vast majority dipteran
Goose Central	4.7	none	near neutral, soft, low TDS	ultraoligotrophic	-	ISQG: As, Cu	moderate chl *a* biomass; low Apr densities; high genera richness and diversity in Aug	moderate densities; high richness and diversity	high densities; over half dipteran; low richness; moderate diversity
Goose Tail	2.8	all life stages: Apr, mid to bottom depths; Early life stages: Apr, bottom depths	near neutral, soft, low TDS	ultraoligotrophic - oligotrophic	Cu	ISQG: none	low chl *a* biomass and densities; more than 80% cryptophytes; moderate diversity	nc	nc
Propellor	7.8	all life stages: Apr, mid to bottom depths; Early life stages: Apr, bottom depths	near neutral, soft, low TDS	ultraoligotrophic	Cd	ISQG: Cu	low chl a biomass and density; dominated by myxophyte (cyanobacteria)s; low richness and diversity	nc	high densities; vast majority dipteran; low diverstiy

(continued)

Appendix 4-1. Summary of 2012 Freshwater Baseline Results for Lakes (completed)

Lake	Summer Sampling Max Depth (m)	Dissolved Oxygen: Seasons and Depths that Exceed CCME Guidelines*	Water Quality: General Description	Water Quality: Nutrient Status	Water Quality: CCME Guideline Exceedances*	Sediment Quality: CCME Guideline Exceedances*	Primary producers: Phytoplankton	Aquatic Macroinvertebrates: Zooplankton	Aquatic Macroinvertebrates: Benthos
George Area									
Lower Long	5.2	all life stages: Apr, mid to bottom depths, Aug, all depths; Early life stages: Apr, bottom depths	slightly basic, soft, low TDS	ultraoligotrophic	-	ISQG: As, Cr, Cu; PEL: As	high chl *a* biomass; moderate densities; more than 5% chrysophytes; moderate richness and diversity	moderate densities; high richness and moderately high diversity	low densities; low richness
Fold	9.8	all life stages: Aug, all depths	slightly basic, soft, low TDS	ultraoligotrophic - oligotrophic	-	ISQG: As, Cr, Cu; PEL: As	higher Apr chl *a* biomass; high Aug densities; more than 5% chrysophytes; low Aug diversity	highest densities; highest copepodite densities; high richness and diversity	moderate densities, richness and diversity
George Central	14.5	all life stages: Aug, all depths	near neutral, soft, low TDS	ultraoligotrophic	-	ISQG: As; PEL: As	low chl a biomass; high Aug densities; more than 90% myxophyte (cyanobacteria)s in Aug; more than 5% chrysophytes; low diversity	crustacean dominated; lowest richness; very low diversity	over half bivalves; moderately high richness and diversity
George South	3.0	none	slightly acidic, soft, low TDS	ultraoligotrophic	-	ISQG: As, Cr; PEL: As	nc	nc	over half bivalves; moderate high richness and diversity
Lytle	1.4	all life stages: Aug, all depths	near neutral, soft, low TDS	ultraoligotrophic	Cu	ISQG: As, Cr, Cu, Zn; PEL: As	low chl *a* biomass; more than 5% chrysophytes; lowest genera richness	lowest densities; crustacean dominated; low richness and diversity	highest densities; vast majority dipteran; lowest diversity
Occurrence	1.5	all life stages: Aug, all depths	slightly basic, soft, low TDS	ultraoligotrophic	Cu	ISQG: As, Cr, Cu, Zn; PEL: AS, Cr	low chl *a* biomass; more than 5% chrysophytes; lowest genera richness	lowest densities; crustacean dominated; low richness and diversity	low densities; highest diversity
Sleigh	1.5	all life stages: Aug, all depths	near neutral, soft, low TDS	ultraoligotrophic	Cu	ISQG: As	low chl *a* biomass; more than 5% chrysophytes	lowest densities; crustacean dominated; low richness and diversity	low densities; vast majority dipteran; low diversity
Dragon	3.4	all life stages: Apr, bottom depths, Aug, all depths; Early life stages: Apr, bottom depths	near neutral, almost moderately hard in Apr, higher TDS in Apr	ultraoligotrophic	-	ISQG: As, Cr, Cu, Zn; PEL: As	higher Apr chl *a* biomass; more than 5% chrysophytes	crustacean dominated; high richness	moderate densities, richness and diversity
Komatic	7.0	all life stages: Apr, bottom depths, Aug, all depths; Early life stages: Apr, bottom depths	slightly basic, moderately hard in Apr, higher TDS in Apr	ultraoligotrophic - oligotrophic	Cu	ISQG: As, Cd, Cr, Cu, Zn; PEL: As	high Apr chl a biomass; high Aug densities; more than 50% bacillariophyte (diatoms) in Apr; more than 90% myxophyte (cyanobacteria)s in Aug; more than 5% chrysophytes; low Aug diversity	highest copepodite densities; crustacean dominated; high richness and diversity	high densities; vast majority dipteran
Reference C	35.0	all life stages: Aug, all depths above thermocline and most depths below thermocline	slightly basic, moderately hard, higher TDS	ultraoligotrophic - oligotrophic	-	ISQG: As, Cu	moderate chl a biomass and density; more than 90% myxophyte (cyanobacteria)s in Apr; very low diversity in Apr	moderate densities; crustacean dominated; moderate richness and diversity	lowest densities; over half bivalves; lowest richness

nc = not collected

** Parameters which, on average, exceeded CCME guidelines as calculated in tables.*

Half the detection limit was substituted for values that were below the detection limit for the calculation of exceedance factors.

Underlined values show sites where all samples that exceeded a particular parameters guideline were below the detection limit.

Appendix 4-2

Summary of 2012 Freshwater Baseline Results for Streams

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Appendix 4-2. Summary of 2012 Freshwater Baseline Results for Streams

			Dissolved Oxygen	Water Quality			Sediment Quality	Primary Producers	Aquatic Macroinvertebrates
Stream	General Description	Substrate	Seasons that Exceed CCME Guidelines	General Description	Nutrient Status	CCME Guideline Exceedances*	Parameters that Exceed CCME Guidelines	Periphyton	Benthos
Goose Area									
Moby OF	Small stream running through flood plain.	Mainly silt, few small stones	-	Slightly acidic, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd, Cu, Ni	-	dominated by myxophyceae (cyanobacteria)	high richness and diverstiy
Gander IF	Wide and deep, slow moving stream.	Mainly silt, few small stones	-	Near neutral, soft, low TDS	Oligotrophic	Cd	-	dominated by myxophyceae (cyanobacteria); highest richness	over 80% chironomids; over 10% bivalves; lowest richness; low diversity
Gander US	Medium stream with medium flow over cobble to boulders.	Mainly cobbles, some large stones, boulders	-	Near neutral, soft, low TDS	Oligotrophic	Cd	ISQG: As	low chl a biomass; dominated by myxophyceae (cyanobacteria); highest richness	high richness; moderate diversity
Pond 19 OF	Very small stream, nearly dry during summer sampling.	Mainly silt, few small stones	Early life stages: Aug	Near neutral, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd, Cu	-	low chl *a* biomass; dominated by bacillariophyceae	high and variable densities; over 80% chironomids; lowest richness and diversity
Chair OF	Small stream through floodplain.	Mainly silt, few small stones	-	Variable pH, soft, low TDS	Oligotrophic - Mesotrophic	pH, Al	ISQG: As, Cr	high chl *a* biomass; more than 20% chlorophyceae; high diversity	high richness; moderate diversity
Llama OF	Medium stream through large boulder field.	Cobbles, large stones, boulders	Early life stages: Aug, Sept; All life stages: Aug, Sept	Slighty acidic, soft (June) to hard (Sept) water, highest TDS particularly high in Sept	Ultraoligotrophic	Cd	nc	low chl *a* biomass; more than 20% chlorophyceae; lowest richness and diversity	nc
Echo OF	Very small stream through flood plain, dry during summer sampling.	Mainly silt, few small stones	-	Slightly acidic, soft, low TDS	Ultraoligotrophic	pH, Al, Cd, Cu	nc	nc	nc
Giraffe OF	Short, medium-sized stream, cobbles.	Cobbles, large stones, boulders	Early life stages: Aug	Slightly acidic, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd	-	highest and most variable densities; dominated by myxophyceae (cyanobacteria); high diversity	lowest densities; over 80% chironomids; lowest richness; low diversity
Wolf OF	Small stream running through flood plain.	Mainly silt, few small stones	-	Near neutral, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd	-	dominated by myxophyceae (cyanobacteria)	lowest densities; over 80% chironomids
Goose OF	Short, medium-sized stream, cobbles.	Cobbles, large stones, boulders	-	Slightly acidic, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd	-	dominated by myxophyceae (cyanobacteria); high diversity	high richness and diversity
Propellor OF	Large stream draining largest lake in the area. Runs through boulder field.	Large stones, boulders	Early life stages: Aug	Slightly acidic, soft, low TDS	Ultraoligotrophic - Oligotrophic	<u>Cd</u>	ISQG: As, Cr; PEL: As	dominated by myxophyceae (cyanobacteria); high diversity	over 80% chironomids; moderate richness and diversity
Reference B OF	Small stream through floodplain.	Mainly silt, few small stones	Early life stages: Aug	Near neutral, soft, low TDS	Oligotrophic - Mesotrophic	Cd, Fe	-	dominated by myxophyceae (cyanobacteria); more than 20% chlorophyceae; high richness; high diversity	lowest densities; over 80% chironomids; lowest richness; low diversity
George Area									
George OF	Short, small-sized stream, cobbles. Split into two channels.	Cobbles, gravel, sand	-	Near neutral, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd	ISQG: As, Cu; PEL: As	low densities; high diversity	moderately high richness and diversity
Sleigh OF	Small stream running through flood plain.	Cobbles, silt	Early life stages: Aug	Near neutral, soft, low TDS	Ultraoligotrophic - Oligotrophic	Cd, Cu	ISQG: As, Cr	low densities; low richness; high diversity	high densities; moderate richness; high diversity
Dragon OF	Small stream running through flood plain.	Cobbles, silt	Early life stages: Aug	Slightly basic, soft, low TDS	Ultraoligotrophic - Oligotrophic	-	ISQG: As, Cr; PEL: As	high chl biomass; low densities; high richness; high diversity	highest richness and diversity
Komatic IF	Medium stream meandering through grass plain. No rocks present.	Mainly silt, no stones present	-	Slightly basic, soft, low TDS	Oligotrophic - Mesotrophic	Cu	ISQG: As, Cr	low densities; moderate richness; high diversity	moderate richness and diversity
Reference C OF	Short, small-sized stream, cobbles. Nearly dry during summer. Split into two channels.	Cobbles, gravel, silt	-	Slightly basic, soft to moderately hard, low TDS	Ultraoligotrophic - Oligotrophic	-	-	high densities; dominated by myxophyceae (cyanobacteria); high diversity	over 10% gastropods; moderate richness; high diversity

nc = not collected

** Parameters which, on average, exceeded CCME guidelines as calculated in tables.*

Half the detection limit was substituted for values that were below the detection limit for the calculation of exceedance factors.

Underlined values show sites where all samples that exceeded a particular parameters guideline were below the detection limit.

Appendix V6-3D

Back River Project: Bathymetric Surveys of Lakes in the Goose and George Property Areas

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Appendix V6-3D. Back River Project: Bathymetric Surveys of Lakes in the Goose and George Property Areas

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Appendix V6-3D. Back River Project: Bathymetric Surveys of Lakes in the Goose and George Property Areas

1.1 SUMMARY

Bathymetric surveys of lakes in the Project area were conducted from 2010 to 2013 during open-water and ice-covered seasons. Surveys were conducted on lakes closest to potential infrastructure and activities as well as lakes identified as potential water sources for Project domestic and industrial uses.

1.2 METHODS

The bathymetric surveys were conducted as part of the baseline sampling program, and detailed in the following reports:

- *Back River Project: 2010 Lake Water and Sediment Quality Baseline Report* (Rescan 2011; Appendix V6-3A);
- *Back River Project: 2011 Freshwater Baseline Report* (Rescan 2012; Appendix V6-3B);
- *Back River Project: 2012 Freshwater Baseline Report* (Rescan 2013a; Appendix V6-3C); and
- *Back River Project: 2013 Freshwater Baseline Report* (Rescan 2013b).

Bathymetric surveys were also conducted on ice-covered lakes in 2013 using a ground-penetrating radar system (Appendix V6-3E).

Open-water bathymetric surveys from 2010 to 2013 consisted of two parts:

1. The collection of continuous depth measurements along perpendicular and perimeter transects on the lake and pond surfaces using a Differential Global Positioning System (DGPS) and a Garmin depth sounder; and
2. Establishing on-land benchmarks via DGPS surveys of the lake shorelines.

A Trimble PF Power DGPS was used for positioning during the depth survey, and a Garmin depth sounder and a Trimble TSC1 datalogger were used to collect and store the depth data in electronic files. The DGPS and sounder were mounted on the boat for surveys along the lake surfaces.

Depth surveys were carried out by navigating a course of regularly spaced transects across the width of each lake, followed by a longitudinal transect through the long axis of the lake (i.e., e-line). A hand-held GPS, pre-loaded with transect tracks, was used to maintain the correct course with the boat.

Bathymetric surveys conducted on ice-covered lakes in 2013 used a Ground-Penetrating RADAR (GPR) array. MALA's Ramac CUII was used with a 50 MHz rough-terrain antenna. Real-time positioning was attained using a Topcon HyperLite+GPS/Glonass unit. Positions were recorded at 1 Hz with a typical absolute horizontal accuracy of ± 1 metre. The GPR survey was conducted at a speed of approximately 15 km/hr and data were acquired at a frequency of approximately 10 readings per second, giving an

average horizontal resolution of approximately one GPR trace per 42 cm along survey lines. Data were later corrected for ice thickness (Appendix V6-3E).

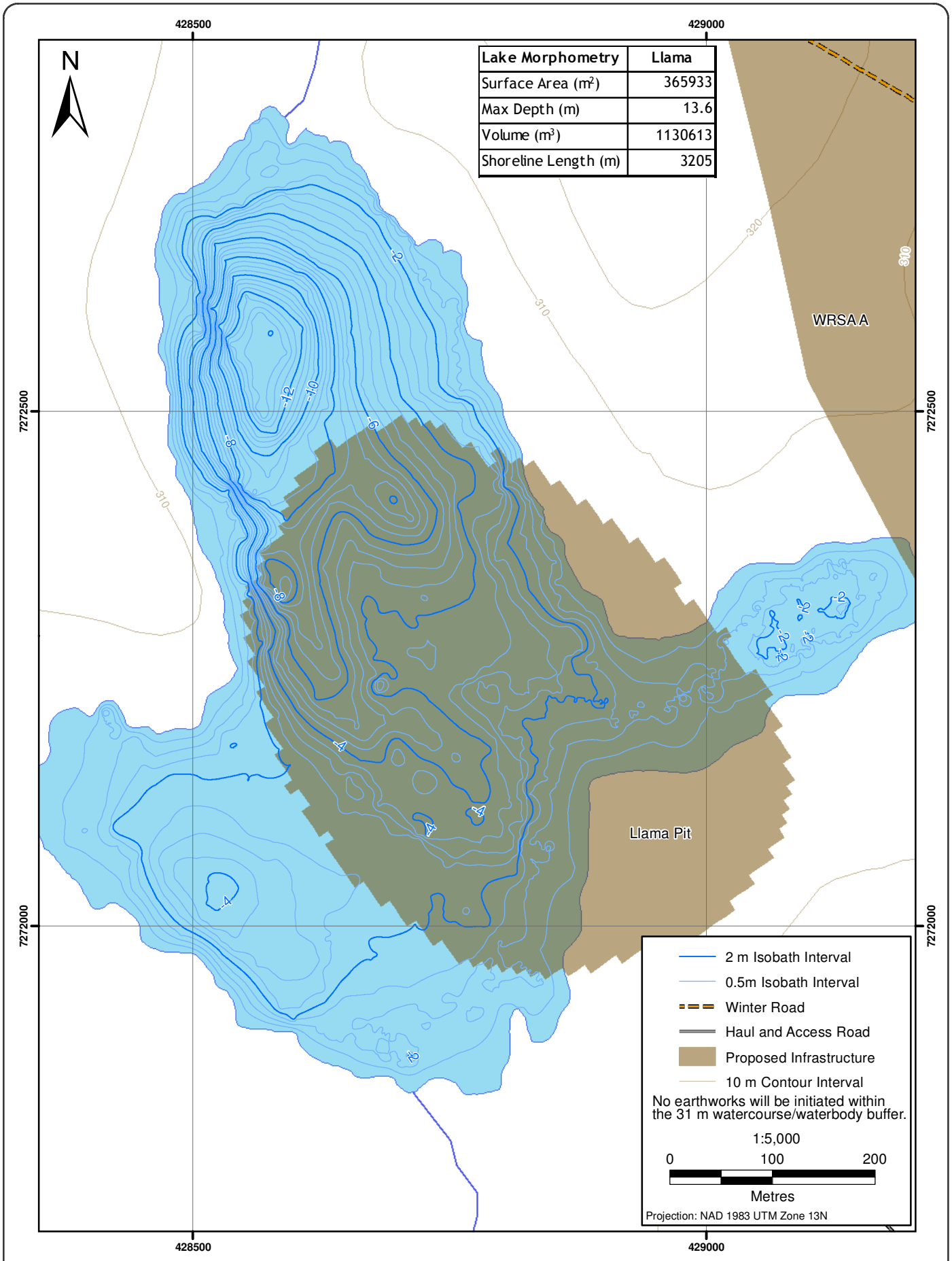
1.3 RESULTS

The bathymetry of 19 lakes in the Goose Property Area and 10 lakes in the George Property Area were surveyed between 2010 and 2013 (summarized in Table V6-3D-1). Smooth bathymetric contours were calculated using standard interpolation techniques and were used to create the bathymetric maps shown in Figures V6-3D-1 to V6-3D-27. For results of bathymetric surveys completed by EBA in winter on ice-covered lakes see Appendix V6-3E.

Table V6-3D-1. Summary of Bathymetry Data Collected in the George and Goose Property Areas, Back River Project, 2010 to 2013

Lake	Year Bathymetry Completed	Lake	Year Bathymetry Completed
George Property		***Goose Property (cont'd)***	
Lytle Lake	2012	Reference Lake B	2010
Occurrence Lake	2012	Goose Lake	2011
Sleigh Lake	2012	Round Pond[1]	2011
George Lake	2012	Pond NE of Round Pond[2]	2011
Reference Lake C	2012	Del Lake	2012
Mosquito	2013	Big Lake	2012
Bob	2013	Fox Lake	2012
Komatic	2013	Rabbit Lake	2012
Reference Q	2013	Giraffe Lake	2012
McCoy	2013	Rascal	2013
Goose Property		Wasp	2013
Llama Lake	2010	Pond A	2013
Umwelt Lake	2010	Propeller[3]	2013
Mam Lake	2010	Leaf[4]	2013
Chair Lake	2010	Wolf[4]	2013

Notes:
[1] Round Pond is also known as Pond 1.
[2] Pond NE of Round Pond is also known as Pond 2.
[3] Bathymetry was conducted on Propeller Lake in the open-water season using the standard methods and by GPR (Rescan 2013b and Appendix V6-3E).
[4] Under-ice bathymetry conducted using GPR (Appendix V6-3E).

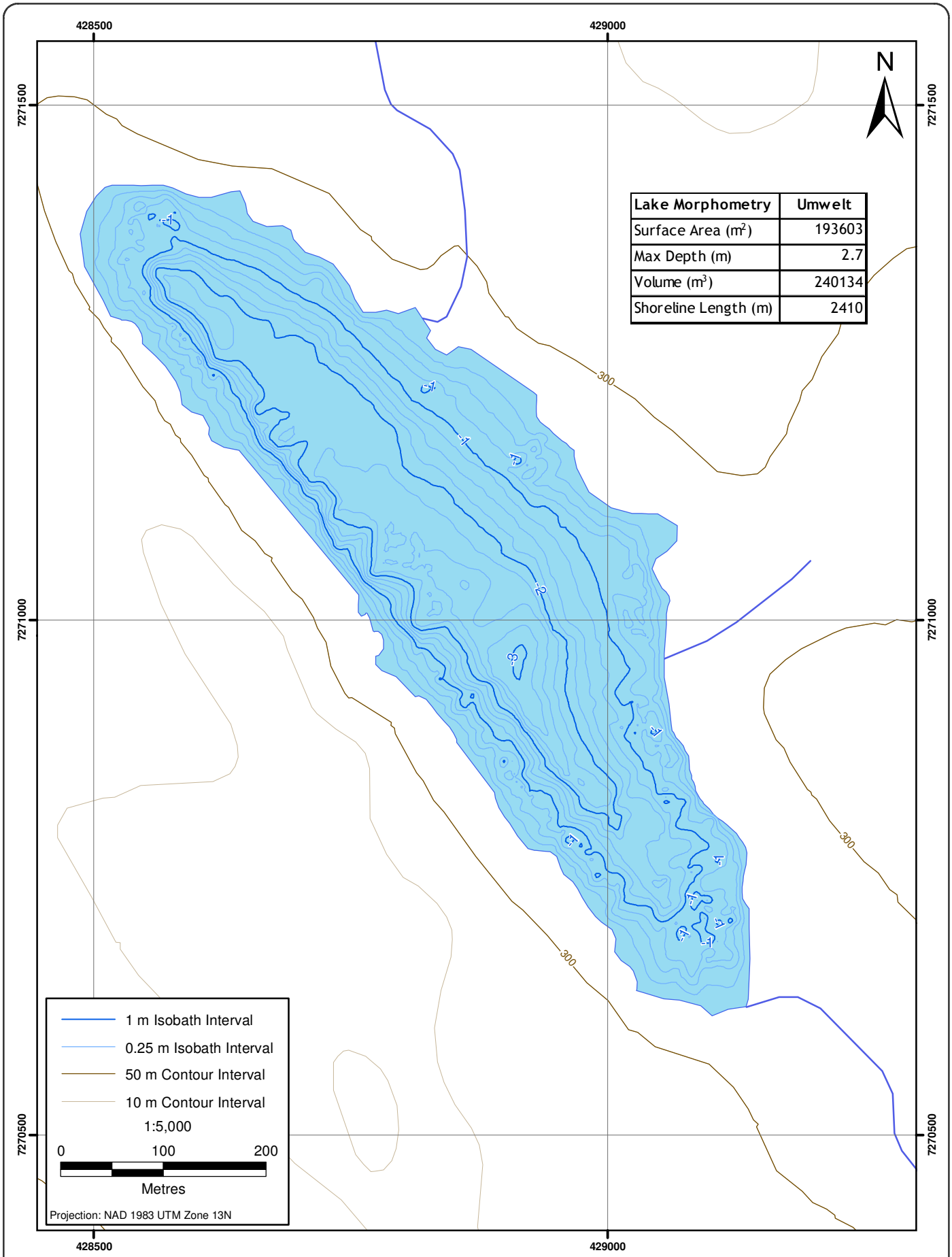


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Bathymetry of Llama Lake, Back River Project, 2010

Figure V6-3D-1

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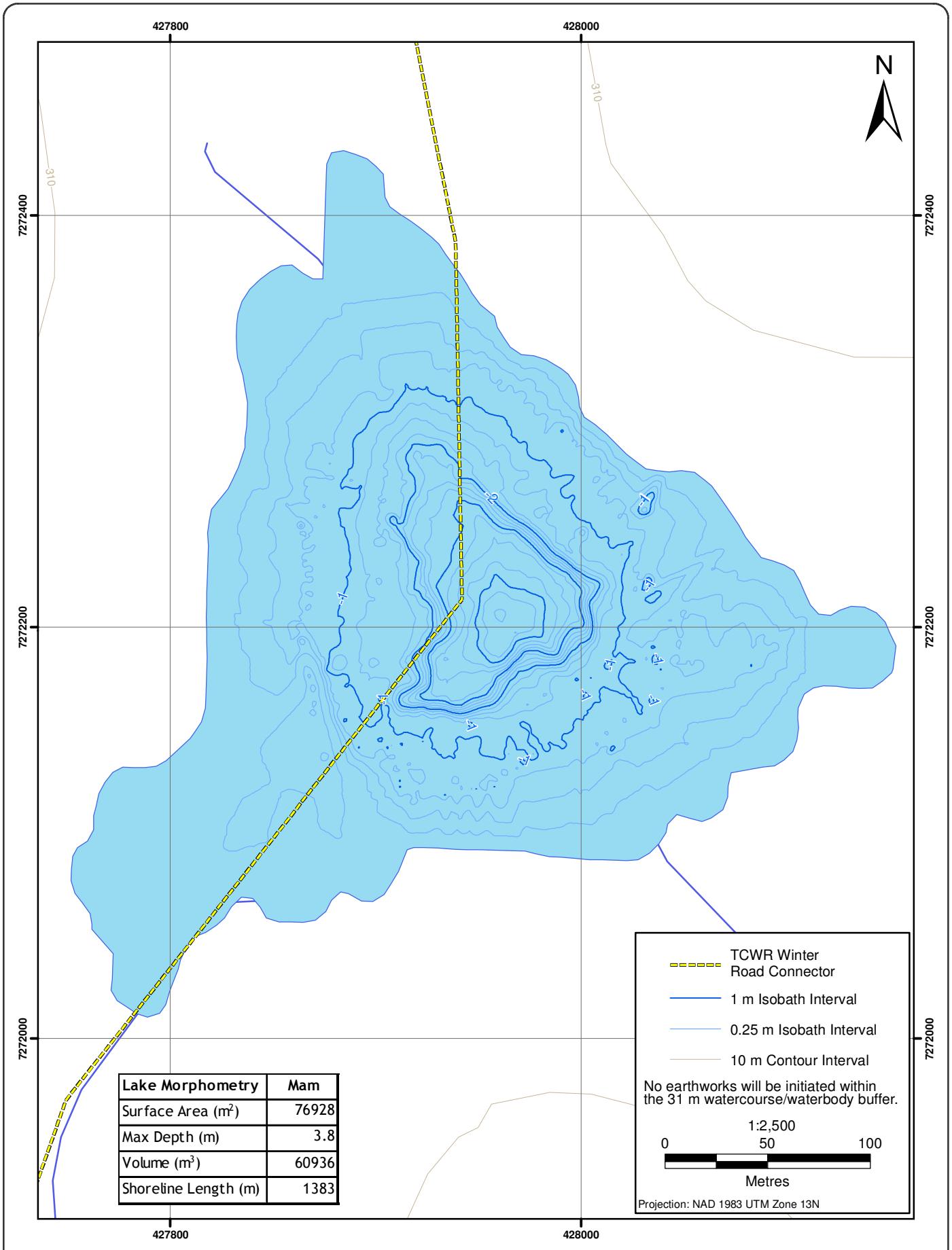


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Bathymetry of Umwelt Lake, Back River Project, 2010

Figure V6-3D-2

Rescan an ERM company



Lake Morphometry	Mam
Surface Area (m^2)	76928
Max Depth (m)	3.8
Volume (m^3)	60936
Shoreline Length (m)	1383

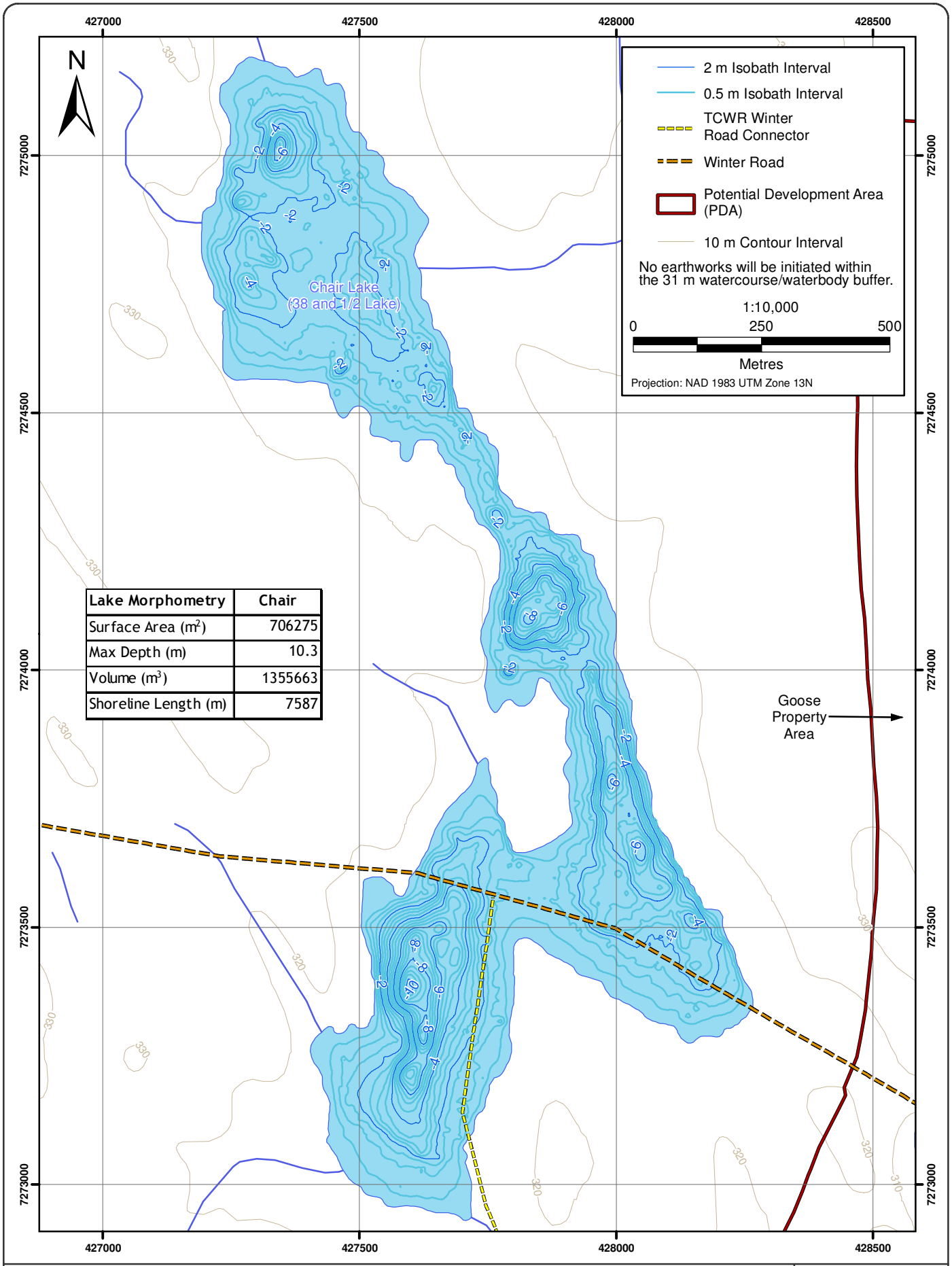
Sabina GOLD & SILVER CORP.

Bathymetry of Mam Lake, Back River Project, 2010

Figure V6-3D-3

Rescan an ERM company

PROJECT # 0194096-0040 GIS # BAC-10-083c October 30 2013



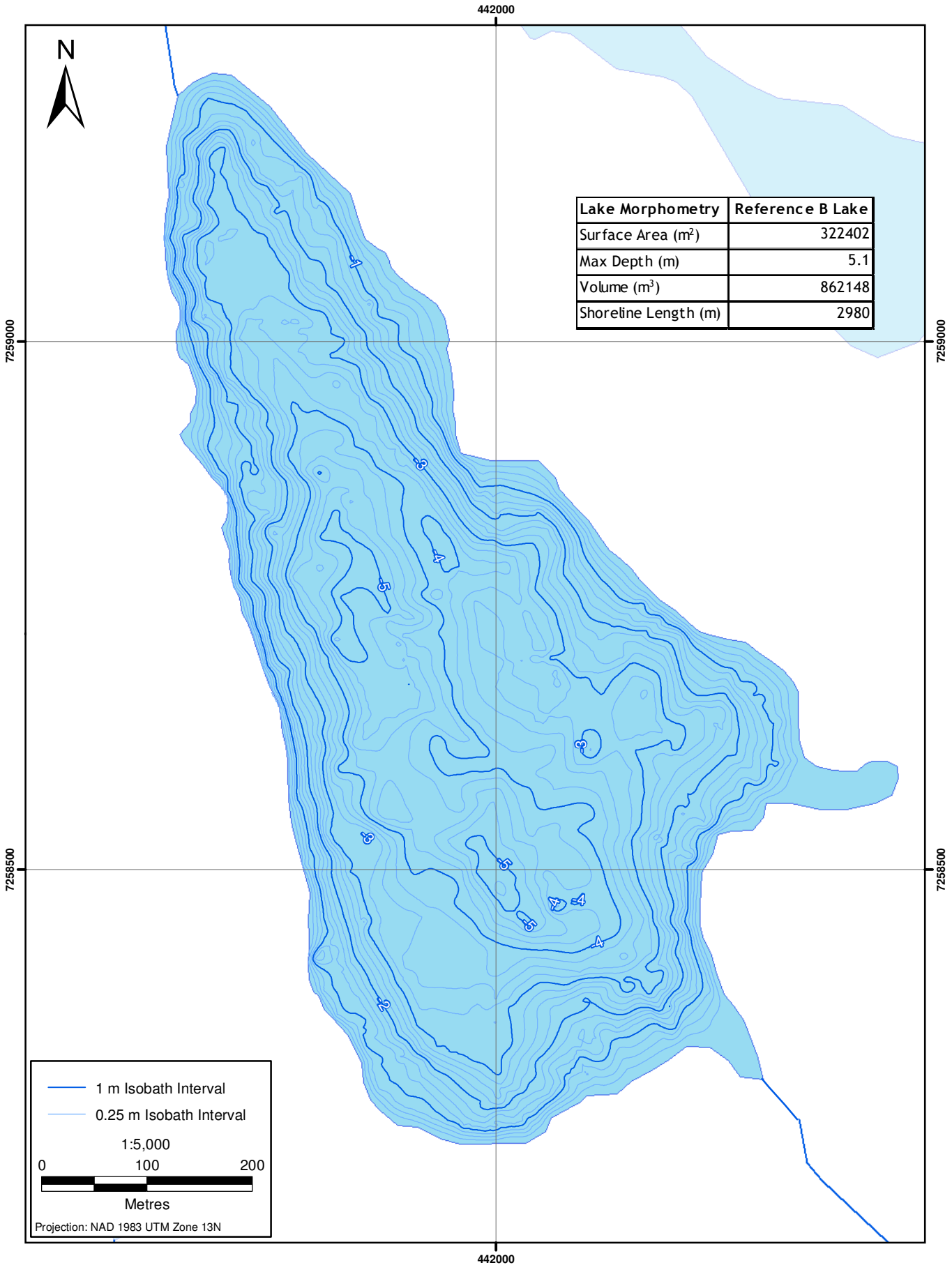
Lake Morphometry	Chair
Surface Area (m^2)	706275
Max Depth (m)	10.3
Volume (m^3)	1355663
Shoreline Length (m)	7587

Figure V6-3D-4

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Bathymetry of Chair Lake, Back River Project, 2010

Rescan an ERM company

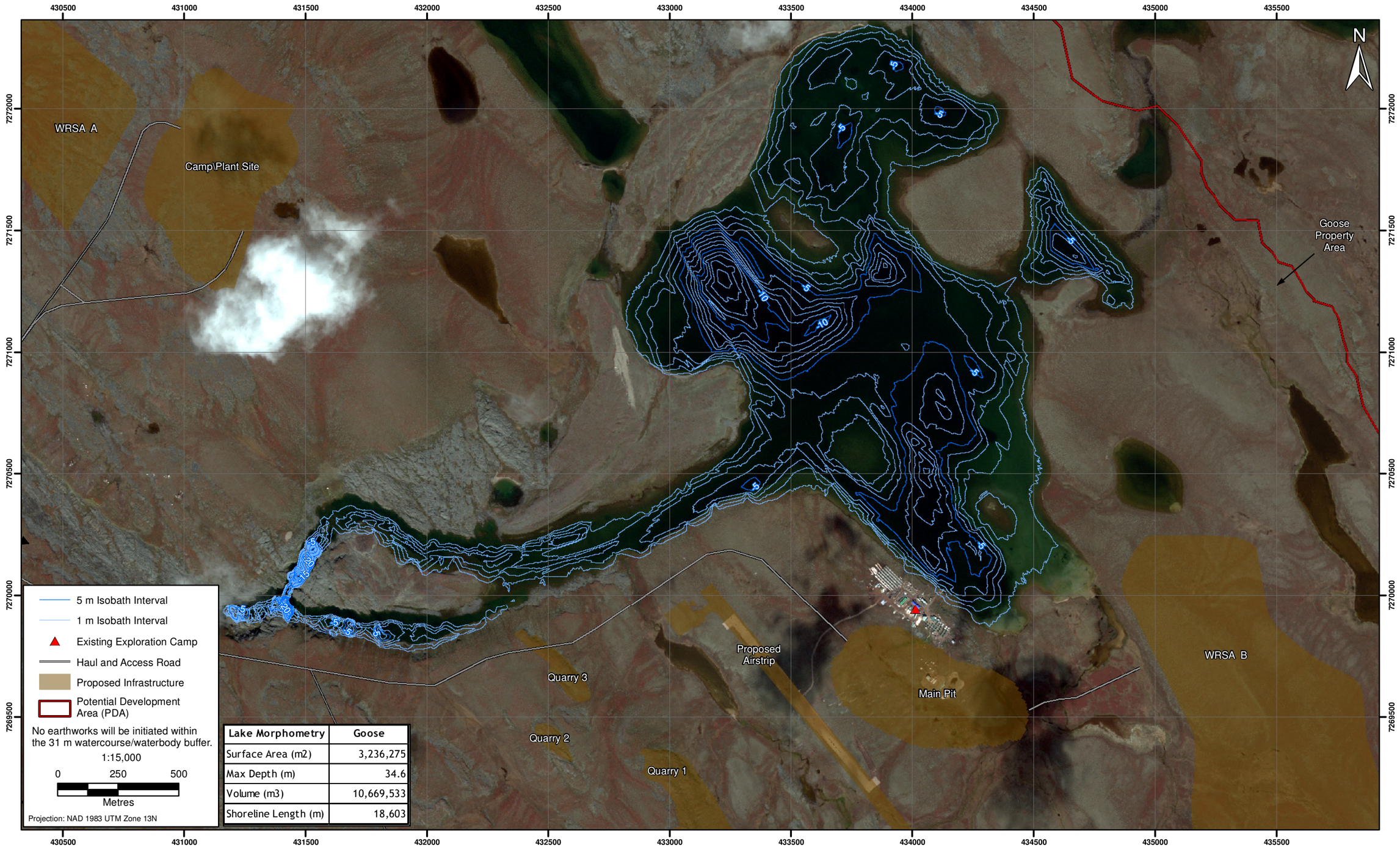


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Bathymetry of Reference B Lake, Back River Project, 2010

Figure V6-3D-5

Rescan an ERM company

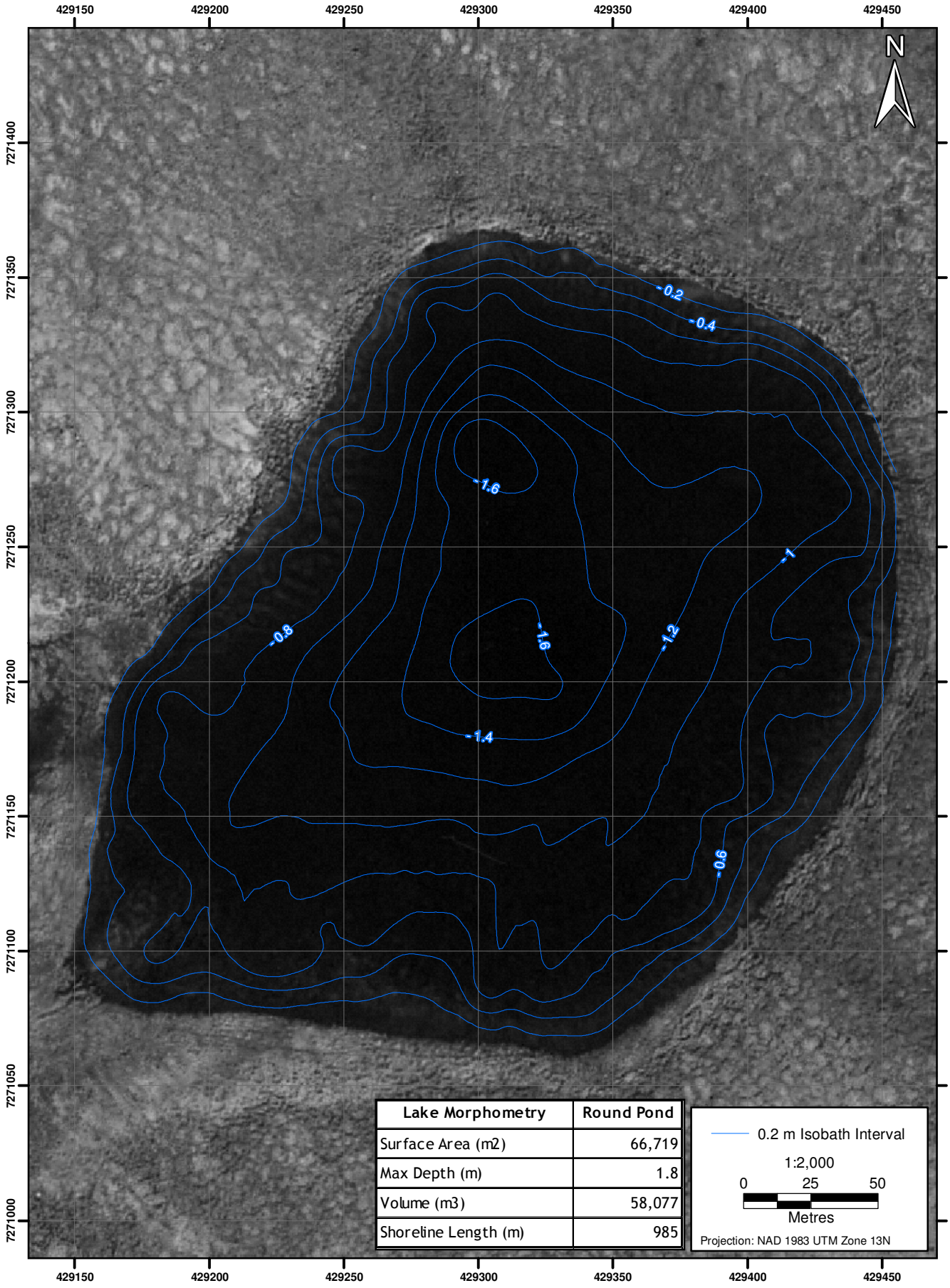


Lake Morphometry	Goose
Surface Area (m2)	3,236,275
Max Depth (m)	34.6
Volume (m3)	10,669,533
Shoreline Length (m)	18,603

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Figure V6-3D-6

Bathymetry of Goose Lake, Back River Project, 2011



Lake Morphometry	Round Pond
Surface Area (m2)	66,719
Max Depth (m)	1.8
Volume (m3)	58,077
Shoreline Length (m)	985

0.2 m Isobath Interval

1:2,000

0 25 50

Metres

Projection: NAD 1983 UTM Zone 13N

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Bathymetry of Round Pond (Pond 1), Back River Project, 2011

Figure V6-3D-7

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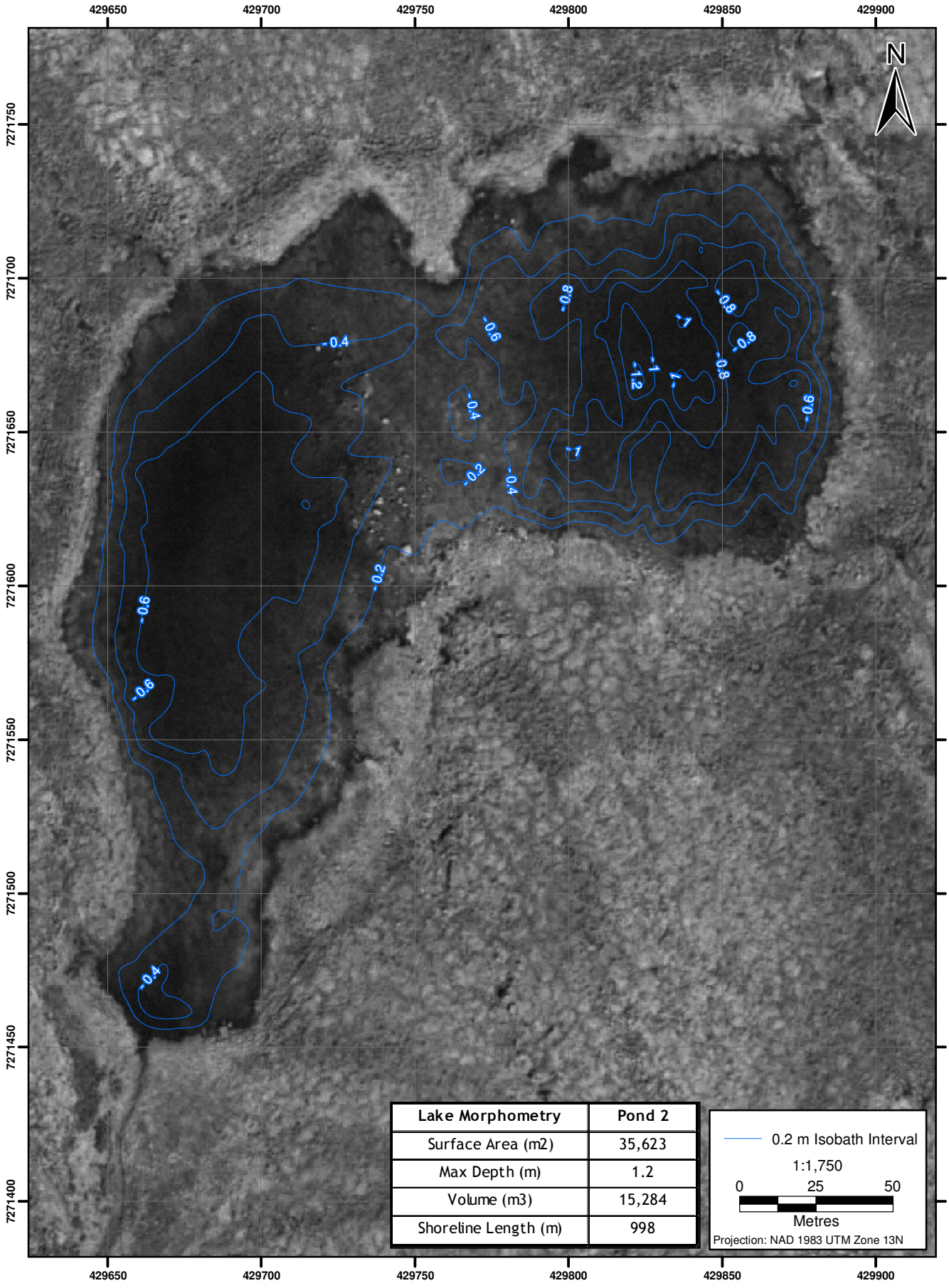


Figure V6-3D-8

Bathymetry of Pond NE of Round Pond (Pond 2), Back River Project, 2011

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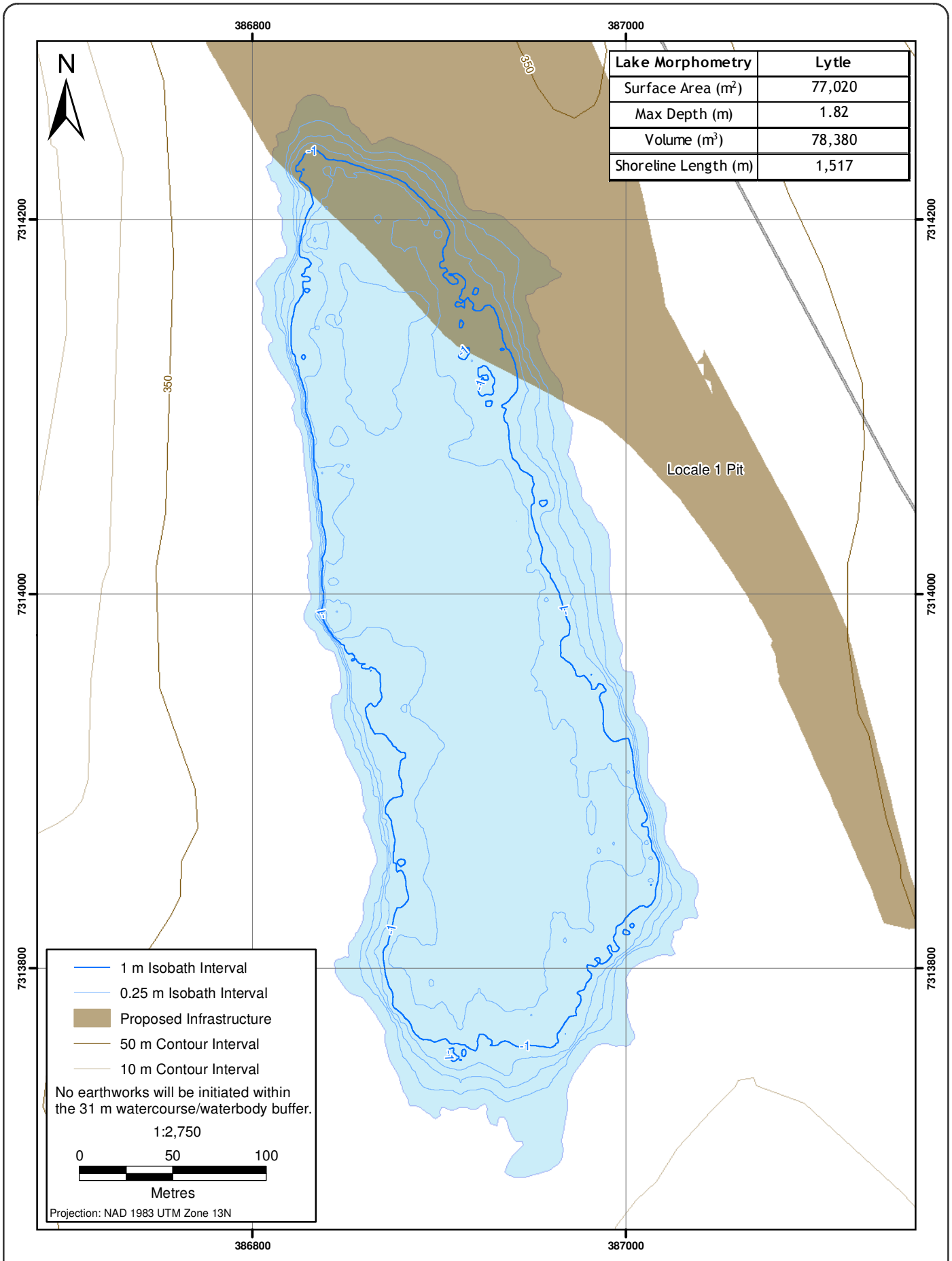


Figure V6-3D-9

Bathymetry of Lytle Lake, Back River Project, 2012

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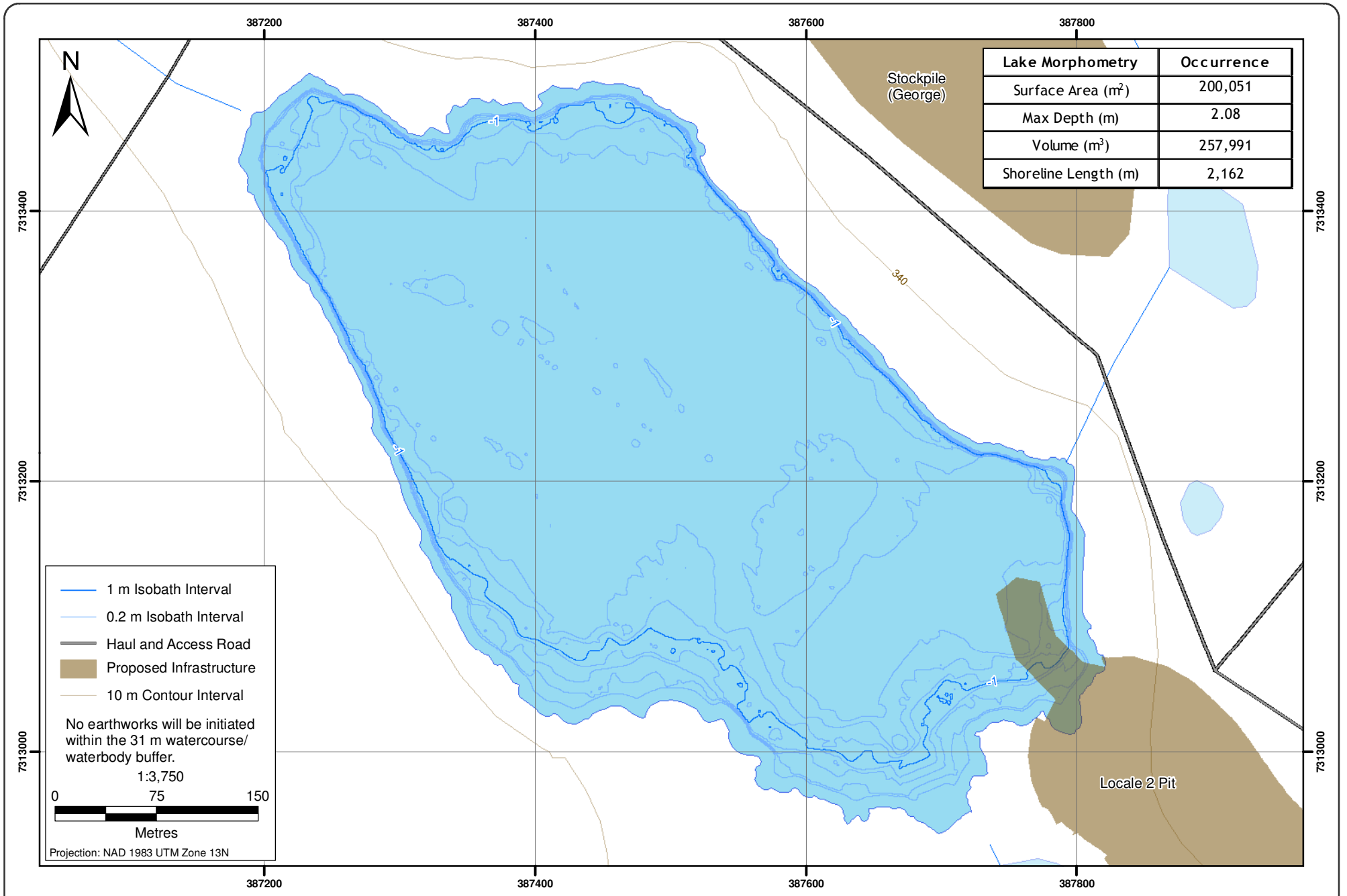


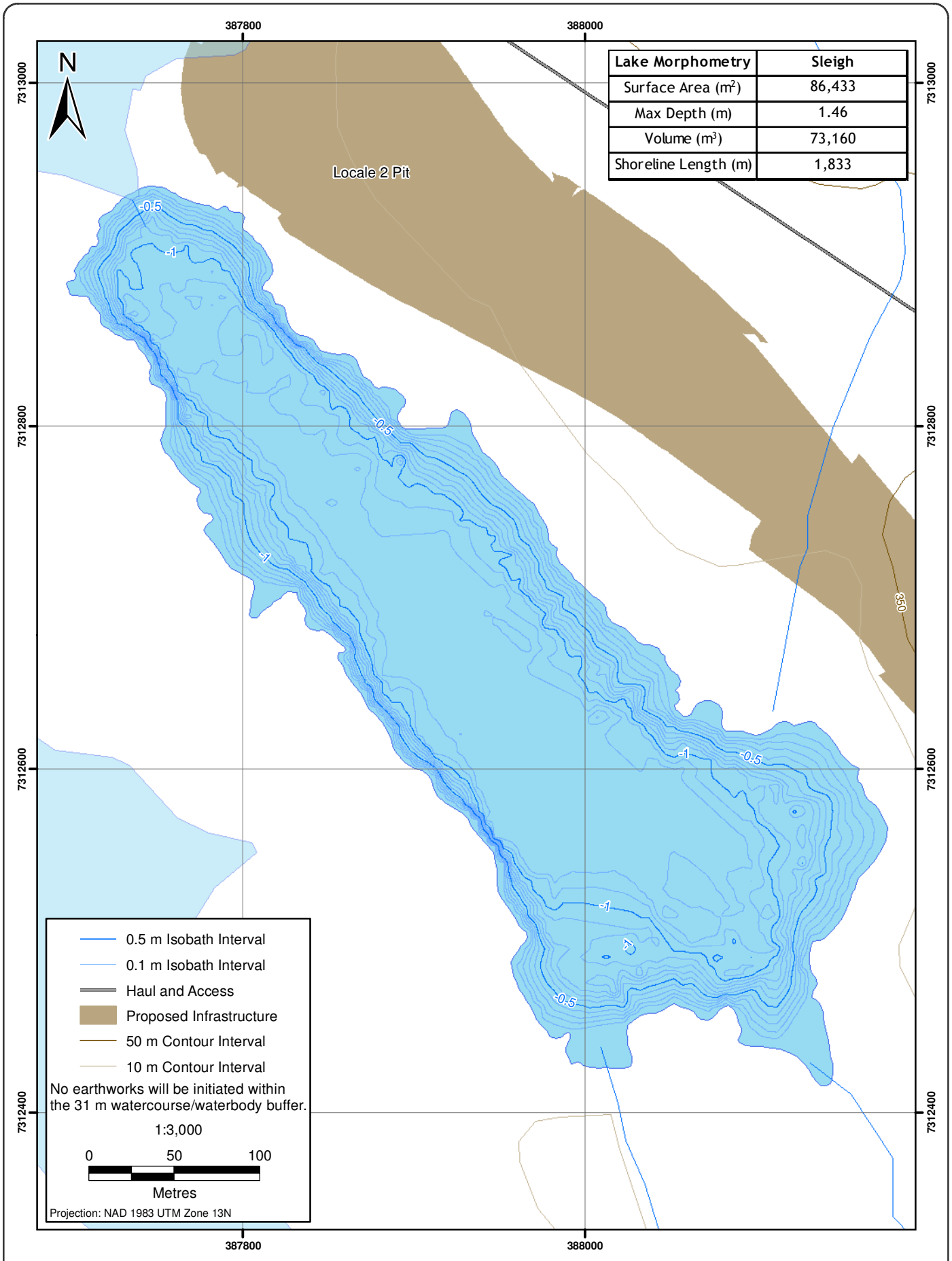
Figure V6-3D-10

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Bathymetry of Occurrence Lake, Back River Project, 2012

Figure V6-3D-10

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Bathymetry of Sleigh Lake, Back River Project, 2012

Figure V6-3D-11

Rescan an ERM company

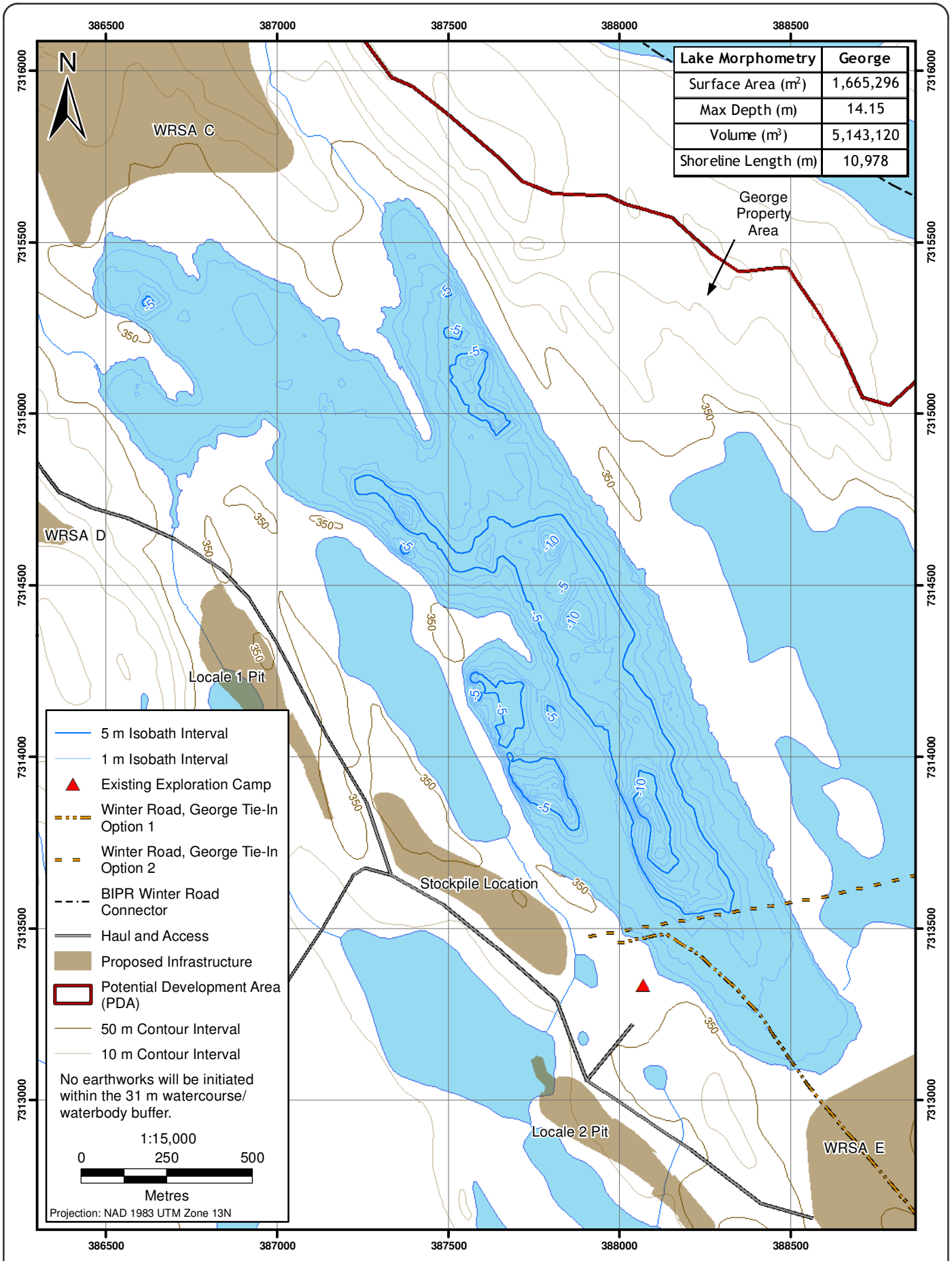
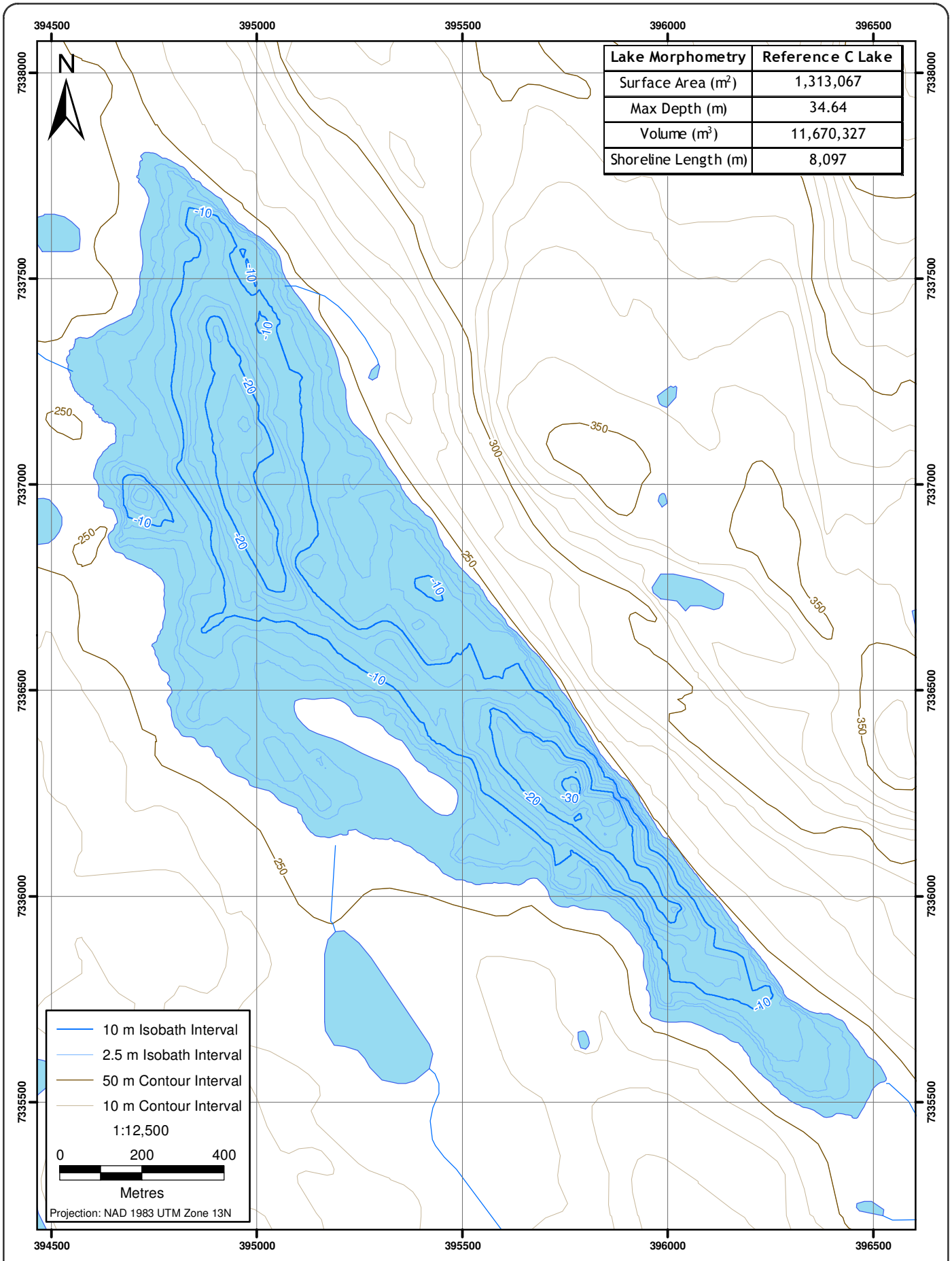


Figure V6-3D-12

Bathymetry of George Lake, Back River Project, 2012

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Bathymetry of Reference C Lake, Back River Project, 2012

Figure V6-3D-13

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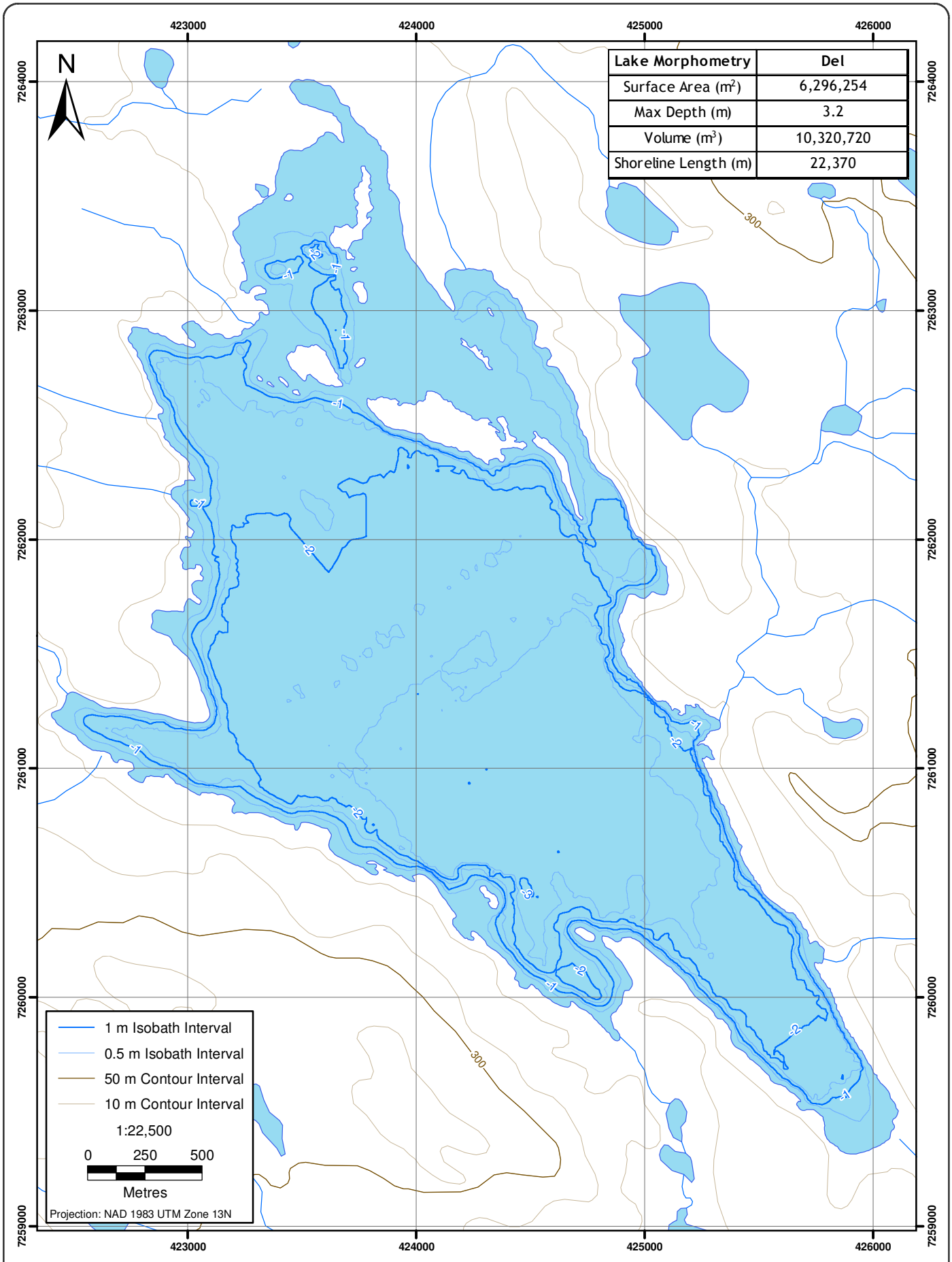


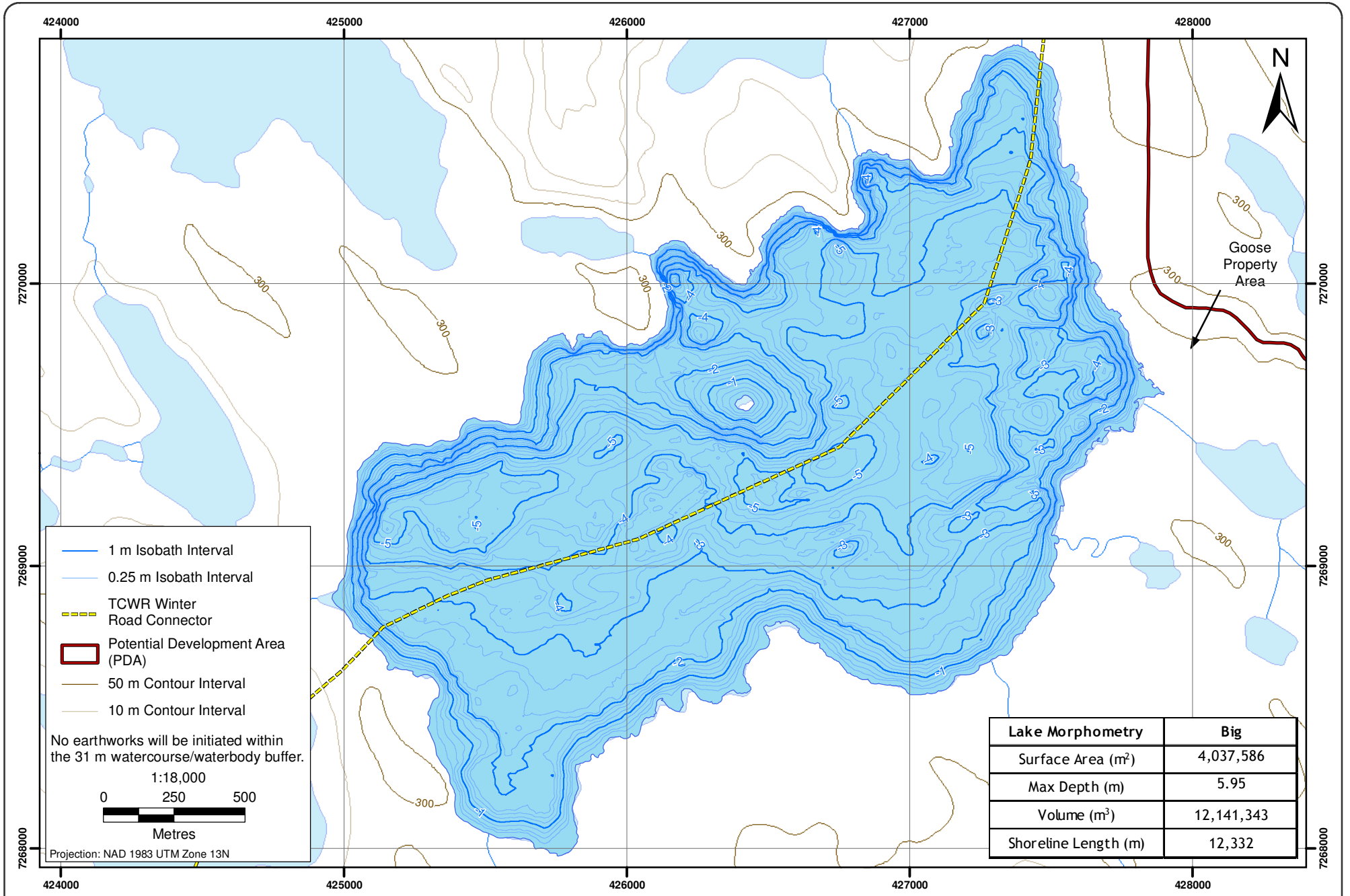
Figure V6-3D-14

Bathymetry of Del Lake, Back River Project, 2012

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PROJECT # 0194096-0040 GIS # BAC-10-083o October 30, 2013



Lake Morphometry	Big
Surface Area (m^2)	4,037,586
Max Depth (m)	5.95
Volume (m^3)	12,141,343
Shoreline Length (m)	12,332

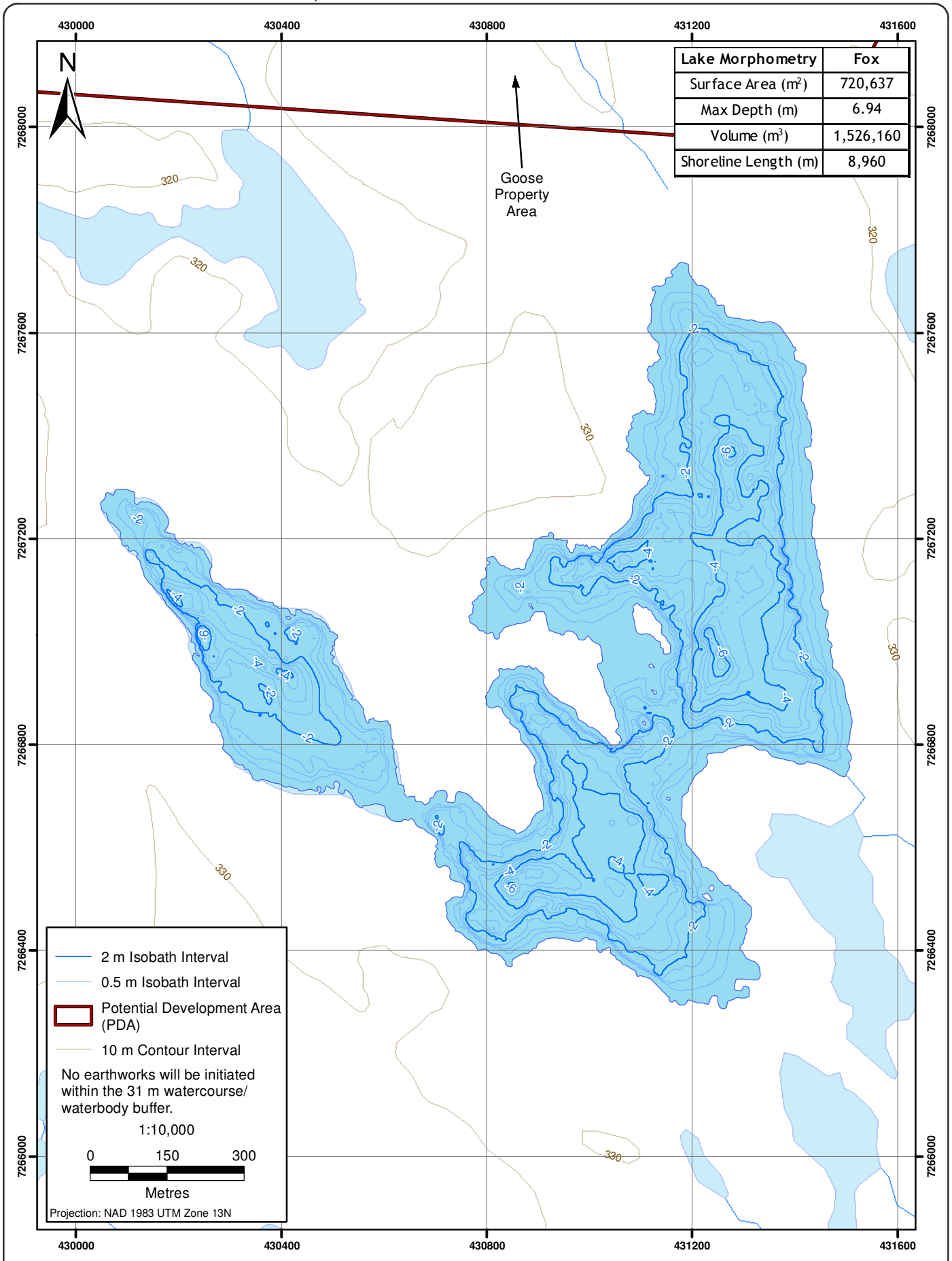
Figure V6-3D-15

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Bathymetry of Big Lake, Back River Project, 2012

Figure V6-3D-15

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Sabina GOLD & SILVER CORP.

Bathymetry of Fox Lake, Back River Project, 2012

Figure V6-3D-16

Rescan an ERM company

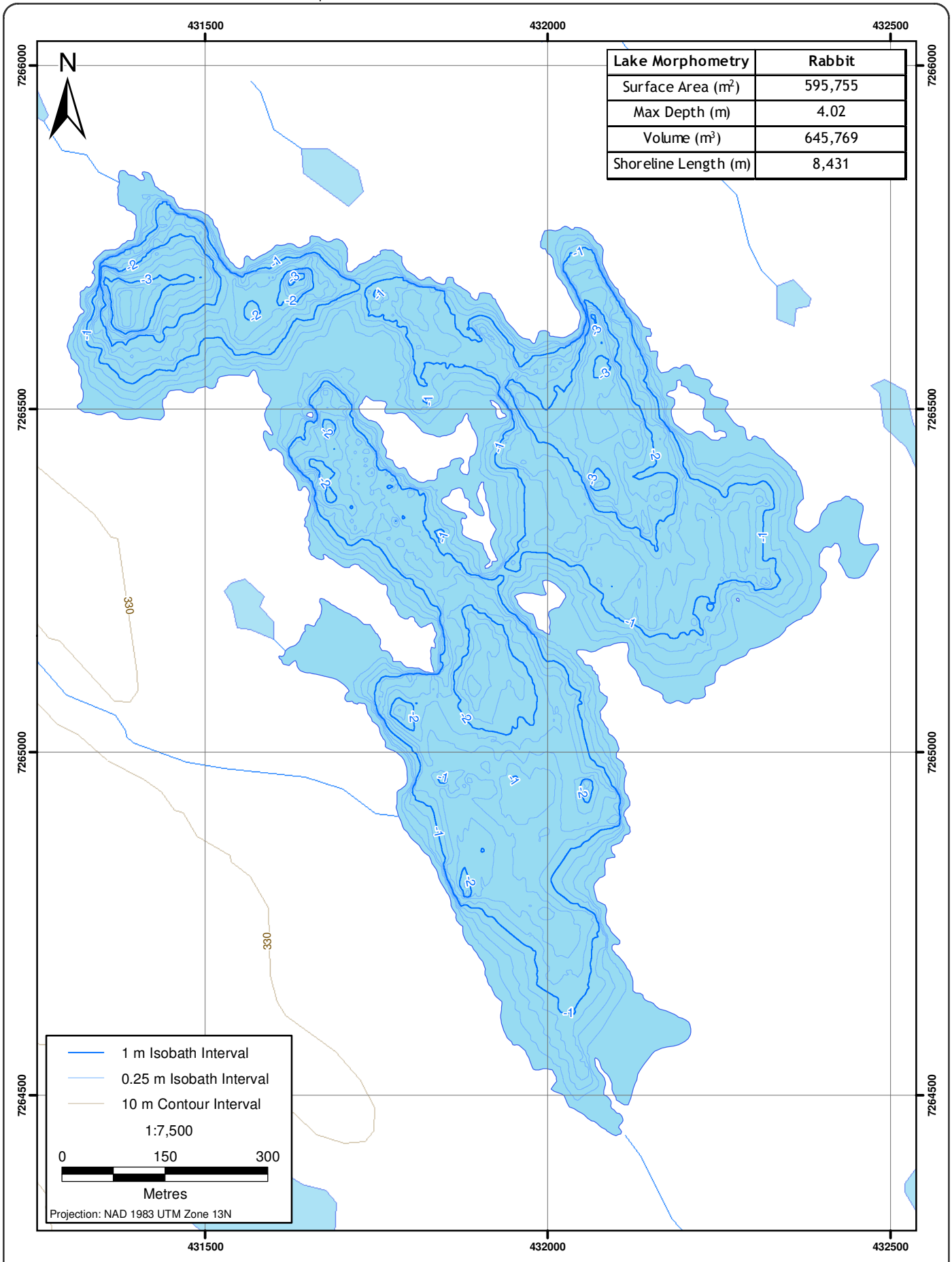
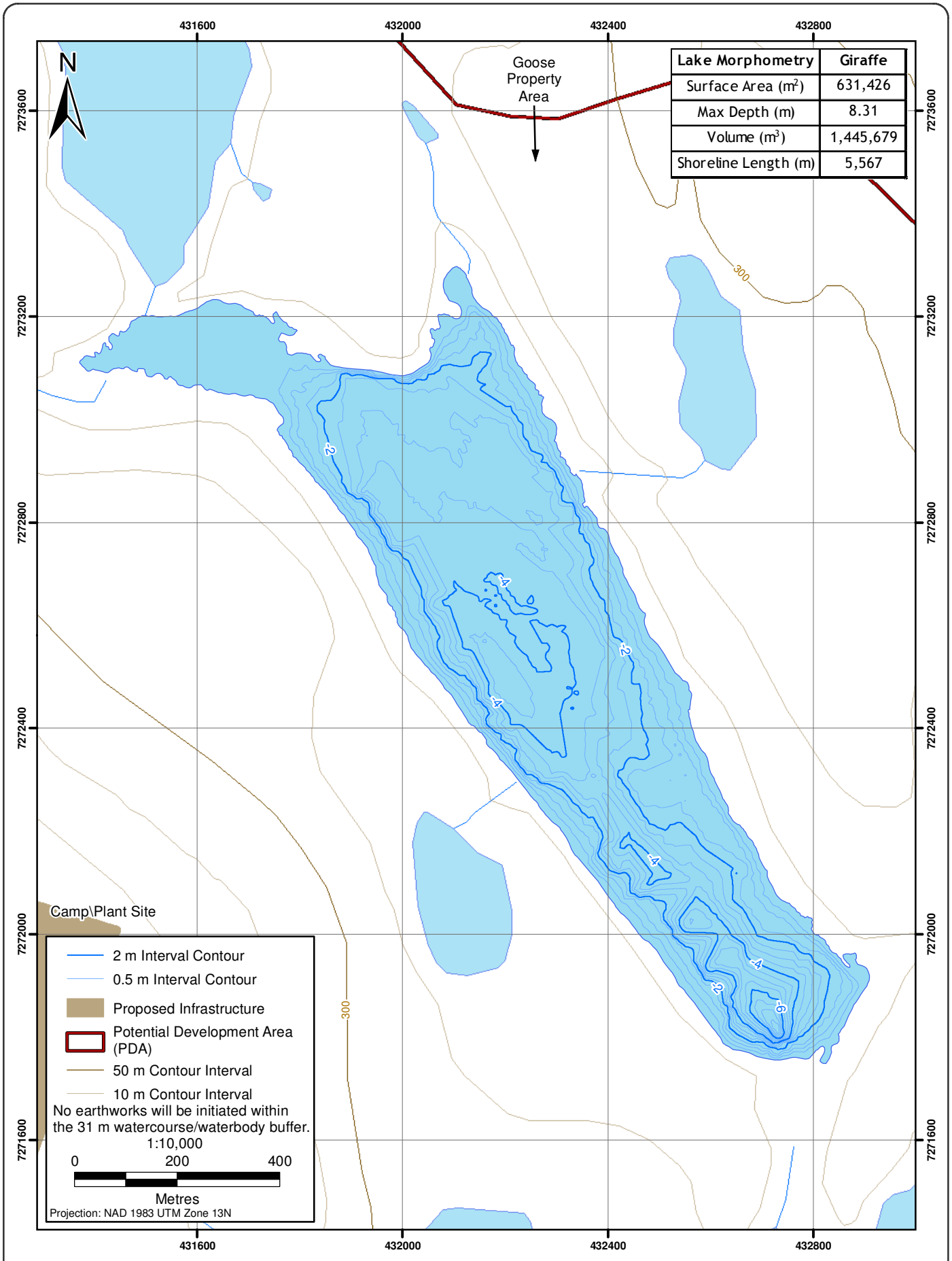


Figure V6-3D-17

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Bathymetry of Rabbit Lake, Back River Project, 2012

Rescan an ERM company

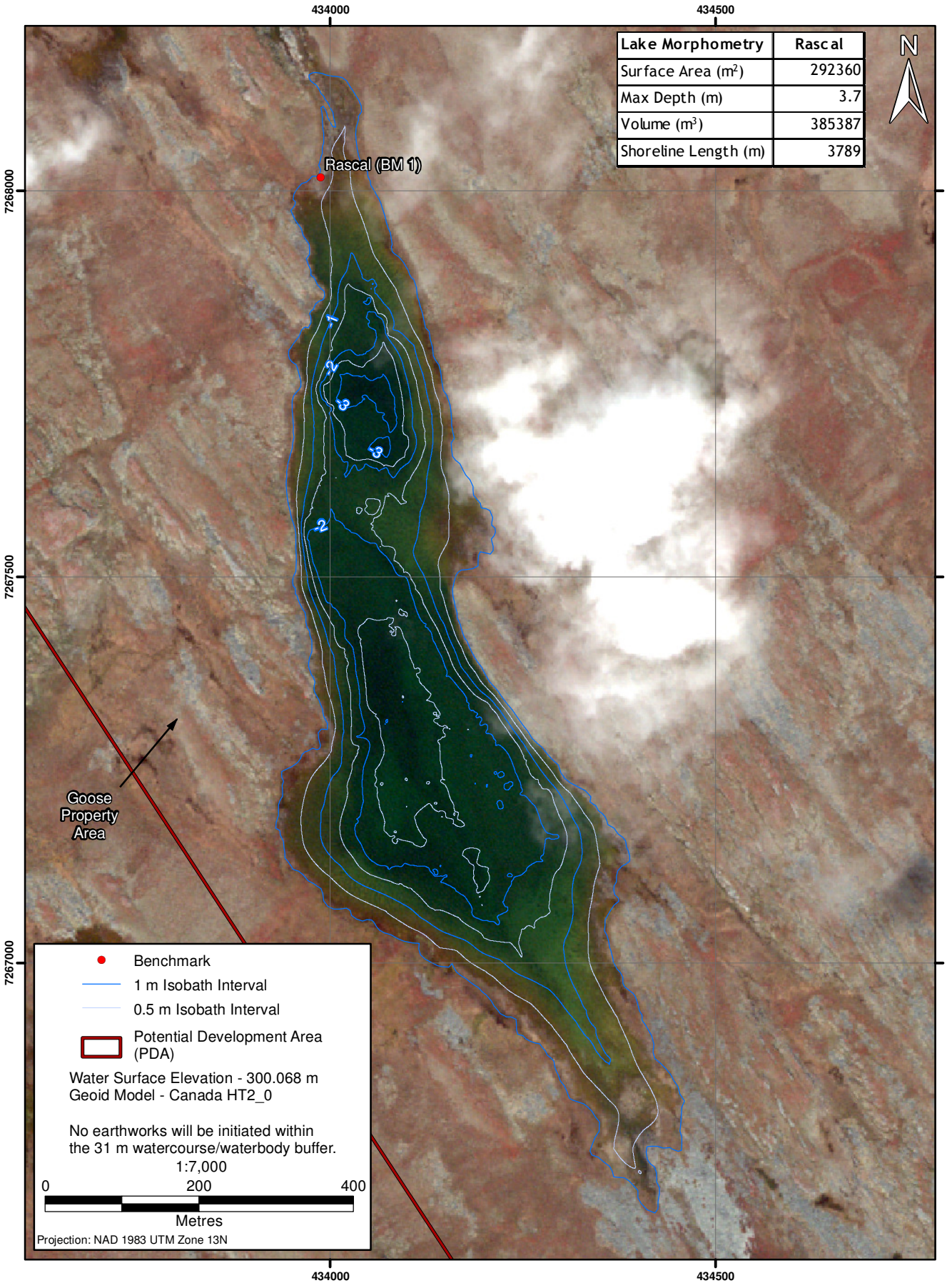


Sabina GOLD & SILVER CORP.

Bathymetry of Giraffe Lake, Back River Project, 2012

Figure V6-3D-18

Rescan an ERM company

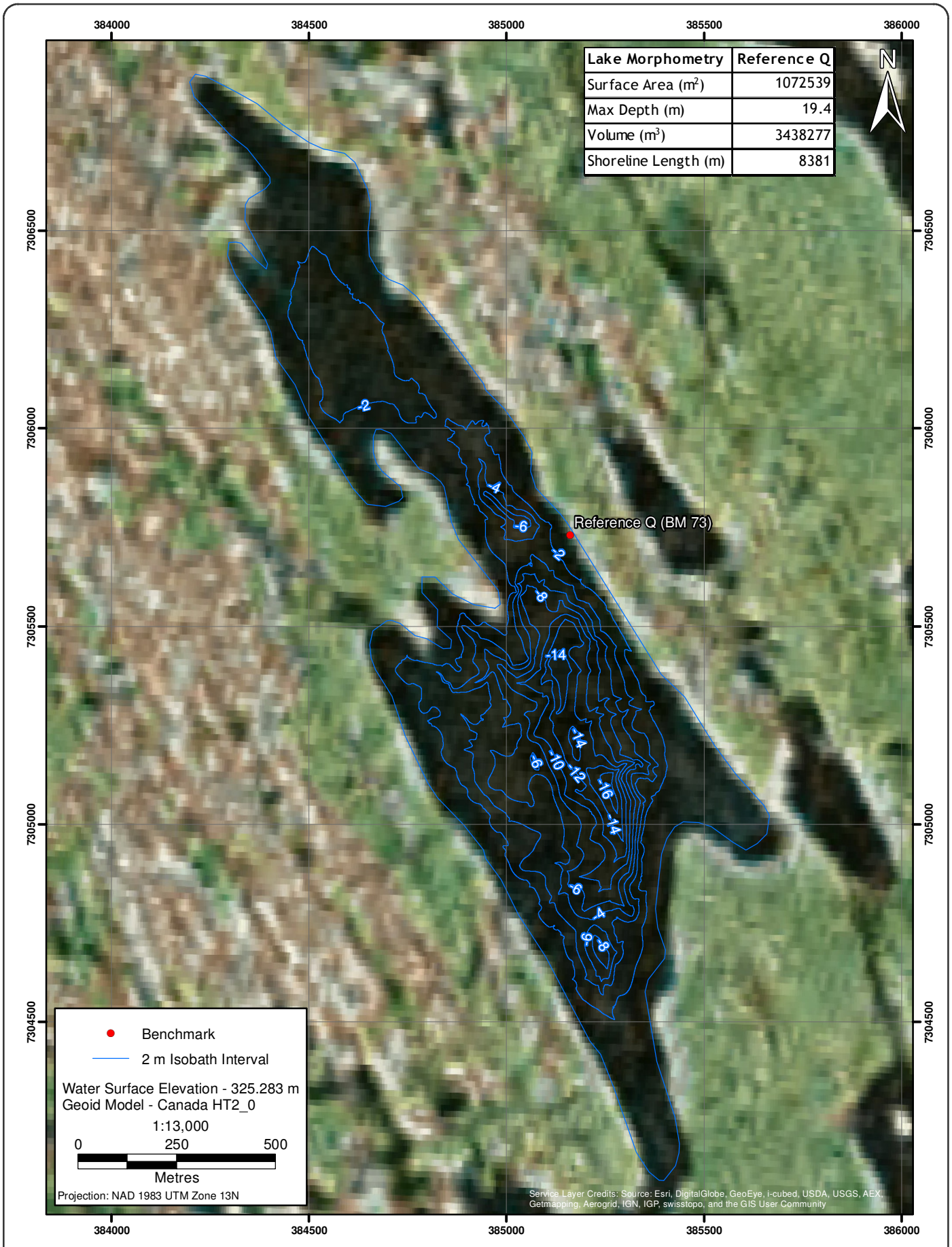


Sabina GOLD & SILVER CORP.

Bathymetry of Rascal Lake, Back River Project, 2013

Figure V6-3D-19

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Bathymetry of Reference Q Lake, Back River Project, 2013

Figure V6-3D-20

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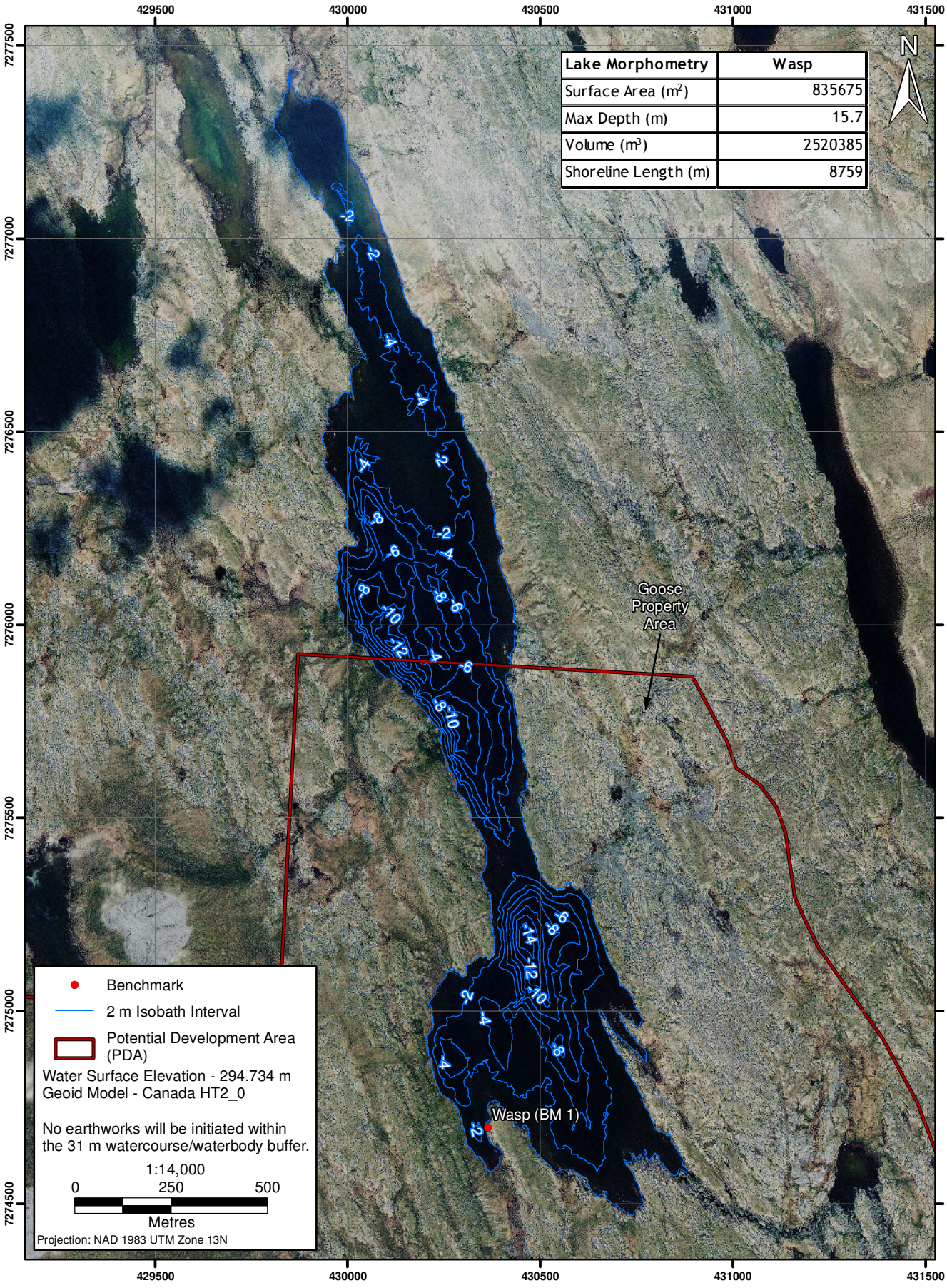
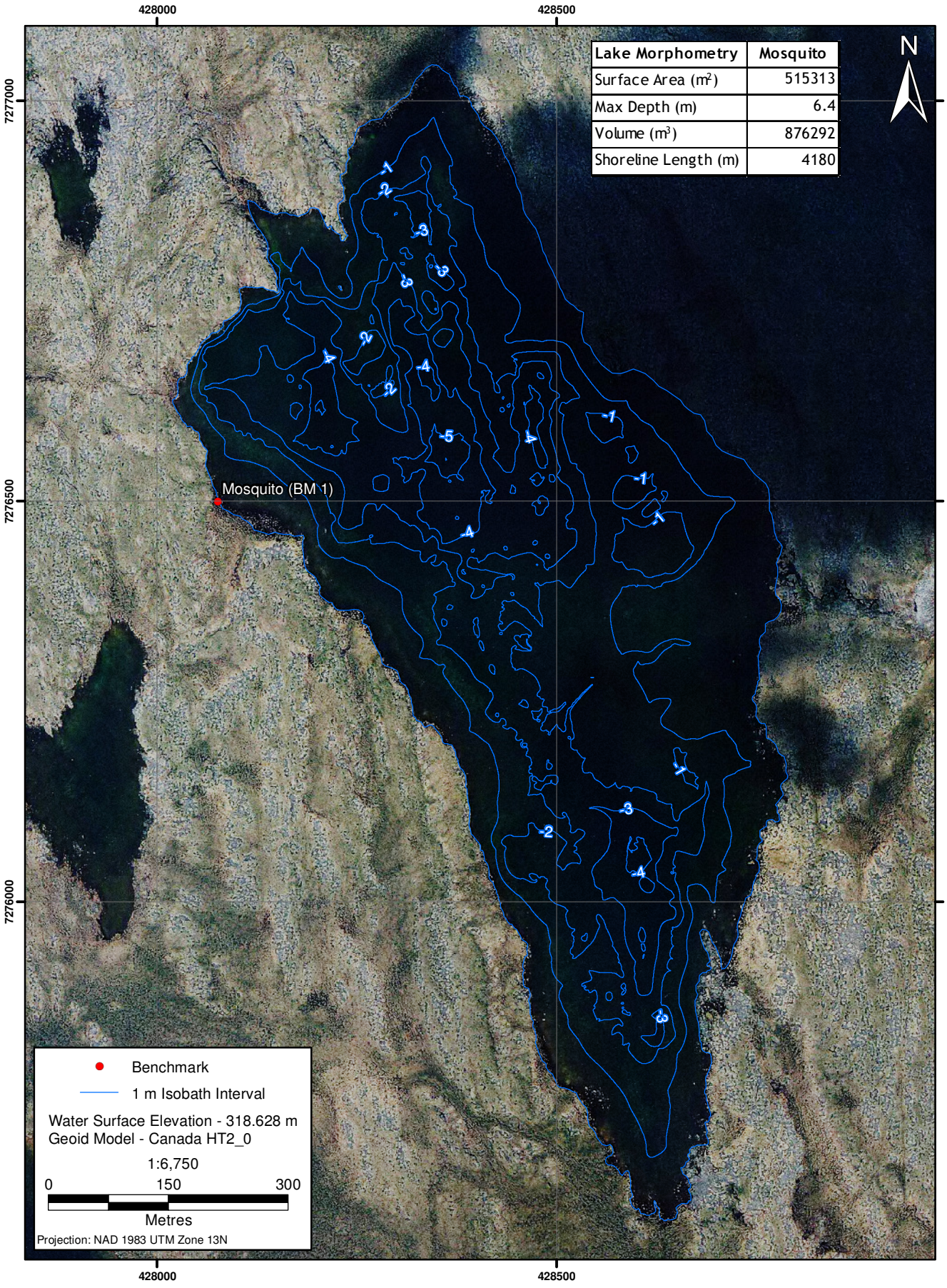


Figure V6-3D-21

Sabina GOLD & SILVER CORP.

Bathymetry of Wasp Lake, Back River Project, 2013

Rescan an ERM company

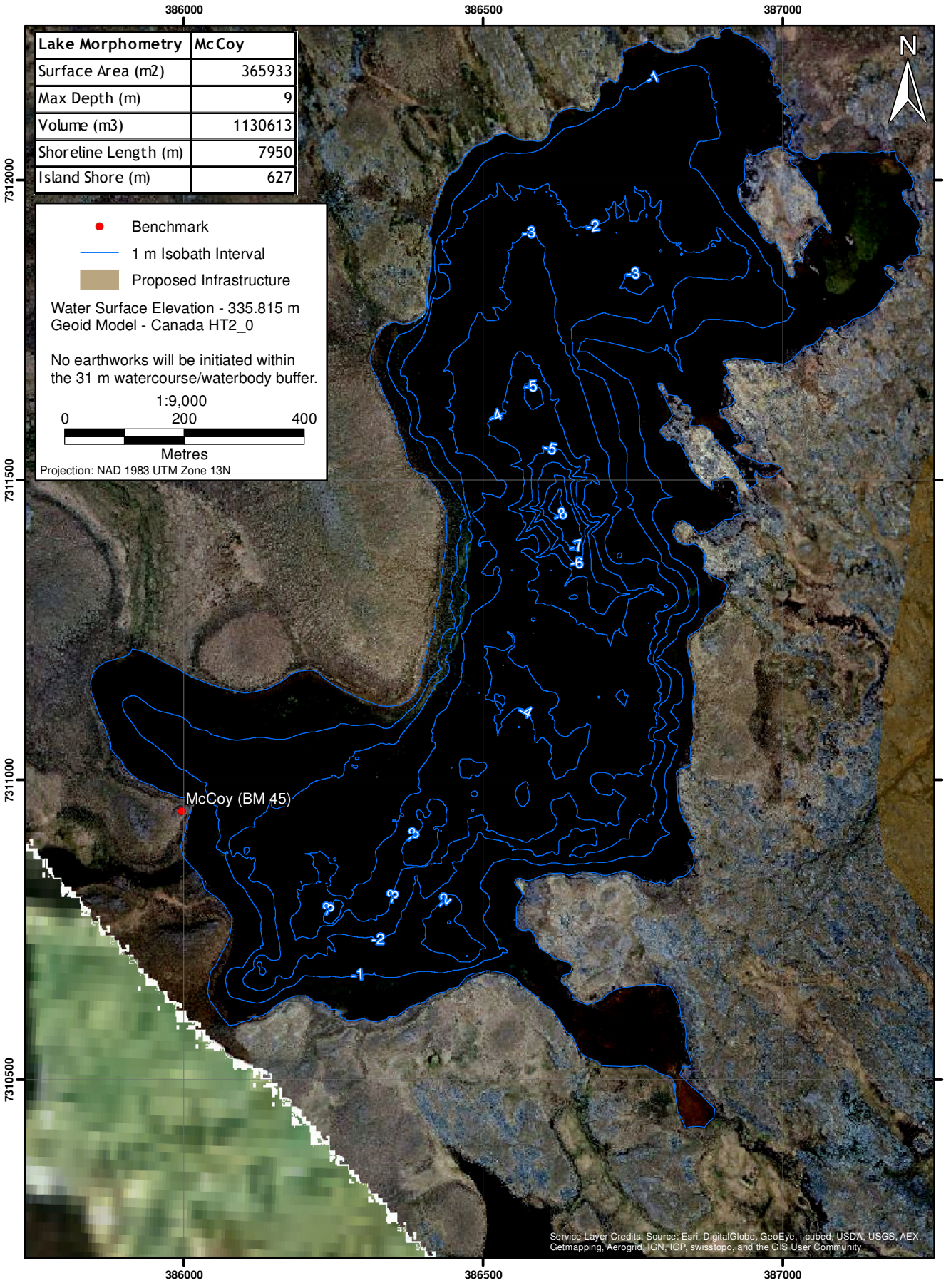


Sabina GOLD & SILVER CORP.

Bathymetry of Mosquito Lake, Back River Project, 2013

Figure V6-3D-22

Rescan an ERM company

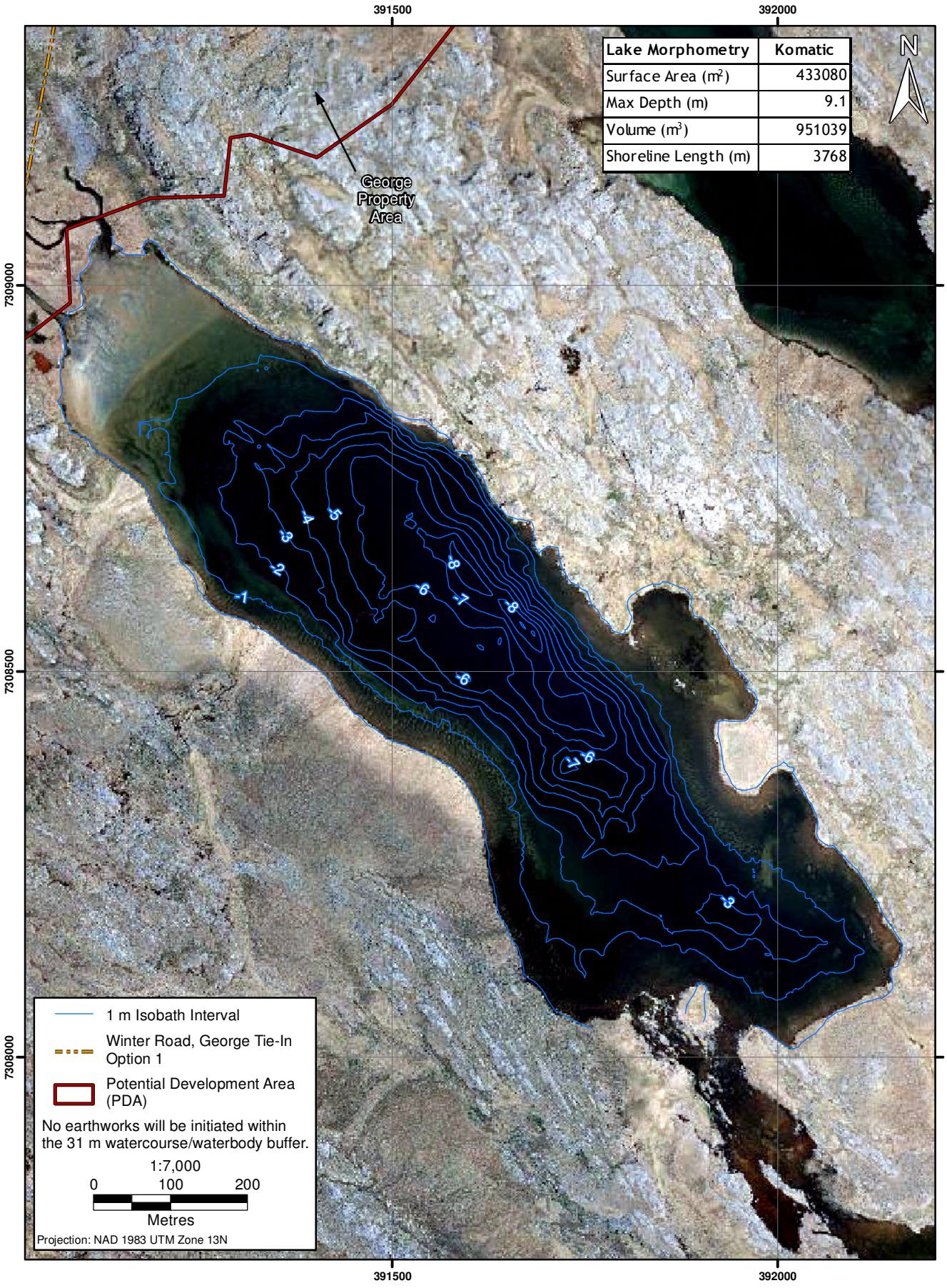


Sabina GOLD & SILVER CORP.

Bathymetry of McCoy Lake, Back River Project, 2013

Figure V6-3D-23

Rescan an ERM company

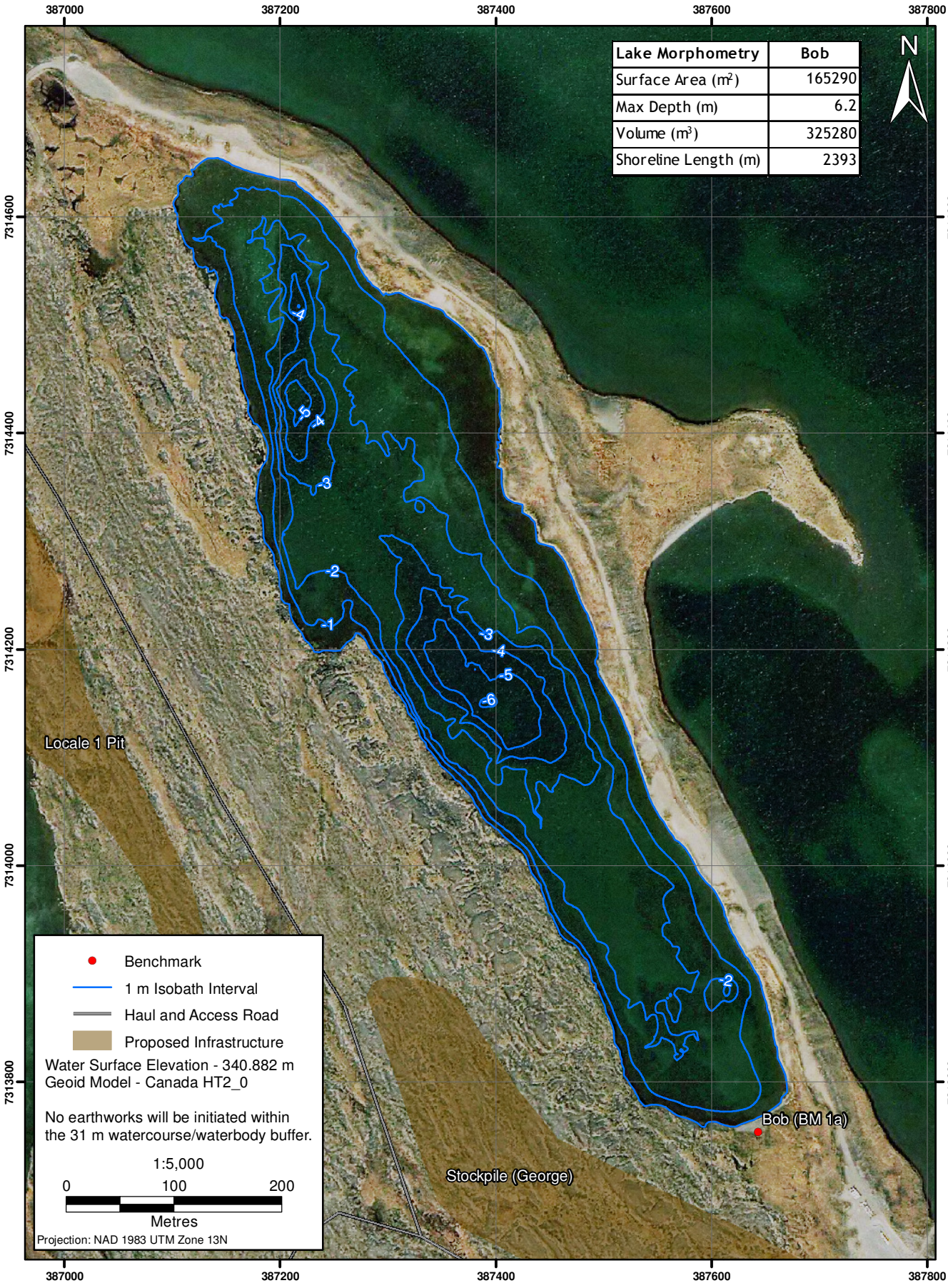


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Bathymetry of Komatic Lake, Back River Project, 2013

Figure V6-3D-24

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Bathymetry of Bob Lake, Back River Project, 2013

Figure V6-3D-25

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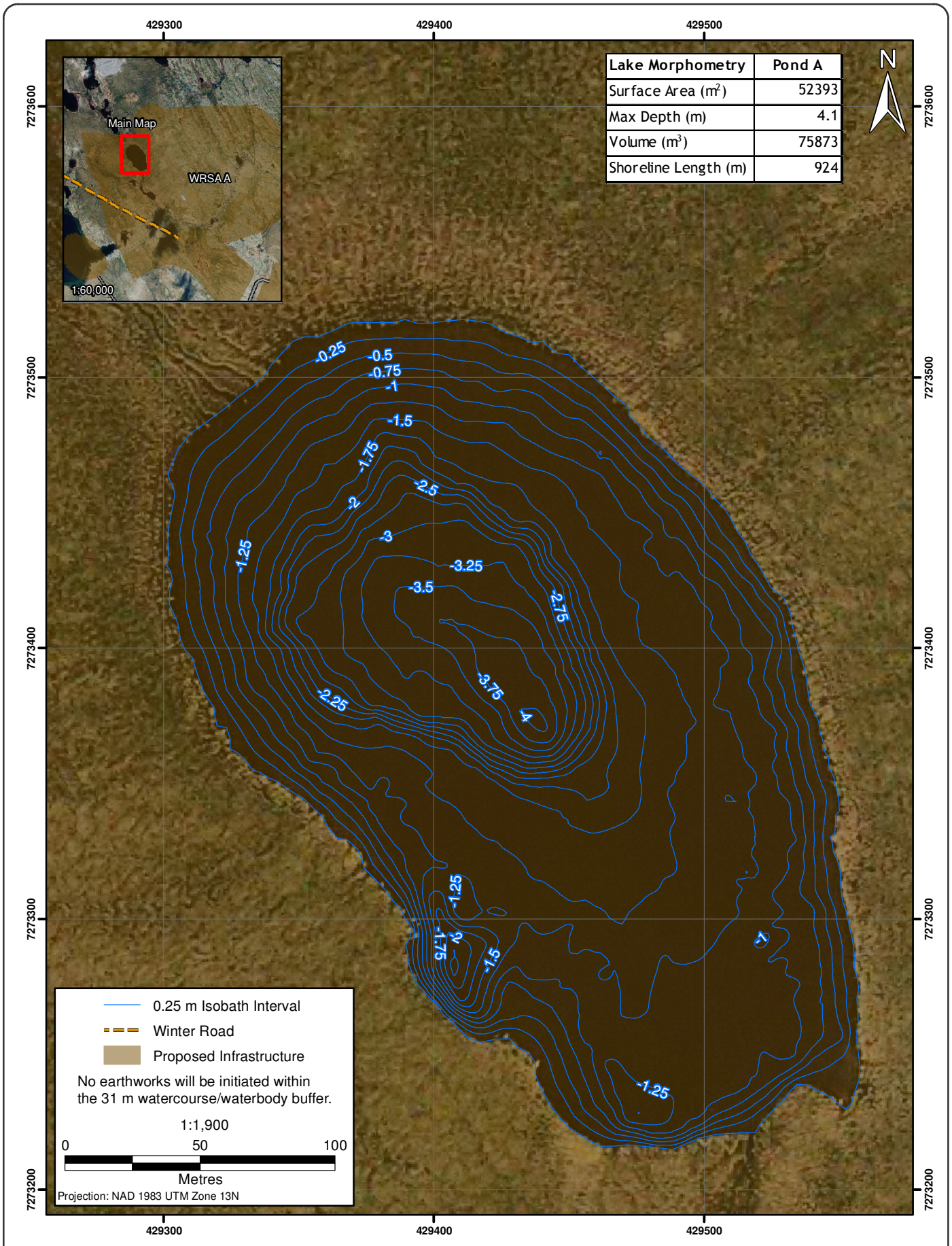


Figure V6-3D-26

Bathymetry of Pond A, Back River Project, 2013

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Lake Morphometry	Propeller
Surface Area (m^2)	12647951
Max Depth (m)	17.1
Volume (m^3)	52652320
Shoreline Length (m)	34351

Goose Property Area

5 m Interval Isobath
1 m Interval Isobath
Potential Development Area (PDA)

1:24,000

0 500 1,000
Metres

Projection: NAD 1983 UTM Zone 13N

Figure V6-3D-27

Sabina GOLD & SILVER CORP.

Bathymetry of Propeller Lake, Back River Project, 2013

Figure V6-3D-27

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REFERENCES

Rescan. 2011. *Back River Project: 2010 Lake Water and Sediment Quality Baseline Report*. Prepared for Sabina Gold & Silver Corp.: Vancouver, B.C.

Rescan. 2012. *Back River Project: 2011 Freshwater Baseline Report*. Prepared for Sabina Gold & Silver Corp.: Vancouver, B.C.

Rescan. 2013a. *Back River Project: 2012 Freshwater Baseline Report*. Prepared for Sabina Gold & Silver Corp.: Vancouver, B.C.

Rescan. 2013b. *Back River Project: 2013 Freshwater Baseline Report (in preparation)*. Prepared for Sabina Gold & Silver Corp.: Vancouver, B.C.

Appendix V6-3E

Geophysical Survey — Sabina Back River Project

Rescan™
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Geophysical Survey
Sabina Gold & Silver Corp.
Back River

File V33103008-01.E111
October 7, 2013

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PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
Signature
Date October 8th, 2013
PERMIT NUMBER: P 018
NWT/NU Association of Professional
Engineers and Geoscientists

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APPENDICES

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APPENDIX B: DFO REPORTS

1.0 INTRODUCTION

1.1 GENERAL

Tetra Tech was retained by Sabina Gold & Silver Corp. (Sabina) to conduct a geophysical investigation at the company's Back River pro ect, based out of Sabina's Goose Lake camp approximately 500 km northeast of Yellowknife, NT, Canada. The geophysical field program, consisting of ground penetrating radar profiling by snowmobile, was carried out by Mr. James Mickle, P.Geoph., and Mr. Gordon Brasnett, Geoph.I.T., of Tetra Tech. The field program was conducted between April 23 and April 29, 2013 and included three main components:

- a ground penetrating radar-based bathymetric survey of three lakes near the Goose Lake camp to calculate under-ice free water volume, for DFO winter water-withdrawal permitting purposes (referred to in this report as DFO Surveys);
- a ground penetrating radar-based ice thickness and bathymetric survey along several proposed winter road (i.e., ice road) routes between Sabina's Goose Lake and George Lake camps and Bathurst Inlet (referred to in this report as the Winter Road Survey); and
- a ground penetrating radar survey of Bathurst Inlet in an attempt to identify areas of grounded sea ice in the vicinity of the proposed winter road alignment

This report details the fieldwork methodology and graphically presents the results of the geophysical investigations.

2.0 THEORY

2.1 GPR THEORY

A ground penetrating radar (GPR) unit operates on the same principles as conventional radar systems used for air traffic or speed enforcement purposes, but is directed into the ground, rather than the air. In basic terms, an electromagnetic (EM) pulse of extremely short duration is transmitted downwards into the ground from a transmitter antenna, is partially reflected from multiple subsurface objects, and the reflections are detected at the receiver antenna, which accurately records their travel time. A series of these soundings, taken at known intervals along a line, builds up a cross-sectional profile of the reflections within the medium, beneath the profile line.

As the EM wave propagates through the ground, it encounters and passes through materials having specific physical properties. The two important properties in radar surveys are the dielectric permittivity and electrical conductivity of the various materials.

The dielectric permittivity (whose ratio to that of empty space is called the material's dielectric constant') affects the velocity of the EM wave within that material. At interfaces having different dielectric constants, a reflection occurs, the magnitude of which is proportional to the contrast in permittivity. Ice, for instance, typically has a dielectric constant of approximately 4, while air has a dielectric constant of 1, and water has a dielectric constant of 80. Furthermore, the magnitude of the reflection is also a function of how sudden the change is in dielectric permittivity generally, a sharp change will produce a stronger reflection than a gradual change. Thus, a very strong reflection occurs at the interface between the bottom of floating ice and the water beneath it. A moderately strong reflection typically occurs at the water bottom, where the EM wave encounters a sudden change from water to saturated sediments. Similarly, a moderate reflection often occurs at the interface where ice is frozen to solid ground.

The other physical property of concern, electrical conductivity, serves to attenuate the radar pulse. When a high-frequency EM pulse encounters an electrically-conductive material, it induces electrical currents within that material that are proportional to the pulse's frequency, removing energy from the pulse. In practical terms, this means that electrically conductive materials (such as saltwater) are impossible to penetrate with GPR and that higher radar frequencies, while providing better resolution, are attenuated more easily than lower frequencies.

The result of a GPR survey is typically a collection of profile lines. These cross-sections consist of all the individual GPR soundings (or traces') acquired on a particular profile displayed next to each other. The trace number represents the location along the profile line at which the trace was collected and the distance down the trace represents the time it took for any particular reflection to be detected after the pulse transmission. This time is proportional to the depth below grade at which the reflection occurred, as well as the velocities of the materials through which the EM pulse travelled. Knowing the time it took until each reflection was received and the velocity of the EM wave in the subsurface, the depth to the various reflectors can be determined. Additionally, when GPS positioning is collected along with the GPR data, each trace has a real-world coordinate associated with it.

2.2 THROUGH-ICE GPR BATHYMETRY

GPR is a very useful tool for through-ice fresh water bathymetric surveying. As mentioned above, the difference in dielectric permittivities between fresh water and the lake bottom is relatively high and the transition is abrupt, typically resulting in a strong, easy to identify reflection in the dataset. In addition, ice and clear fresh water are low-loss materials to GPR signals and therefore the GPR bathymetry data can be collected through the ice surface during the winter months. Undulations in the ice thickness, however, will lead to amplified apparent undulations in the bathymetry for instance, for each centimetre that the ice thickness decreases, the water depth will appear to increase by 4.5 cm, and vice versa. By simultaneously collecting ice-thickness and water depth GPR datasets along the same track, the larger ice thickness undulations can be identified and the resulting artificial undulations in the bathymetric data can be corrected.

3.0 SURVEY METHODOLOGY

3.1 UNDER-ICE LAKE VOLUME ("DFO") SURVEYS

The GPR system utilized in the survey was a Mala Geosciences Ramac CUII system using an unshielded 50MHz rough terrain antenna. The GPR system was set to acquire 10 radar traces per second, while the antennas were towed behind a snowmobile at a speed of approximately 15 km/h. This yielded an average horizontal data density of 2.4 scans per metre, or 42 cm spacings. All GPR data was recorded using Mala's GroundVision software and saved to a field laptop. Real time positioning of the data was achieved using a Topcon GPS/GLONASS unit operating in autonomous mode, with positions recorded once per second. Positions were integrated with the GPR data as it was collected.

Handheld GPS units with pre-programmed survey grids were used for navigation purposes during data acquisition. The exact survey profile location was a function of terrain and other obstacles encountered while acquiring the GPR data.

In total, 76 km of GPR data was collected during the DFO surveys: 14 km on Wolf Lake, 60 km on Propeller Lake and 2 km on Leaf Lake, which had respective grid line spacings of 450 m, 450 m and 200 m.

3.2 WINTER ROAD SURVEY

The Winter Road Survey was performed in much the same manner as the DFO Surveys, with the addition of a second Ramac CUII GPR unit towed behind a snowmobile while following the first system. The second system used a shielded 500 MHz antenna to measure ice and snow thickness, and had its own Topcon GPS/GLONASS unit to provide positioning information once per second.

In total, approximately 200 km of ice and bathymetry GPR data was collected, divided into four datasets: Goose Camp to George Camp (65 km, taking the southern route from the junction), George North (13 km, heading south-east from George Camp to the northern junction), Bypass Southbound (16 km, collected from the northern junction to the southern junction), and Junction to Bathurst (75 km, collected from the northern junction to the south edge of Bathurst Inlet). Data was collected along a single profile track along each of the routes. The Goose Camp to George Camp route started approximately 5 km NW of Goose Camp, due to a lack of water body crossings along the proposed route in the omitted area. The current proposed road route goes around the lake on land at Goose Camp.

Because the depths of the lakes to be encountered along the winter road route were completely unknown prior to the program, the bathymetry system was initially set to acquire approximately 10 m of water depth. At some point on the first day, between Goose and George Lakes, it was discovered that this depth had been exceeded at one point, meaning the water bottom reflection temporarily dropped off the bottom of the GPR profile, and thus no conclusive water depth could be determined at this one location (although it can be conclusively stated that the water at this location is at least greater than 10 m deep). The bathymetric system was then adjusted to acquire approximately 15 m of water depth and remained at this setting for the remainder of the program, with the exception of Bathurst Lake. It was reasoned that 15 m struck the best compromise between obtaining good vertical resolution at the shallower depths (as shallow water is often more likely to cause issues related to ice road operation), while providing as complete a record as possible of the deeper lake bottoms. The ice GPR system was configured to maximize the resolution of the ice-water interface, at an average depth of approximately 1.8 m.

It is not anticipated that these scaling adjustments compromise either the validity of the water depth data for DFO purposes or the accuracy of the ice profile data.

3.3 BATHURST INLET SURVEY

Although GPR signals cannot penetrate through saltwater to map bathymetry (due to the high conductivity of saltwater), GPR can be used to successfully identify areas of grounded sea ice. The ice overlying the solid ground generally has low conductivity, and therefore the signal is not significantly attenuated and is able to penetrate through and reflect off the frozen ground. As explained in Section 2.1, a moderate reflection often occurs at the interface between ice and solid ground (grounded ice).

Survey lines were run perpendicular to the shoreline of Bathurst Inlet in the vicinity of the proposed alignment with the objective of identifying which areas had grounded ice and locating the transition between grounded ice and floating ice.

4.0 DATA REDUCTION AND RESULTS

4.1 DFO SURVEYS

For each lake, the data was gained and filtered to best accentuate the lake bottom reflections. Layback corrections were applied to shift the GPS positioning back to account for the fact that the GPS units were mounted on the back of the snowmobiles, some distance forward of the GPR antennas, which were towed behind the snowmobiles. The lake bottom was then digitized in the GPR records; lake depths were compared where grid lines intersected crosslines. An excellent match was observed at all such intersection points. Finally, depths were calculated using a standard radar wave velocity in water of 0.0333 m/ns. Following the DFO protocol for determining under-ice water volumes for areas north of the tree line, the GPR-derived depths were adjusted to account for 2 m of ice cover.

Lake outlines (representing a water depth of zero) were merged into the GPR-derived results, and the resulting dataset was then contoured for display as colour contour plots. It is important to note that in addition to the lake outlines, areas of grounded ice were also included in this dataset to prevent the Kriging contouring algorithm from extrapolating water depth contours into areas that were known to be grounded.

Standalone DFO reports outlining the results of the surveys were provided to Sabina on May 30, 2013 via email. A copy of these reports has been included in Appendix B for convenience. The main points of interest regarding the lake surveys are outlined in sections 4.1.1 through 4.1.3 below.

4.1.1 Wolf Lake Note

Wolf Lake consisted of three distinct basins, all of which were isolated from each other by grounded ice, as illustrated in figure Wolf-02 of Appendix B. Since the intention of the DFO water withdrawal protocols is to avoid over-use of water in a lake, this information should be kept in mind if/when withdrawing water from a particular location in the lake. The largest of the three reservoirs of water is located in the southern half of the lake.

4.1.2 Propeller Lake Note

Information made available to Tetra Tech prior to conducting the GPR bathymetry program was that the maximum expected lake depth in Propeller Lake was 7.8 m. In order to maximize the vertical resolution of the GPR records, the GPR system was set to acquire just slightly more than this depth, approximately 9 m worth of bathymetry. However, in one region, the lake bottom unexpectedly fell off the bottom of the GPR profile (location indicated in figure Propeller-02 in Appendix B). This wasn't noticed until several days later, when Tetra Tech personnel were out of the area, making a re-survey of the appropriate profile lines impractical. The area in question encompasses approximately 16.4 ha, or 1.28% of the entire surface area of the lake. Assuming an average undocumented additional depth of 2 m (ie. the lake in this region is 2 m deeper than the bottom of the GPR record), this would represent a volume underestimate of approximately 329,000 m³, or 1.22% of the total available water volume. The volume reported herein is the lesser amount, ie. assuming the lake bottom to be the maximum proven depth obtained from the GPR.

4.1.3 Leaf Lake Note

Leaf Lake is a relatively small lake, only 635 m in length and 350 m in width. The absolute accuracy of its outlines (and indeed of many of the small- and medium-sized lakes in the remote arctic region) on GPS mapping software is dubious. However, in the absence of any other high-resolution GPS route-planning resources, this mapping software was used to create the DFO survey tracks prior to Tetra Tech's mobilization to site. Once on-site, in instances where there was an obvious discrepancy between where the GPS maps indicated the edge of the lake to be and what was visually distinguishable as the lake edge, the survey lines were extended/moved based on where the edge of the lake was visually obvious. In the case of Leaf Lake, it appears that the survey grid was shifted south by approximately 100 m, but due to snow cover and a lack of any visually identifying features, it was not obvious in the field that this was the case. In practical terms, this means that the north end of the lake was not fully profiled, while the GPR survey proceeded onto dry land on the south end.

4.2 WINTER ROAD SURVEY

The bathymetric GPR data was processed in the same manner as that obtained in the DFO survey. As before, the lake bottom was identified and digitized in the GPR records. Since the ice-water interface is typically very strong and clear, as discussed in Section 2.1, the second GPR dataset, representing the ice thickness record, required very little processing. The ice-water interface was identified and digitized, as was the ice-ground interface (i.e., where the lake had frozen down to the bottom). Custom processing routines developed by Tetra Tech were used to merge the ice and bathymetry datasets together and remove the ice's influence from the bathymetric record (as discussed in Section 2.2). Additionally, the grounded ice identification was used to supplement the bathymetric data, as the bathymetric GPR unit was generally unable to resolve this interface.

Due to the settings used for each GPR instrument, it is often difficult to identify the lake bottom if it lies immediately beneath the ice-water interface. In some areas, the lake bottom is faintly visible in the GPR ice record, but not always. Typically, when the lake became shallower than approximately 2.2 m, it became difficult or impossible to identify its reflection in the bathymetric record. This in of itself is useful information, as for water withdrawal purposes it indicates that the lake is unsuitable unless dissolved oxygen readings are taken which demonstrate that the lake is not fish habitable.

Results of the winter road survey are presented in Figures A1 through D11.

4.2.1 Winter Road Survey Notes

In Figures A10.4 through A10.8, the lake bottom data is intermittent this was caused by a dying GPR transmitter battery, which went unnoticed until later that day.

The lake bottom reflector drops off the bottom of the GPR record in Figures A11.9 & A11.10 (GPR set to record 10 m of water depth), C2.2 & D3.4 (GPR set to 15 m) and numerous pages of D11 (Bathurst Lake) (GPR set to 50 m, but only seeing to a maximum depth of 28 m).

In Figure D12.1 the majority of the lake bottom has not been marked this is due to a bathymetry system malfunction which went unnoticed until later in the day. Select areas of bathymetry have been identified in areas where the lake bottom was visible in the ice data.

In some figures (ie A11.5), there is a slight discrepancy between where the background plan view map indicates that the survey was on land, and where land was actually encountered. Though it was not always visually obvious where the shoreline was, the survey was conducted on ice wherever possible. The discrepancy in the background image is thus simply due to inaccuracies in the map data at this scale.

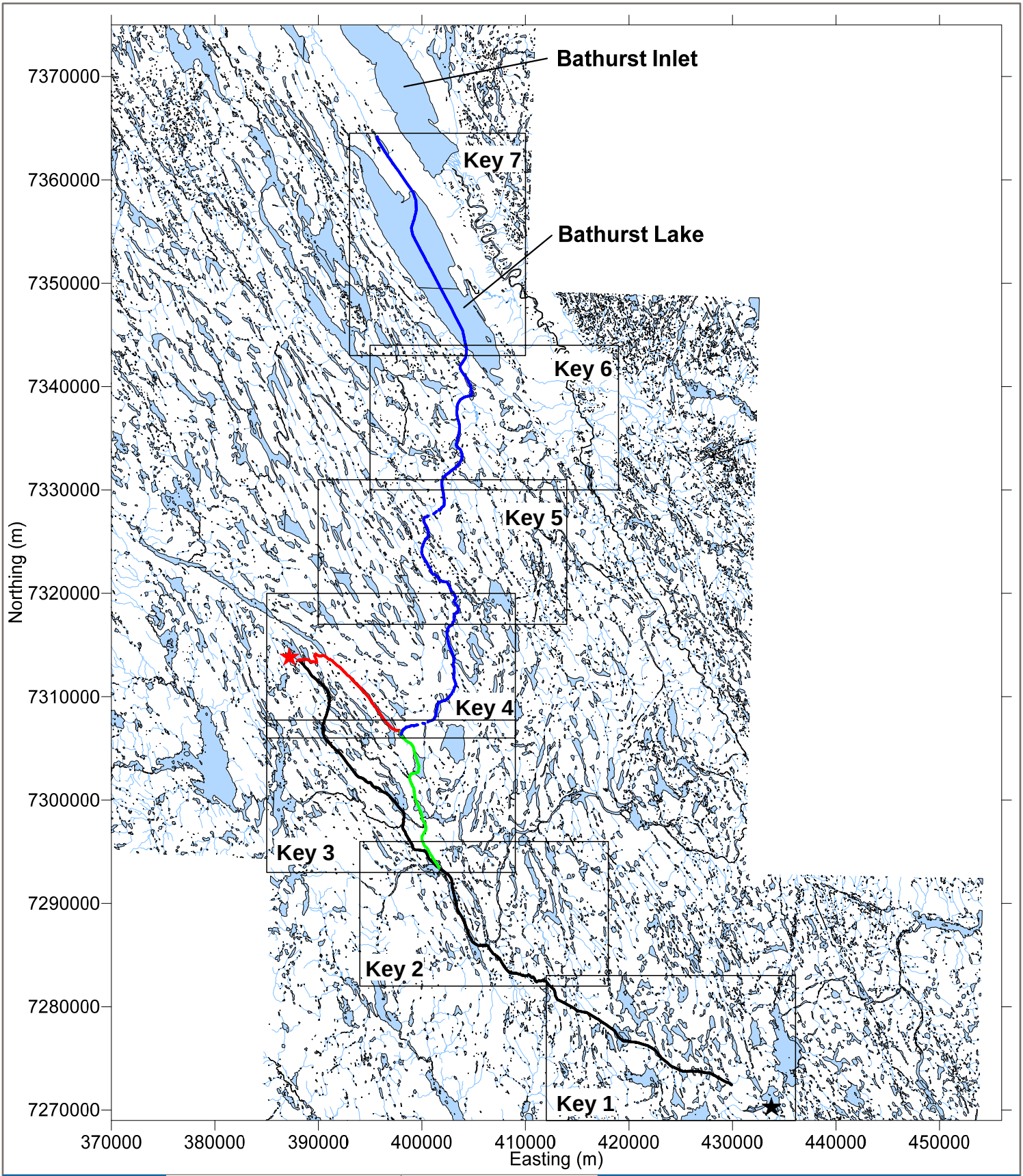
4.3 BATHURST INLET SURVEY

Figure E outlines the results of the Bathurst Inlet Survey in plan map view, indicating areas of grounded versus floating ice cover, where identifiable.

5.0 DATA LIMITATIONS

It should be noted that the results presented in this report are representative of the conditions at the time of data collection (April 23 29, 2013). Ice thicknesses can vary significantly over short periods of time due to changes in conditions such as snow cover or air temperature. The reported ice thicknesses are meant to provide an indication of typical ice characteristics that may be expected along the route under similar conditions. The presented data is not intended for use in any load-bearing capacity calculations.

FIGURES



LEGEND

N

SCALE 1:500,000
NAD83
UTM z13

- Figure Set A
- Figure Set B
- Figure Set C
- Figure Set D
- George Lake Camp
- Goose Lake Camp

CLIENT

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TETRA TECH

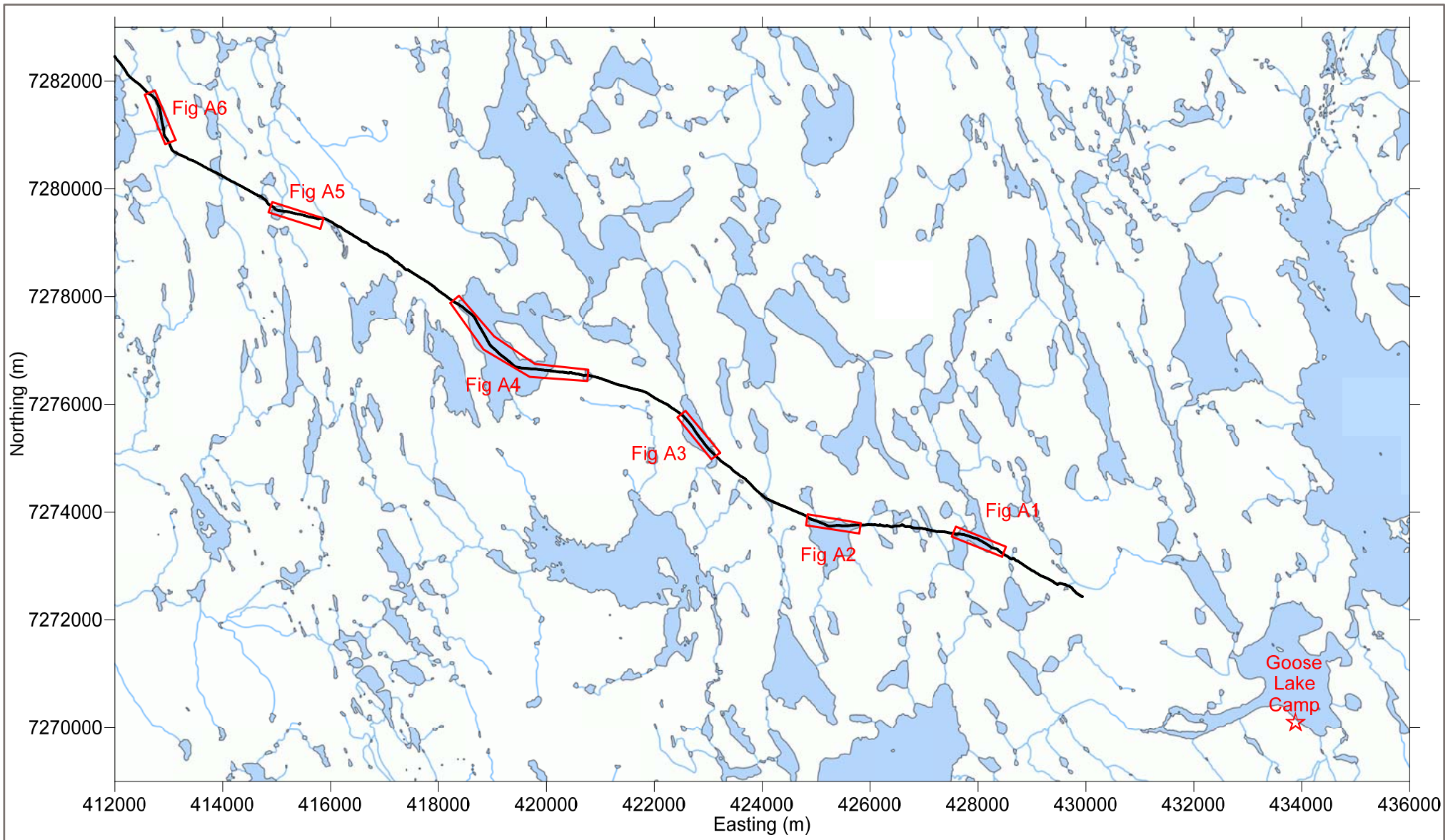
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Back River Project GPR Profiling

Winter Road Option
GPR Profile Survey Overview

PROJECT NO.	DWN	CKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
EBA-EDM	June 15, 2013

Figure 01



LEGEND

N

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NAD83
UTM z13

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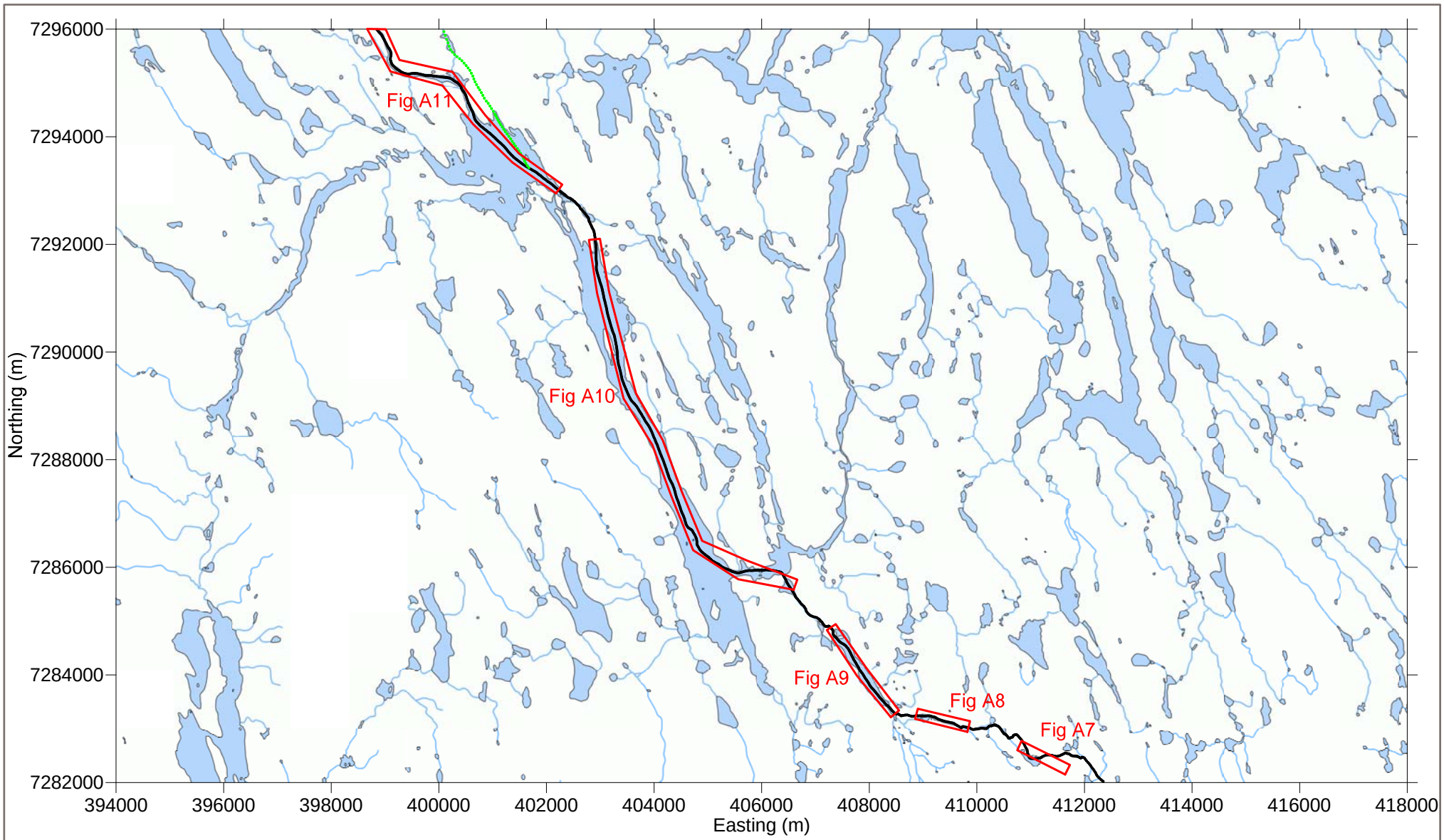
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Winter Road Option
GPR Profiles
Key 1

PROJECT NO.	DWN	CKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure 02



LEGEND

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SCALE 1:100,000
NAD83
UTM z13

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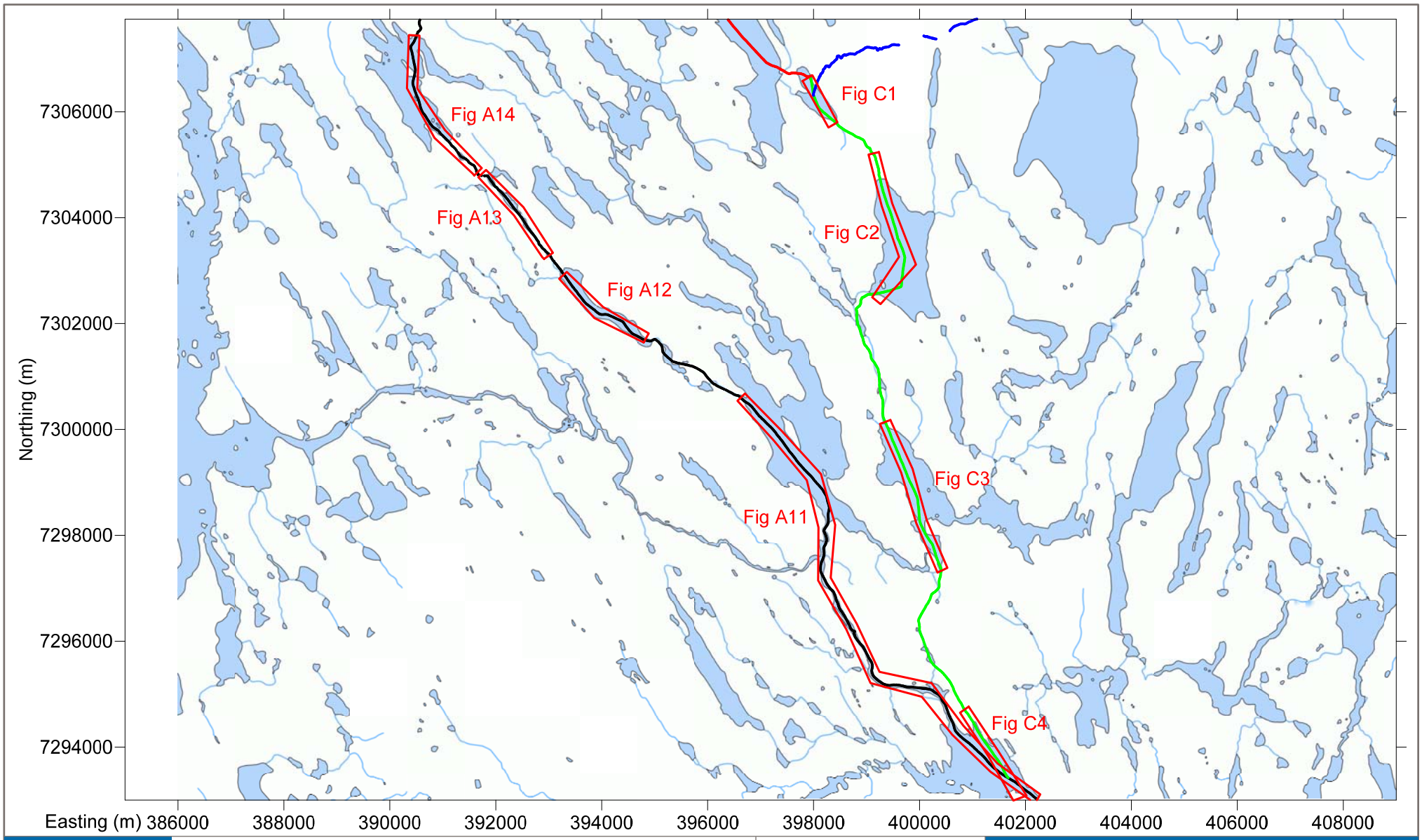
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Winter Road Option
GPR Profiles
Key 2

PROJECT NO.	DWN	CKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
EBA-EDM	June 15, 2013

Figure 03



LEGEND

N

SCALE 1:100,000
NAD83
UTM z13

CLIENT

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TETRA TECH

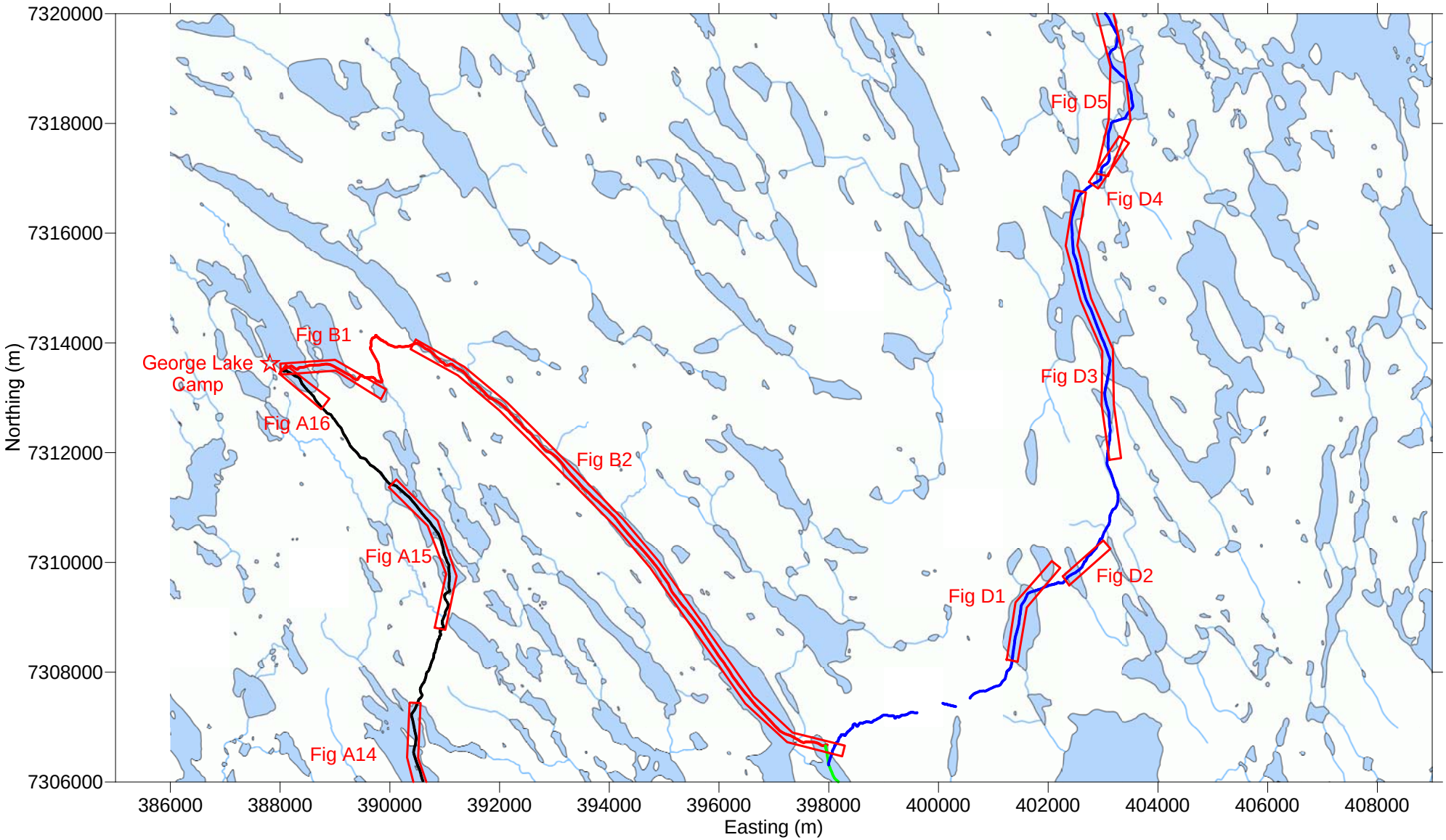
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Winter Road Option
GPR Profiles
Key 3

PROJECT NO.	DWN	CKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
EBA-EDM	June 15, 2013

Figure 04



LEGEND

N

SCALE 1:100,000
NAD83
UTM z13

CLIENT

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TETRA TECH

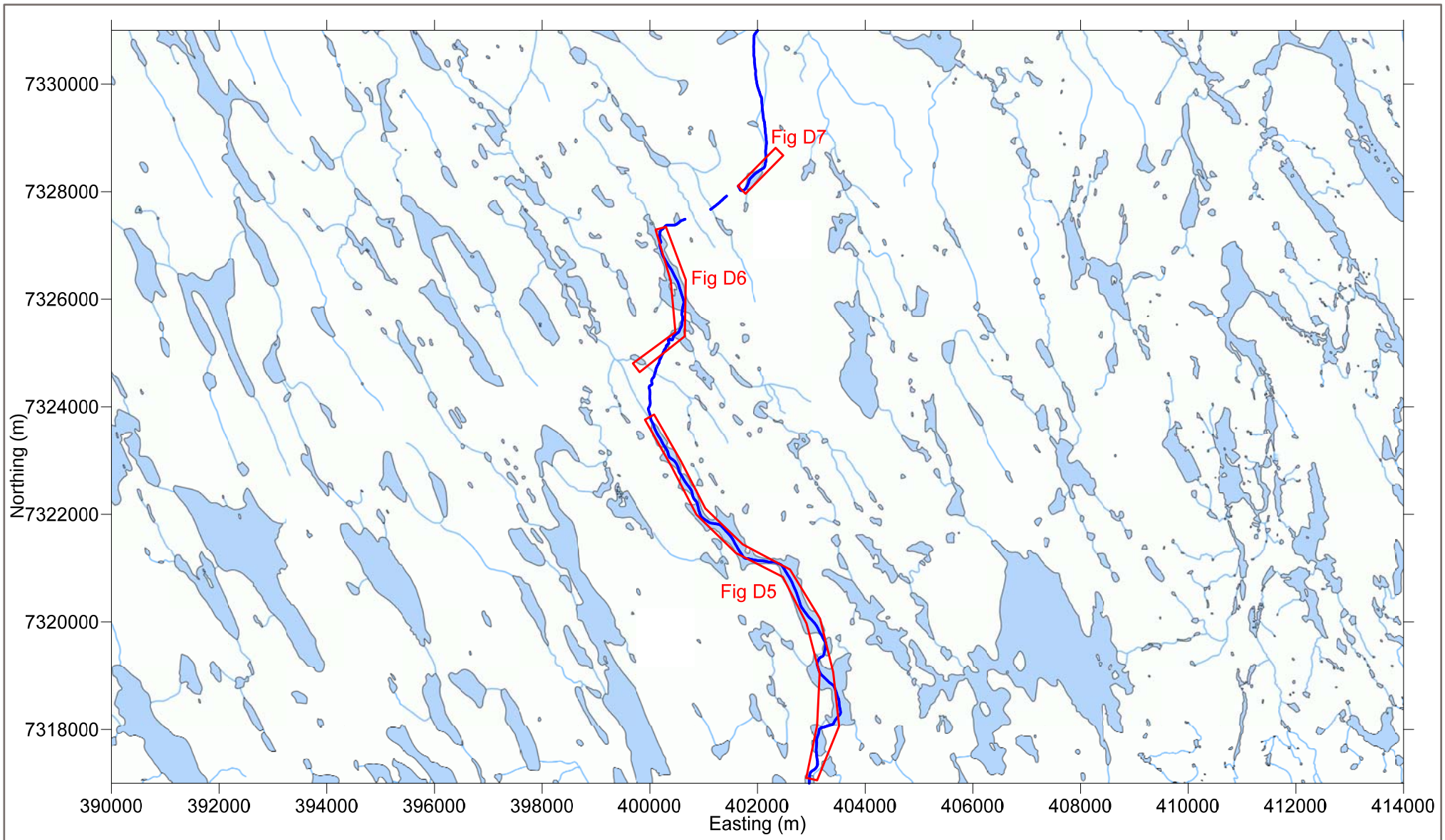
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Winter Road Option
GPR Profiles
Key 4

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V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure 05



LEGEND

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SCALE 1:100,000
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UTM z13

CLIENT

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TETRA TECH

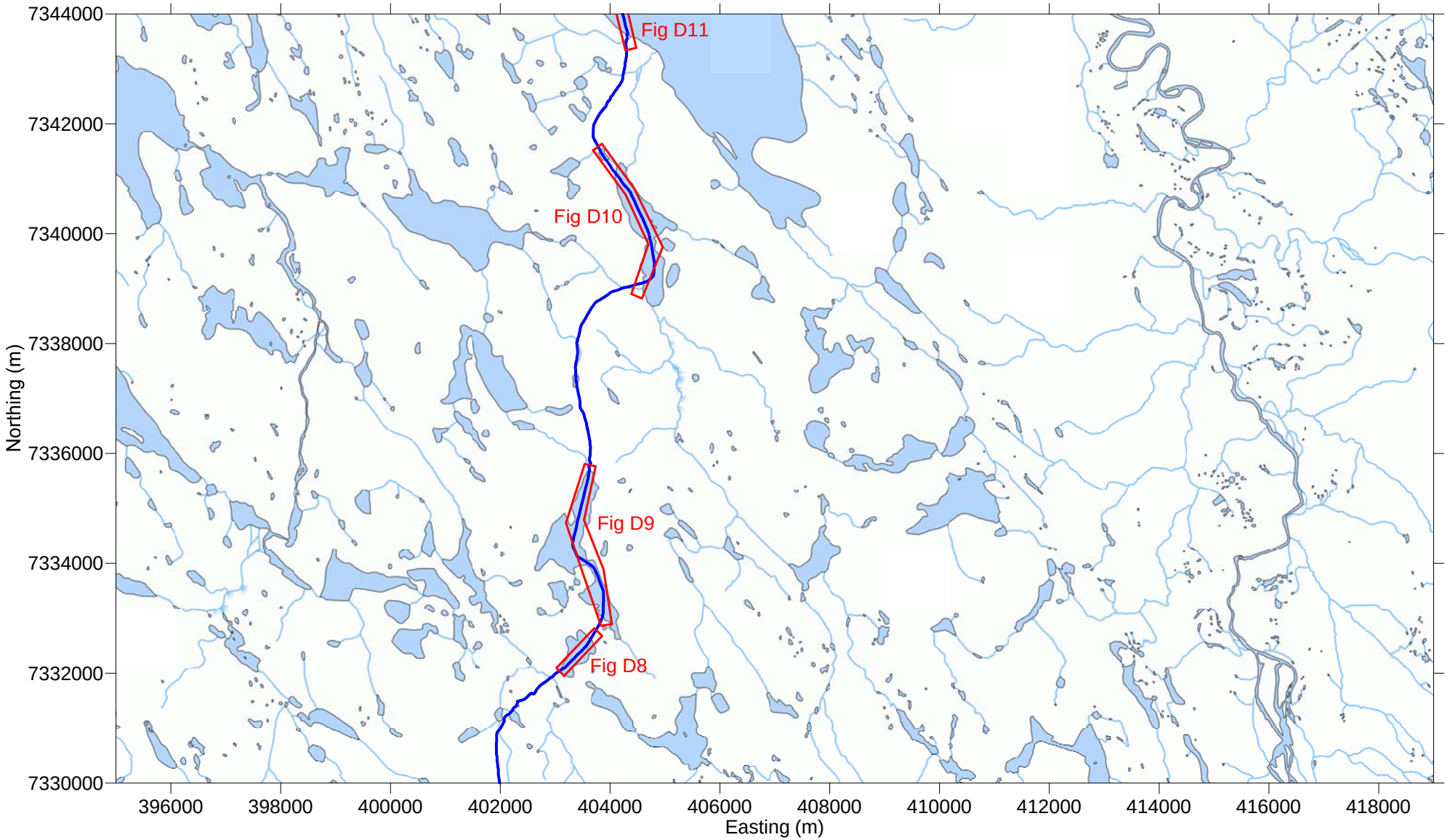
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Winter Road Option
GPR Profiles
Key 5

PROJECT NO.	DWN	CKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure 06



LEGEND

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SCALE 1:100,000
NAD83
UTM z13

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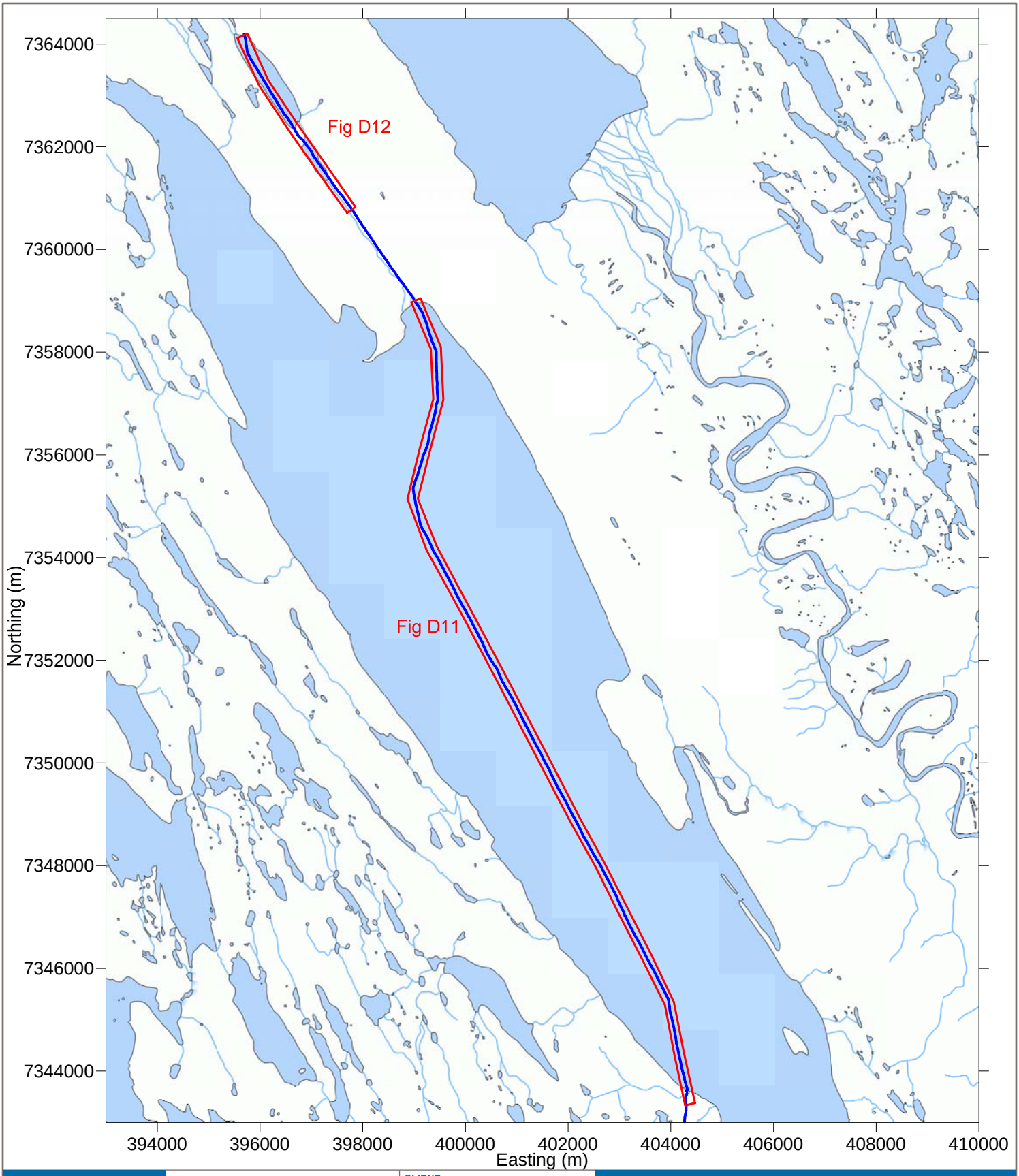
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Winter Road Option
GPR Profiles
Key 6

PROJECT NO.	DWN	CKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
EBA-EDM	June 15, 2013

Figure 07



LEGEND

N

SCALE 1:100,000
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UTM z13

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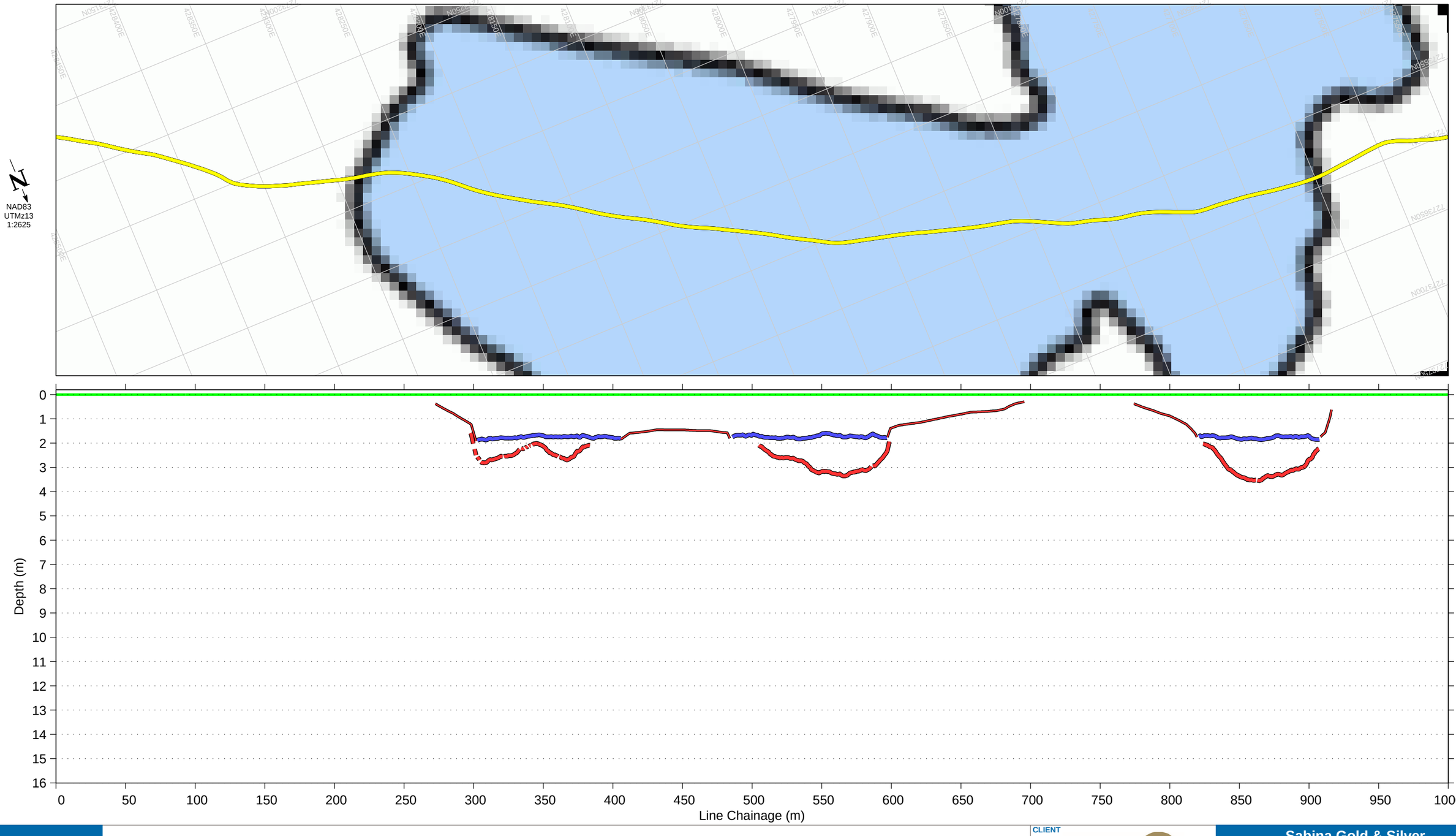
Sabina Gold & Silver
Back River Project GPR Profiling

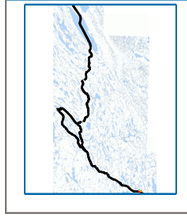
Winter Road Option
GPR Profiles
Key 7

PROJECT NO.	DWN	CKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure 08





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

CLIENT

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TETRA TECH

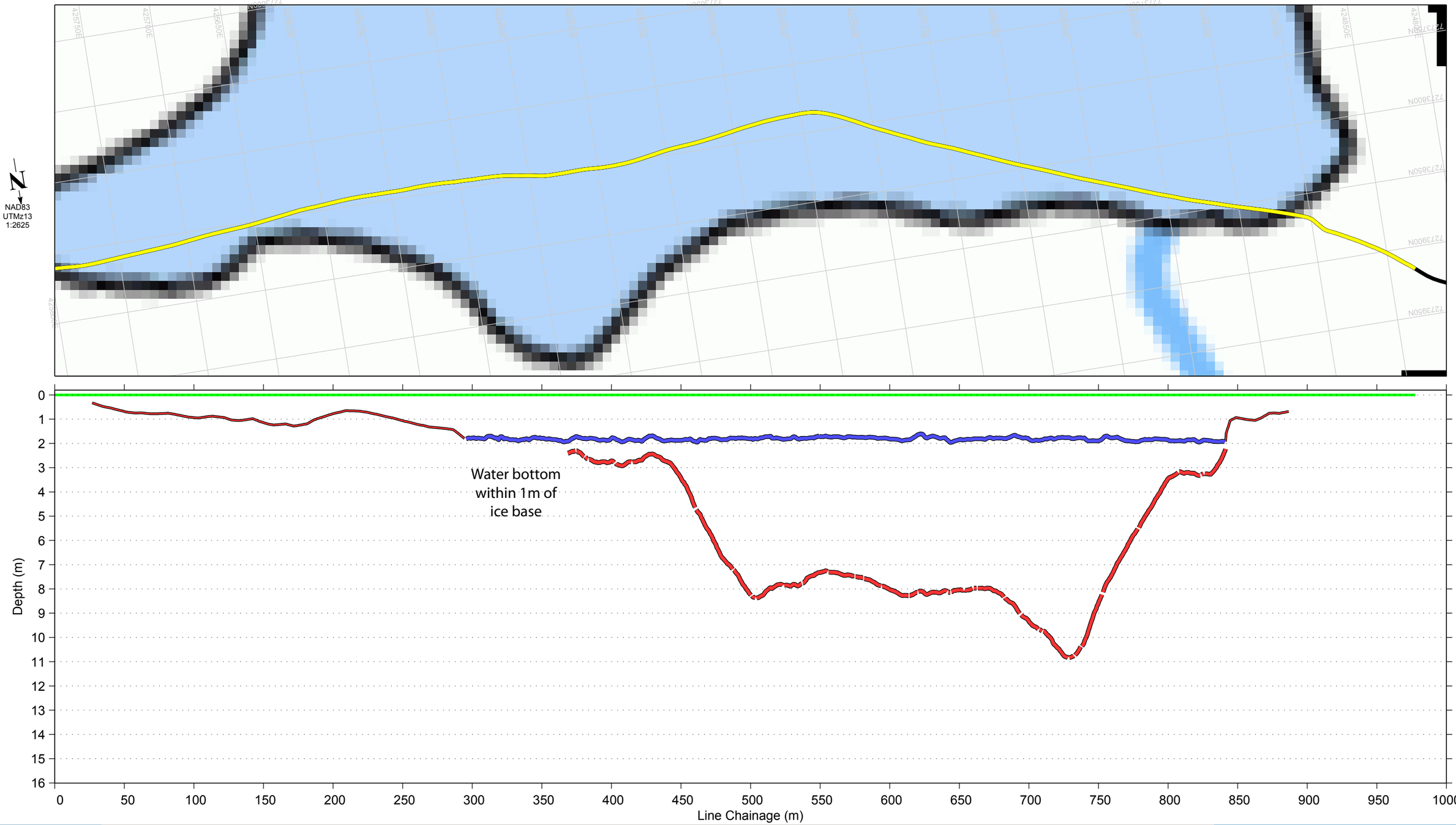
Sabina Gold & Silver
Back River Project GPR Profiling

Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A1





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

CLIENT

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TETRA TECH

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Back River Project GPR Profiling

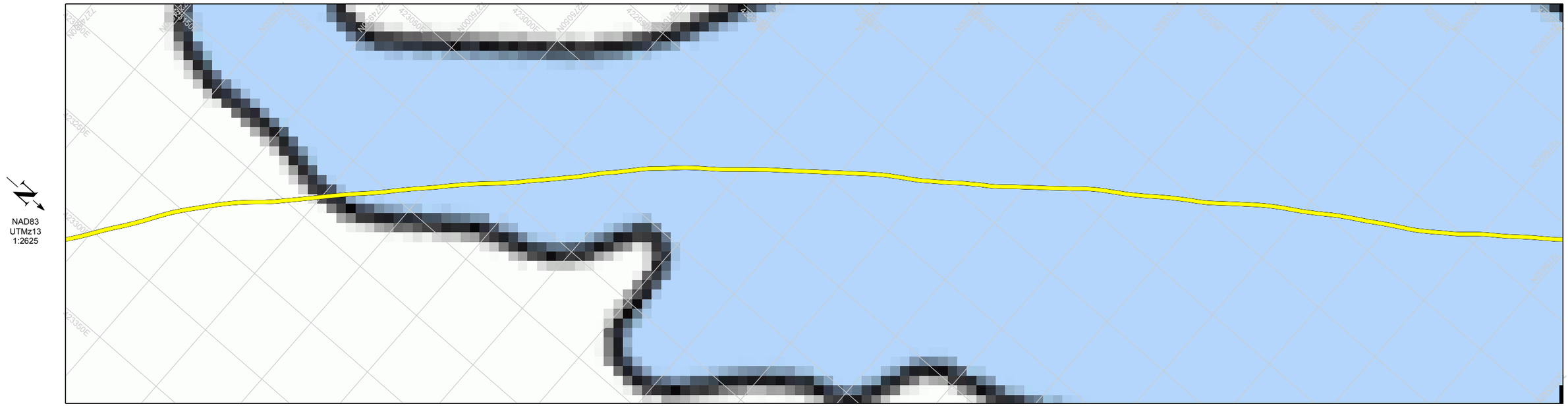
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

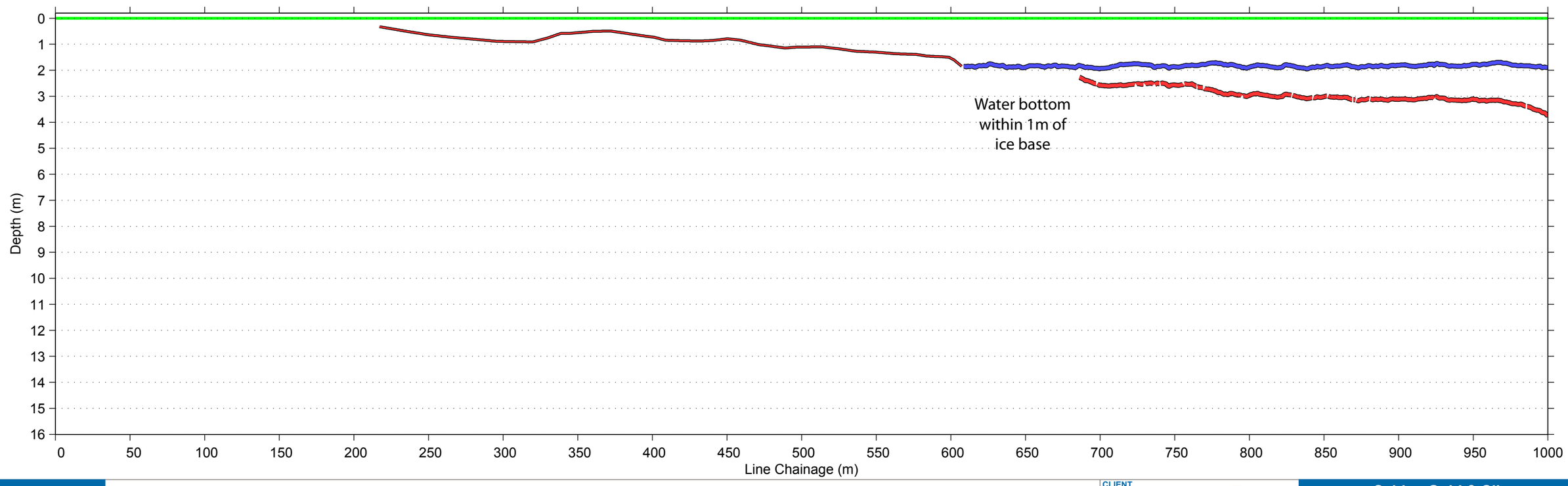
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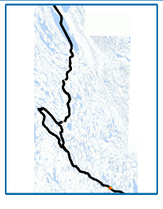
OFFICE: Edmonton

DATE: June 14, 2013

Figure A2







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

CLIENT

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TETRA TECH

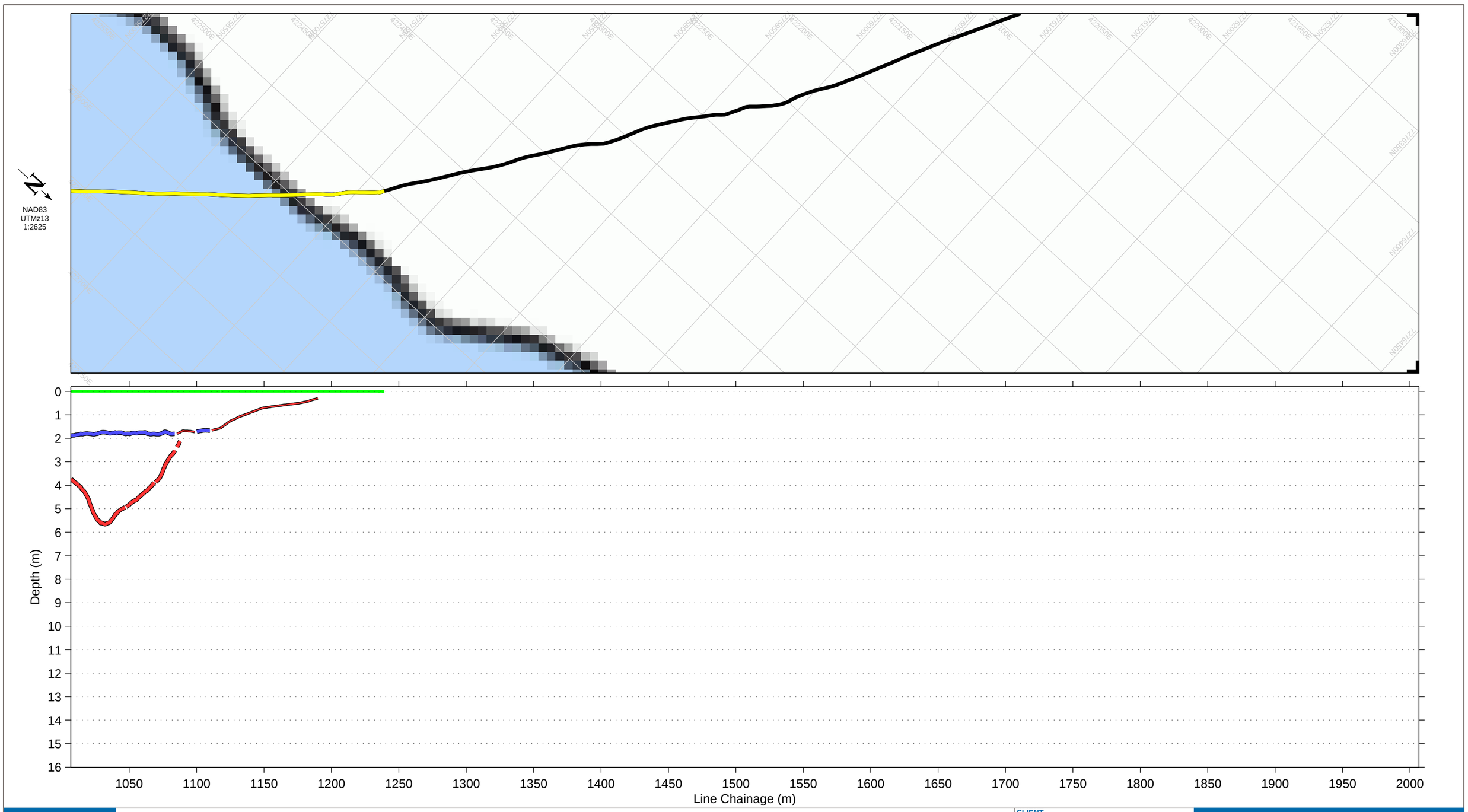
Sabina Gold & Silver
Back River Project GPR Profiling

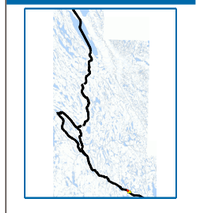
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A3.1





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

CLIENT

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TETRA TECH

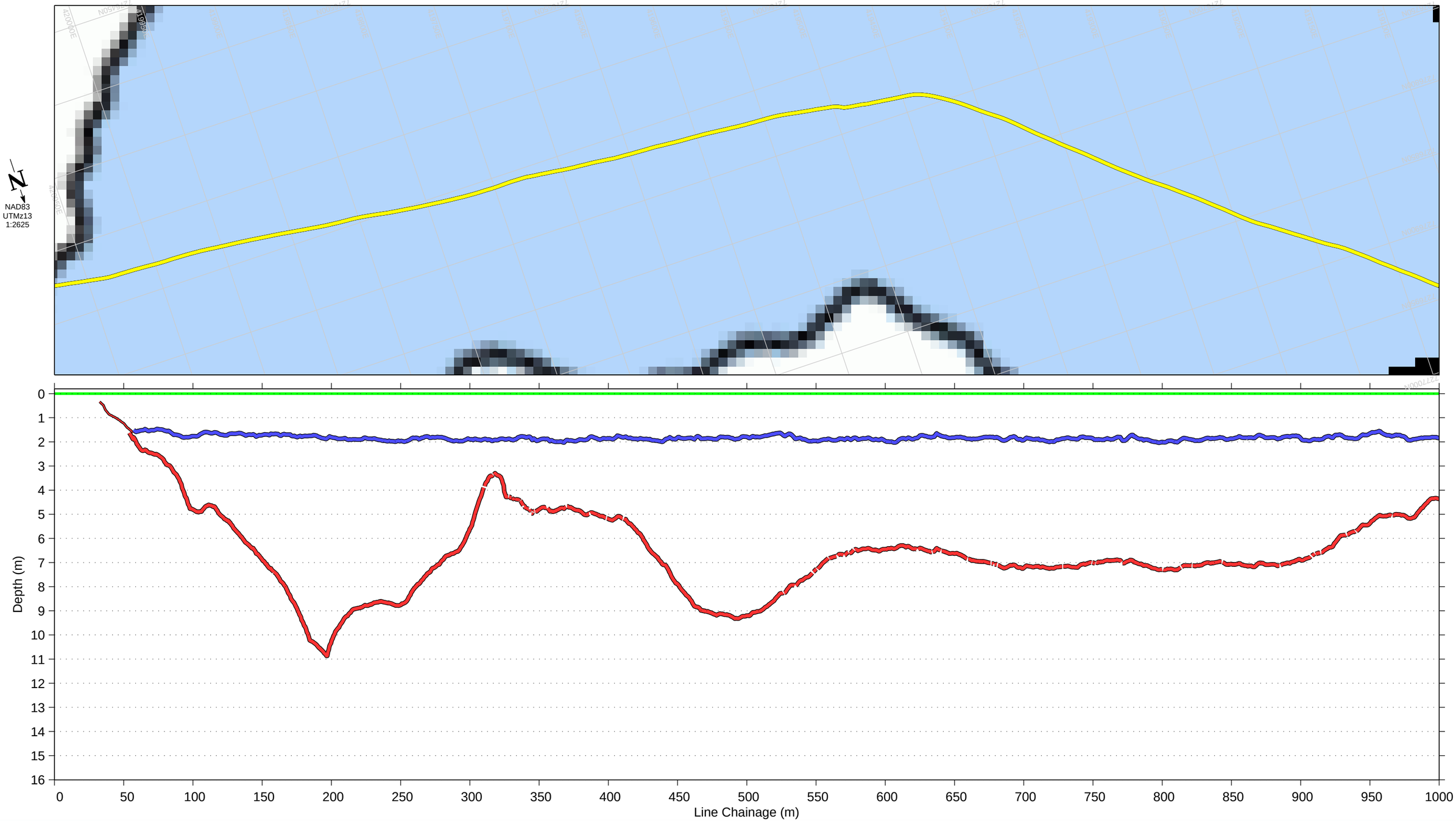
Sabina Gold & Silver
Back River Project GPR Profiling

Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A3.2





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

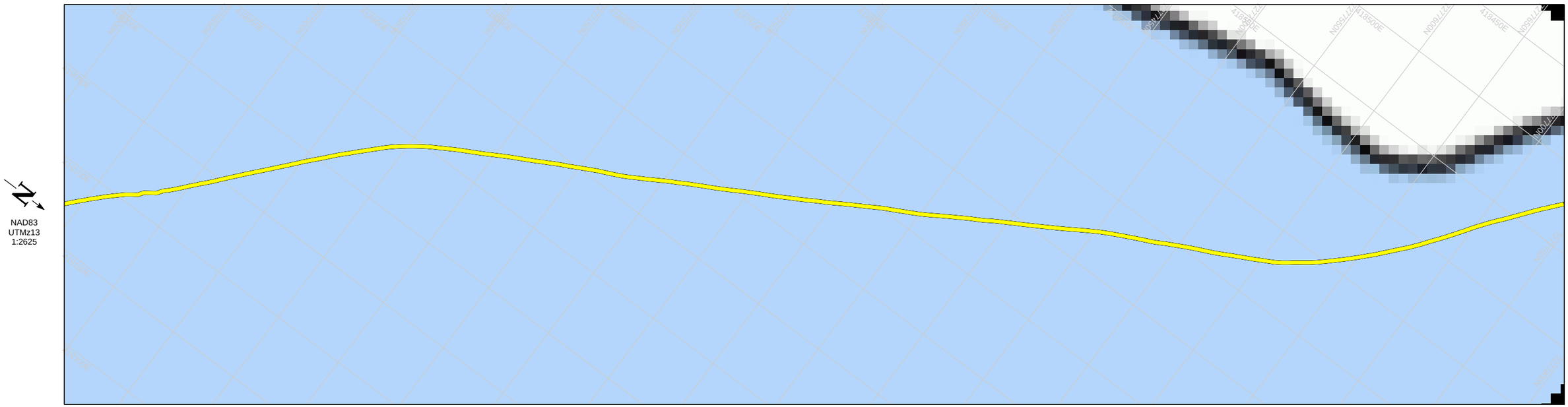
Sabina Gold & Silver
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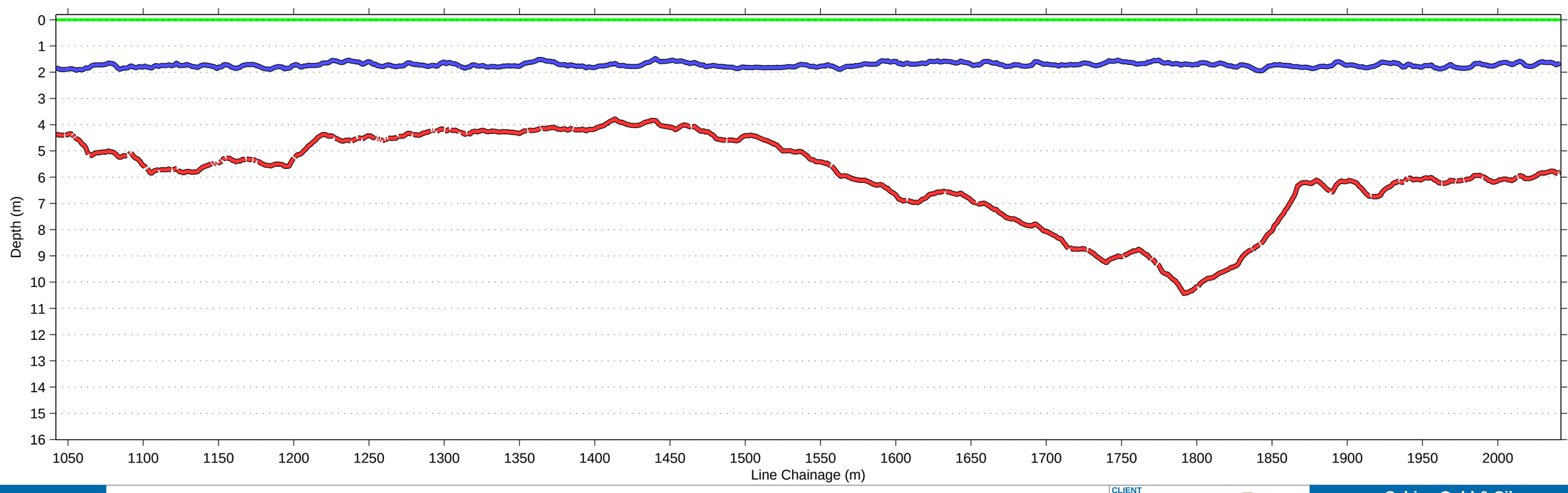
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

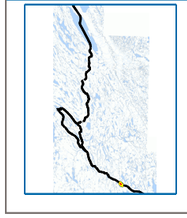
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A4.1







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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V33103008.E111	RJM	CB	RJM	0

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Figure A4.2

NAD83
UTMz13
1:2625

Depth (m)

Line Chainage (m)

LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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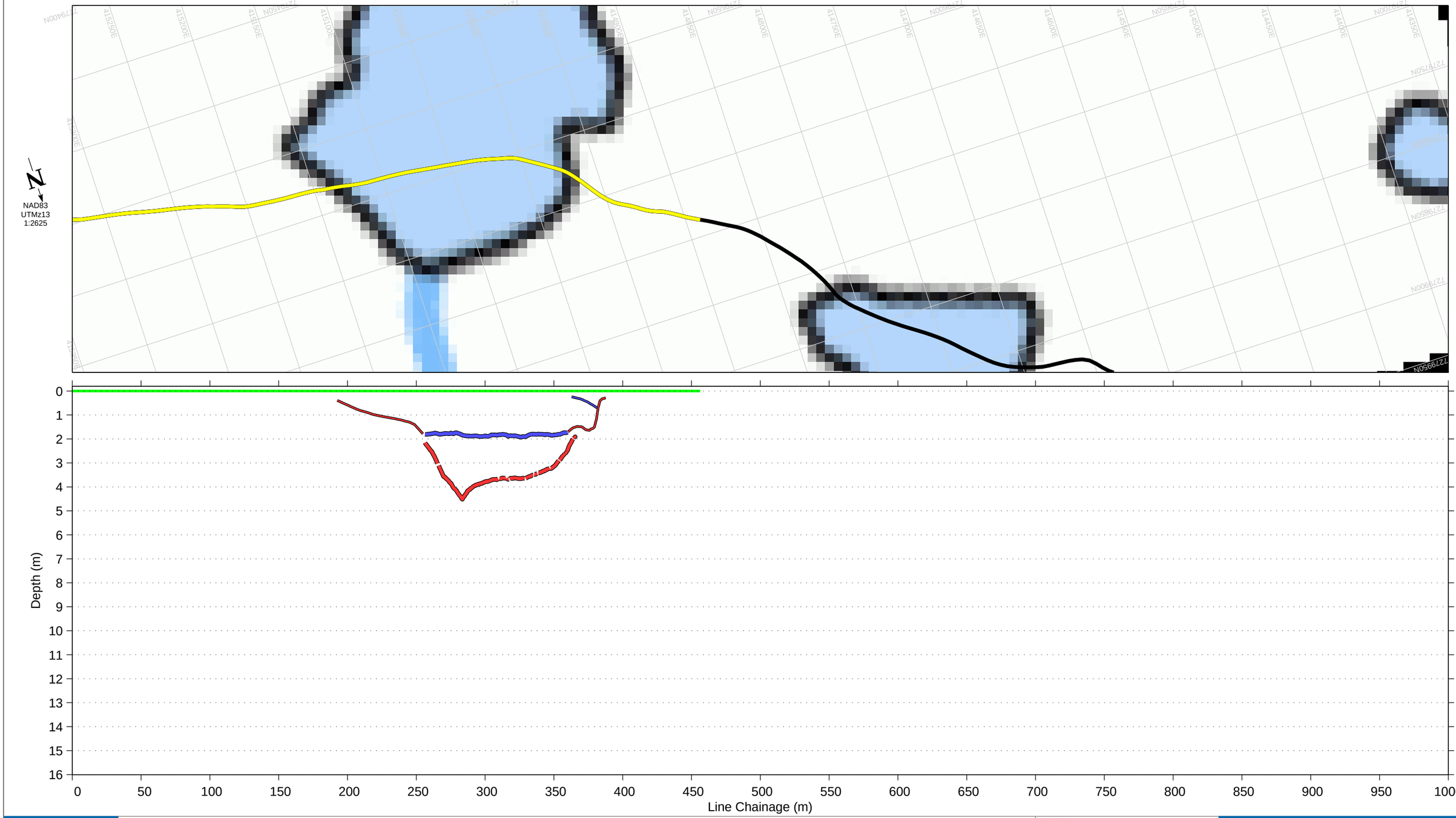
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Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure A4.3





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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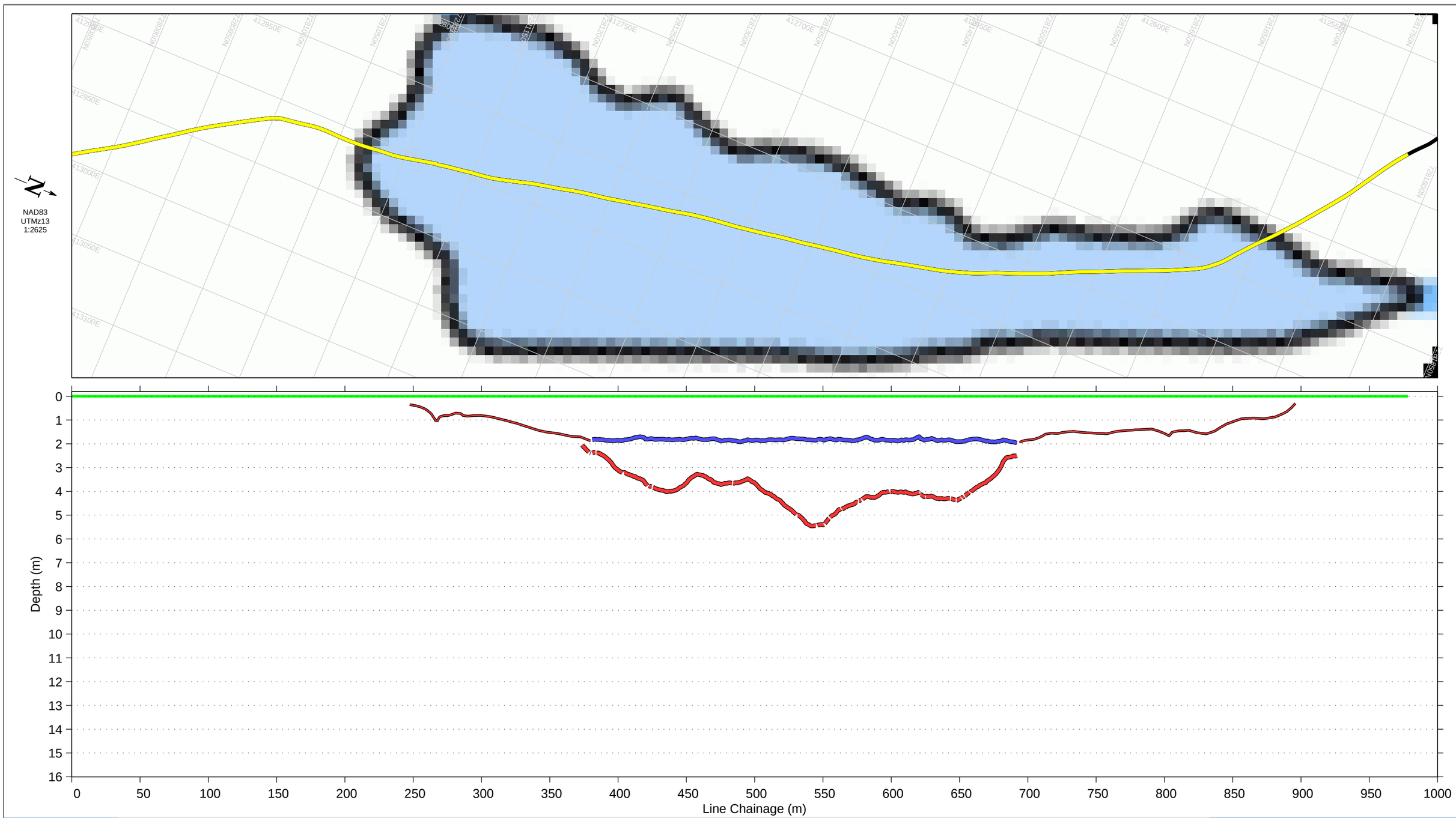
Sabina Gold & Silver
Back River Project GPR Profiling

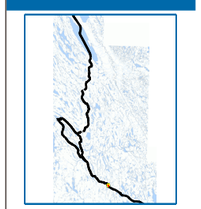
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure A5





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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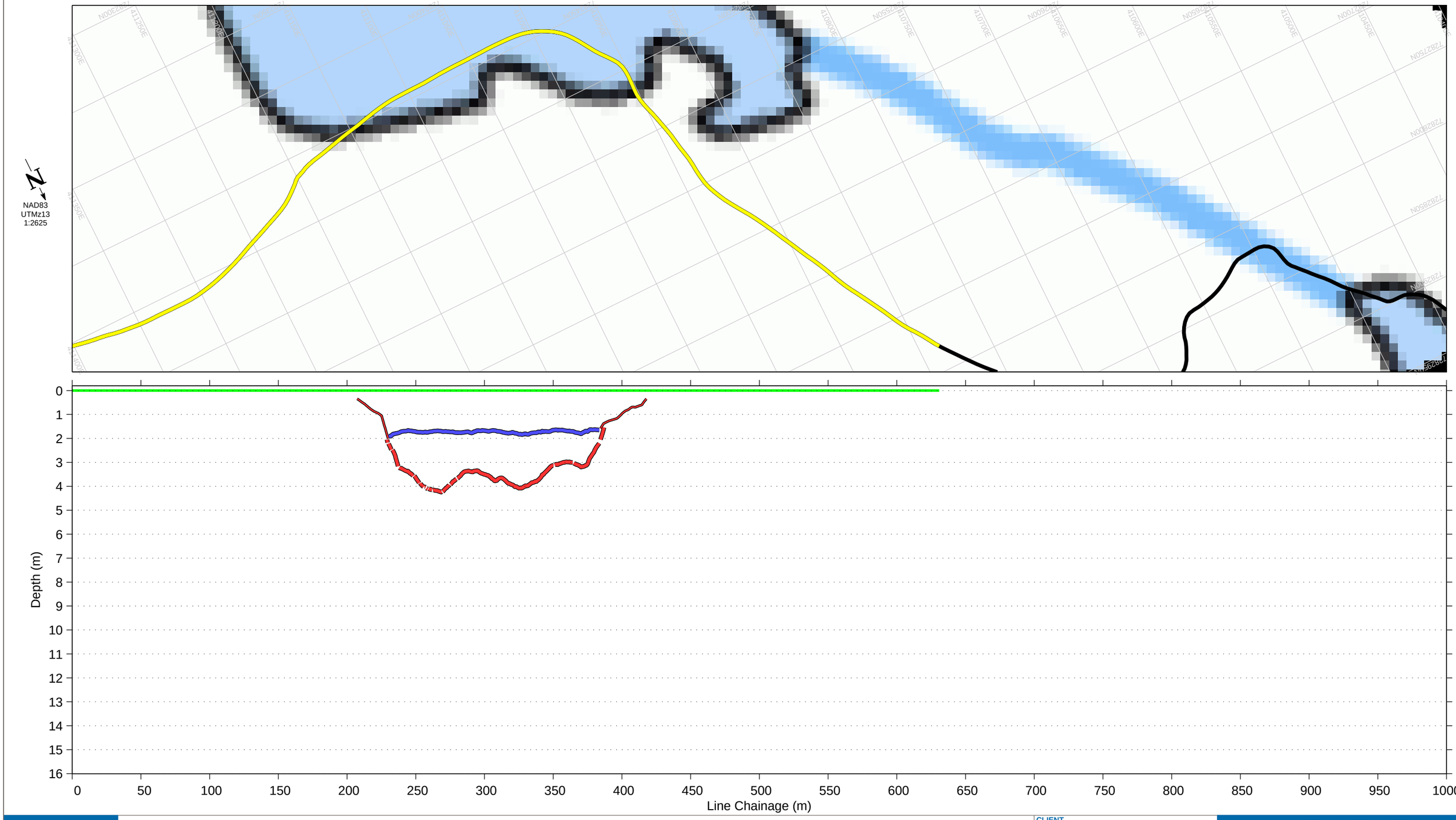
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Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure A6





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

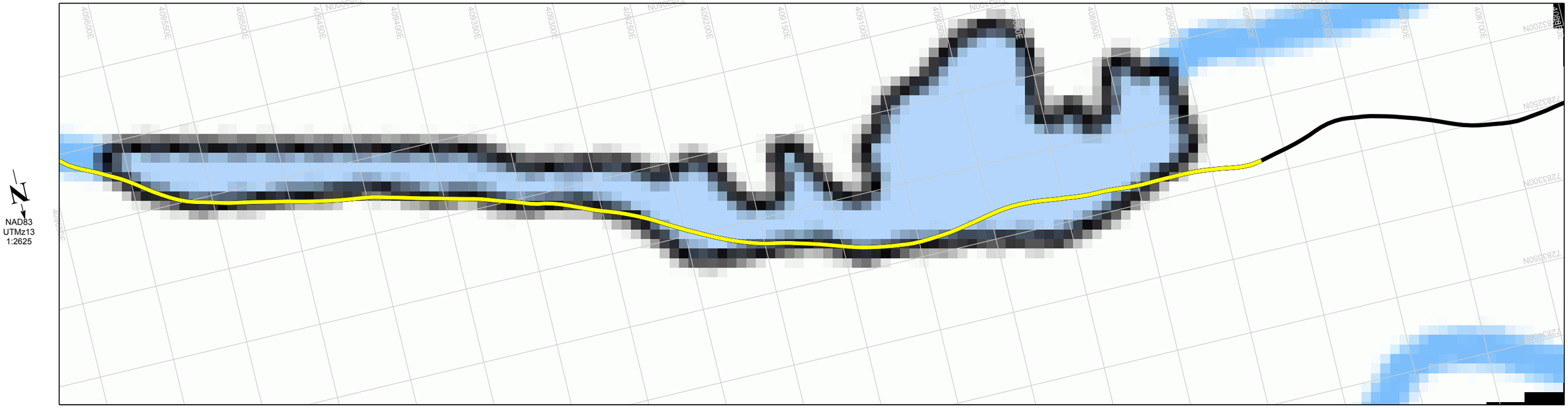
Sabina Gold & Silver
Back River Project GPR Profiling

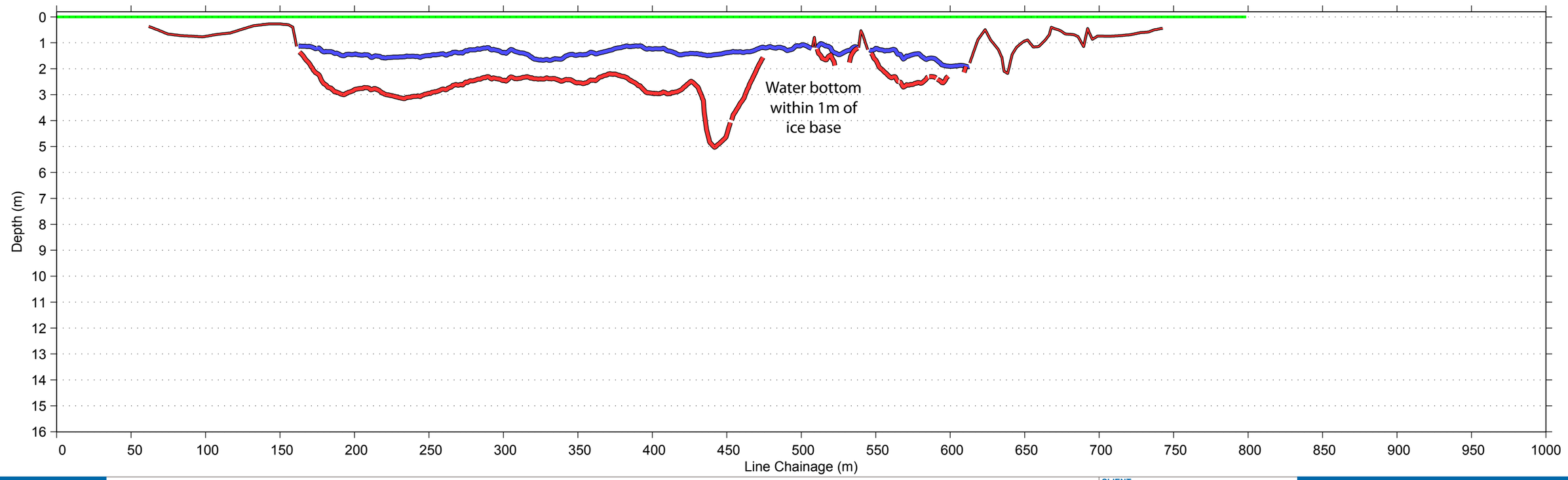
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A7







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

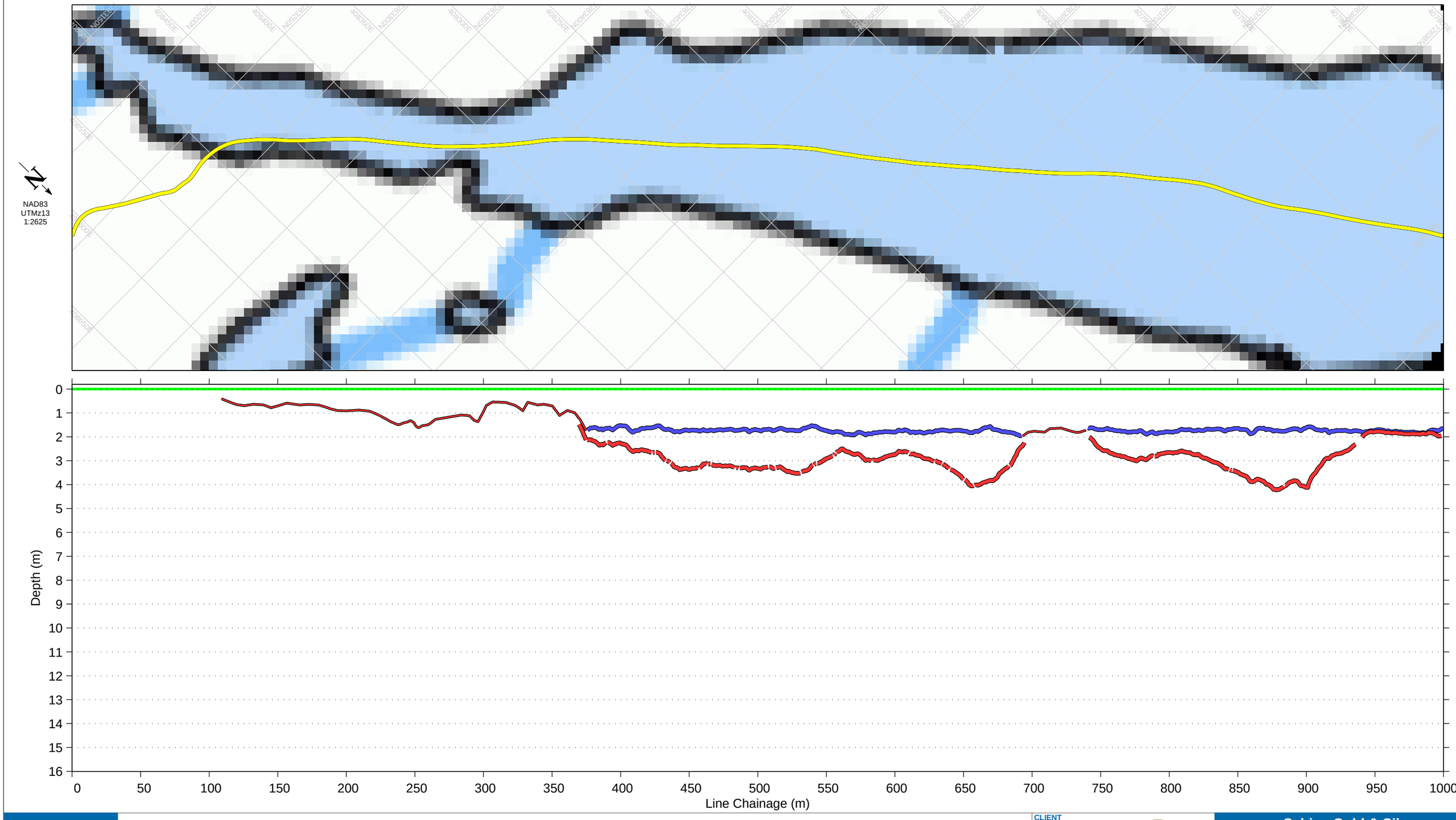
Sabina Gold & Silver
Back River Project GPR Profiling

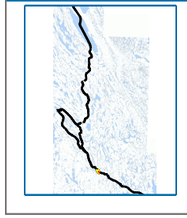
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A8





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

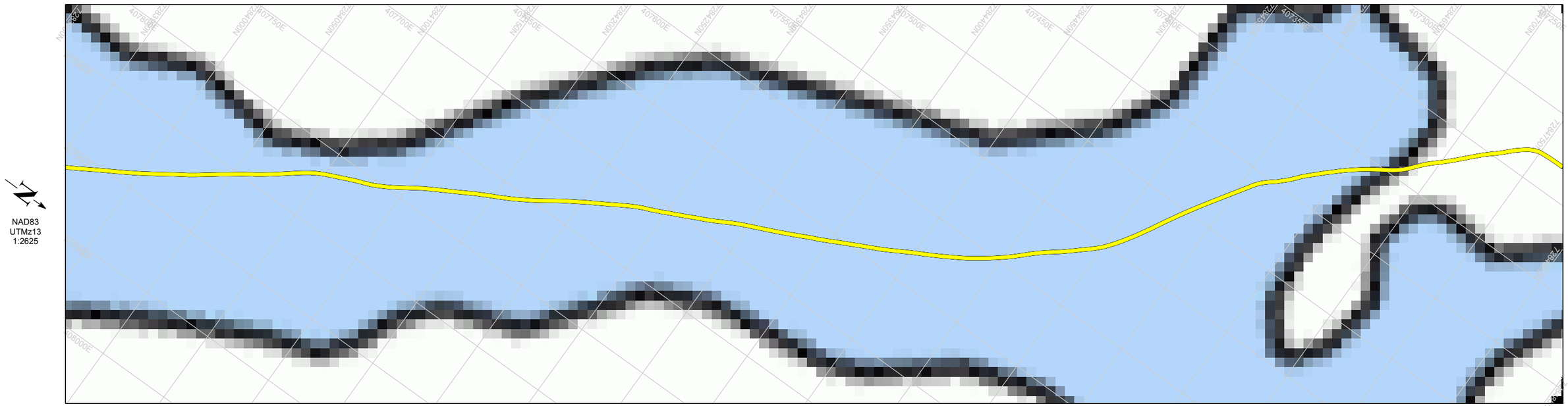
Sabina Gold & Silver
Back River Project GPR Profiling

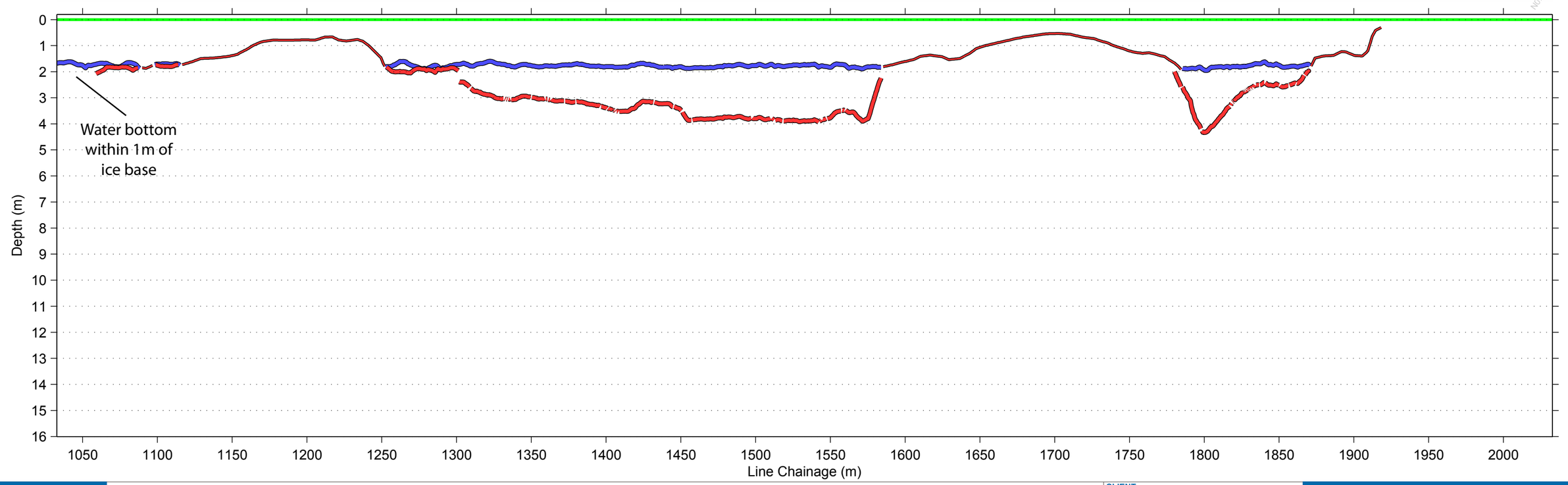
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A9.1







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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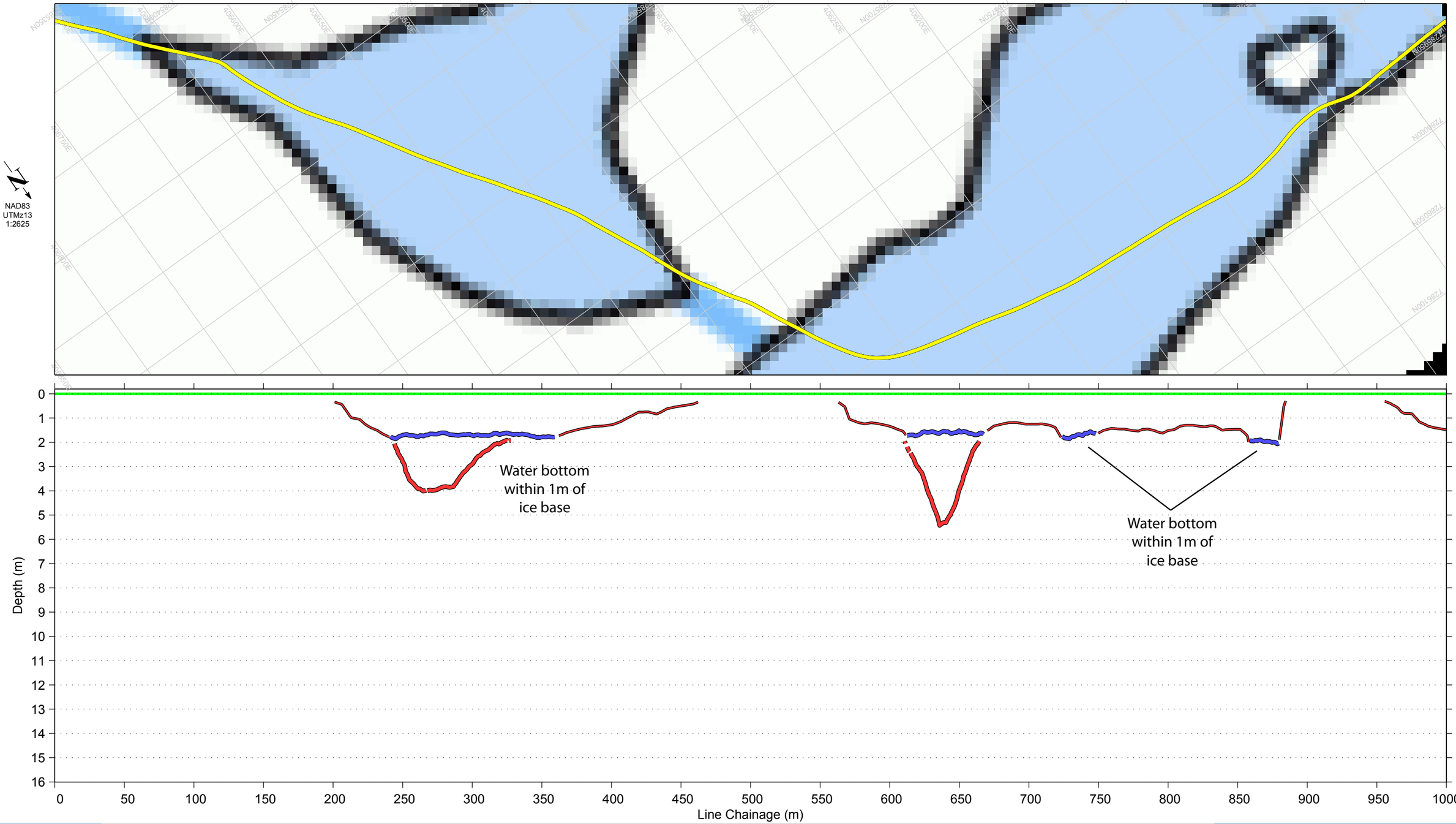
Sabina Gold & Silver
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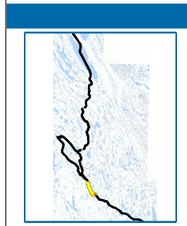
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

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V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A9.2





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

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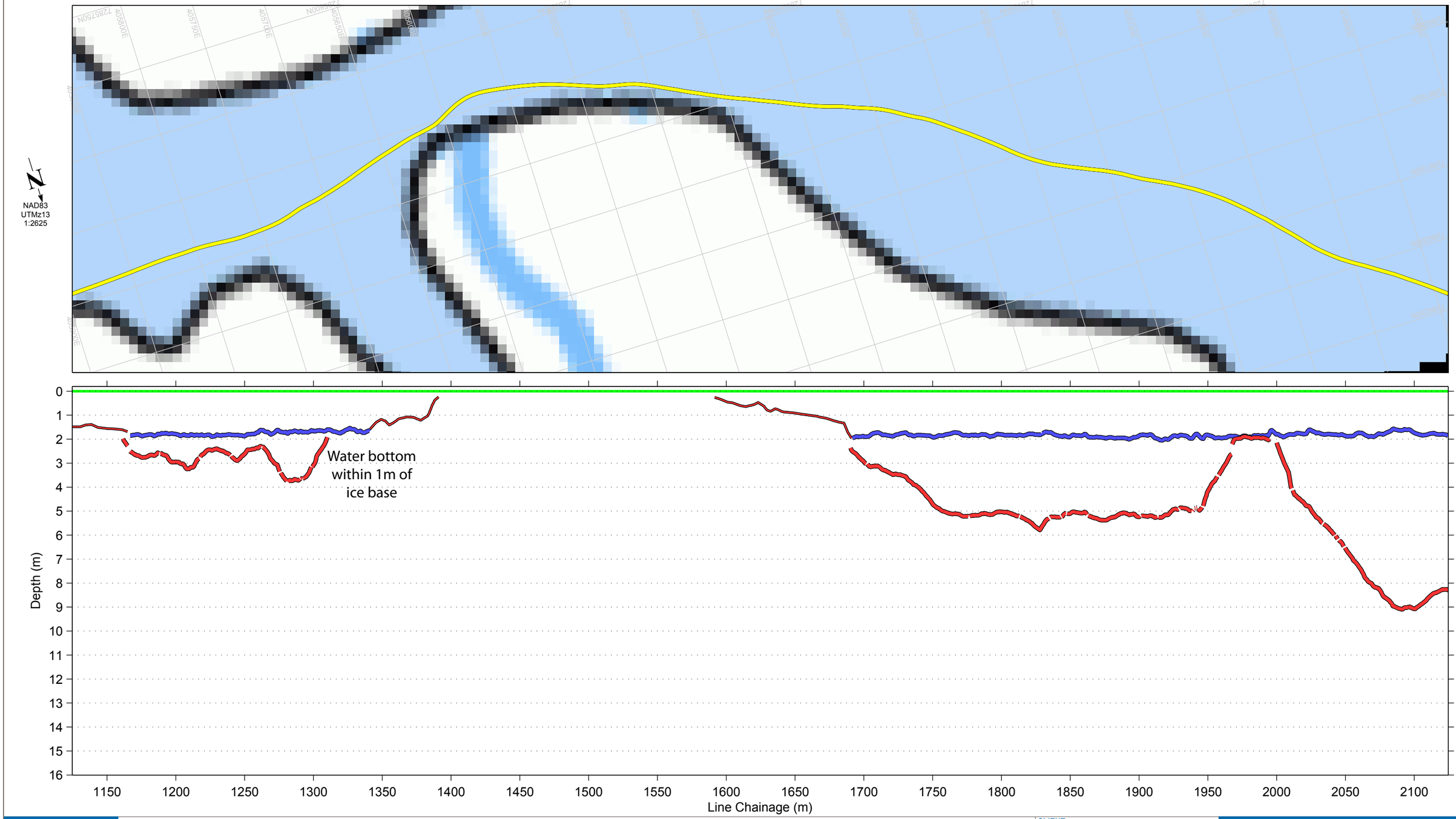
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

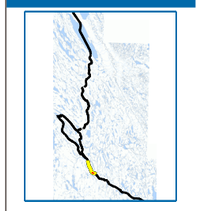
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure A10.1





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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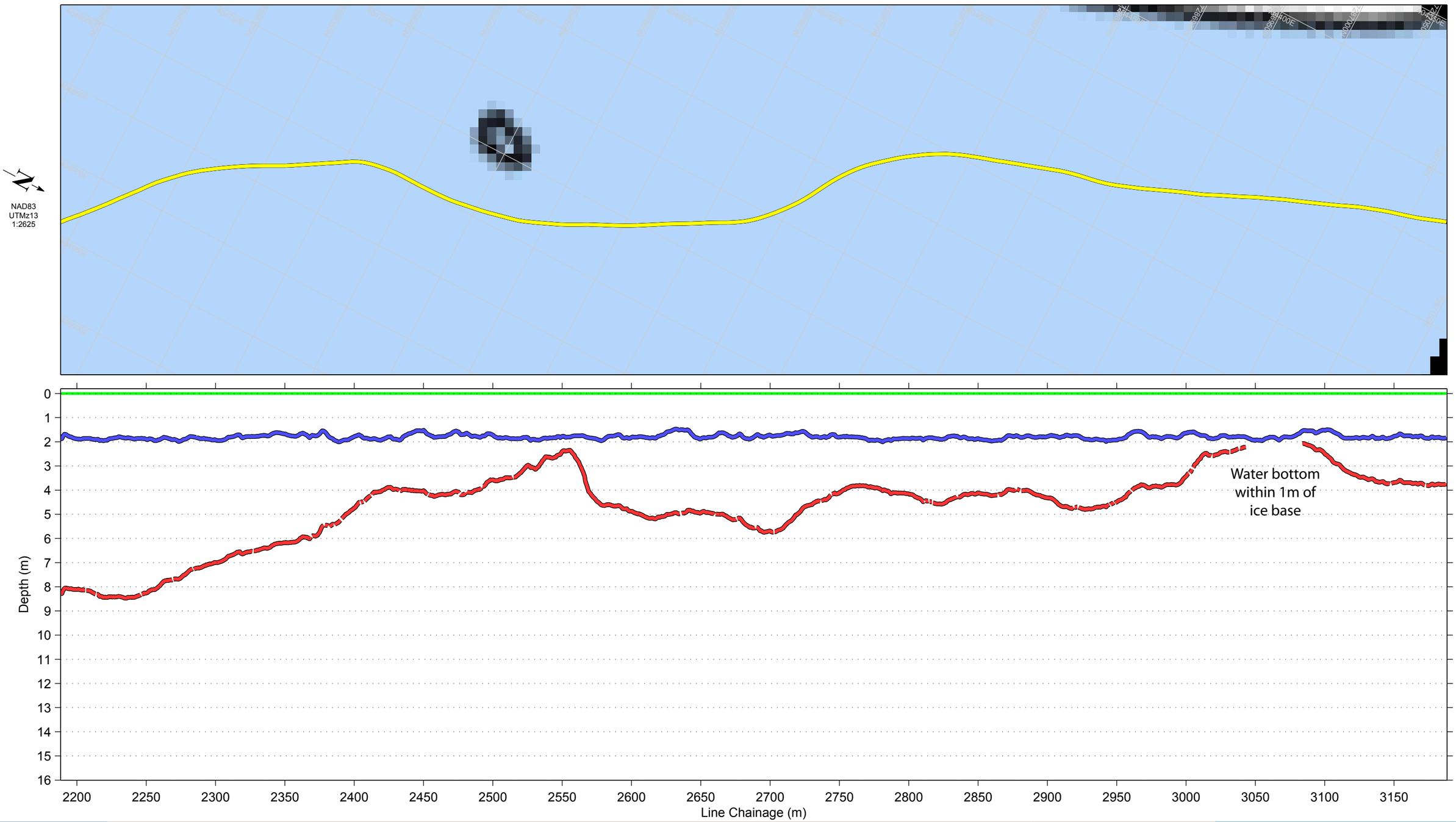
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Back River Project GPR Profiling

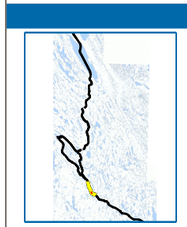
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure A10.2





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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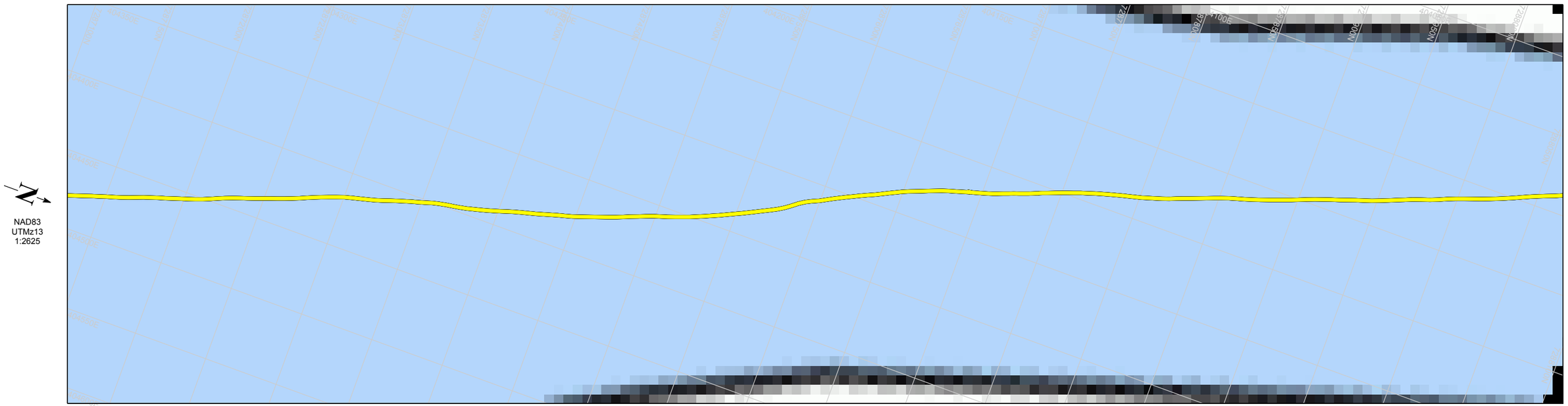
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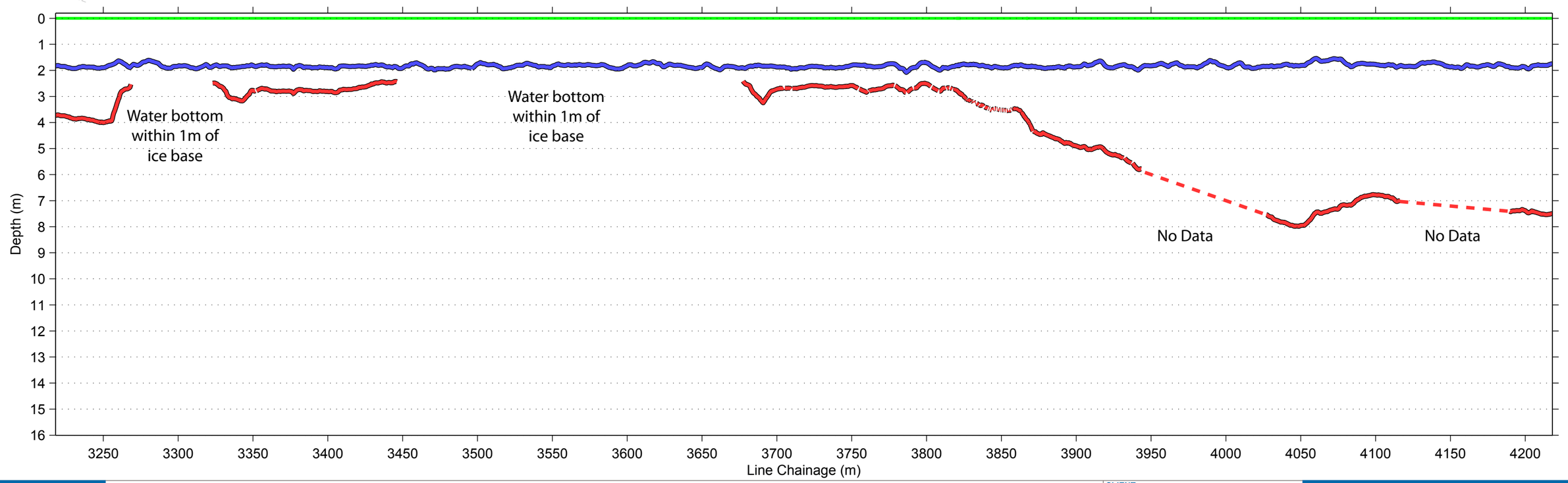
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

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V33103008.E111	RJM	CB	RJM	0

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Figure A10.3







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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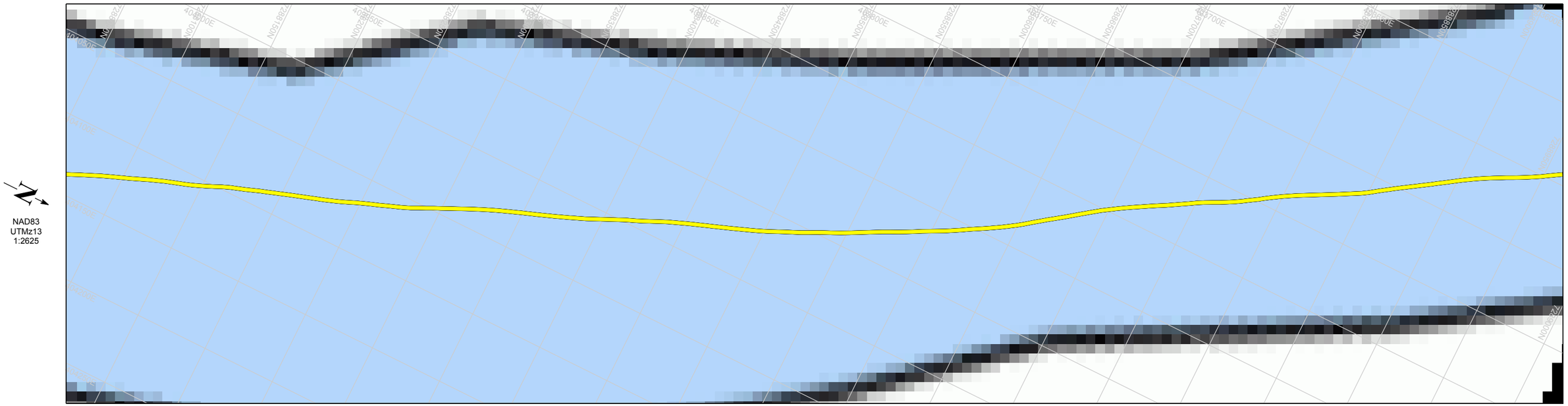
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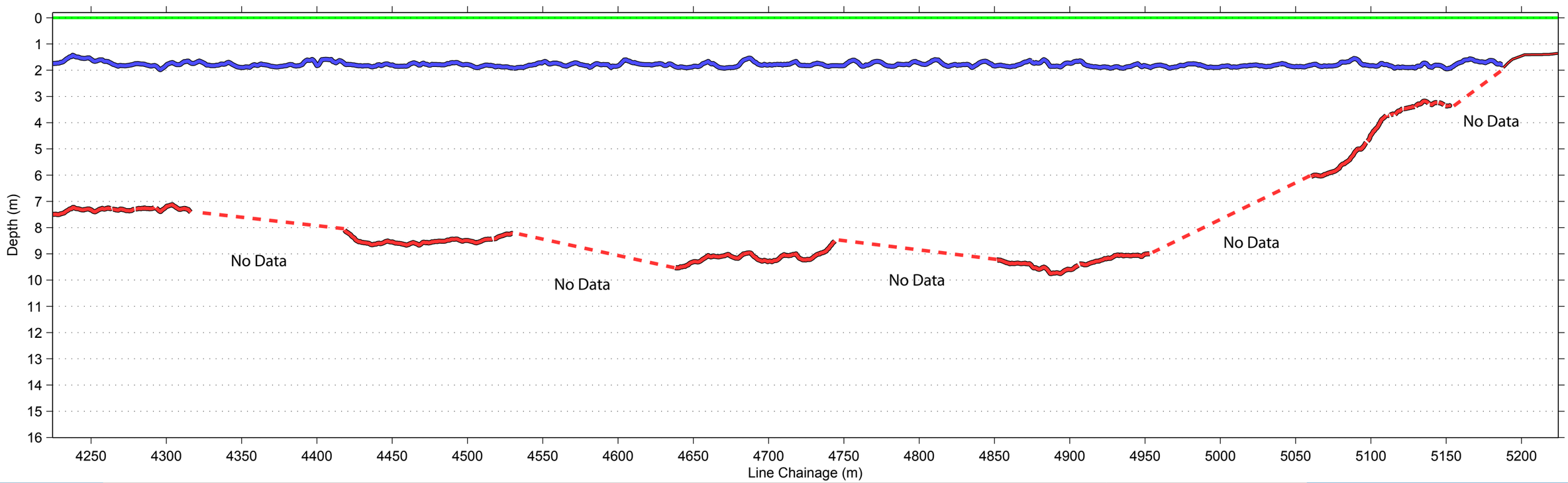
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

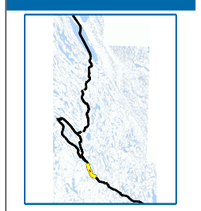
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure A10.4







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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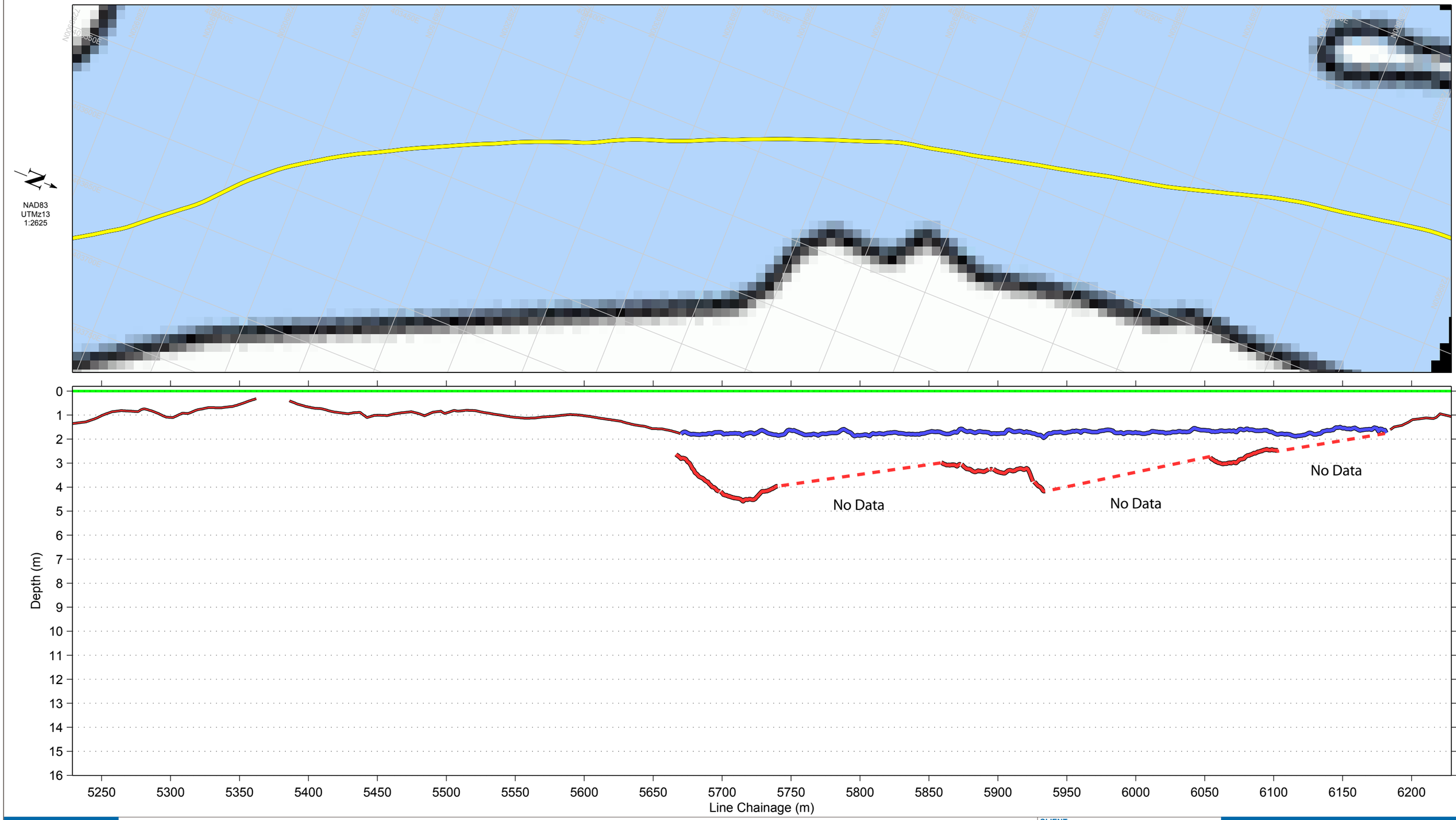
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Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure A10.5





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

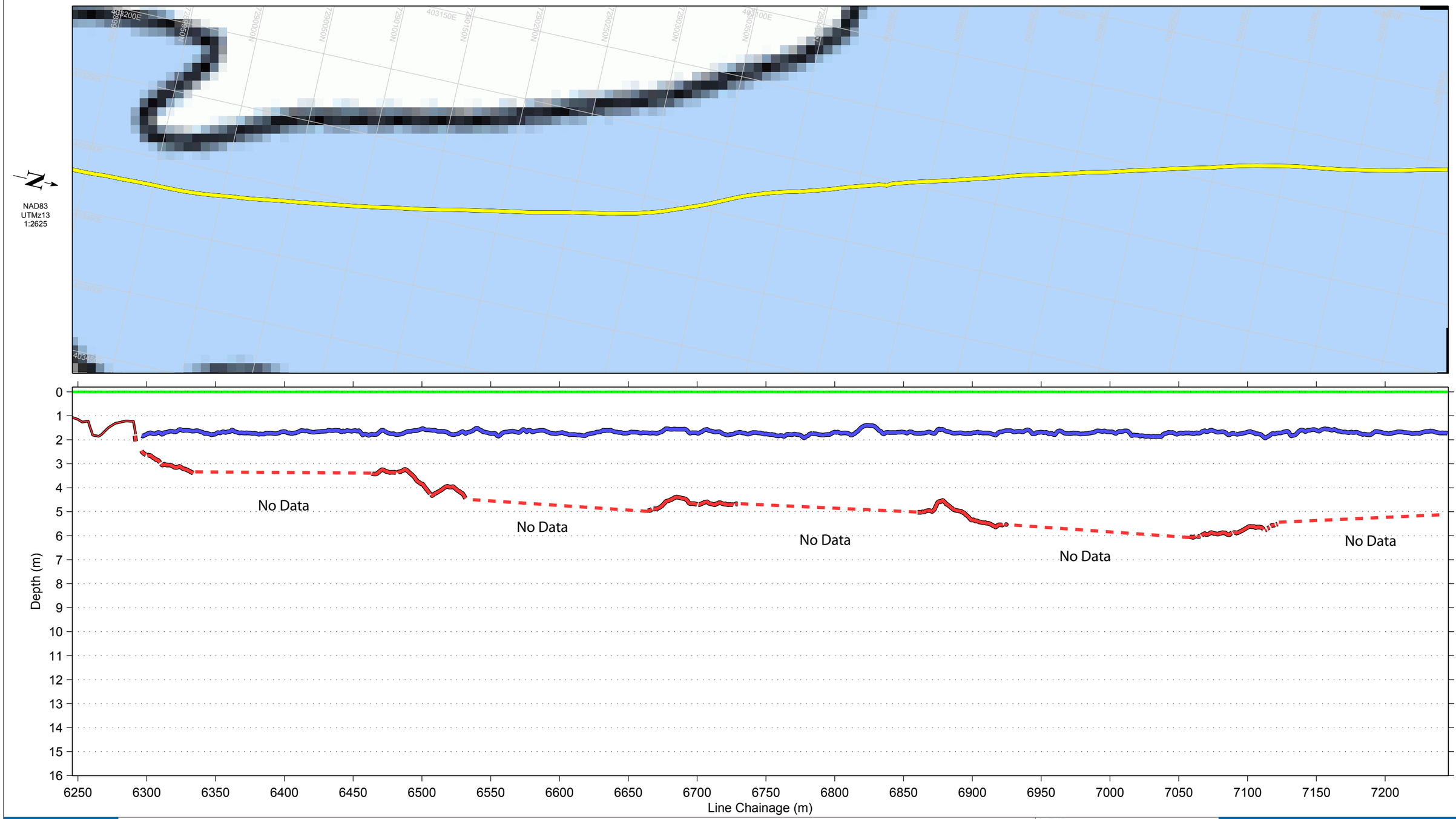
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Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A10.6



LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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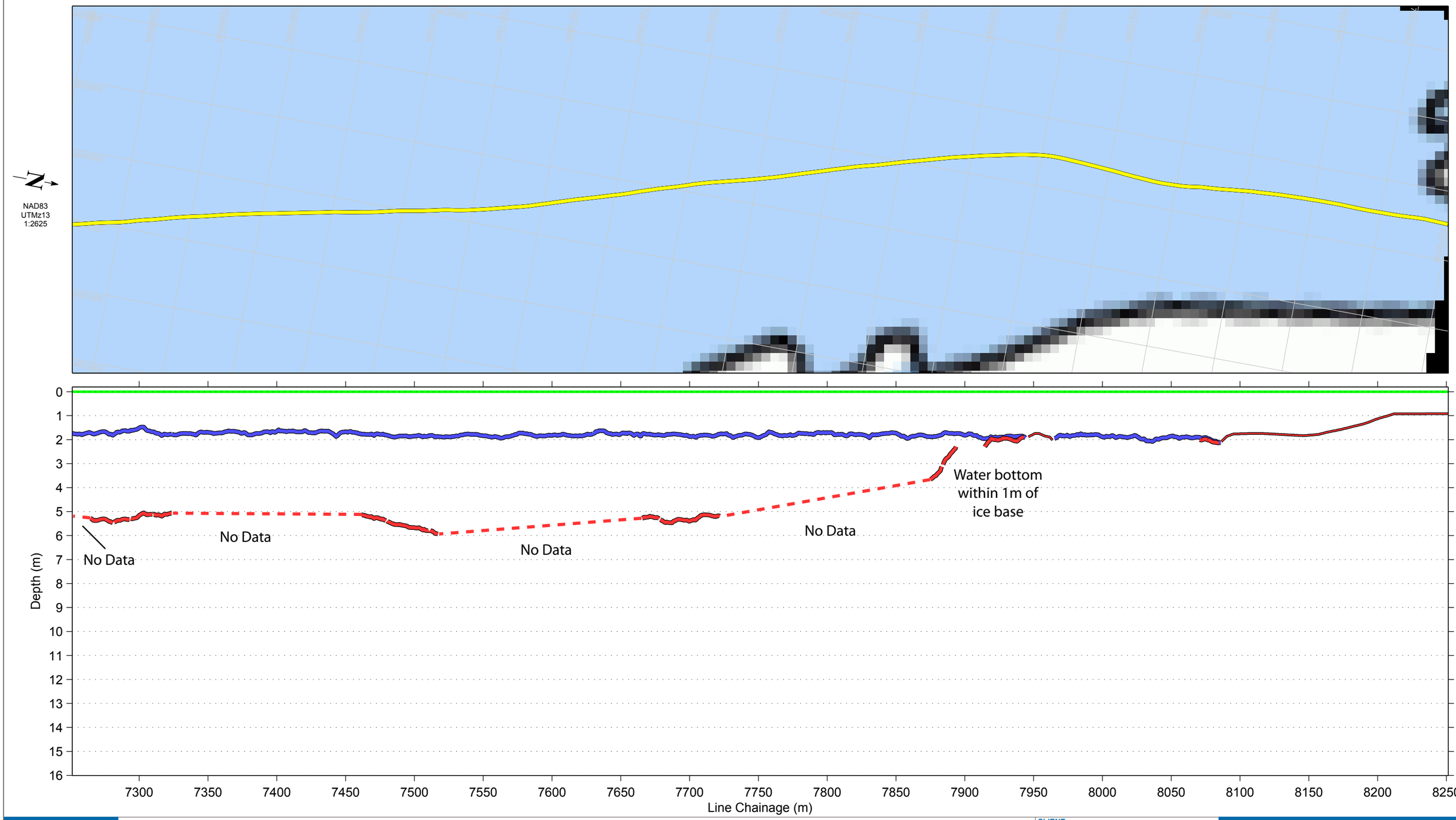
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Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A10.7





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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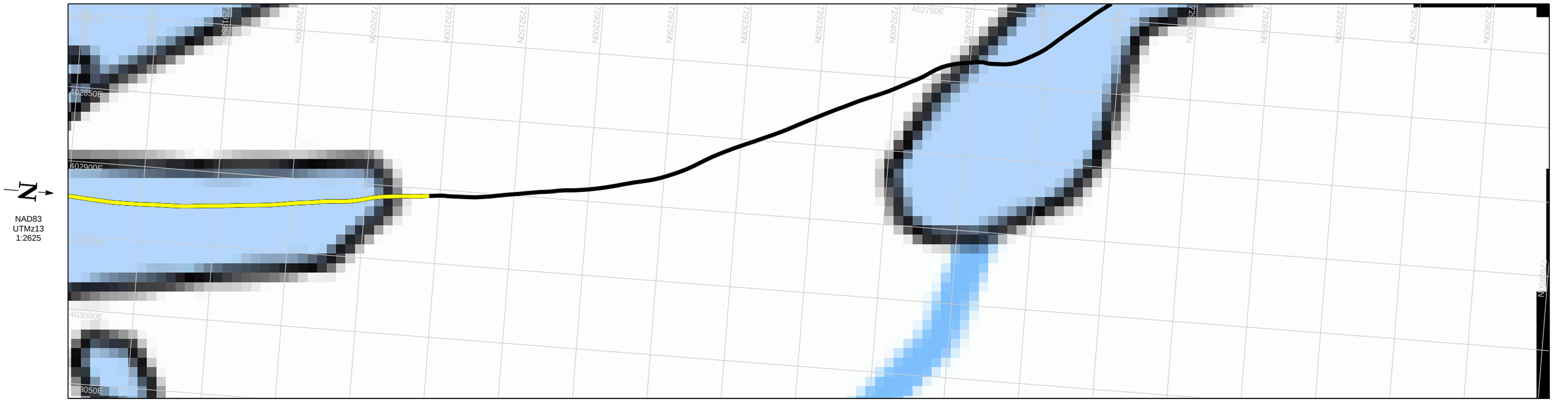
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

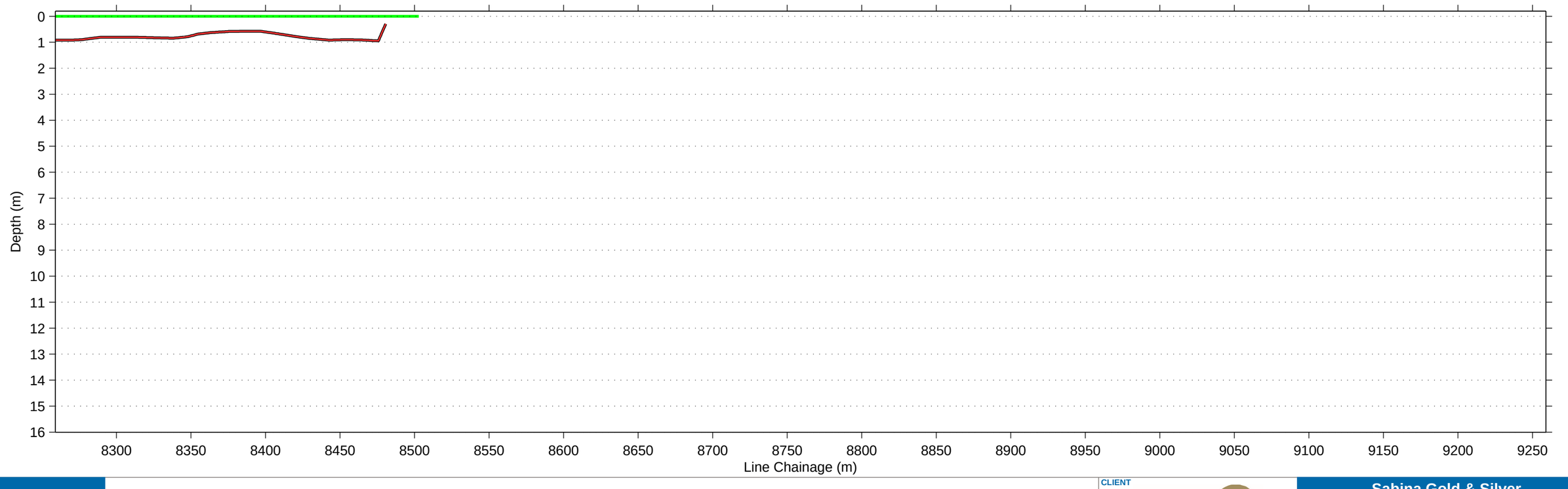
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V33103008.E111	RJM	CB	RJM	0

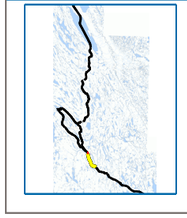
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Figure A10.8







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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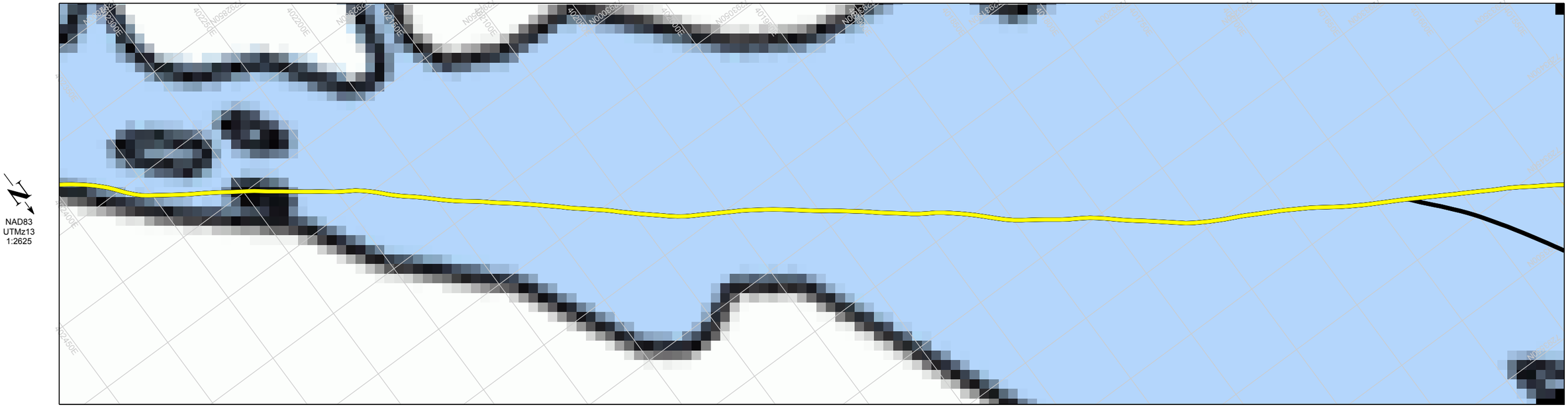
Sabina Gold & Silver
Back River Project GPR Profiling

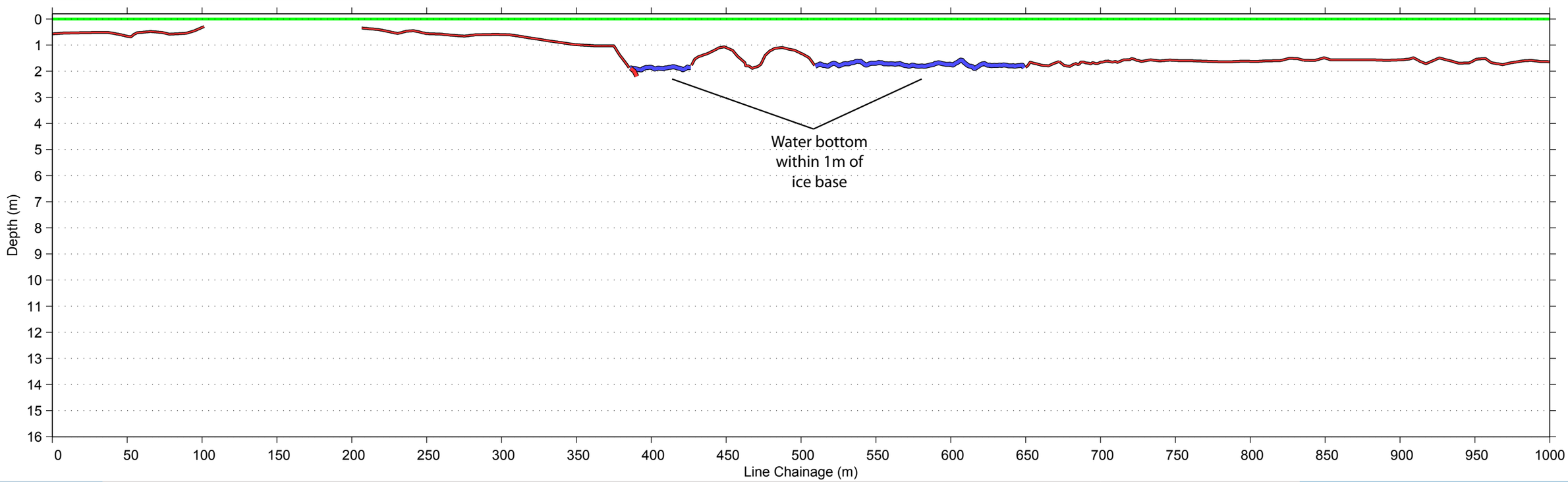
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

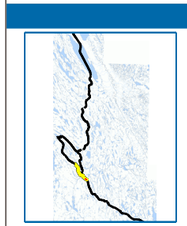
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure A10.9







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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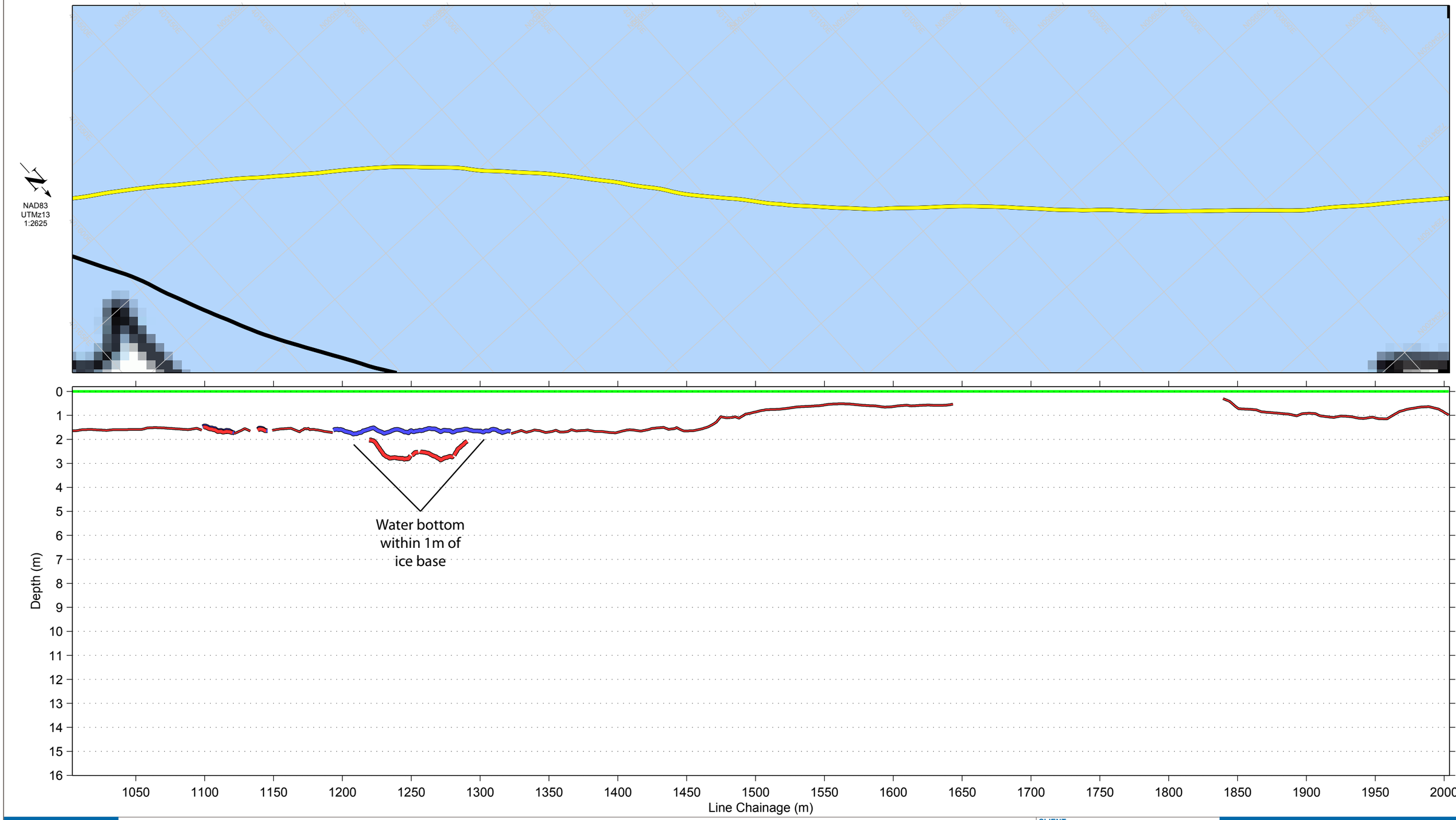
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Winter Road Option – Major Lake Profiles
Goose to George
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Figure A11.1





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

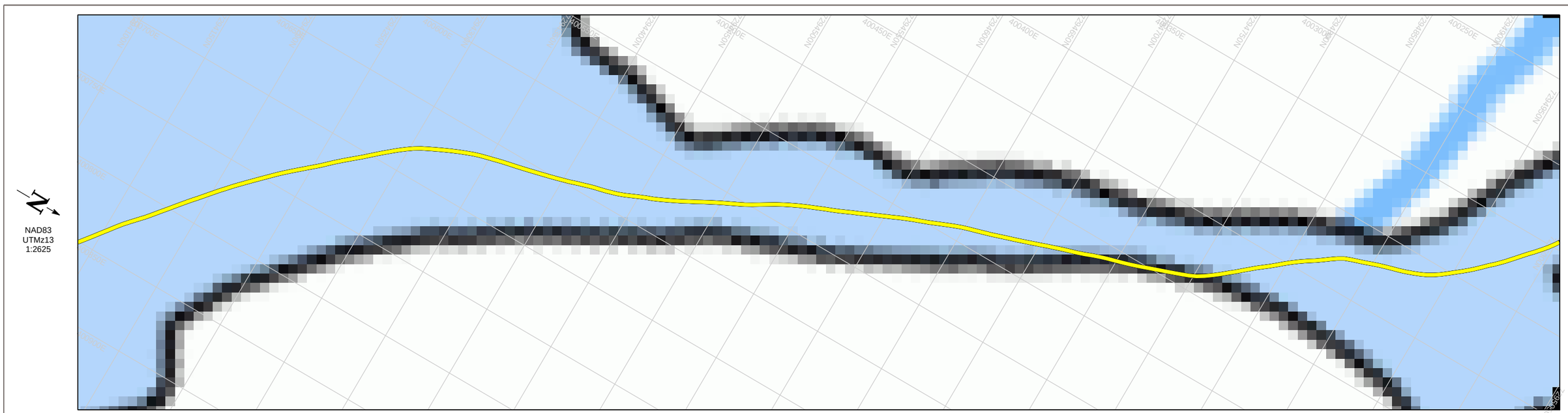
Sabina Gold & Silver
Back River Project GPR Profiling

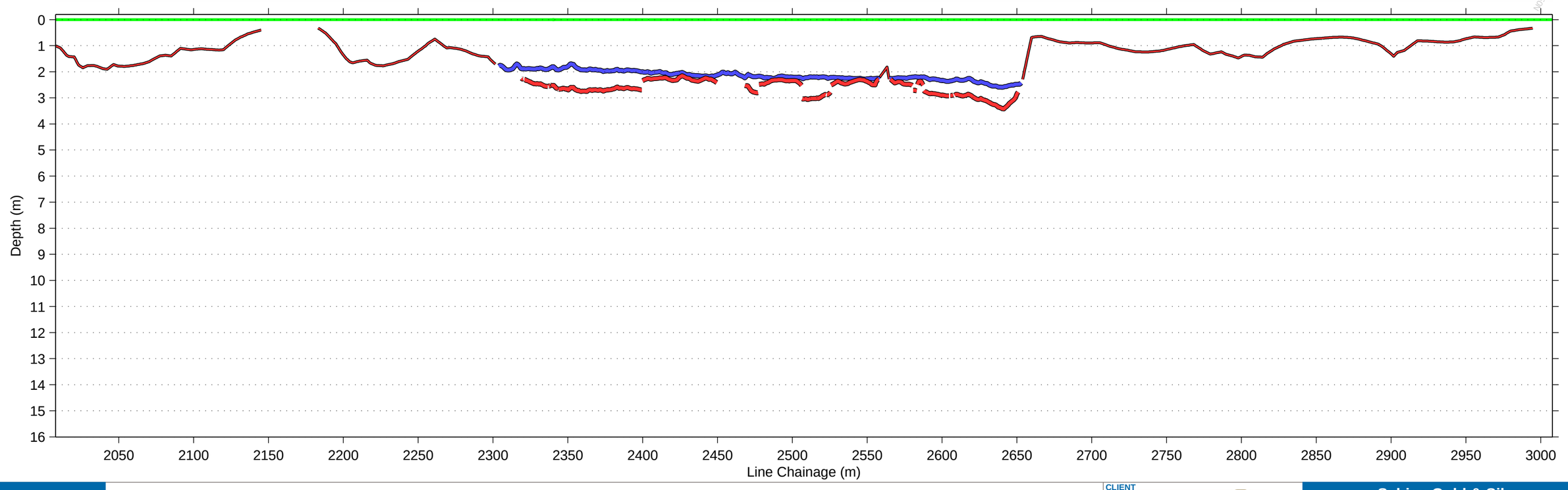
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

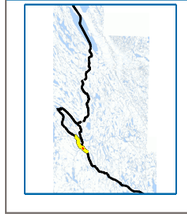
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A11.2







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

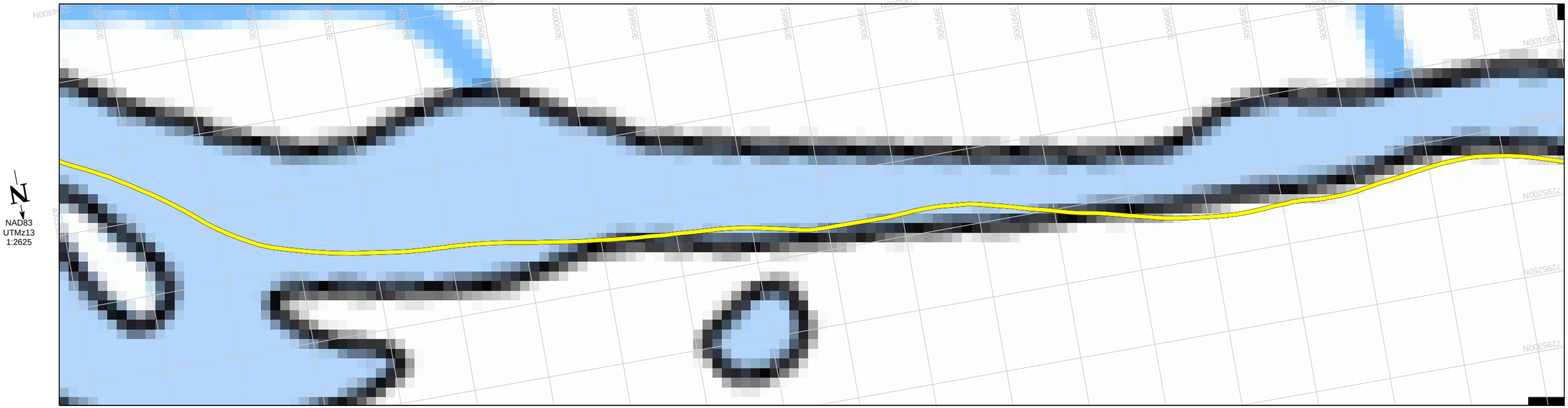
Sabina Gold & Silver
Back River Project GPR Profiling

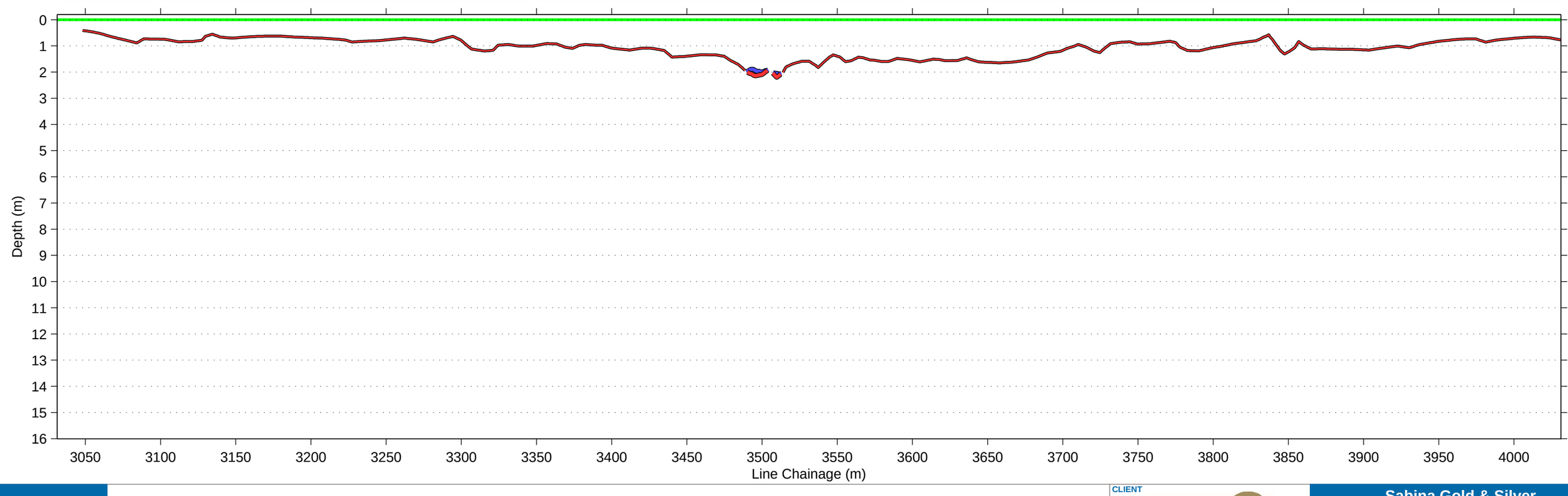
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

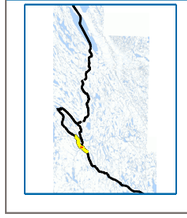
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A11.3







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

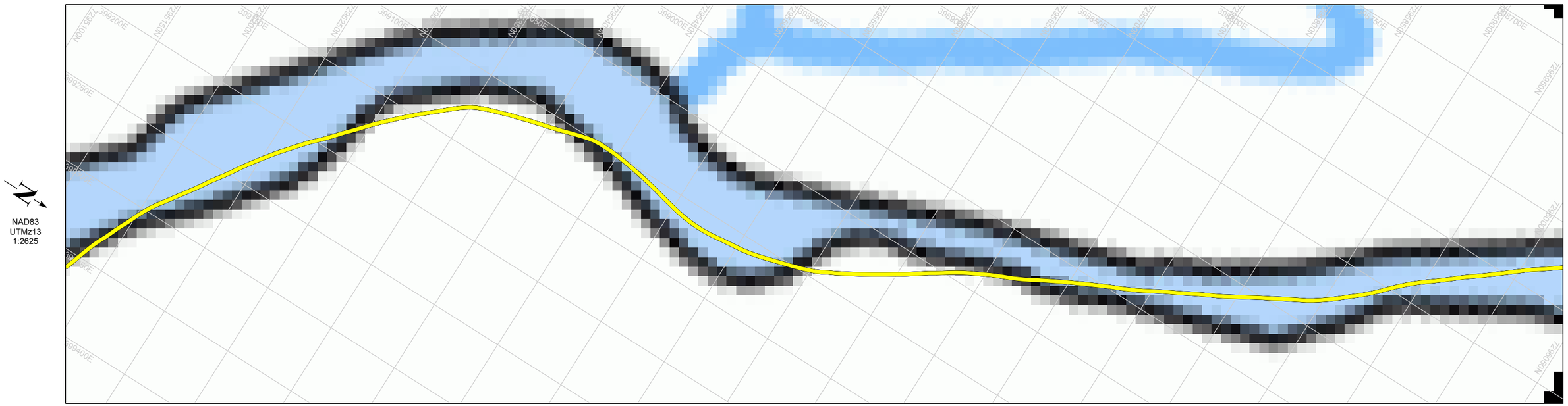
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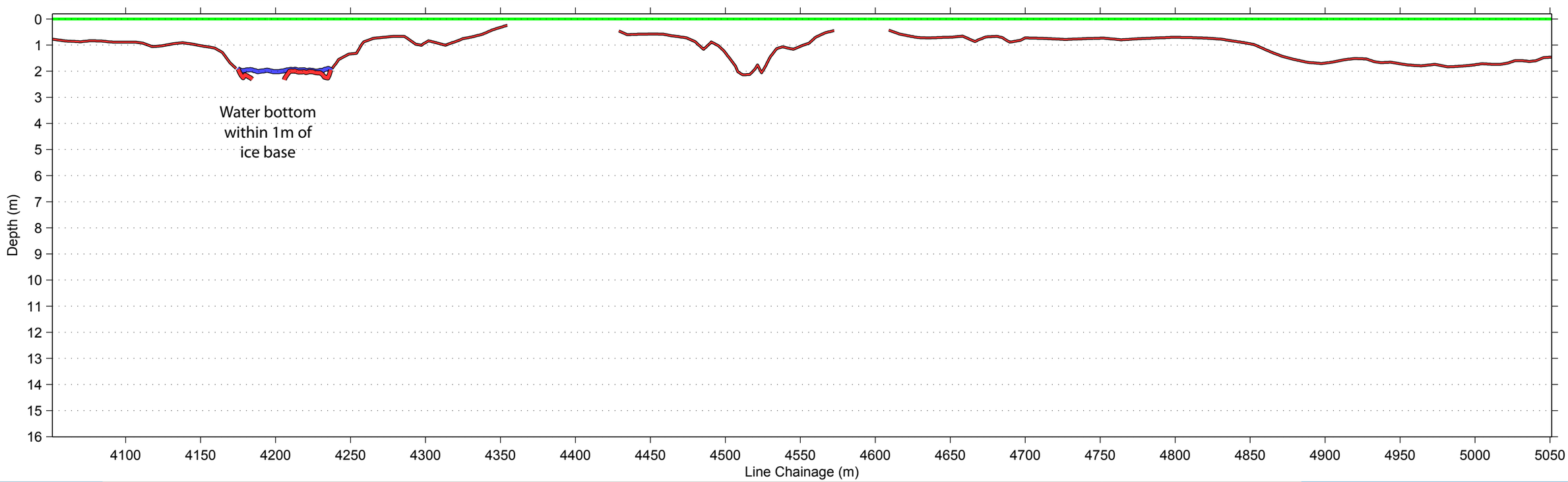
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

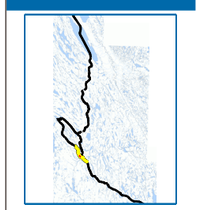
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A11.4







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

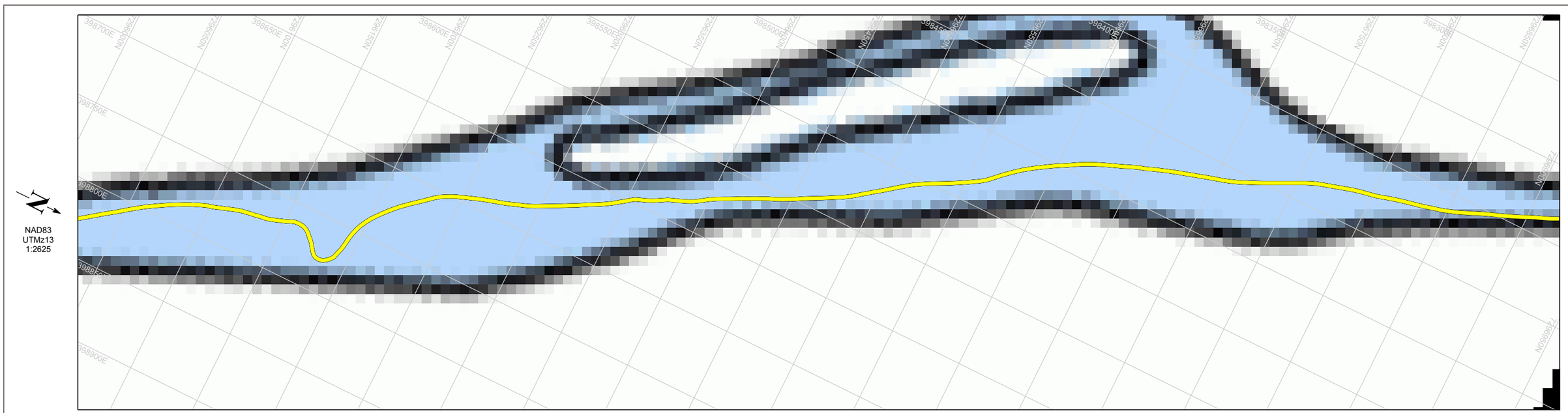
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Back River Project GPR Profiling

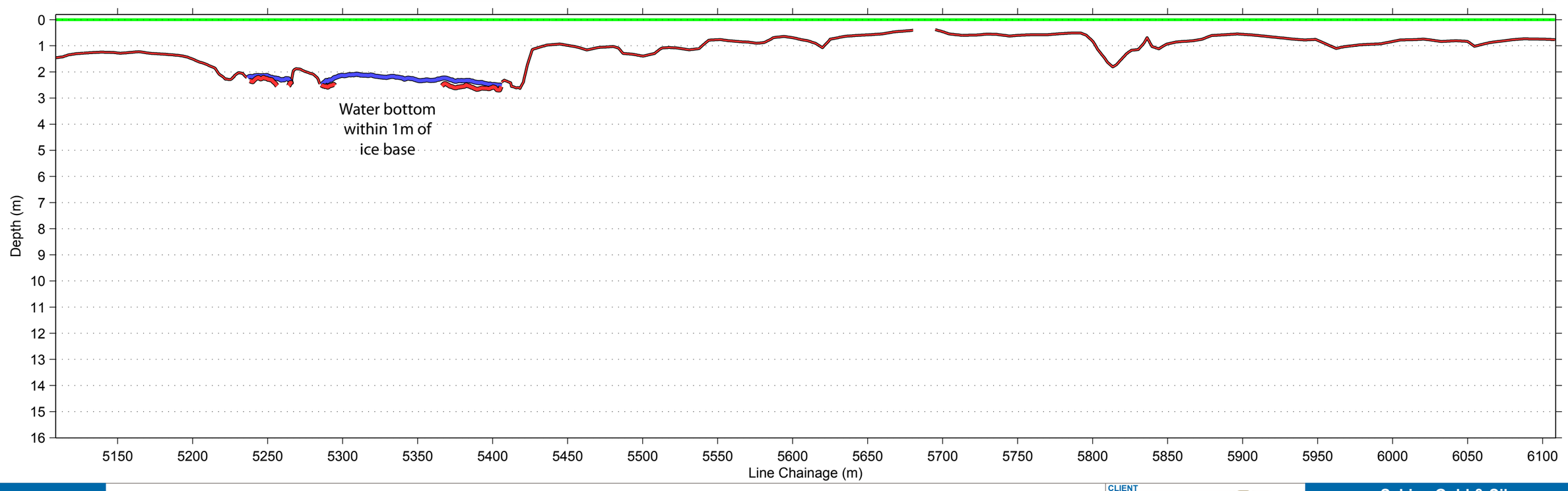
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

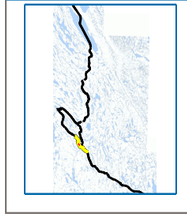
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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DATE: June 14, 2013

Figure A11.5







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

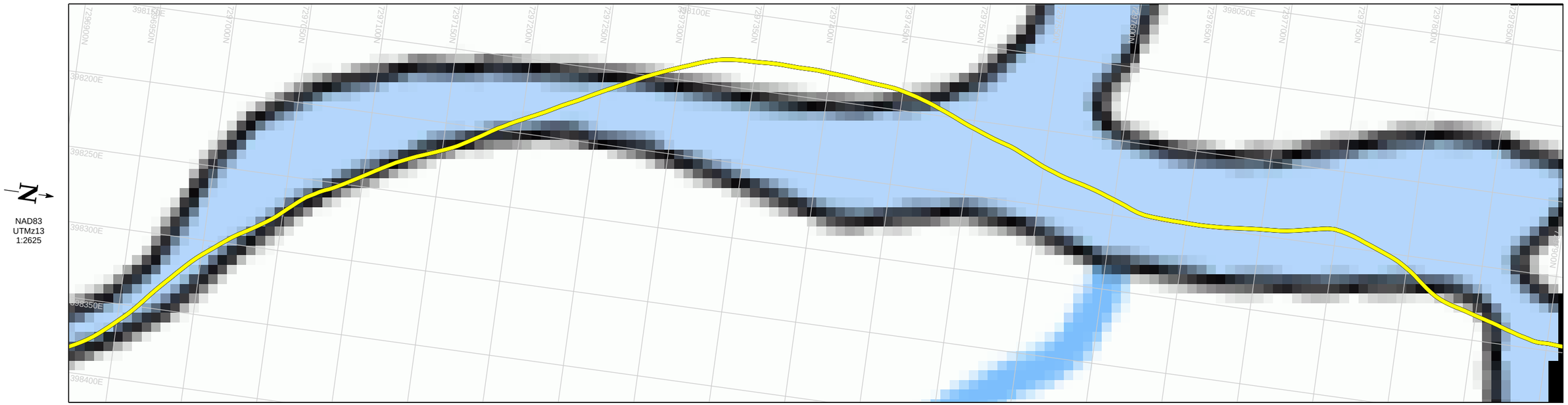
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Back River Project GPR Profiling

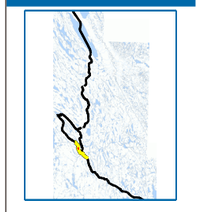
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A11.6





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

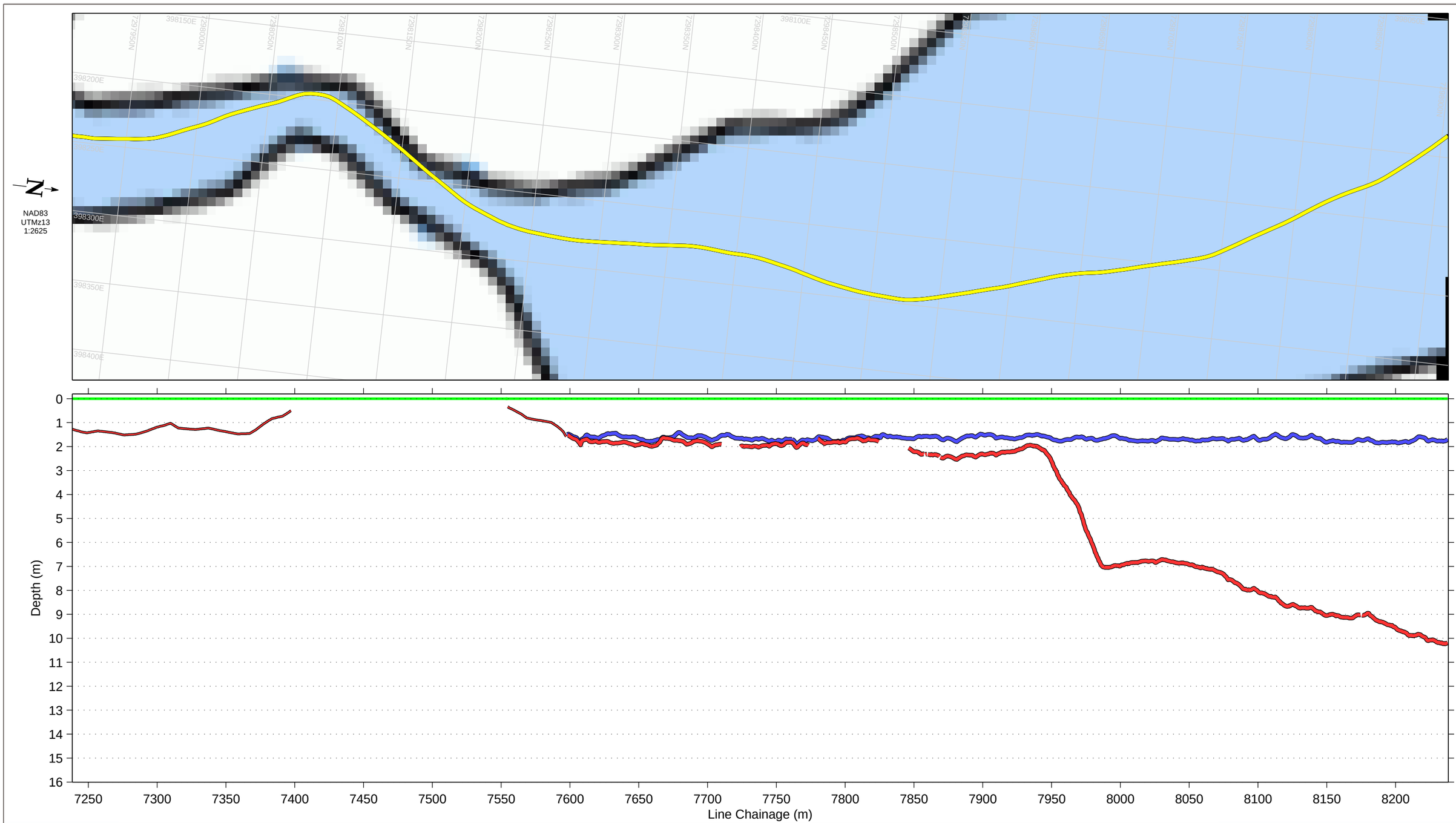
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Back River Project GPR Profiling

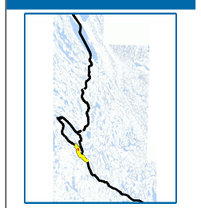
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A11.7





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

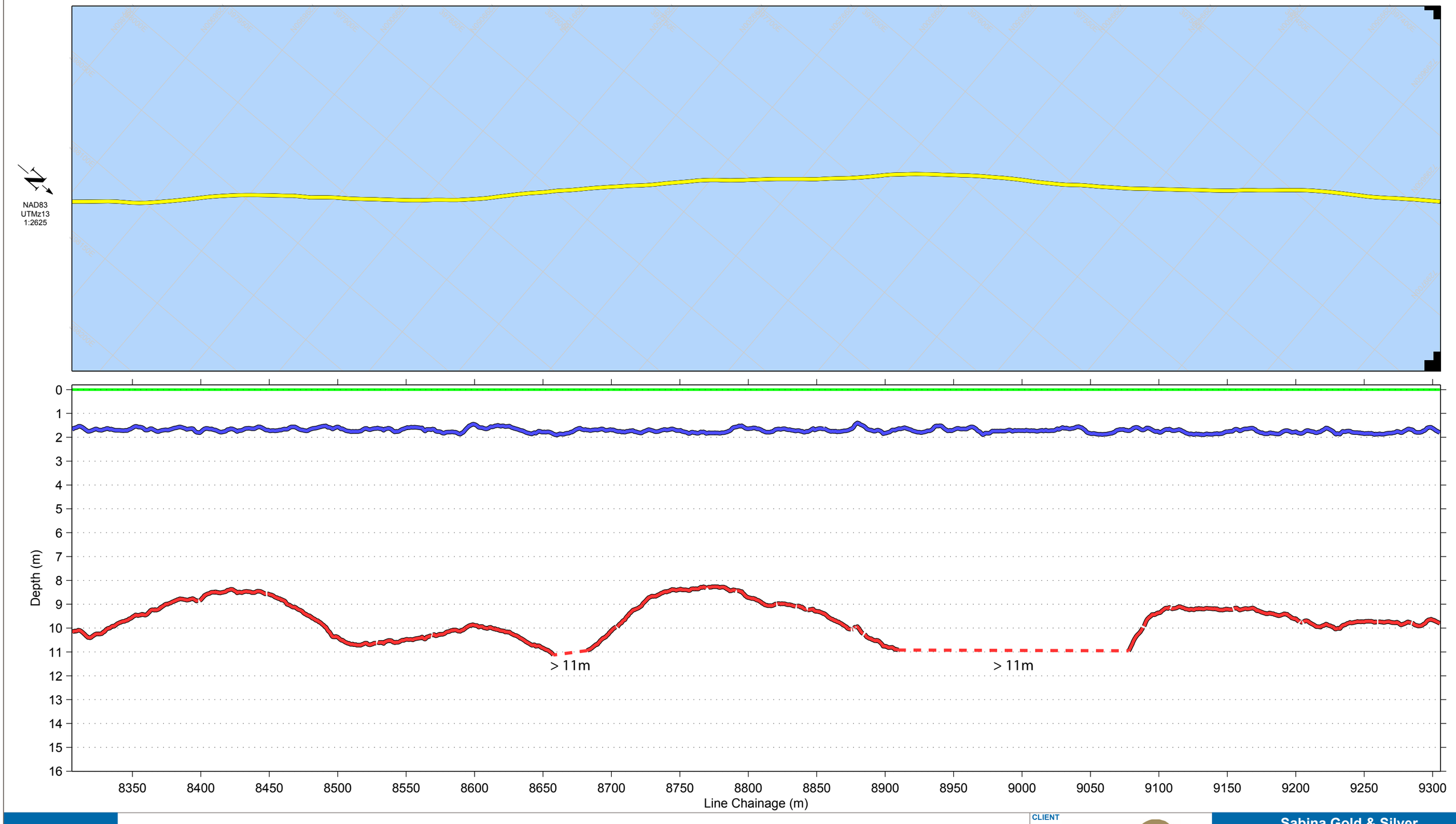
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Back River Project GPR Profiling

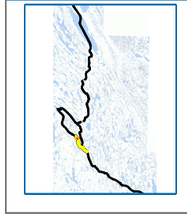
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A11.8





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

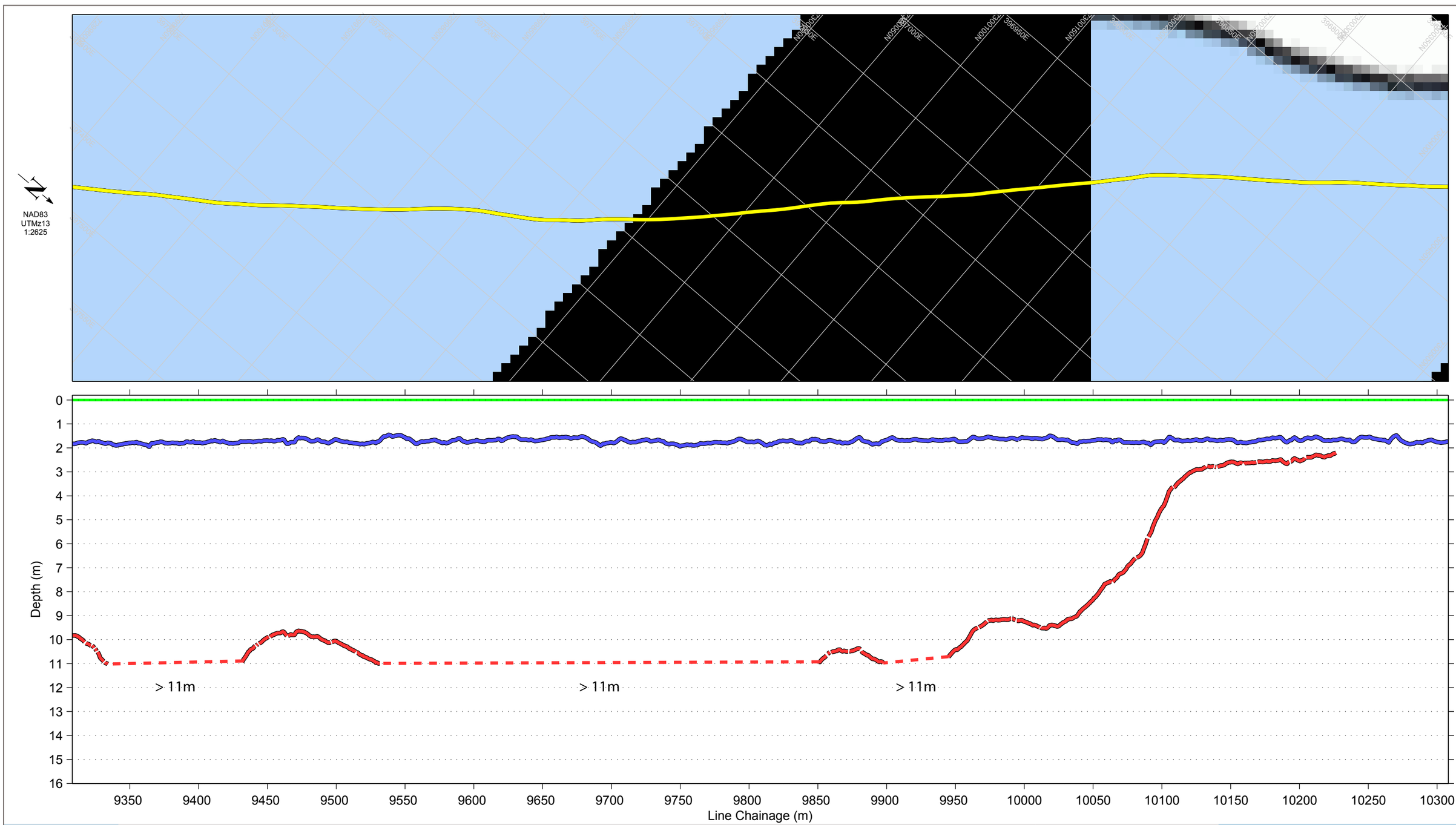
Sabina Gold & Silver
Back River Project GPR Profiling

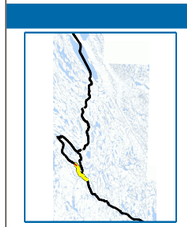
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure A11.9





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

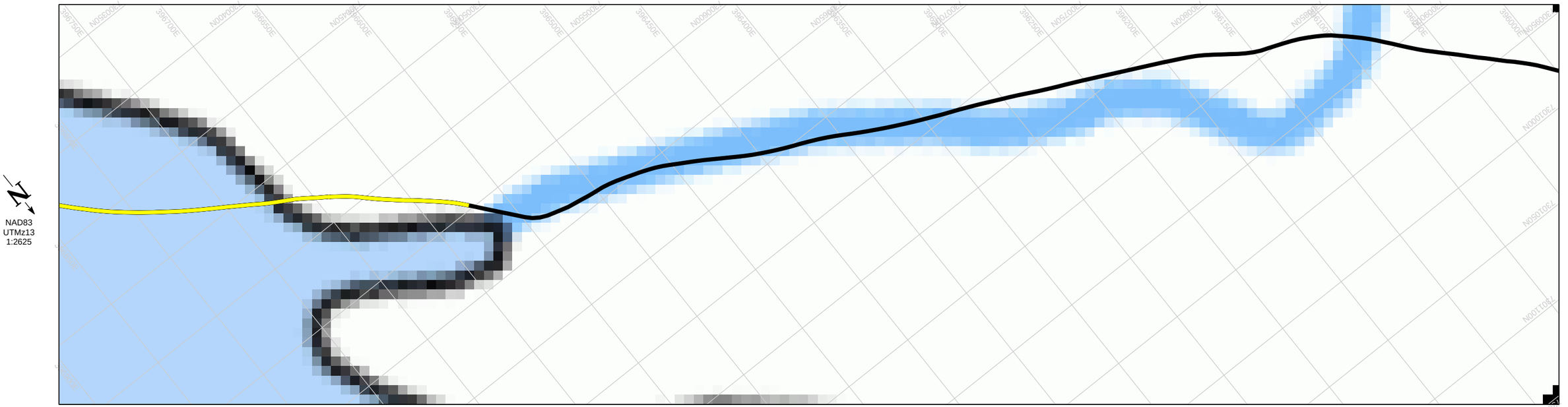
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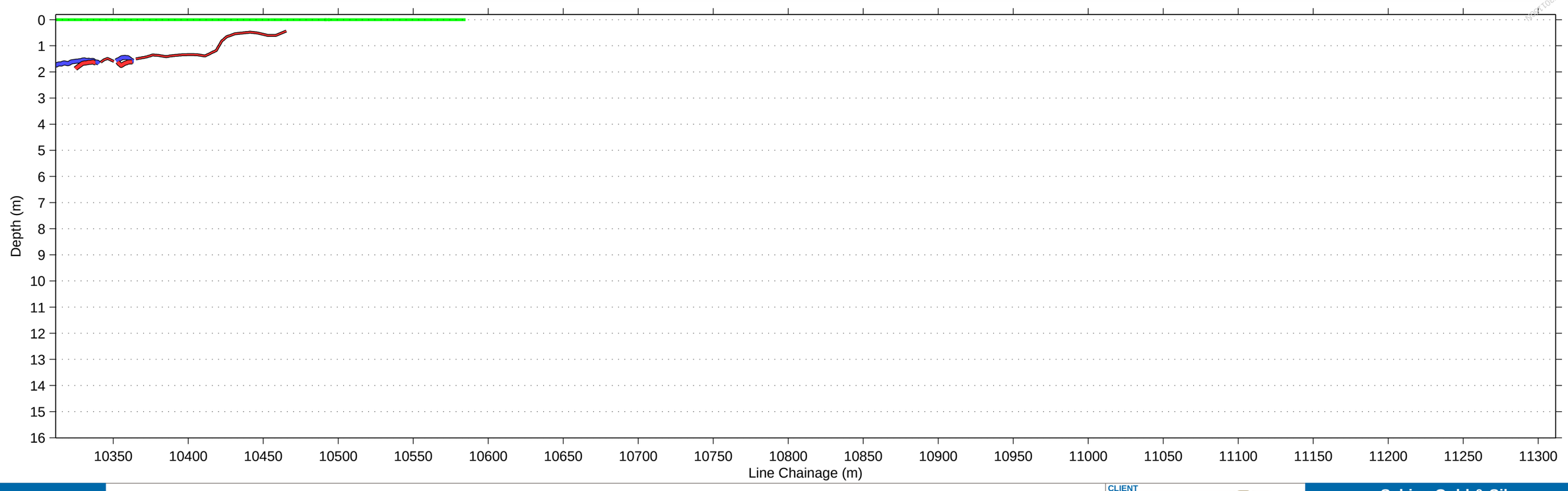
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

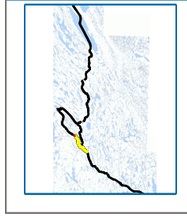
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE: Edmonton
DATE: June 14, 2013

Figure A11.10







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

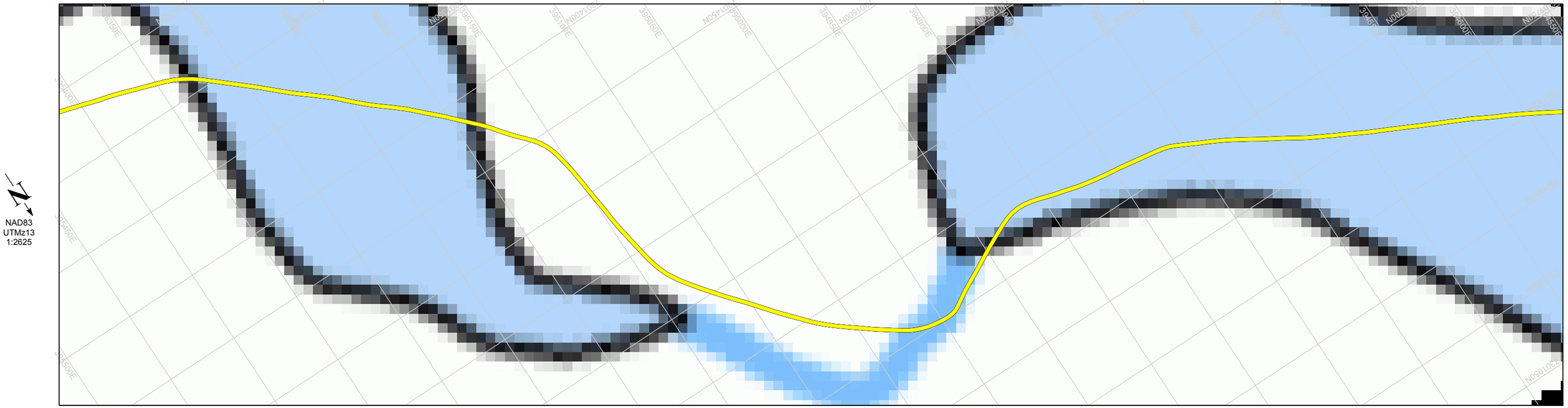
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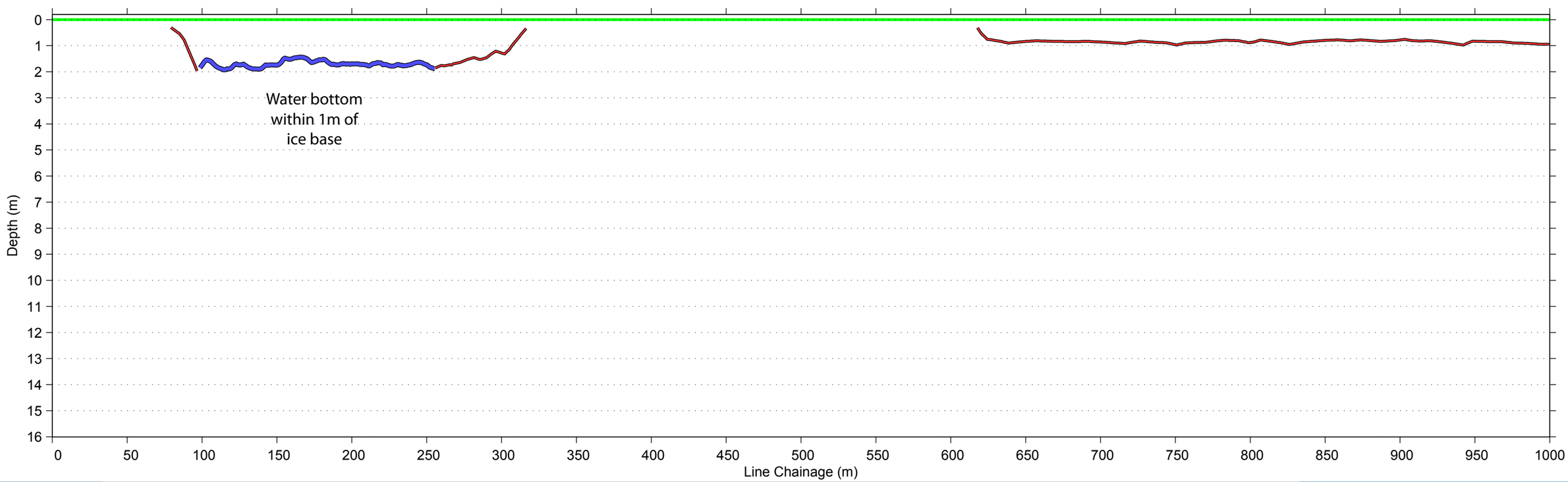
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

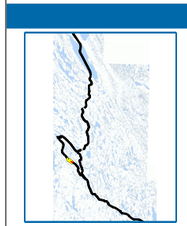
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A11.11







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

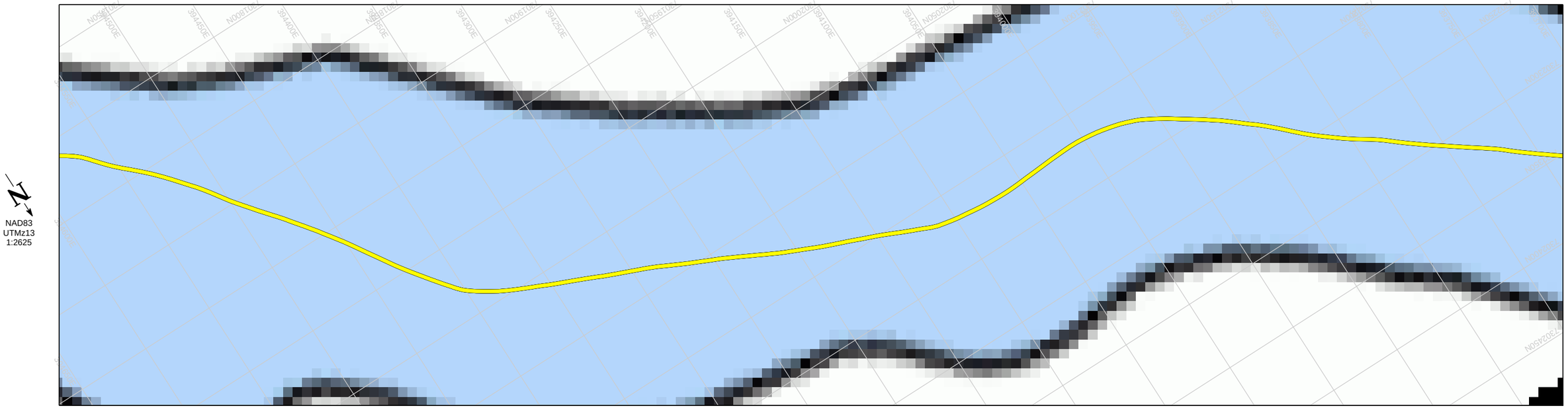
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Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

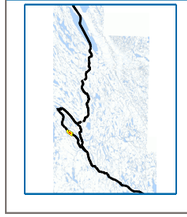
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A12.1







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

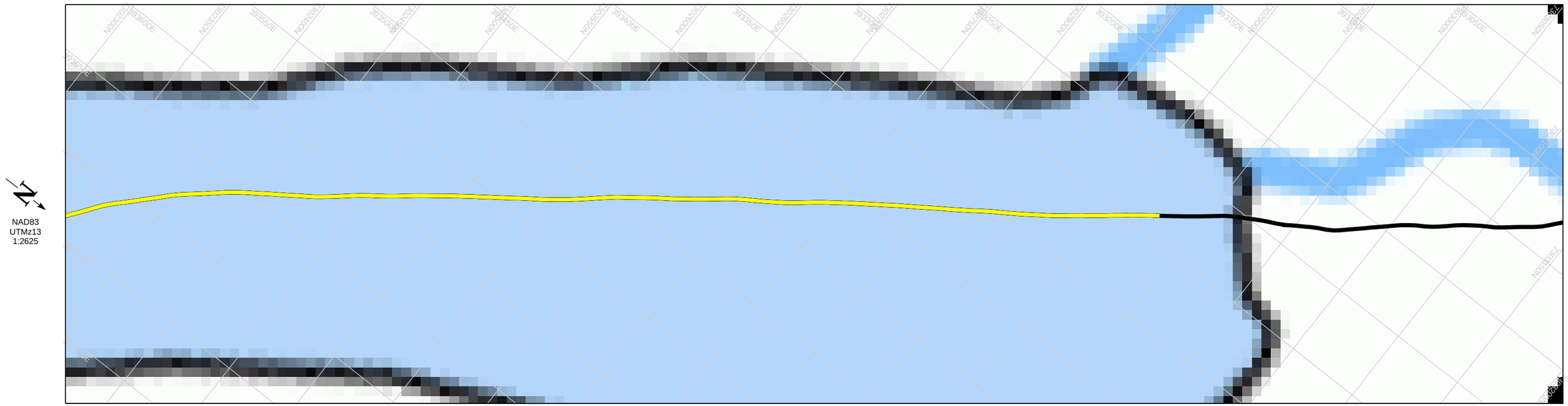
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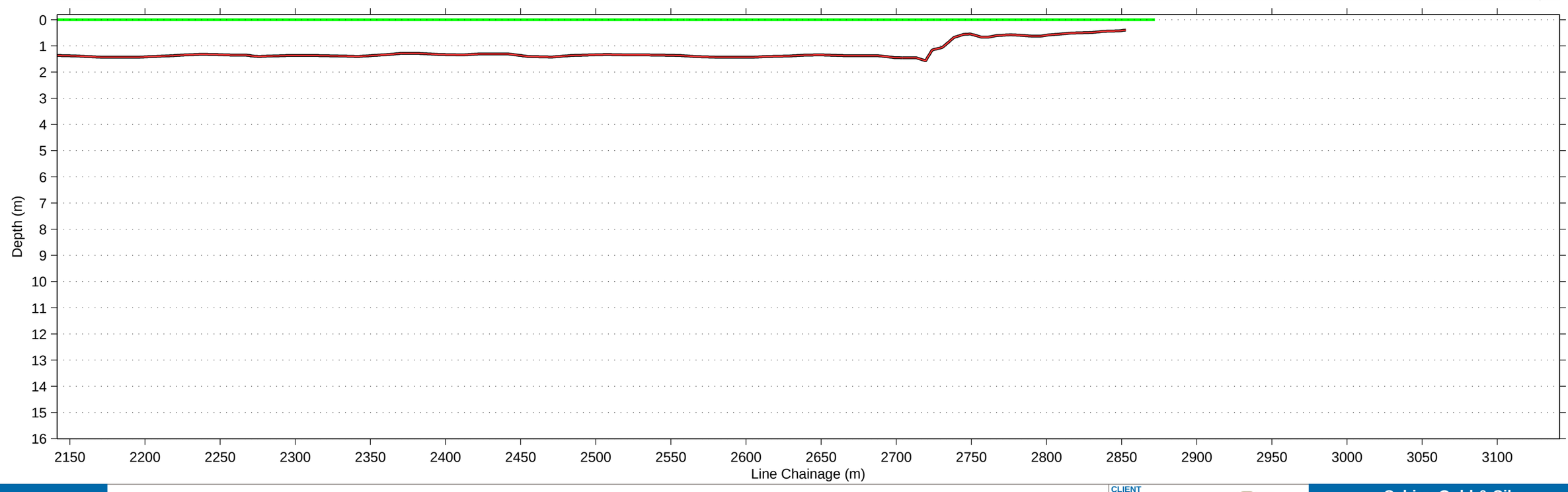
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

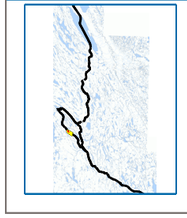
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A12.2







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

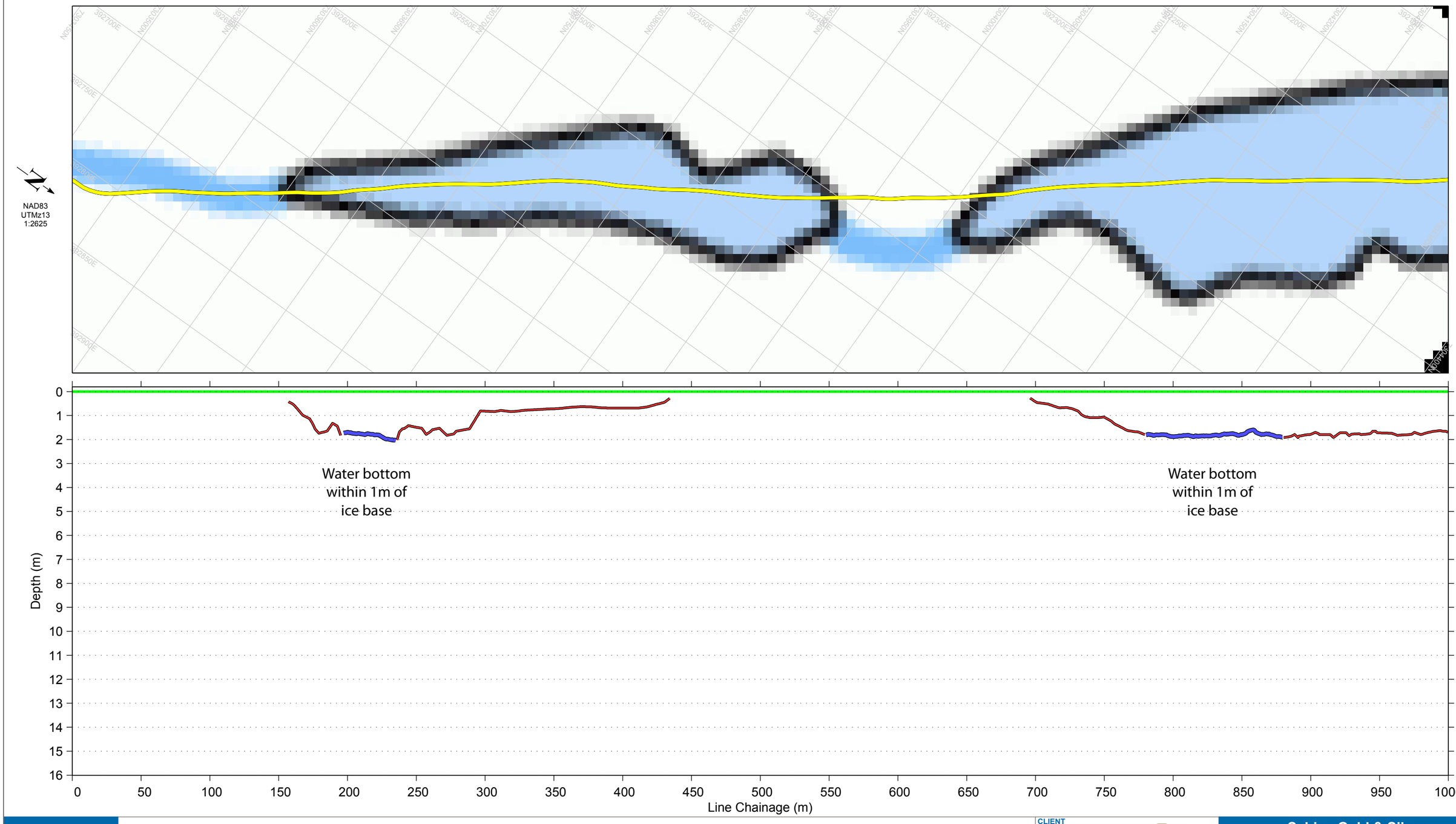
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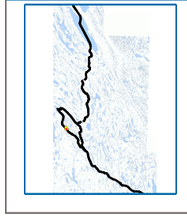
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A12.3





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

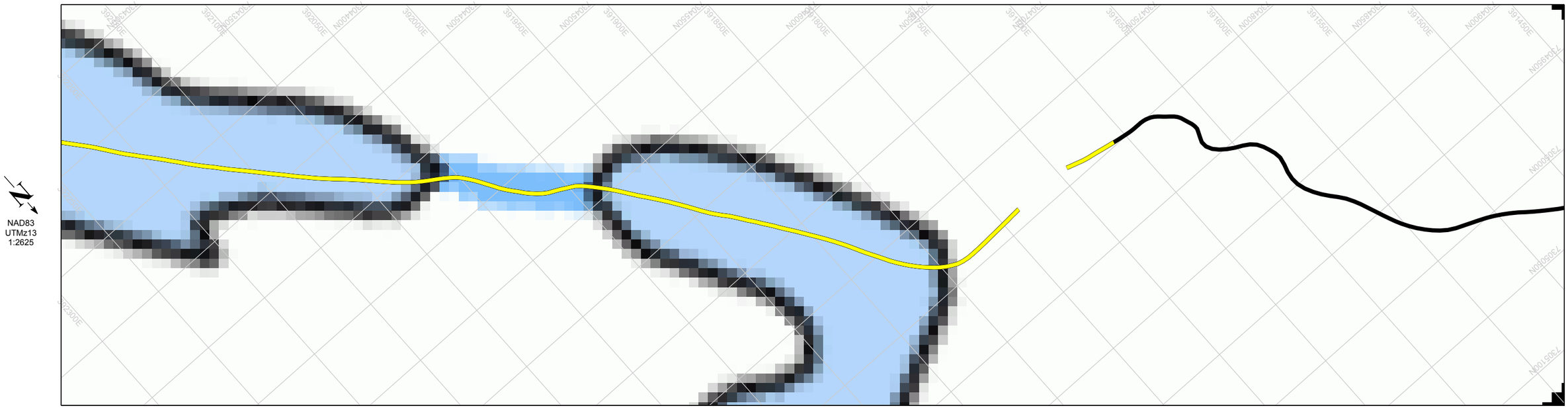
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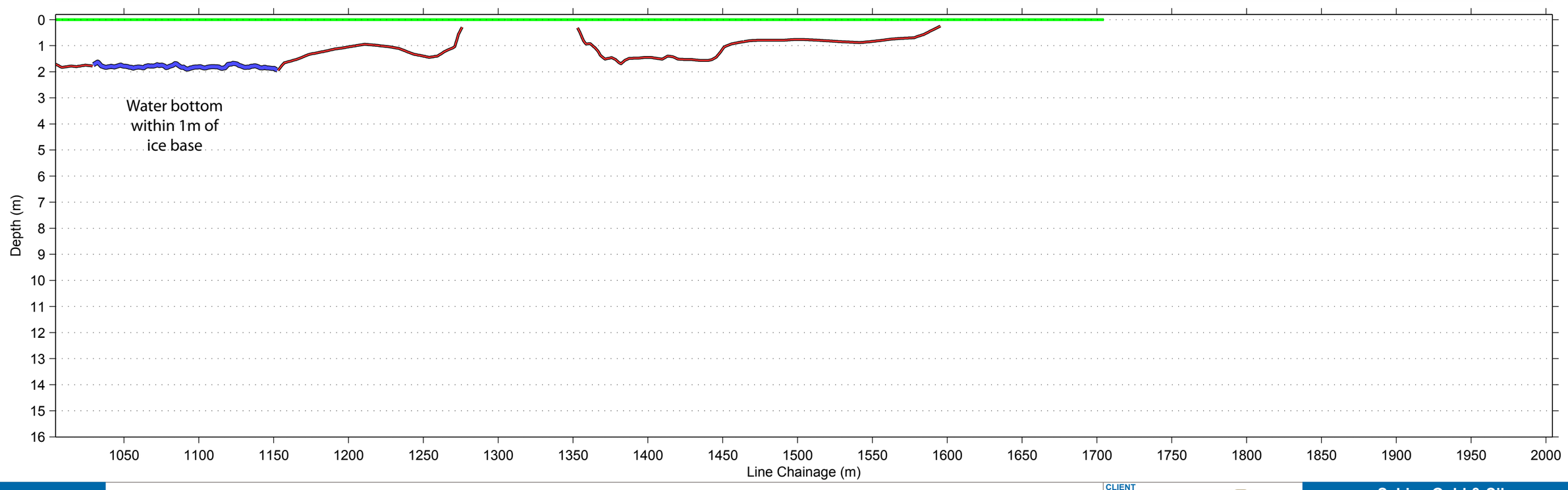
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

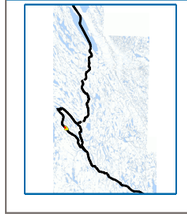
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A13.1







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

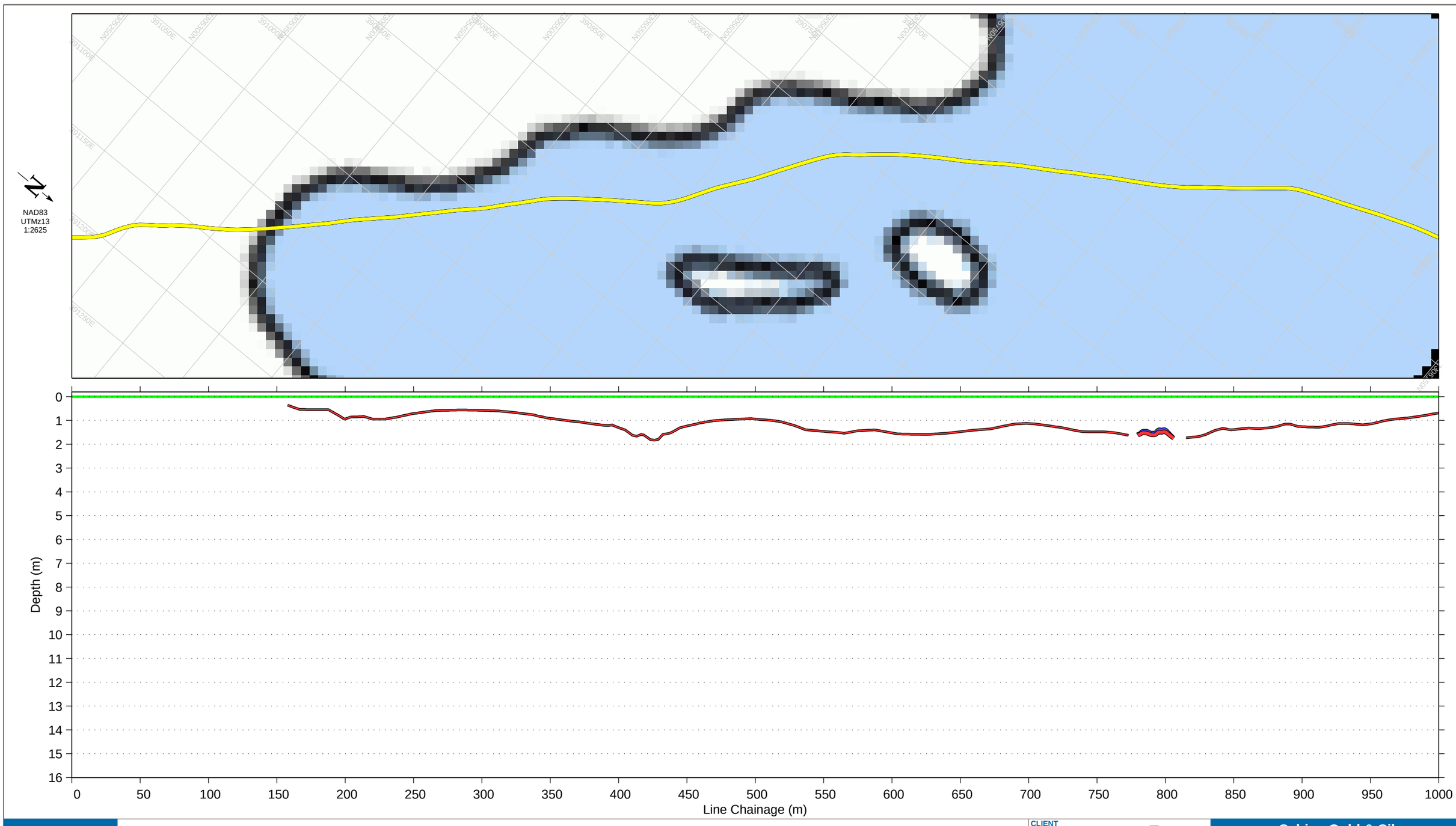
Sabina Gold & Silver
Back River Project GPR Profiling

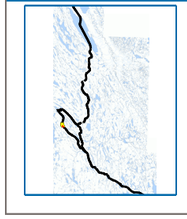
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A13.2





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

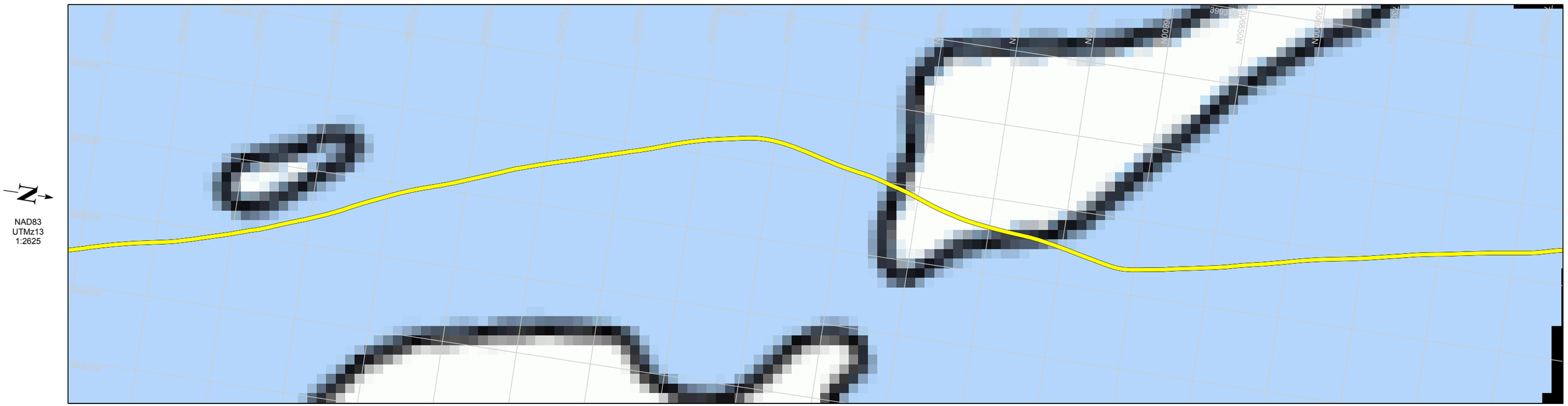
Sabina Gold & Silver
Back River Project GPR Profiling

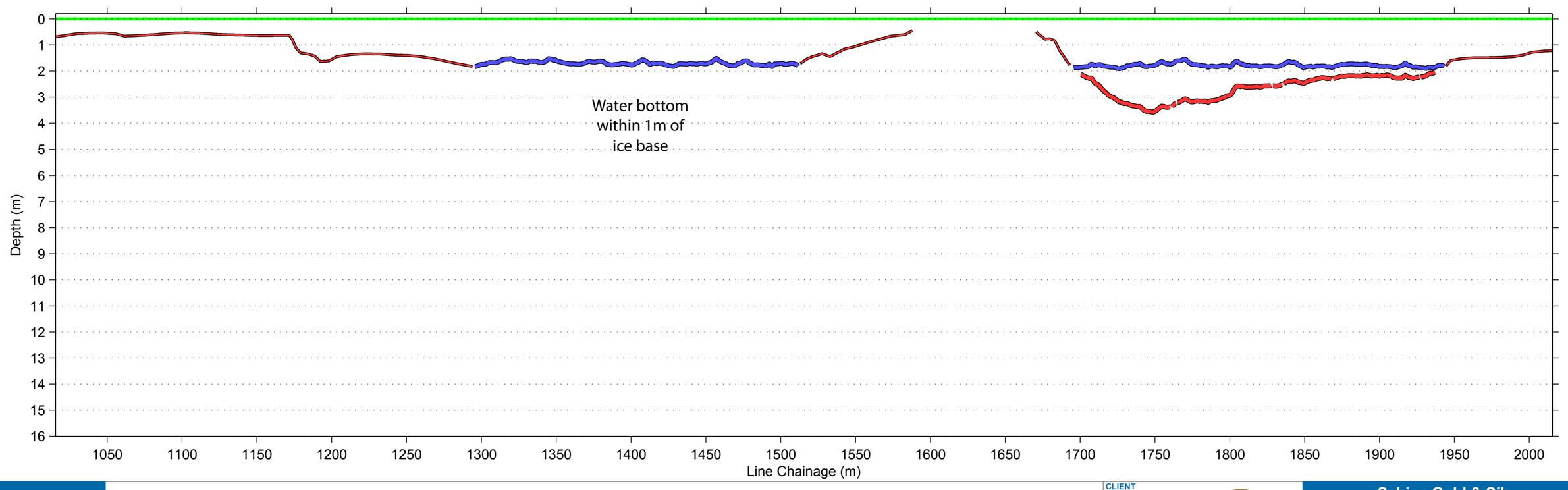
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

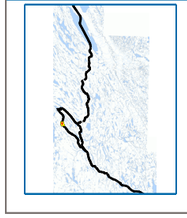
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A14.1







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

CLIENT

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TETRA TECH

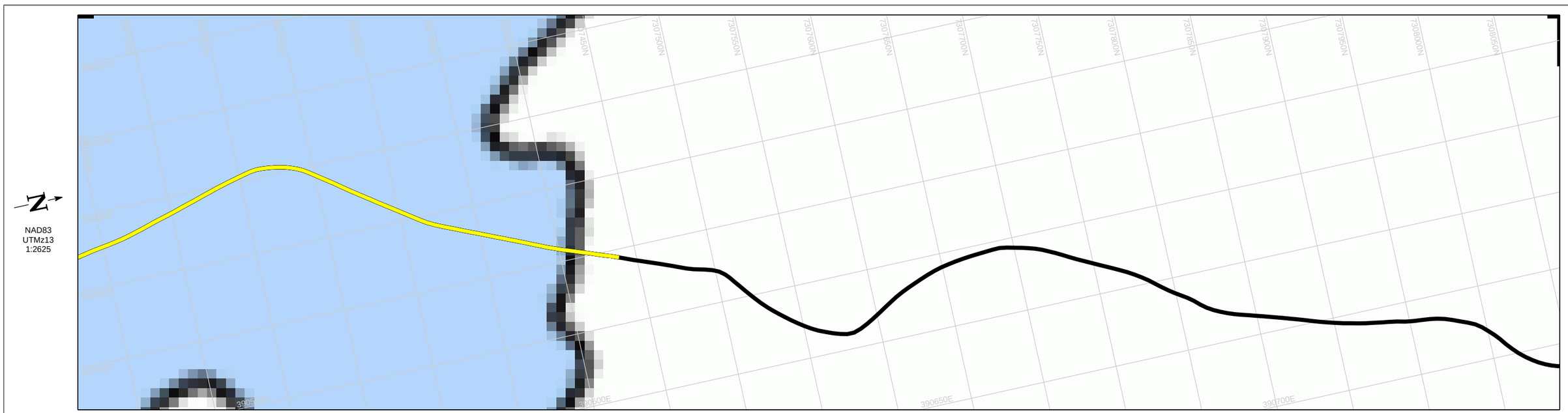
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Back River Project GPR Profiling

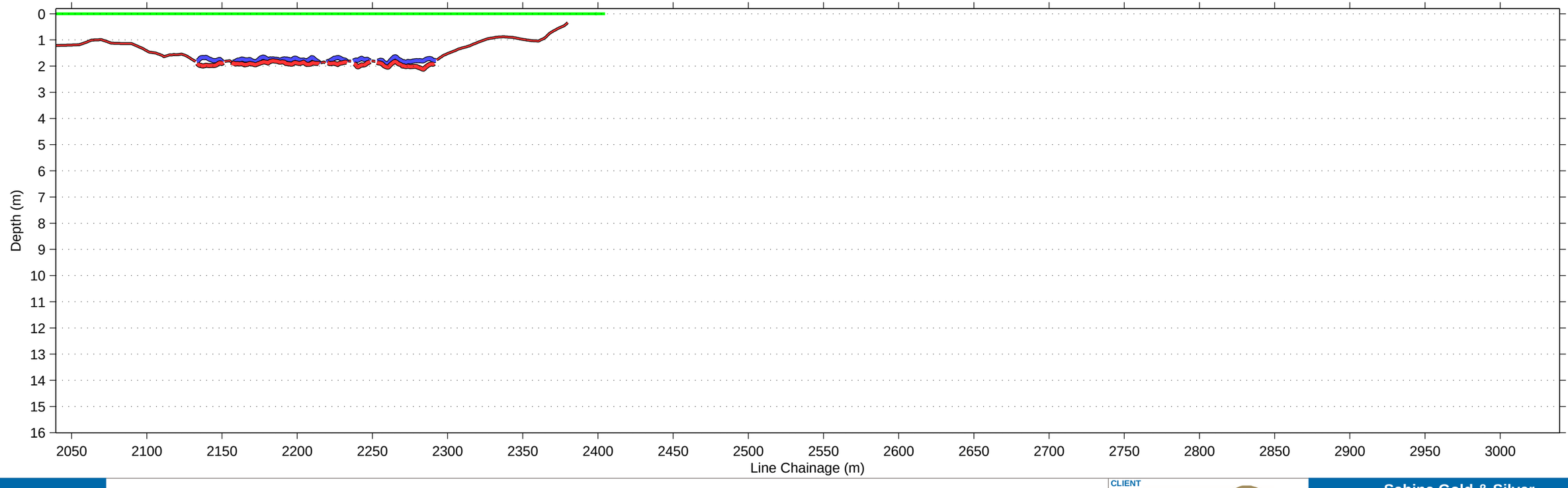
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

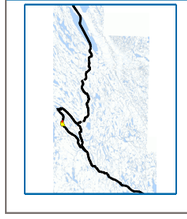
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A14.2







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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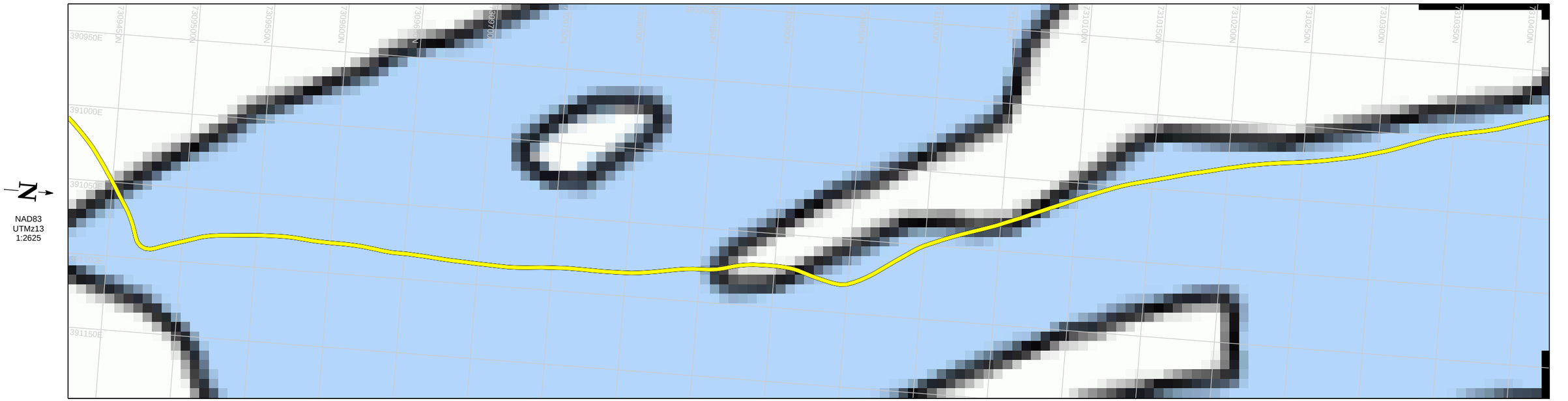
Sabina Gold & Silver
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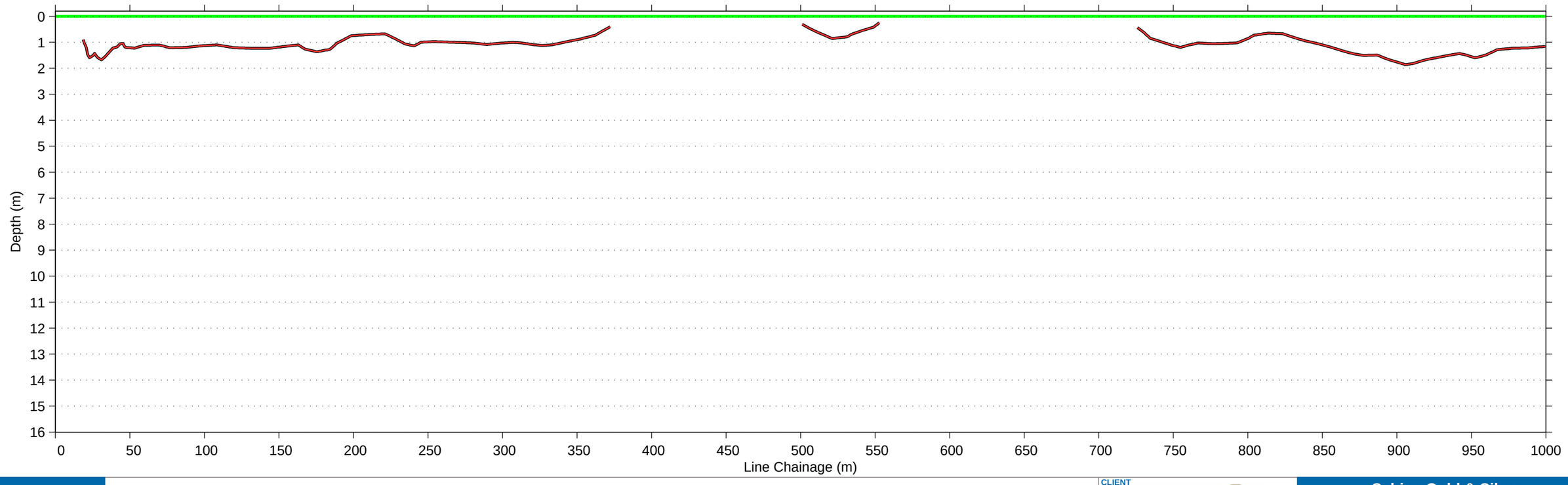
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

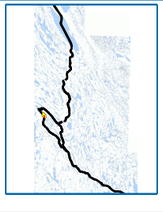
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V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A14.3







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

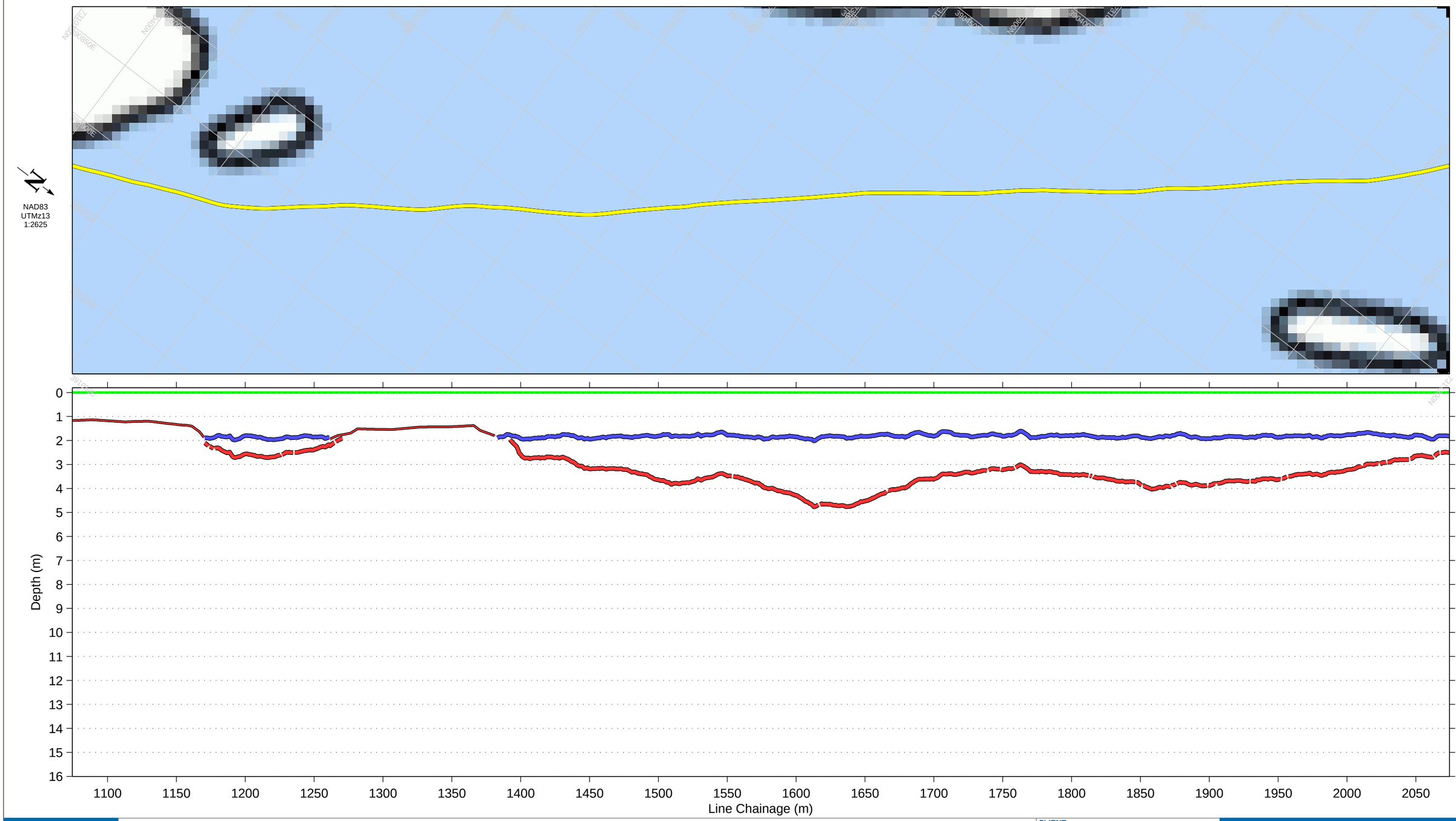
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Back River Project GPR Profiling

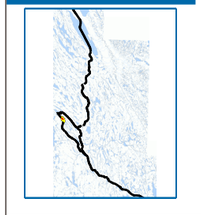
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A15.1





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

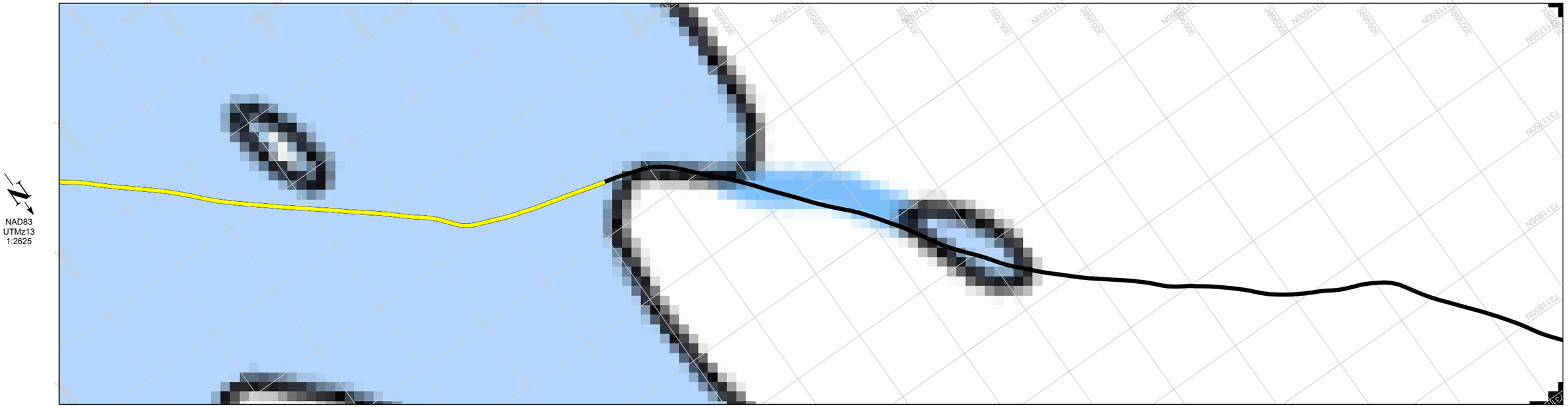
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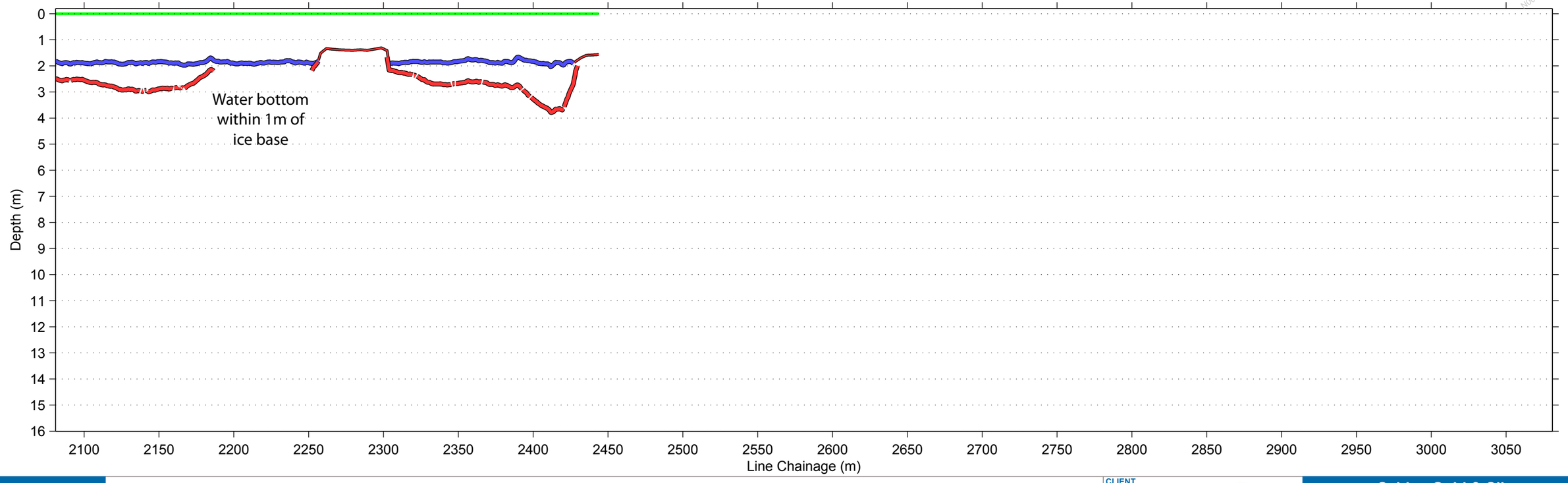
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

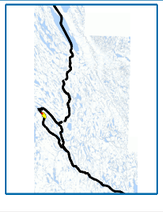
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A15.2







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

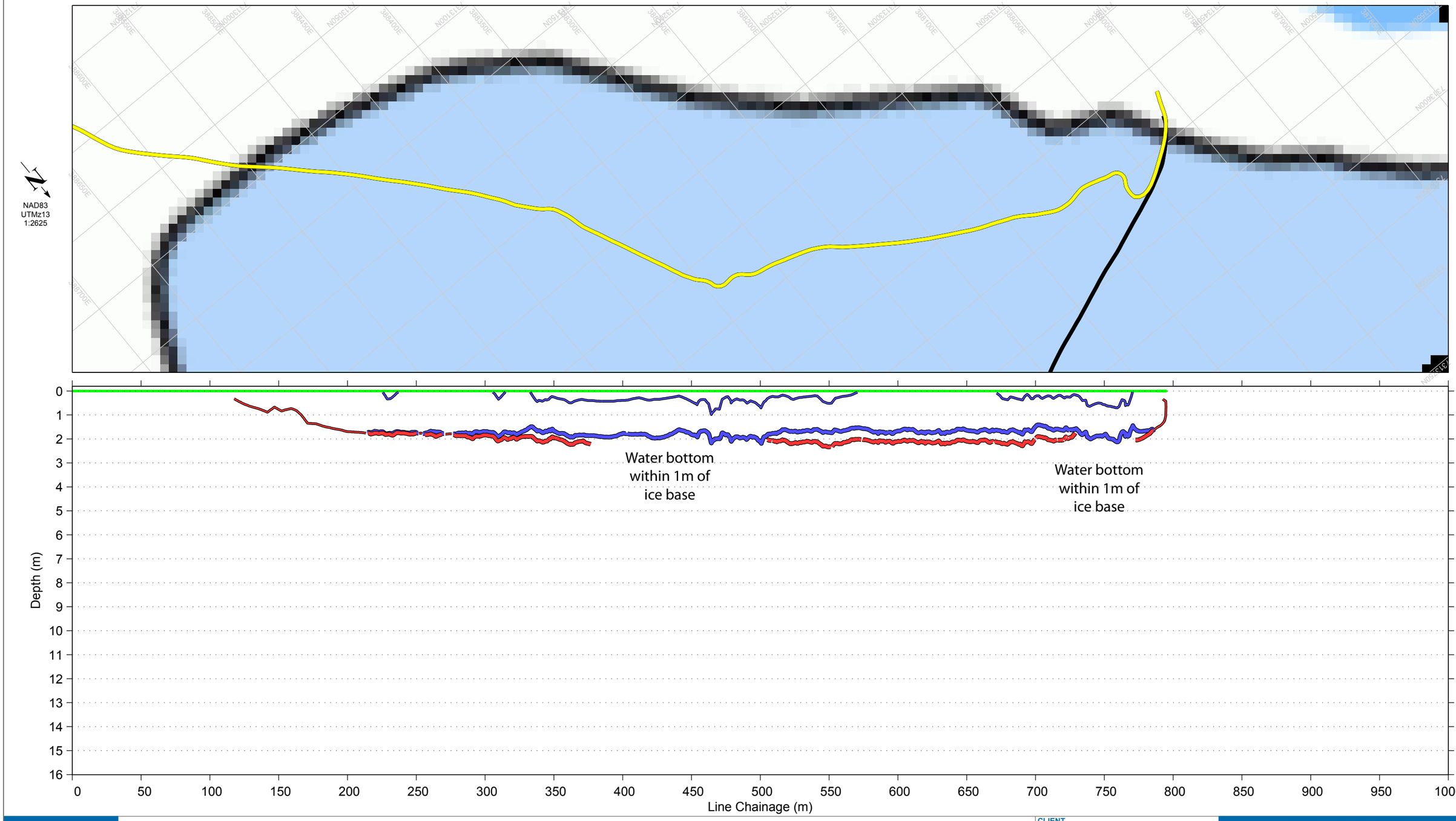
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Back River Project GPR Profiling

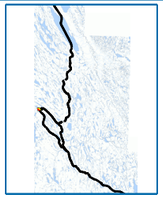
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure A15.3





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

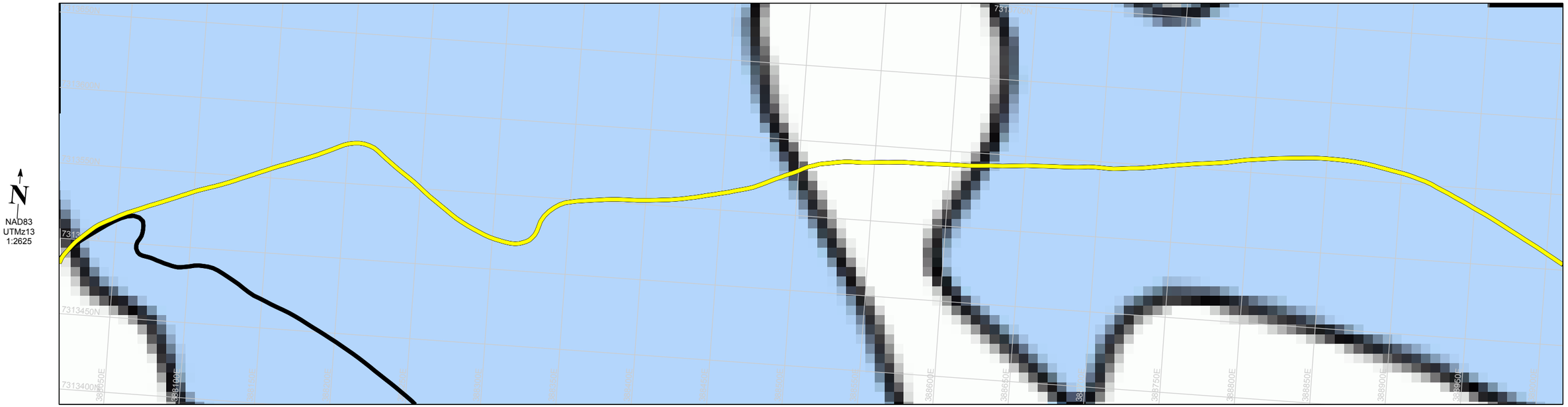
Sabina Gold & Silver
Back River Project GPR Profiling

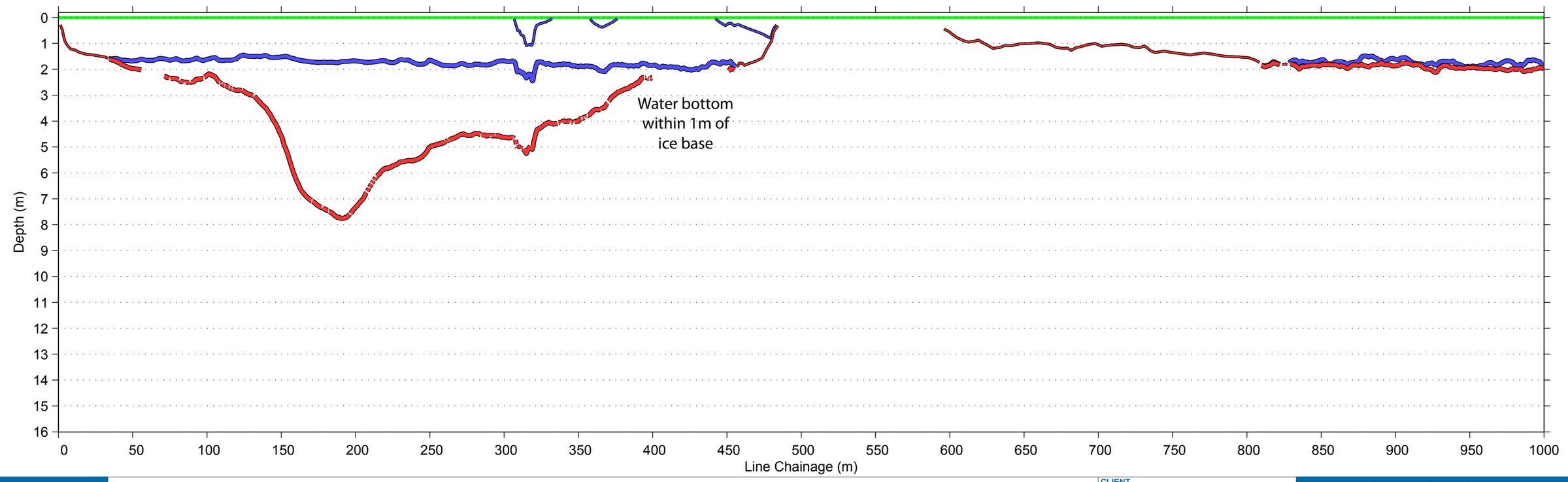
Winter Road Option – Major Lake Profiles
Goose to George
Collected April 25 – 28, 2013

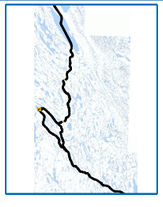
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure A16.1







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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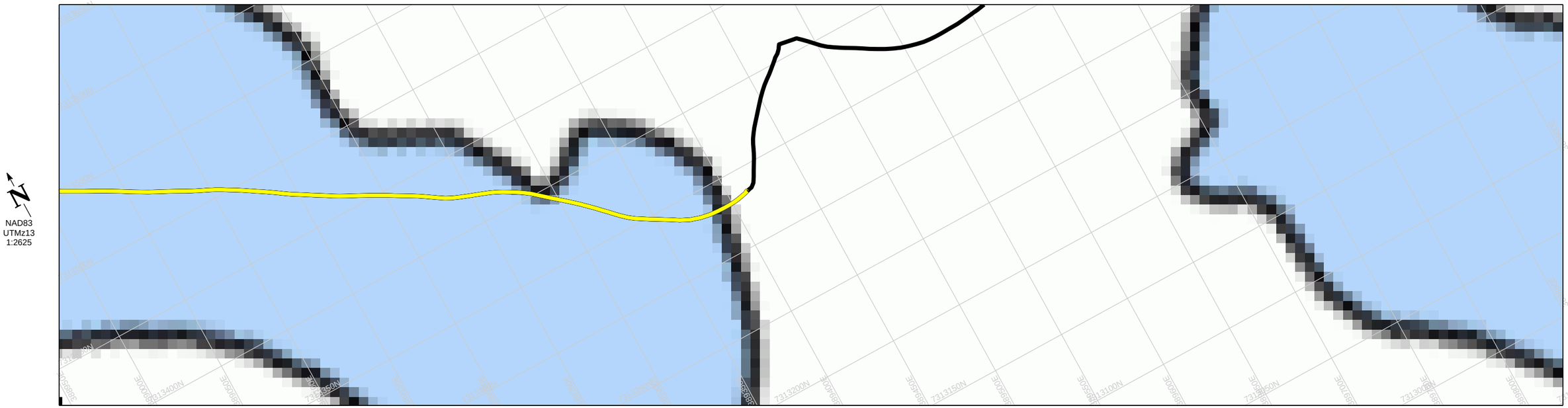
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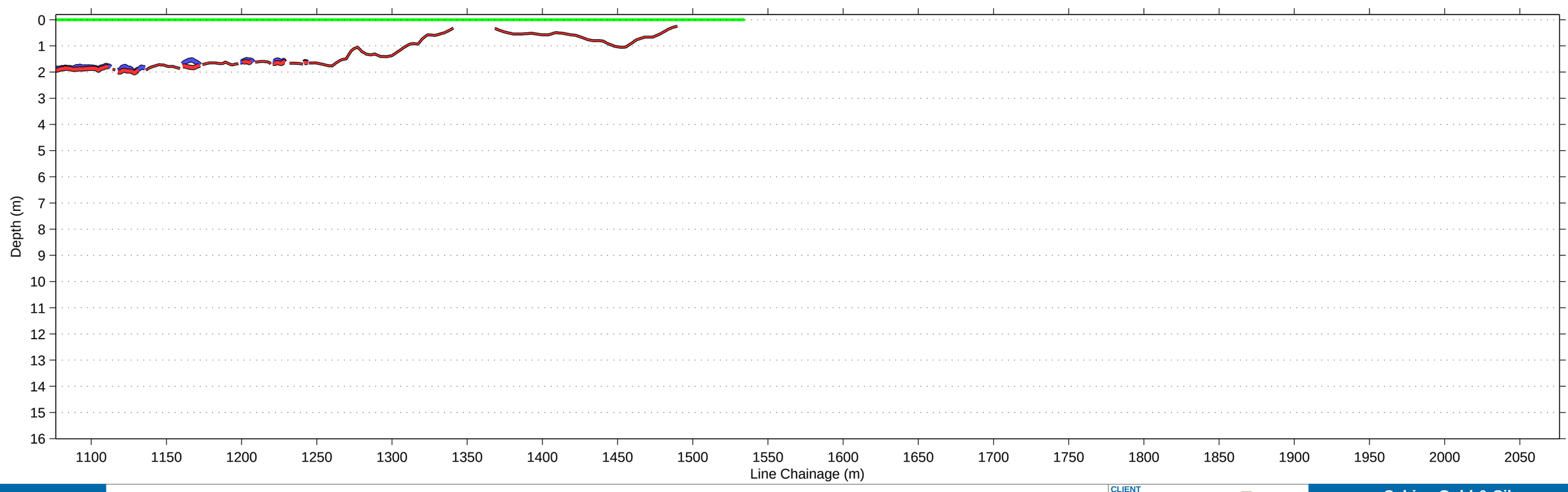
Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

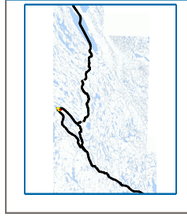
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure B1.1







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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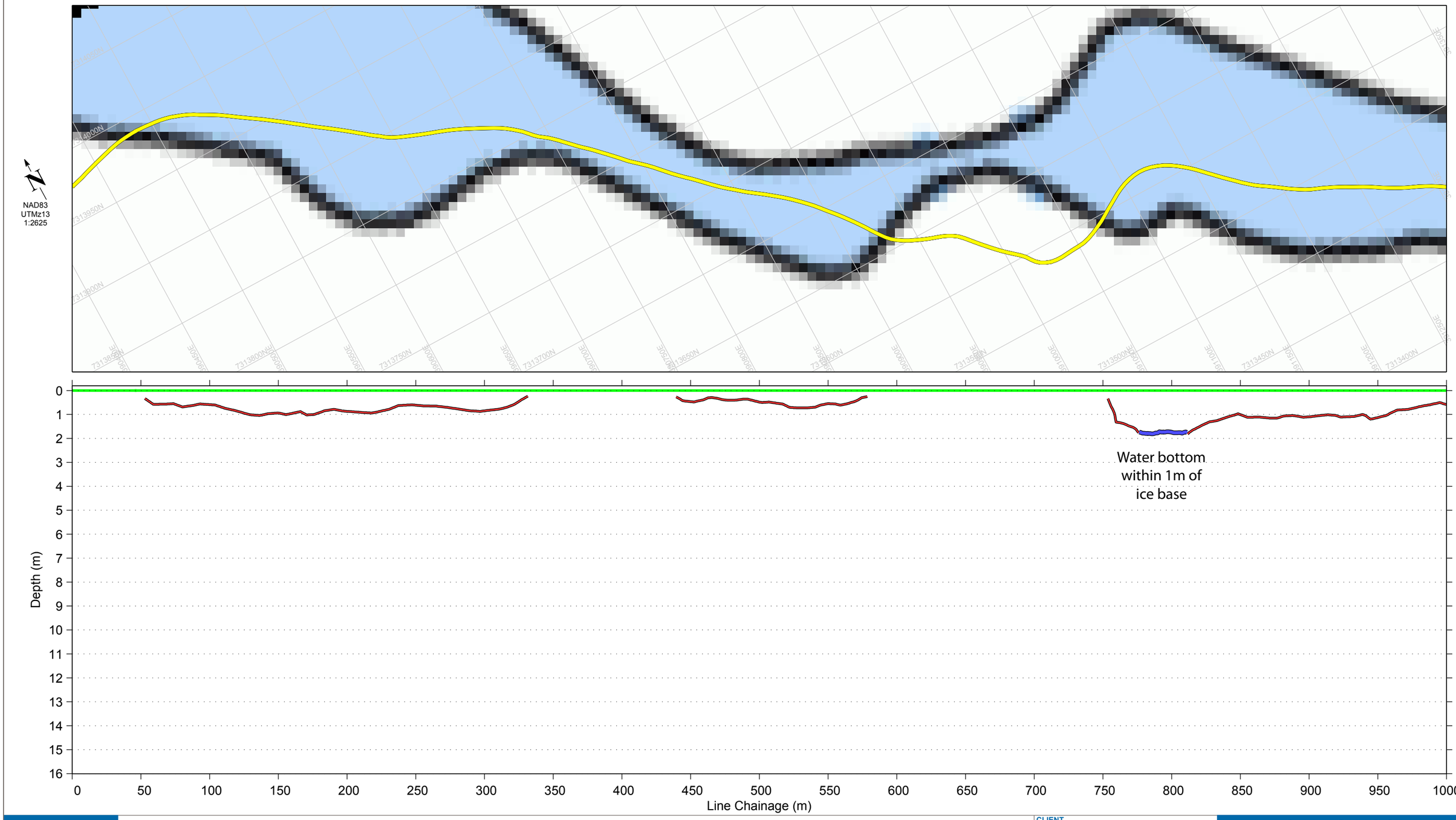
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Back River Project GPR Profiling

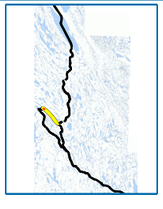
Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure B1.2





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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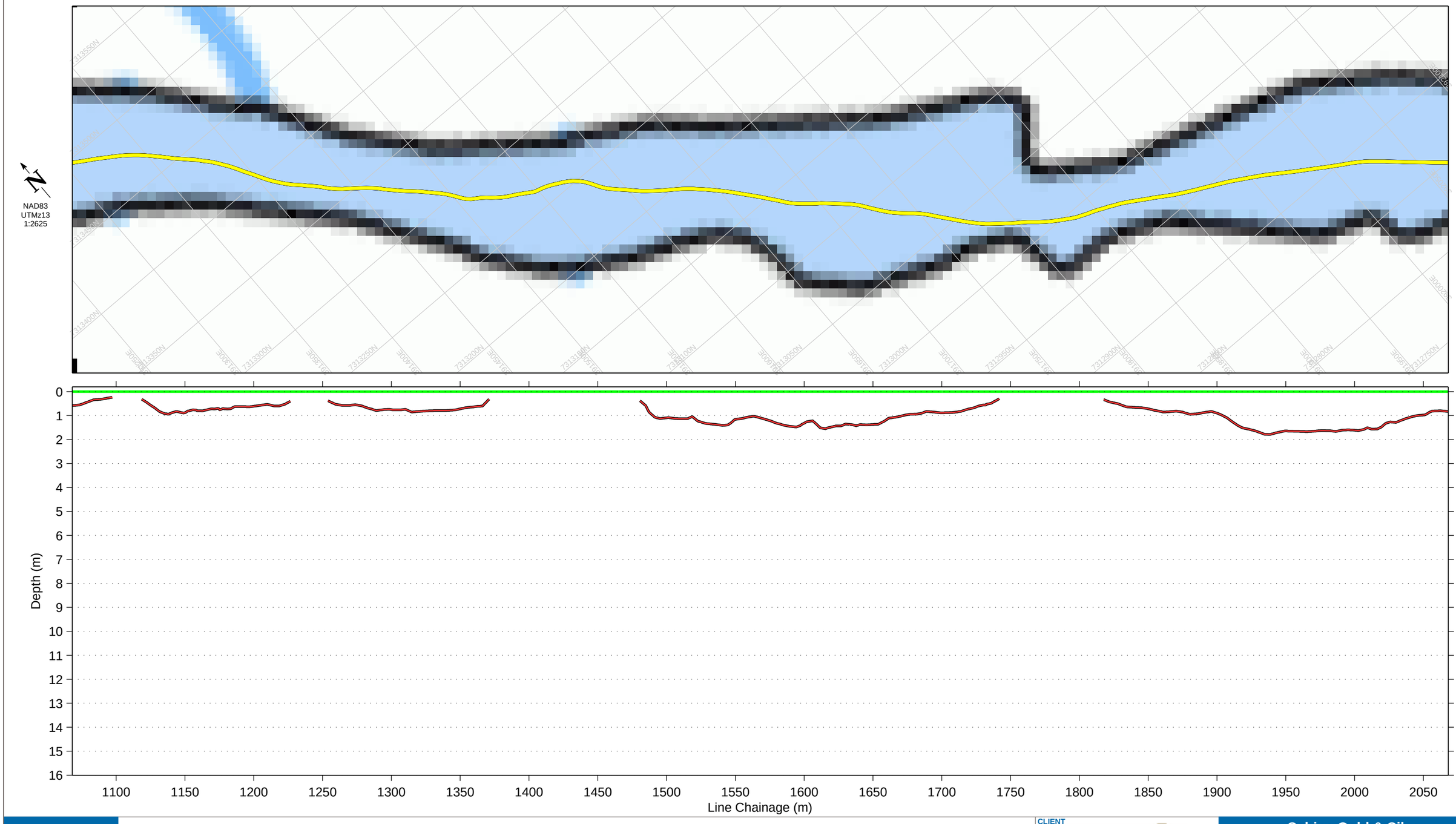
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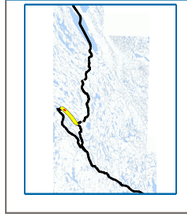
Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure B2.1





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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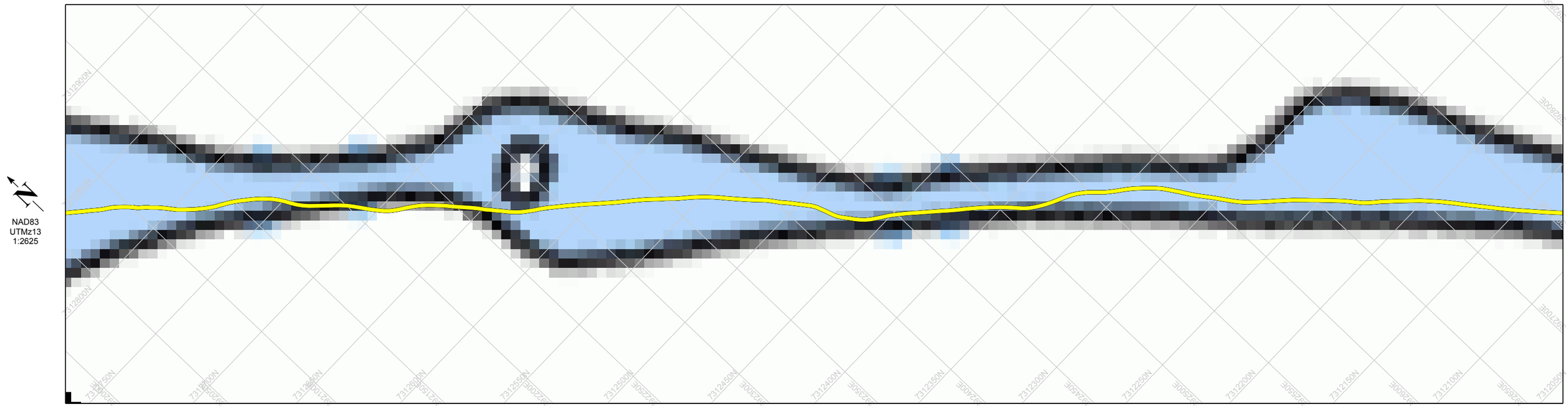
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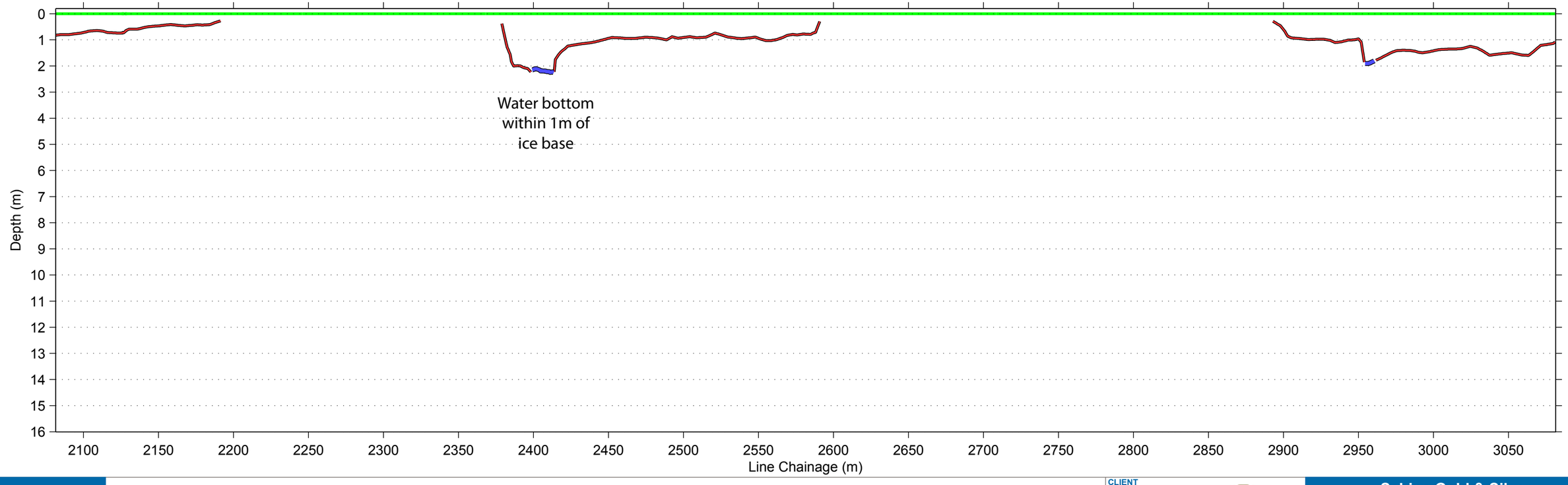
Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

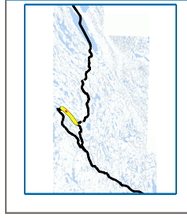
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure B2.2







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE: Edmonton
DATE: June 14, 2013

Figure B2.3

NAD83
UTMz13
1:2625

Water bottom
within 1m of
ice base

Depth (m)

Line Chainage (m)

LEGEND

- Plotted GPR Tracks
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- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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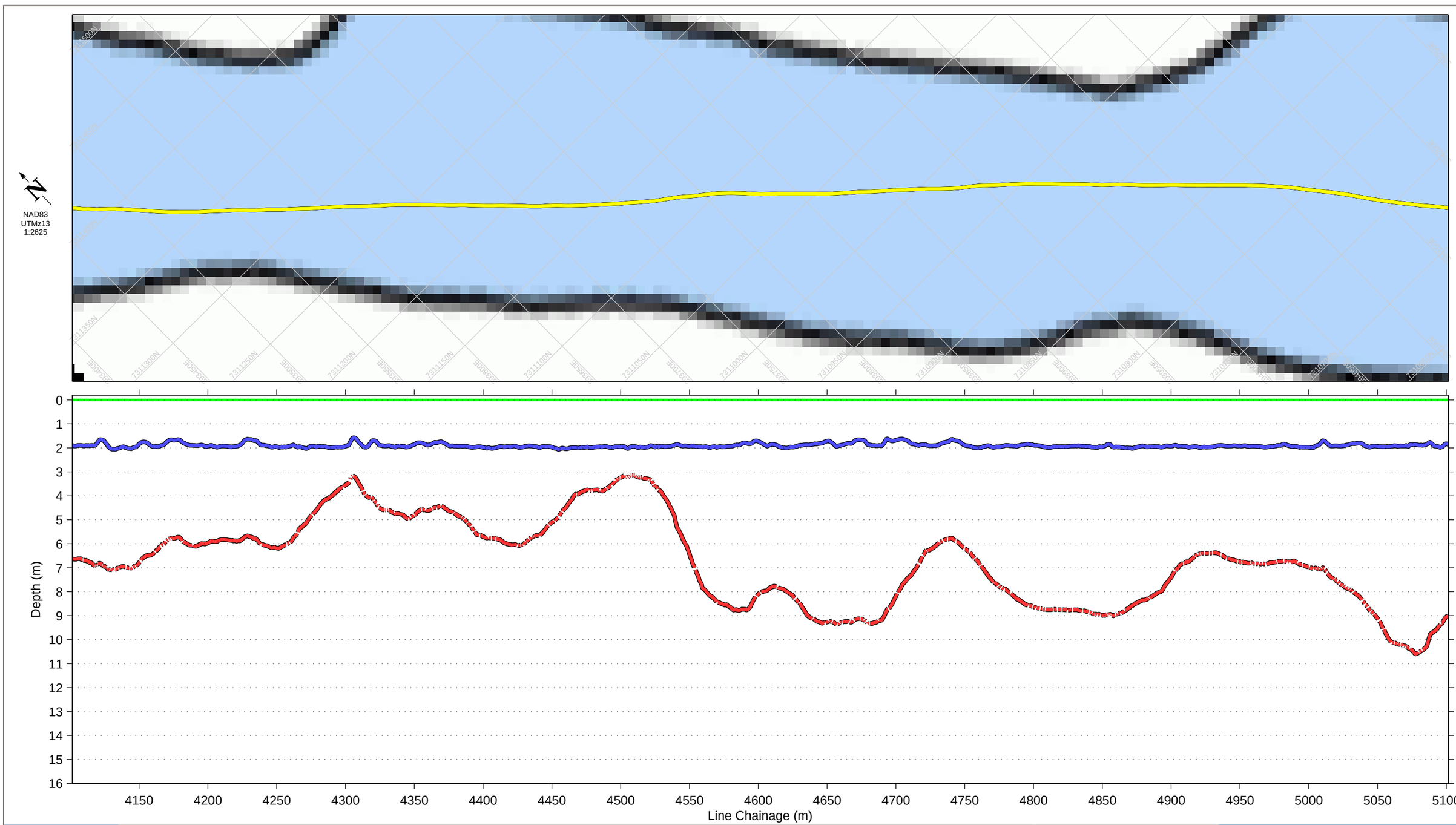
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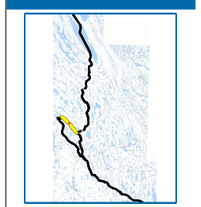
Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure B2.4





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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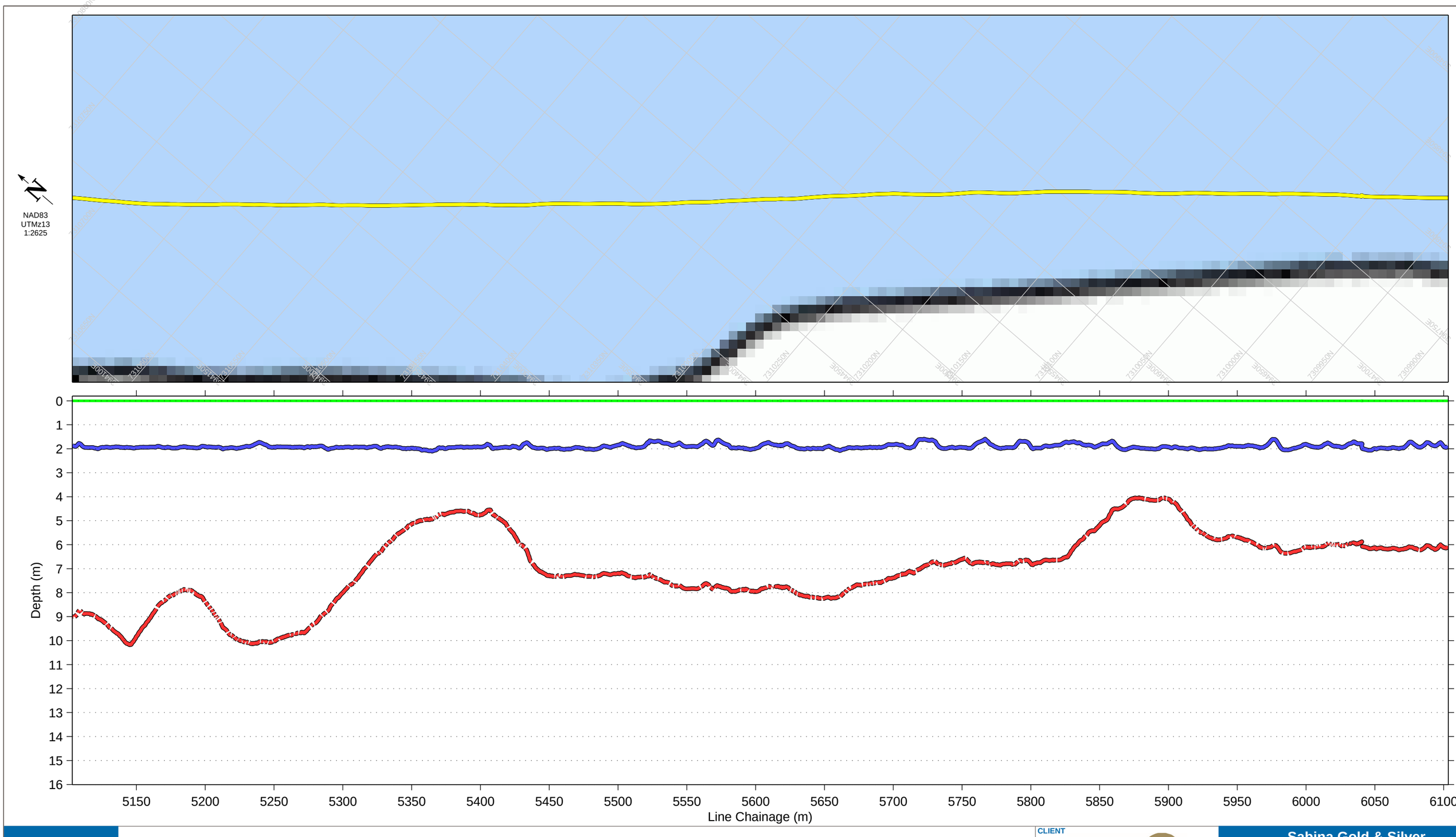
Sabina Gold & Silver
Back River Project GPR Profiling

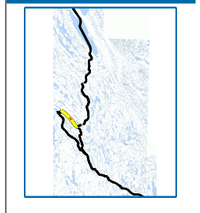
Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure B2.5





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

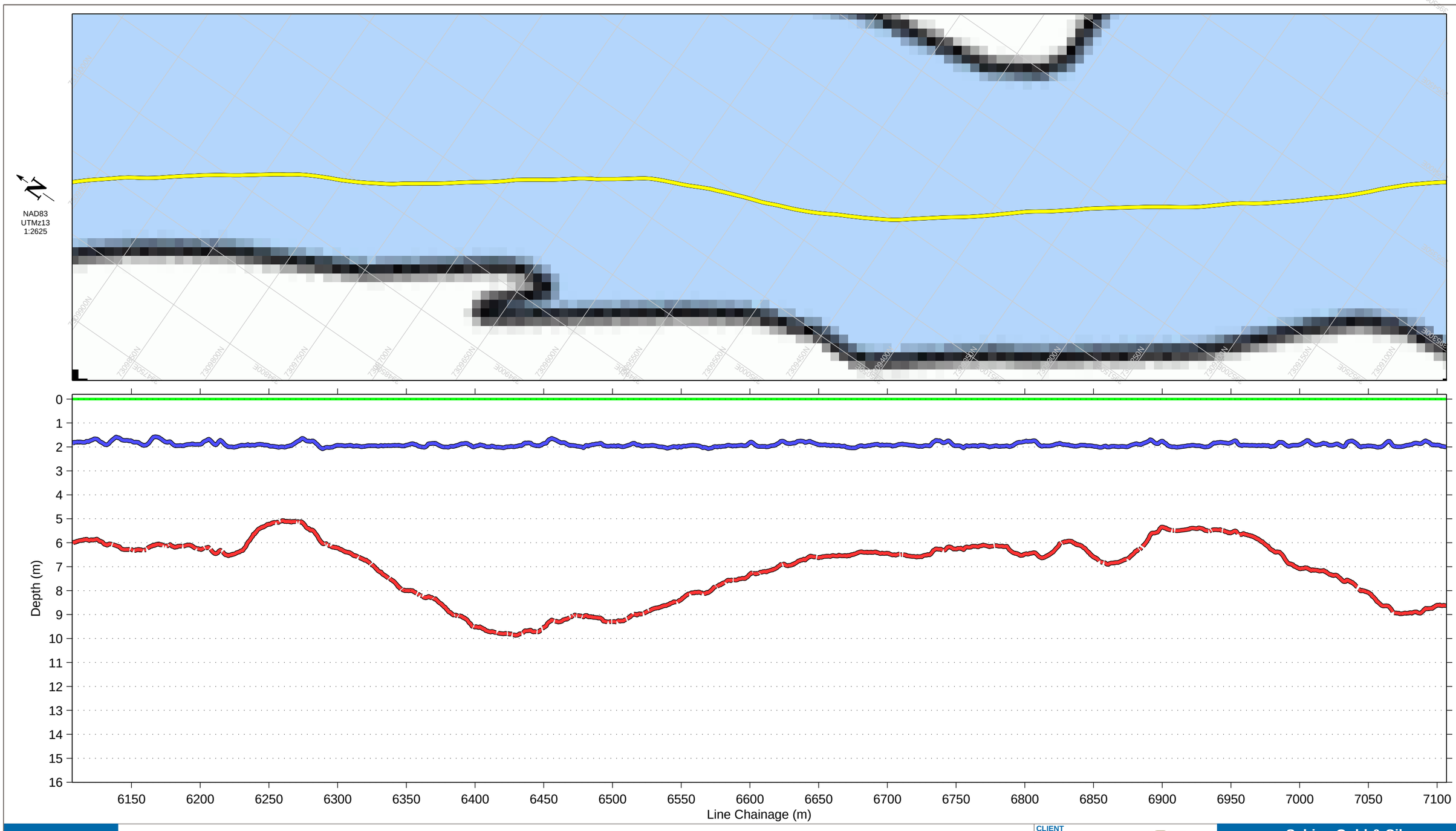
Sabina Gold & Silver
Back River Project GPR Profiling

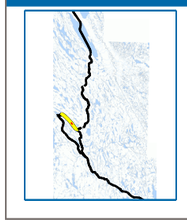
Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure B2.6





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

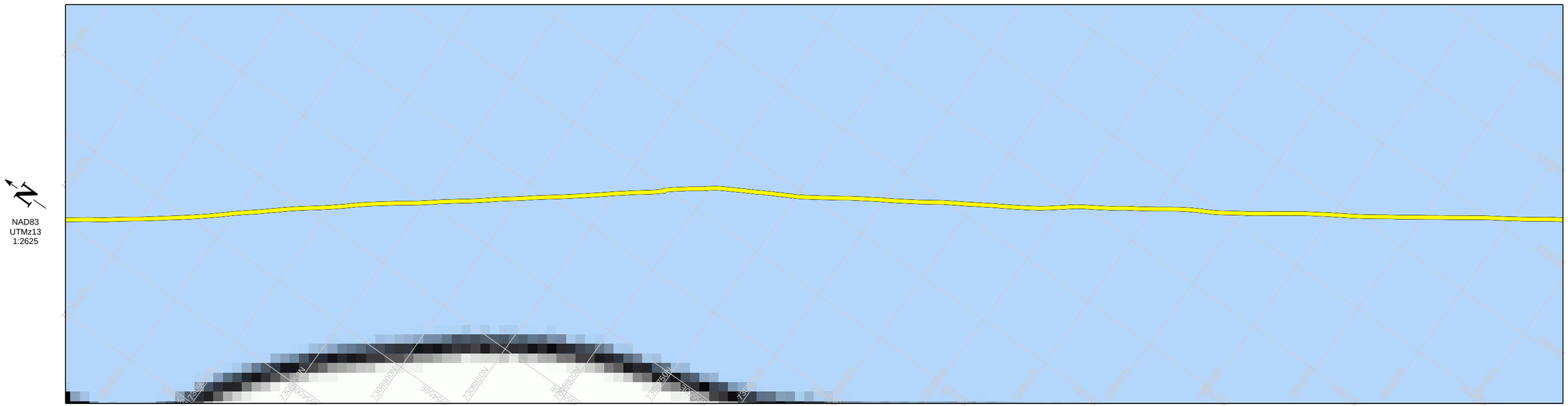
Sabina Gold & Silver
Back River Project GPR Profiling

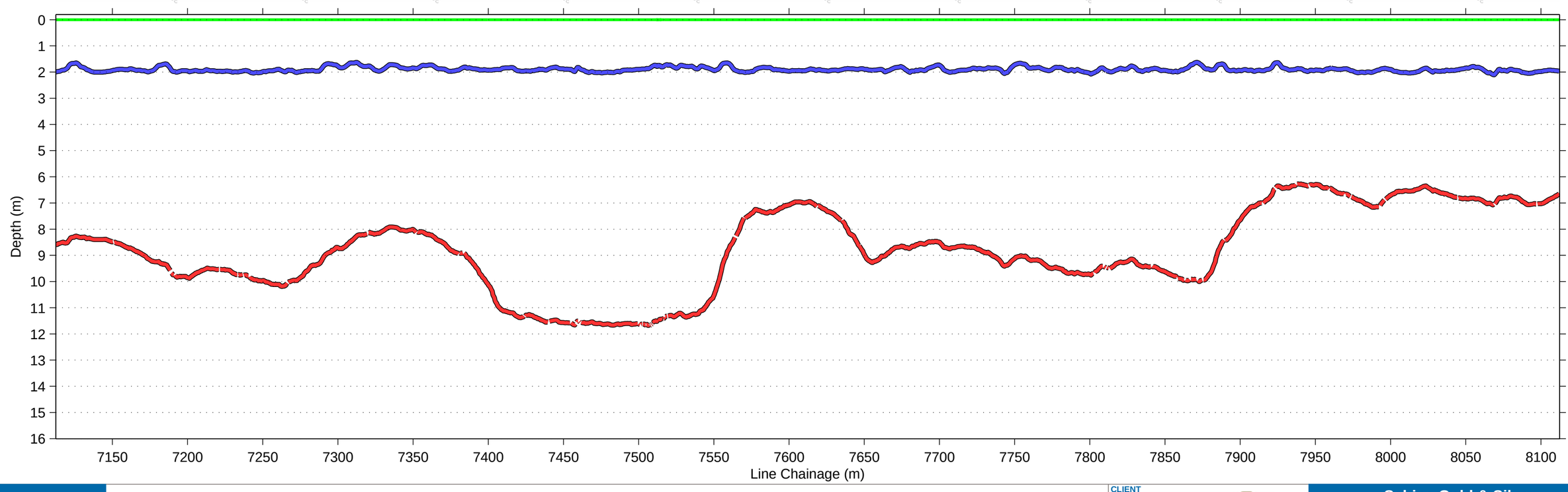
Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

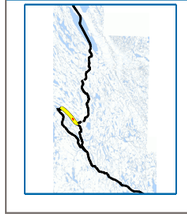
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure B2.7







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

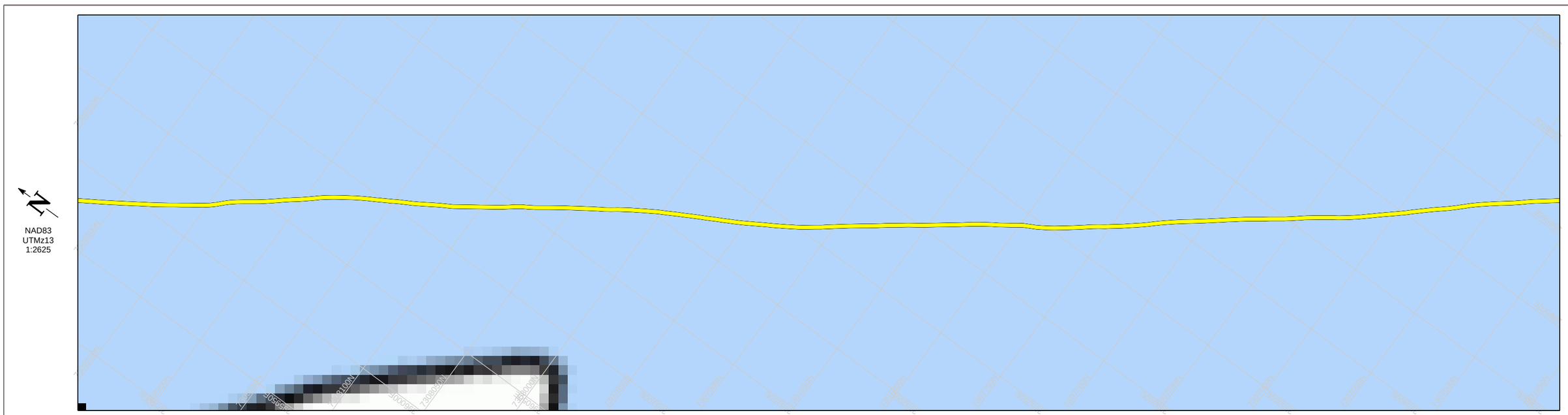
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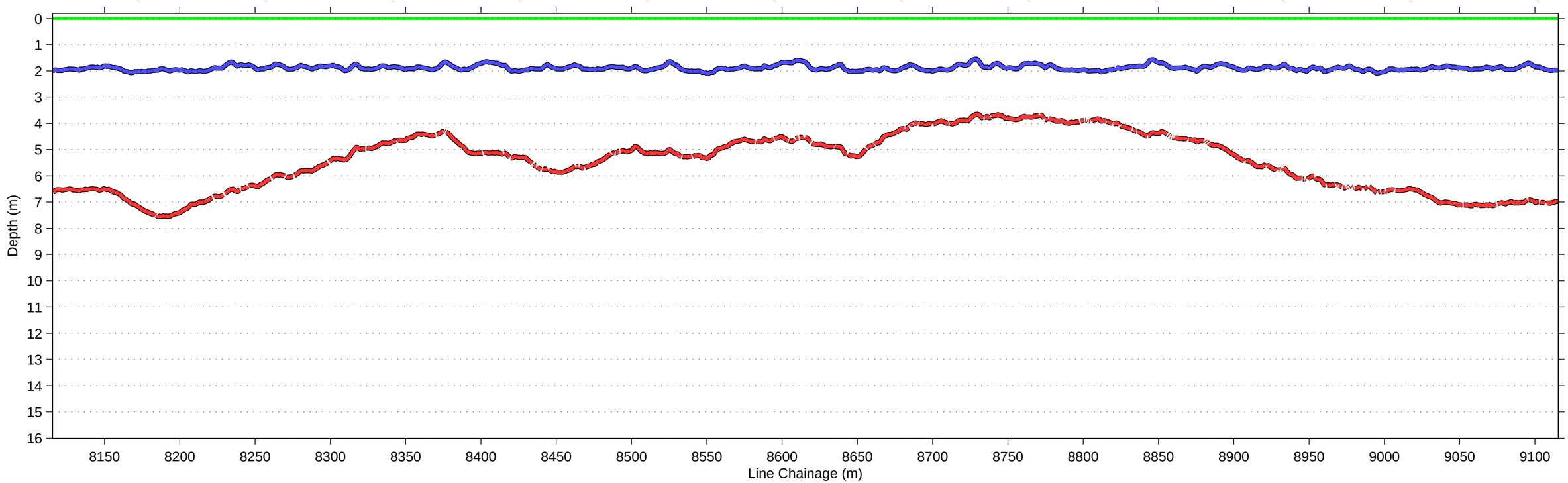
Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

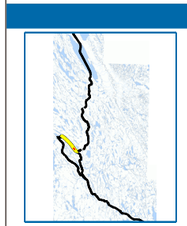
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure B2.8







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

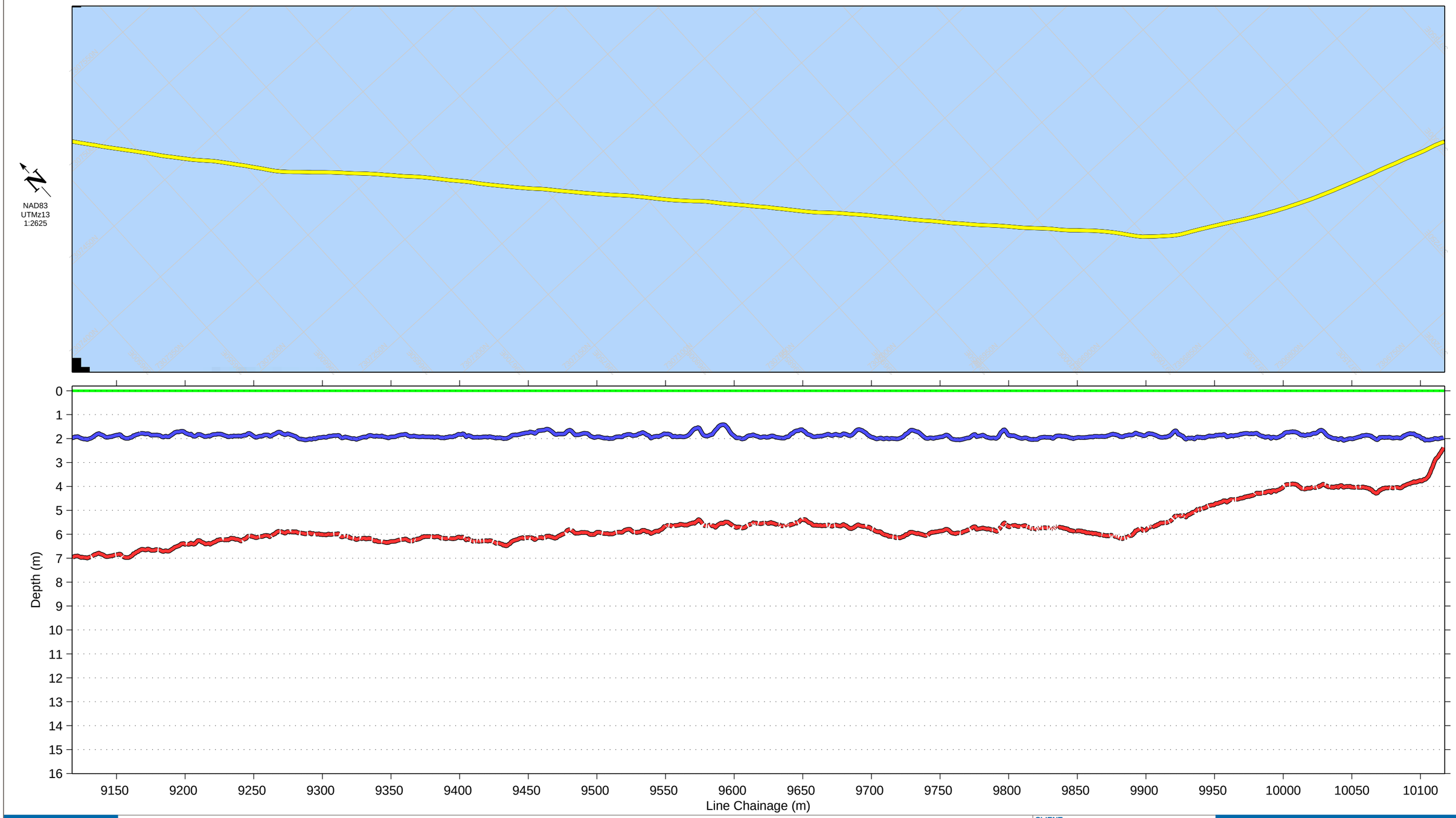
Sabina Gold & Silver
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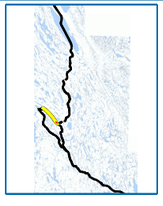
Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure B2.9





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

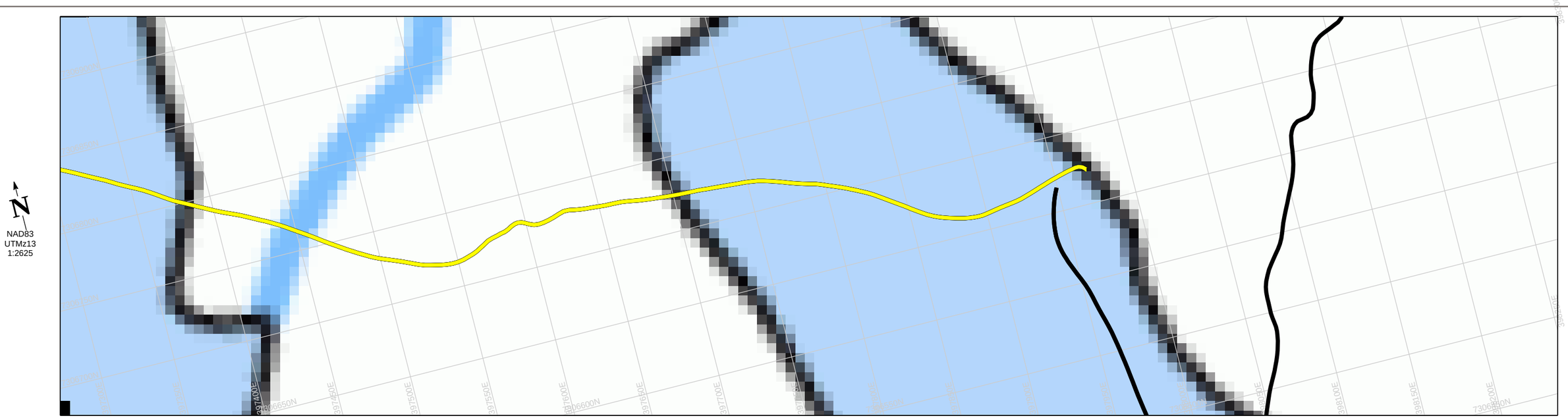
Sabina Gold & Silver
Back River Project GPR Profiling

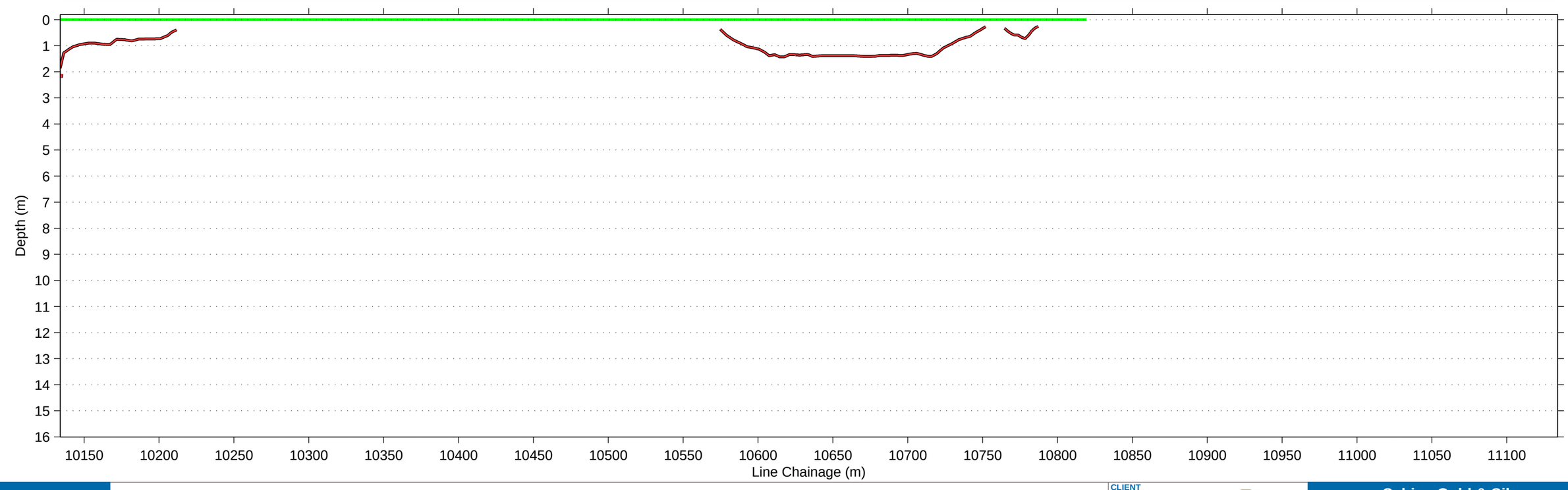
Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

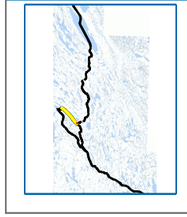
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure B2.10







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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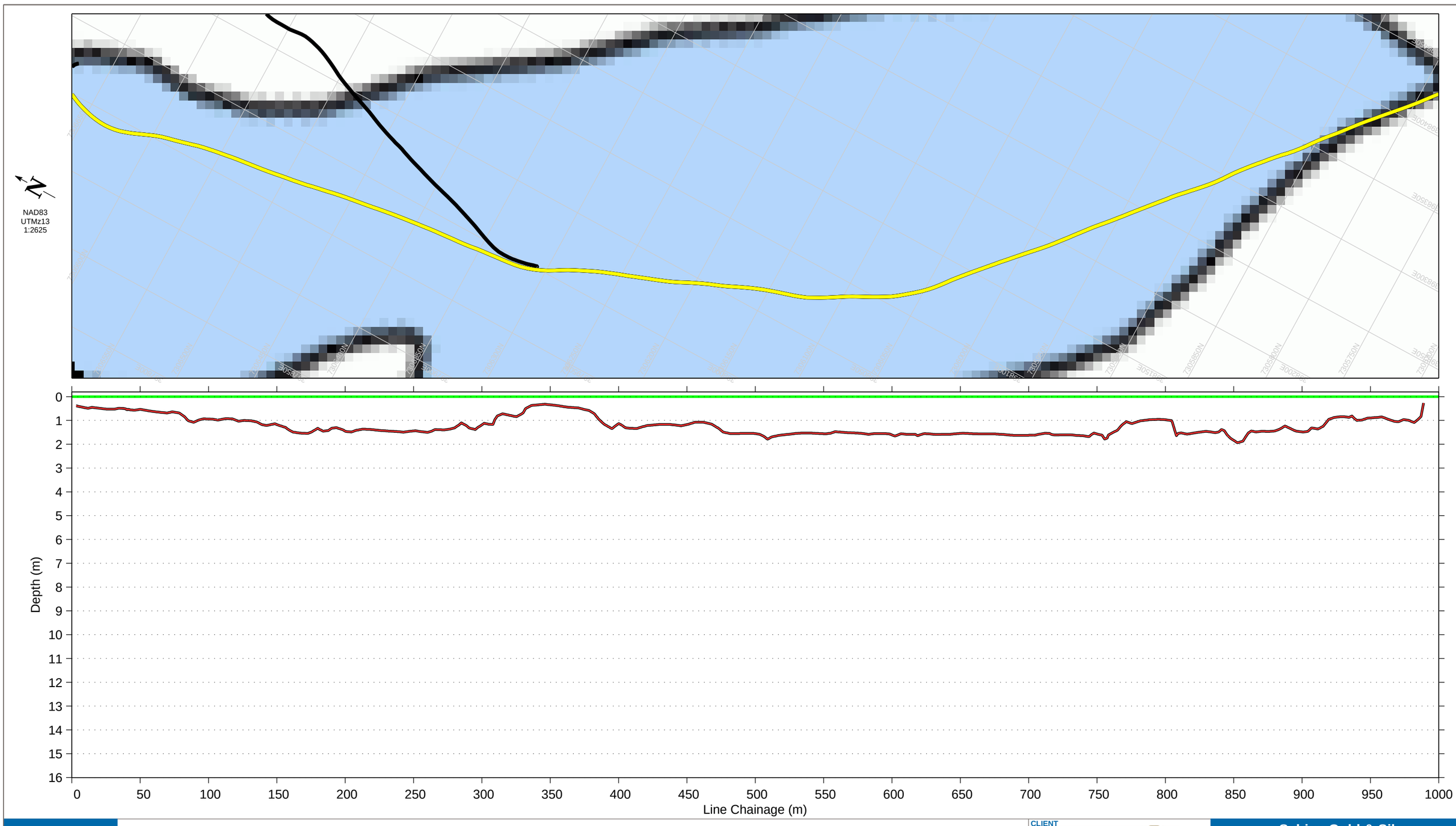
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Winter Road Option – Major Lake Profiles
George to Northern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure B2.11





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

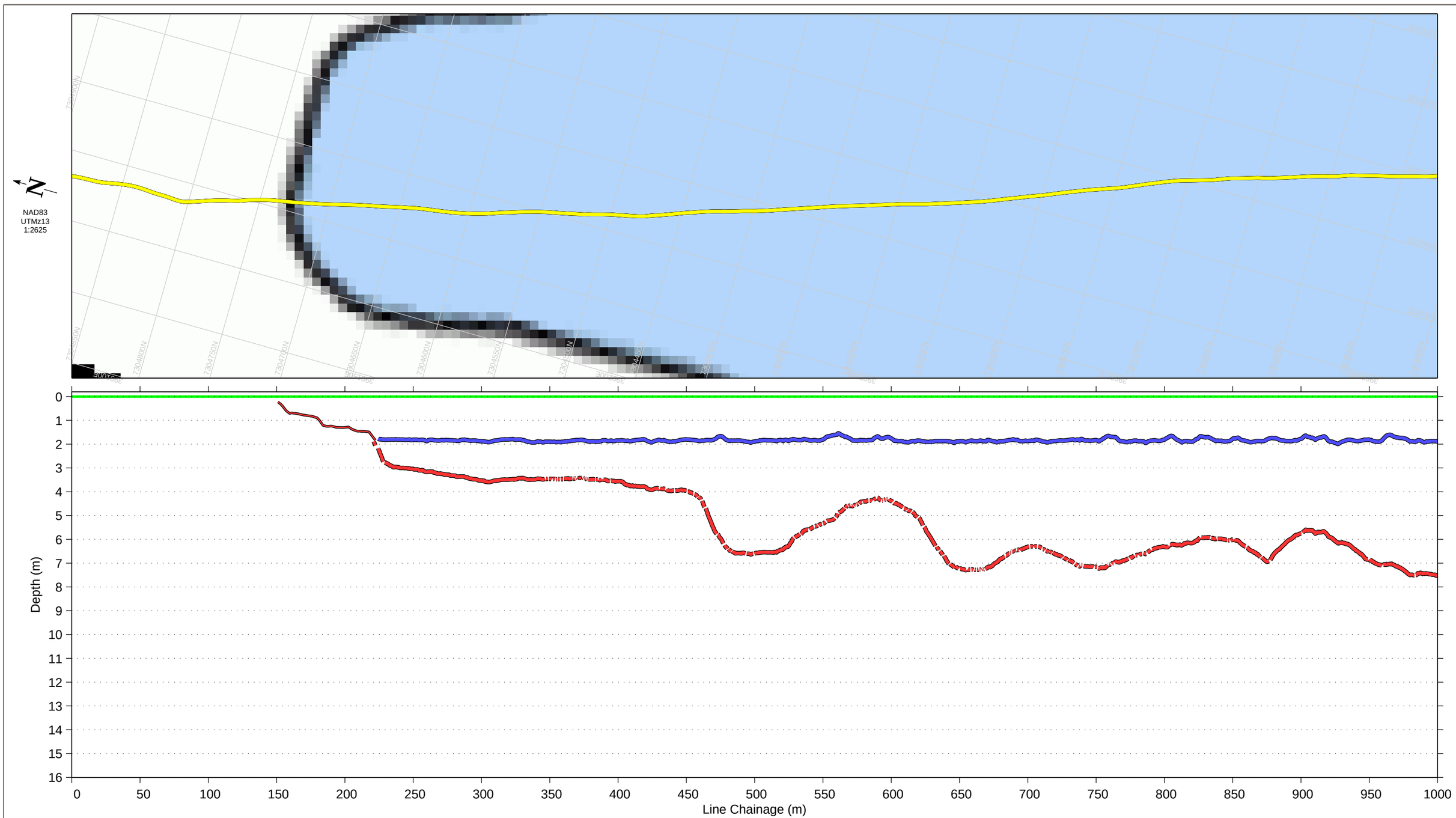
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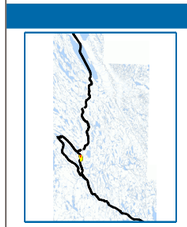
Winter Road Option – Major Lake Profiles
Northern to Southern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure C1.1





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

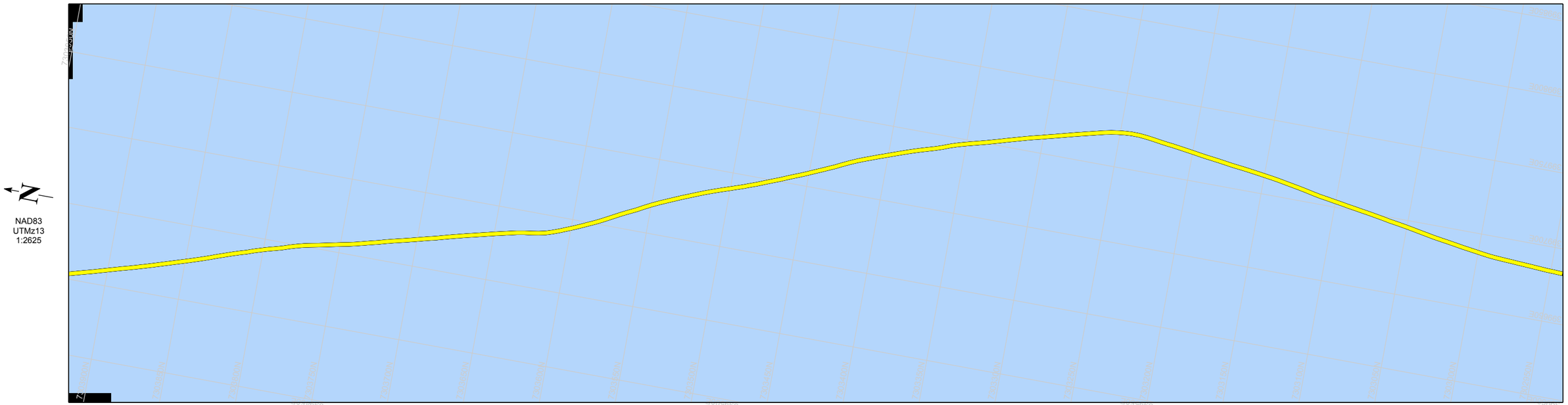
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Winter Road Option – Major Lake Profiles
Northern to Southern Junction
Collected April 25 – 28, 2013

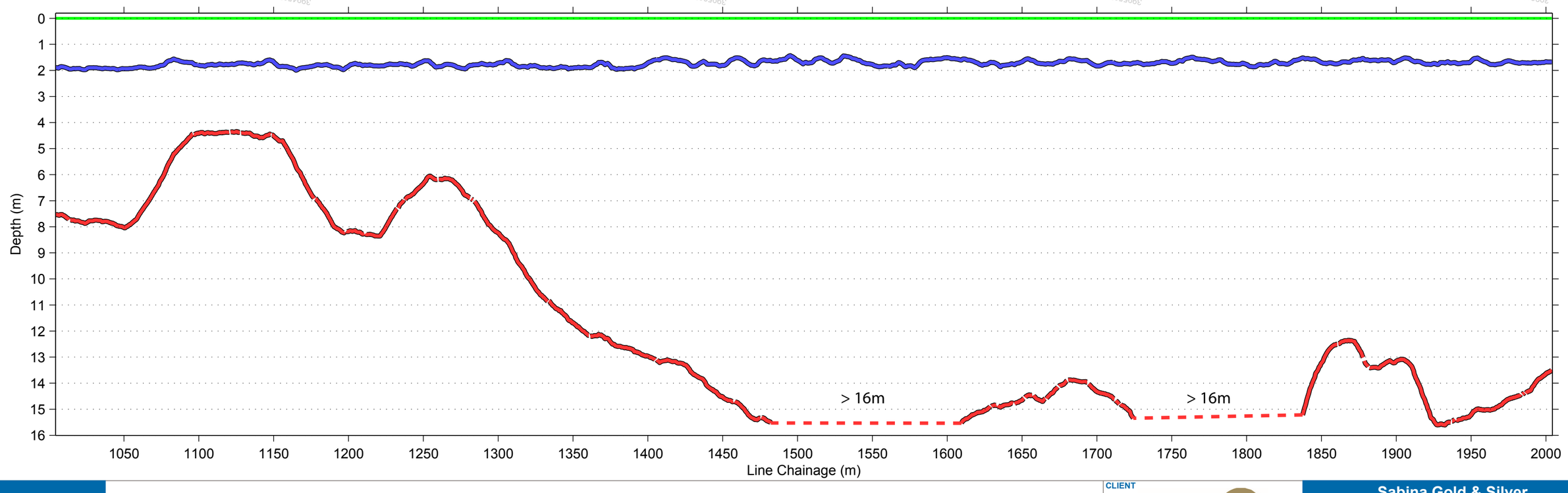
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

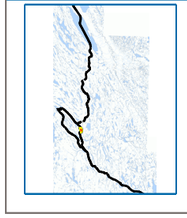
OFFICE	DATE
Edmonton	June 14, 2013

Figure C2.1



NAD83
UTMz13
1:2625





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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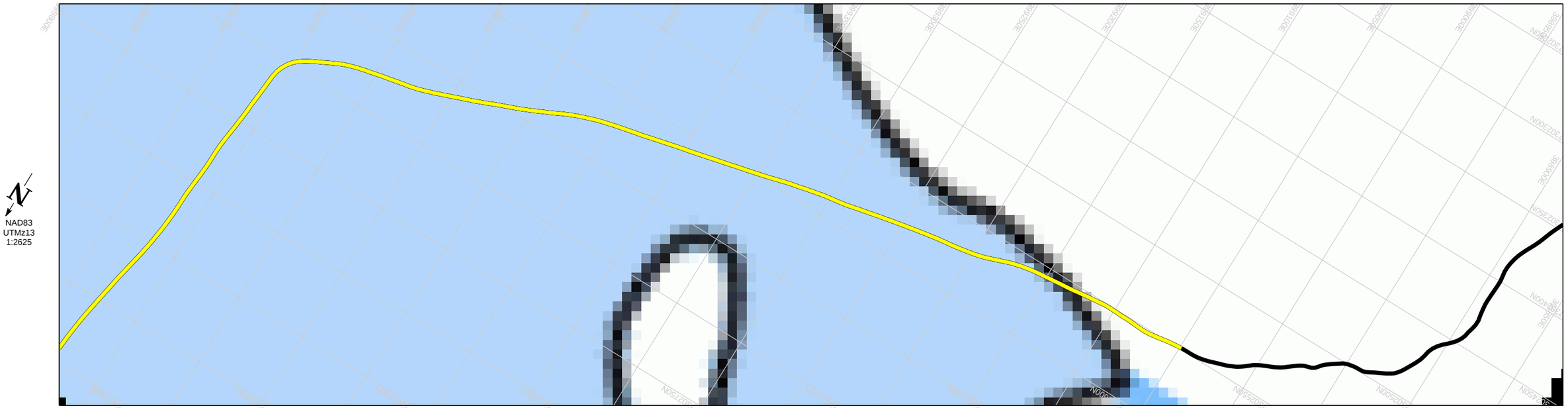
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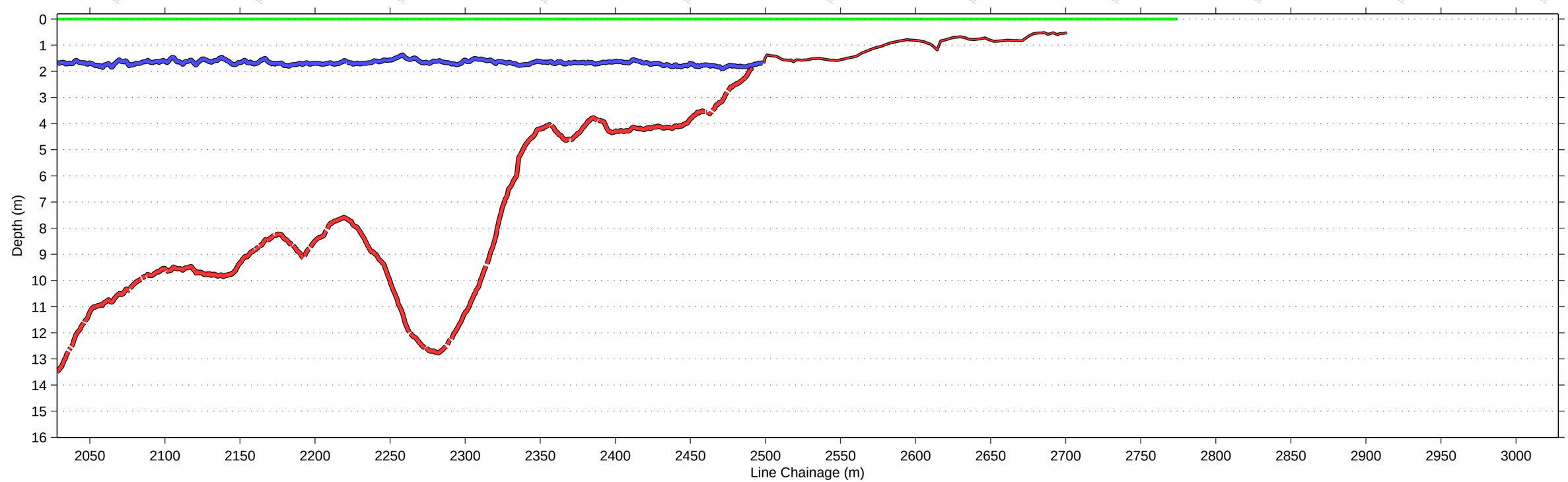
Winter Road Option – Major Lake Profiles
Northern to Southern Junction
Collected April 25 – 28, 2013

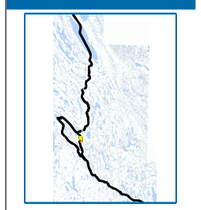
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE: Edmonton
DATE: June 14, 2013

Figure C2.2







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

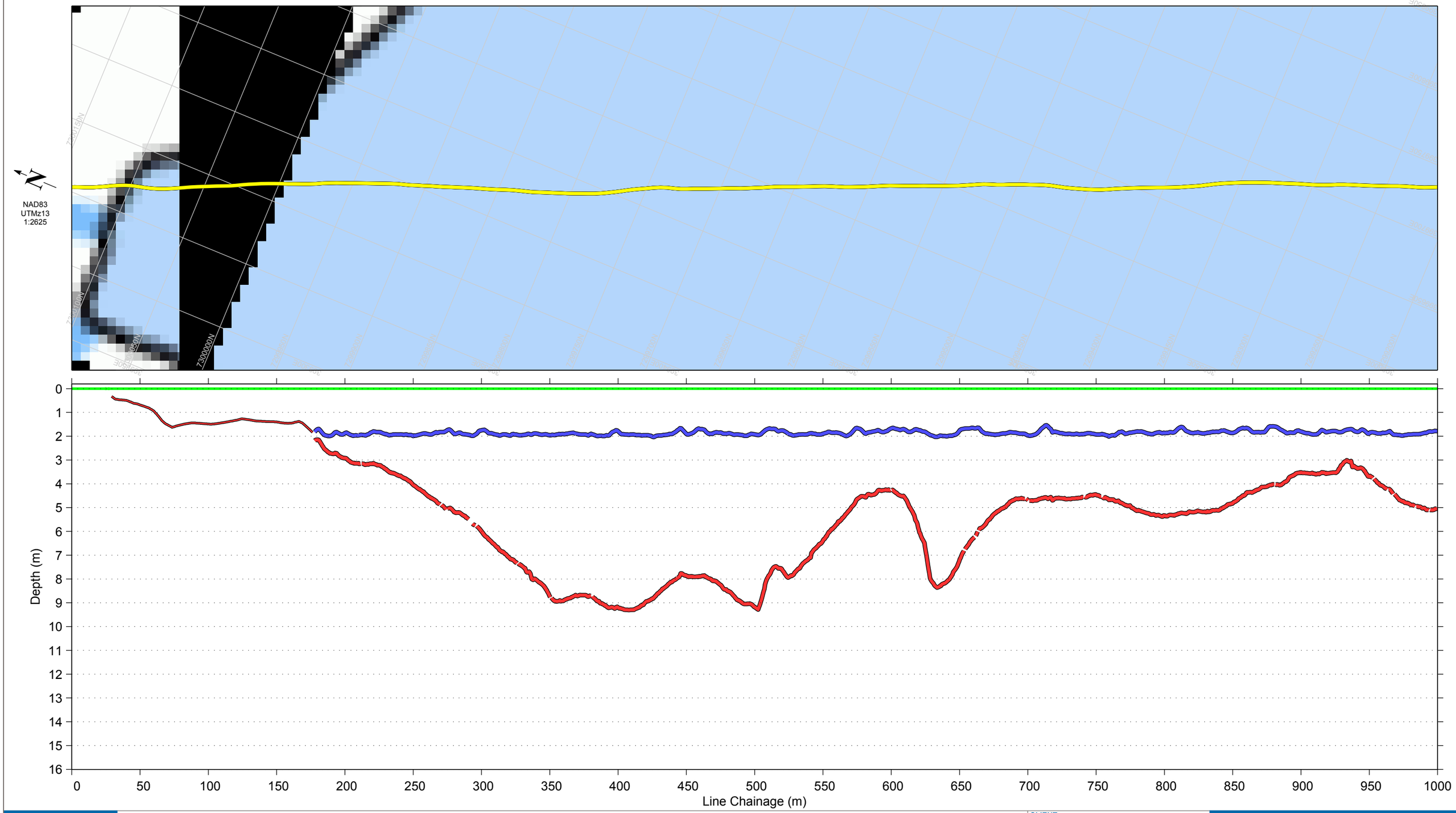
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Winter Road Option – Major Lake Profiles
Northern to Southern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure C2.3





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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Winter Road Option − Major Lake Profiles
Northern to Southern Junction
Collected April 25 − 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

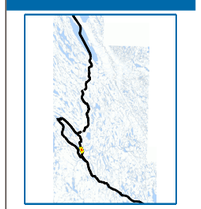
OFFICE	DATE
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Figure C3.1

NAD83
UTMz13
1:2625

Depth (m)

Line Chainage (m)



LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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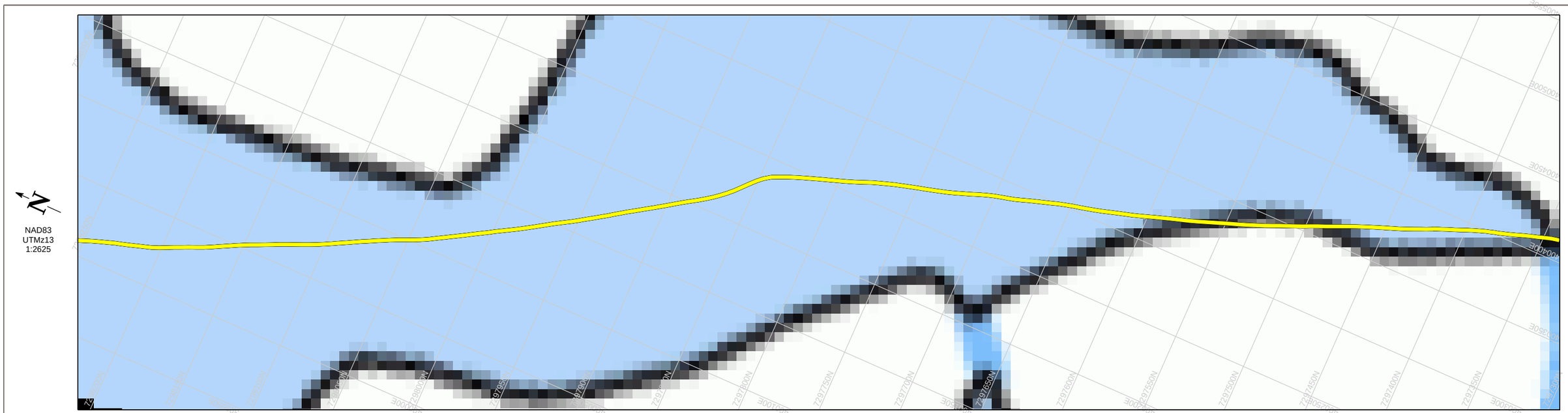
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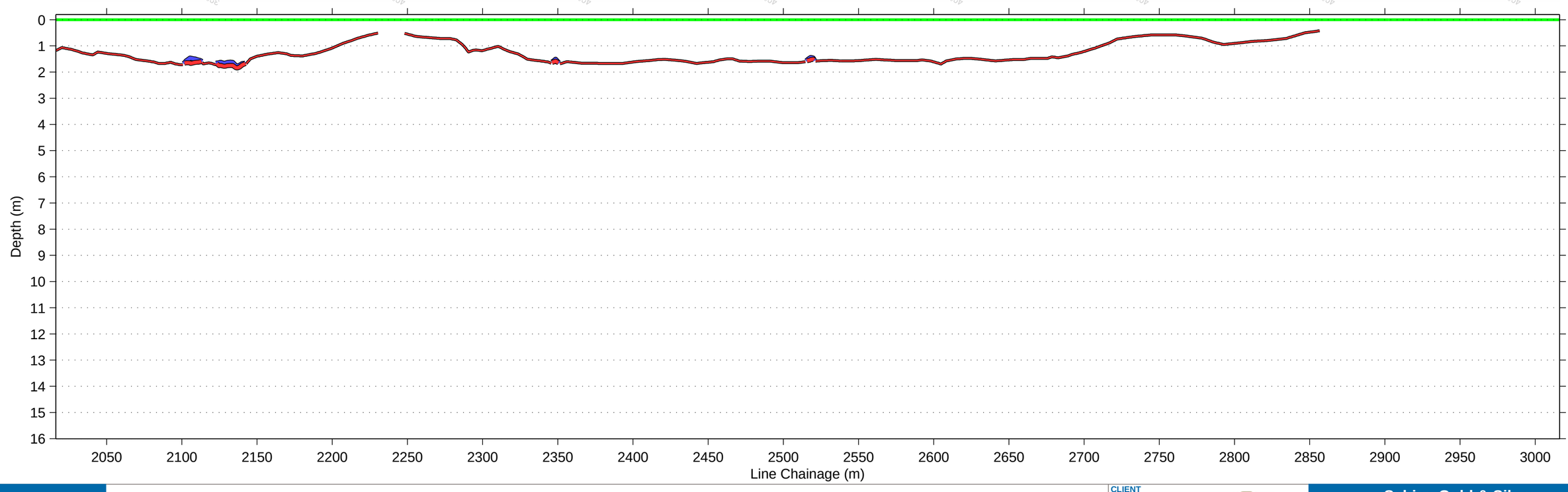
Winter Road Option – Major Lake Profiles
Northern to Southern Junction
Collected April 25 – 28, 2013

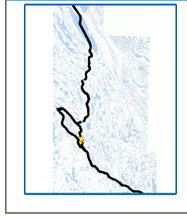
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure C3.2







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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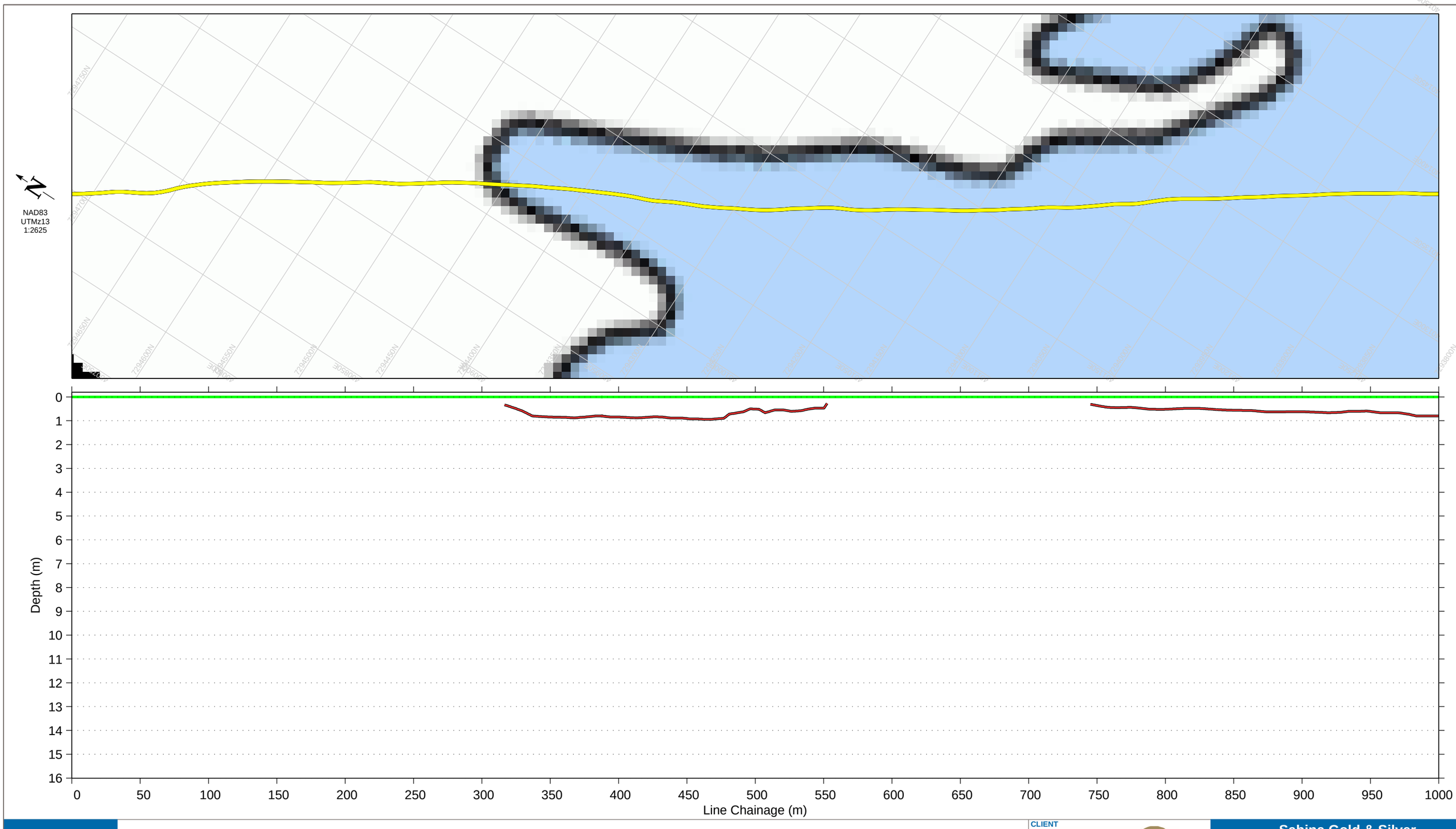
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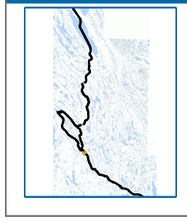
Winter Road Option – Major Lake Profiles
Northern to Southern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure C3.3





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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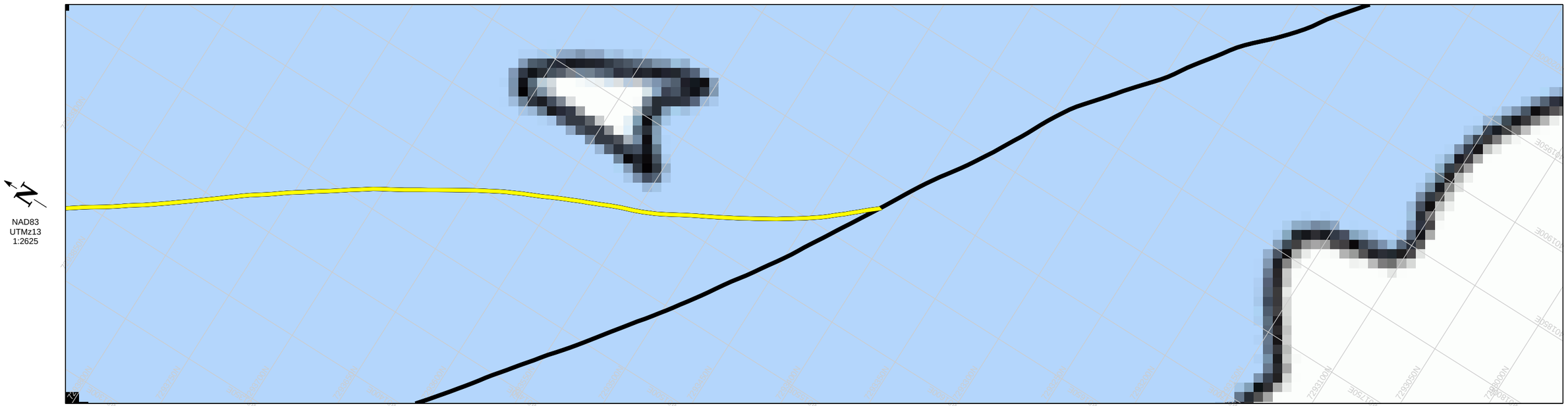
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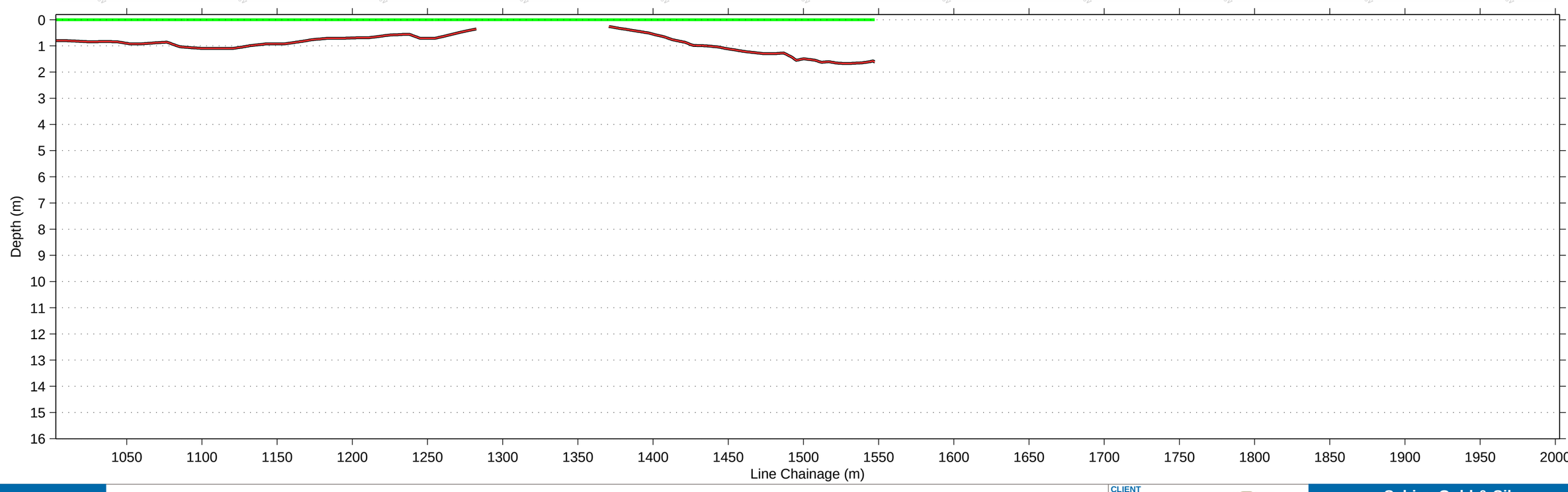
Winter Road Option – Major Lake Profiles
Northern to Southern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure C4.1







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

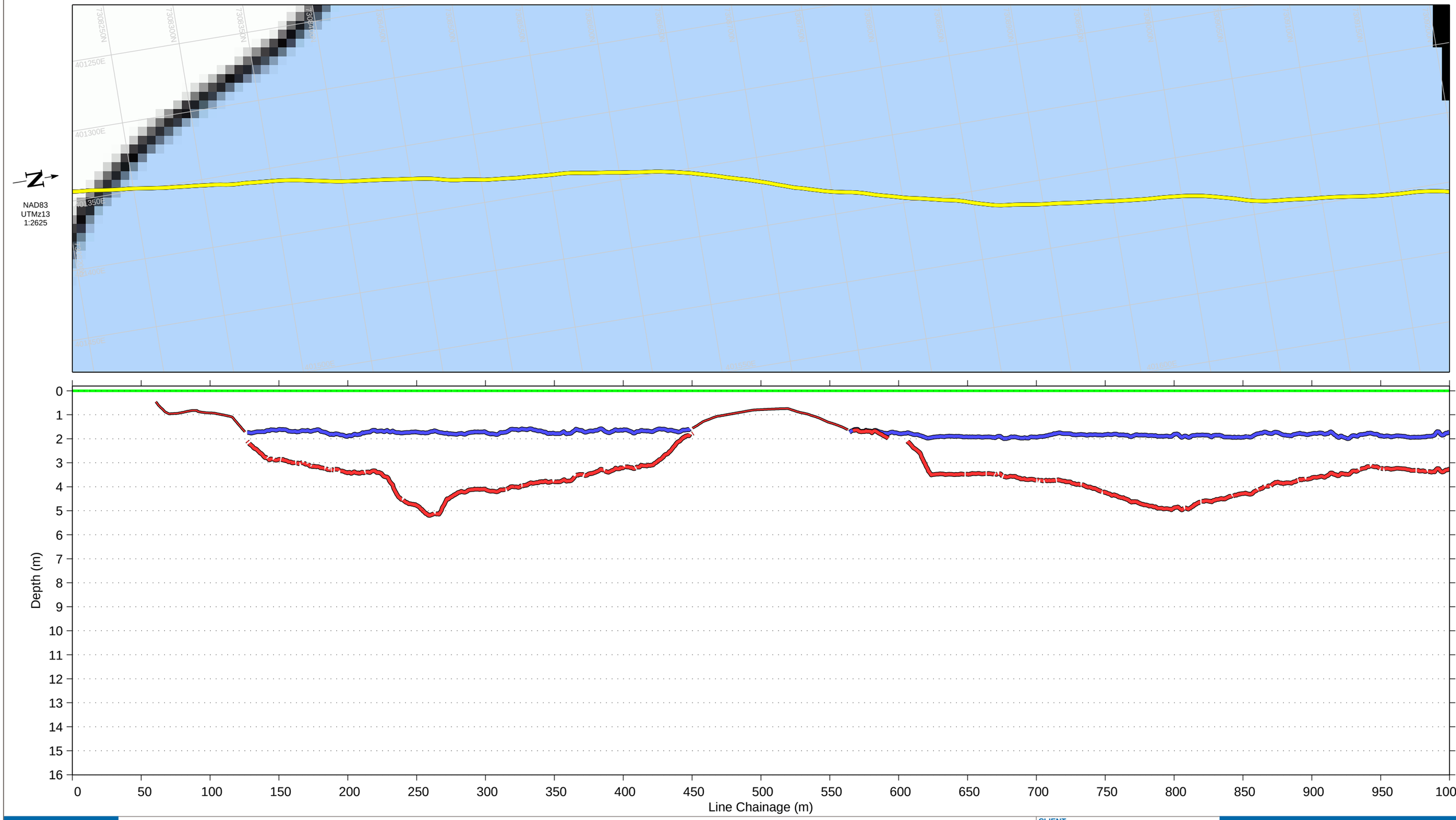
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Winter Road Option – Major Lake Profiles
Northern to Southern Junction
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure C4.2





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

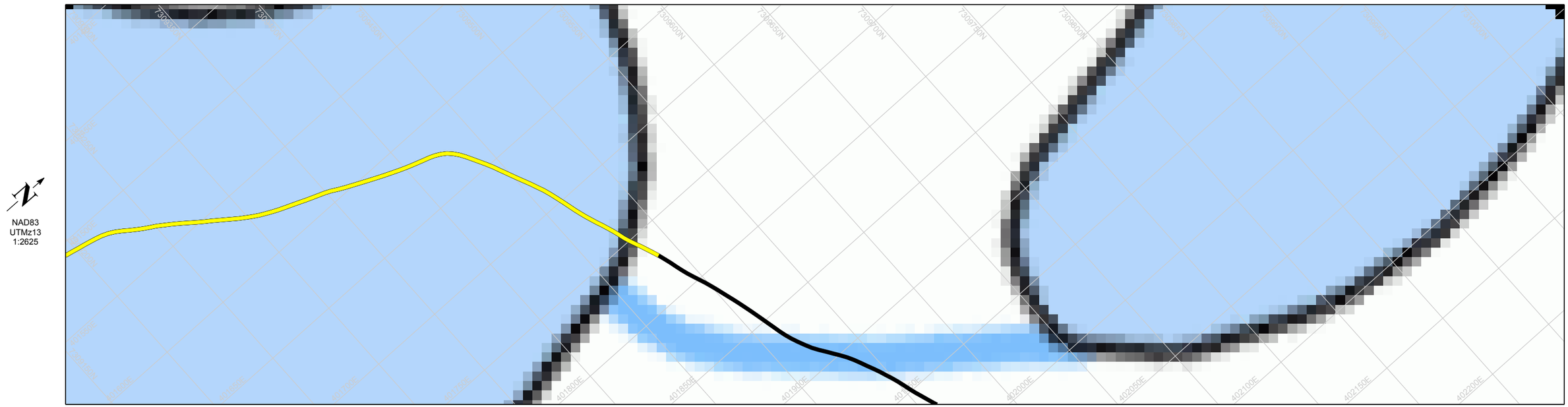
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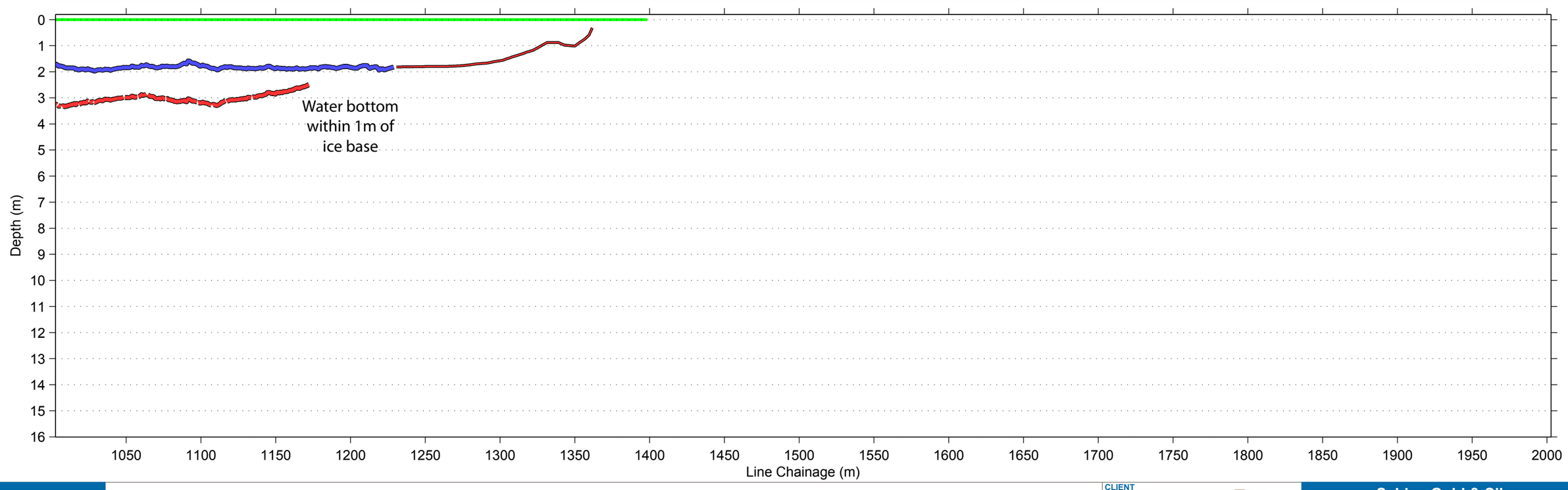
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

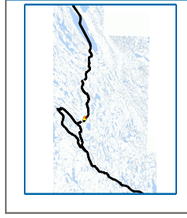
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D1.1







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

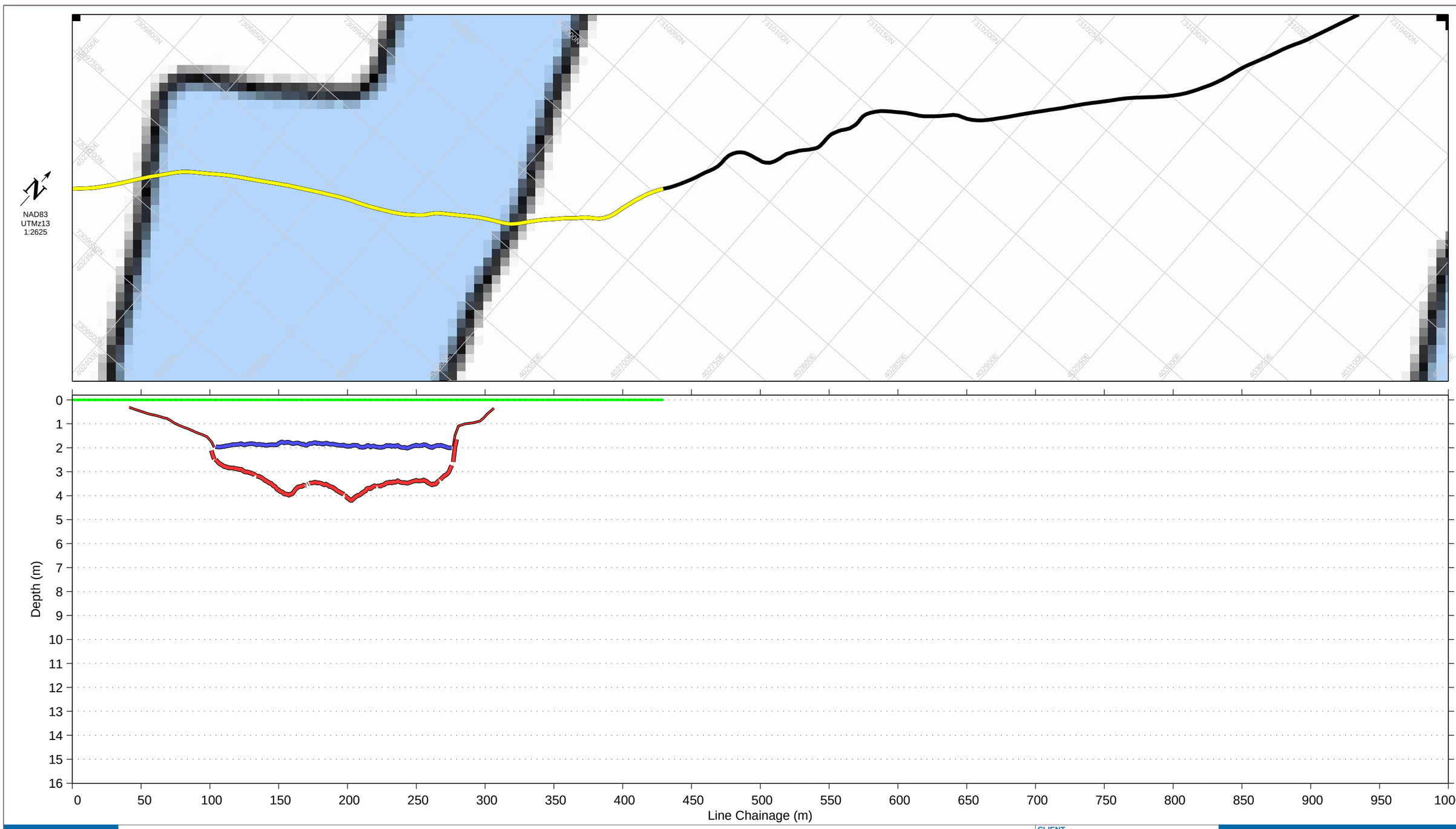
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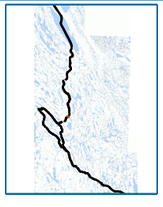
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D1.2





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

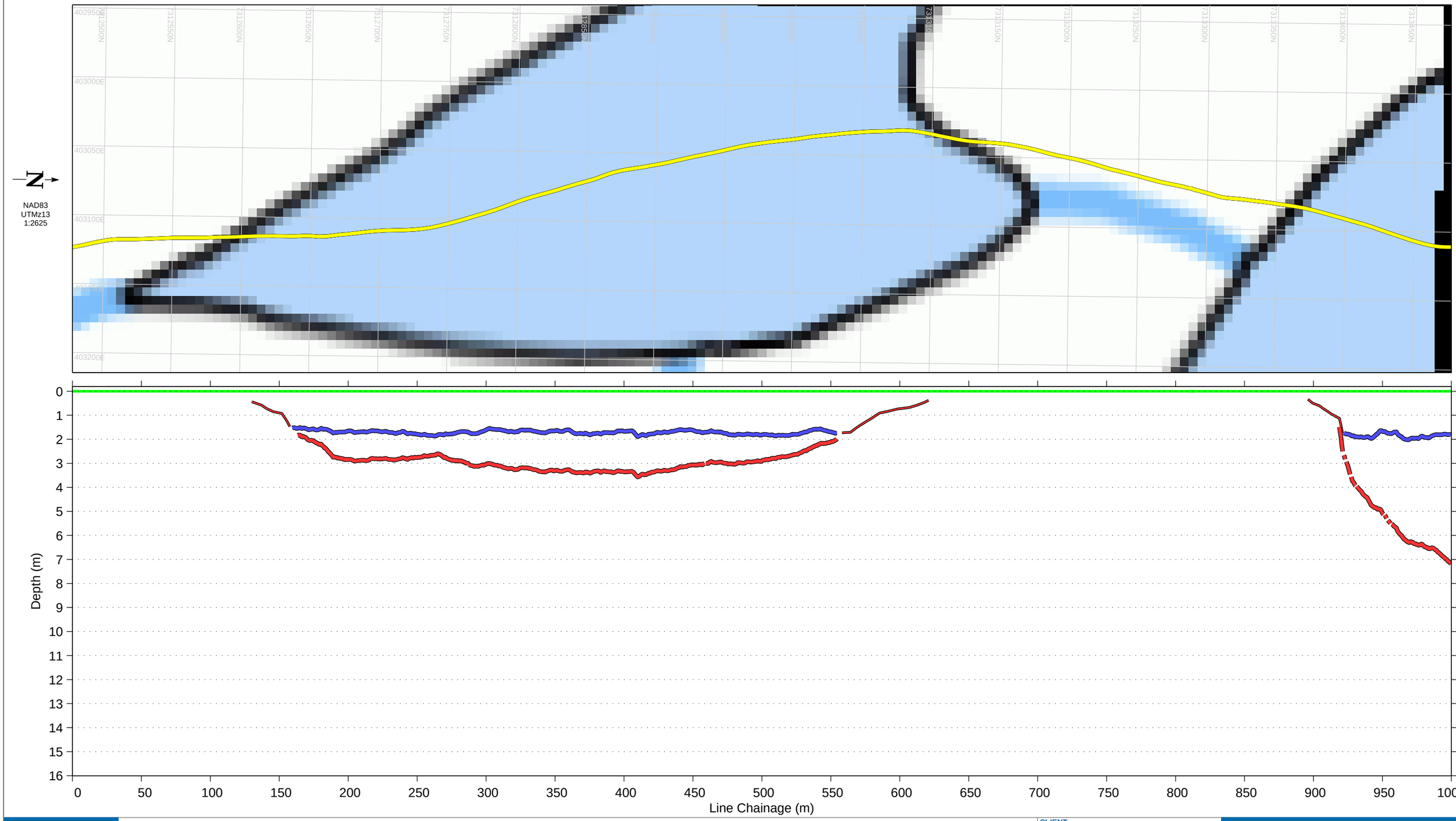
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Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D2



LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

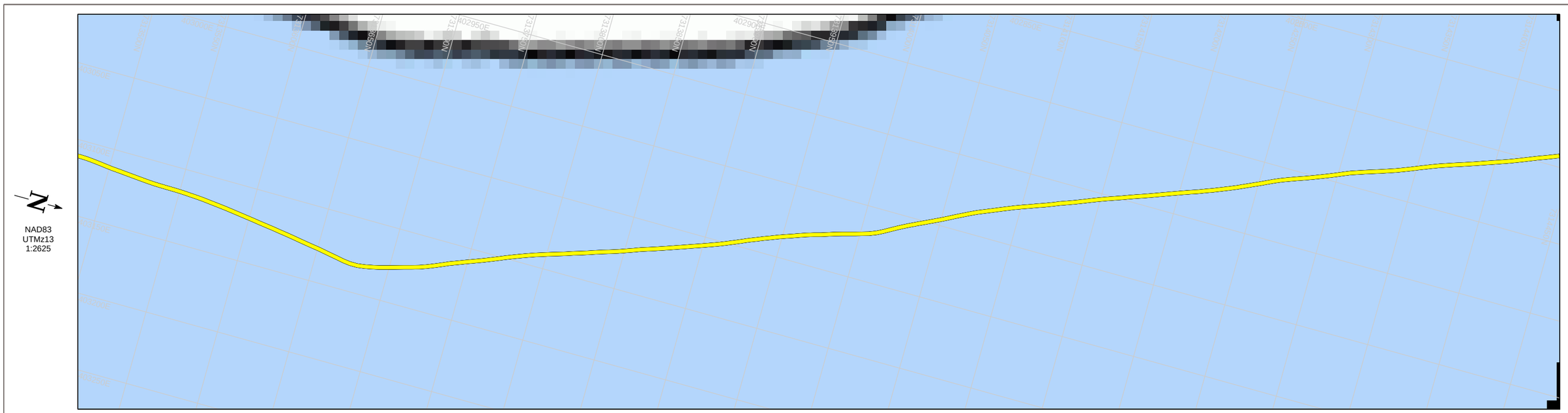
Sabina Gold & Silver
Back River Project GPR Profiling

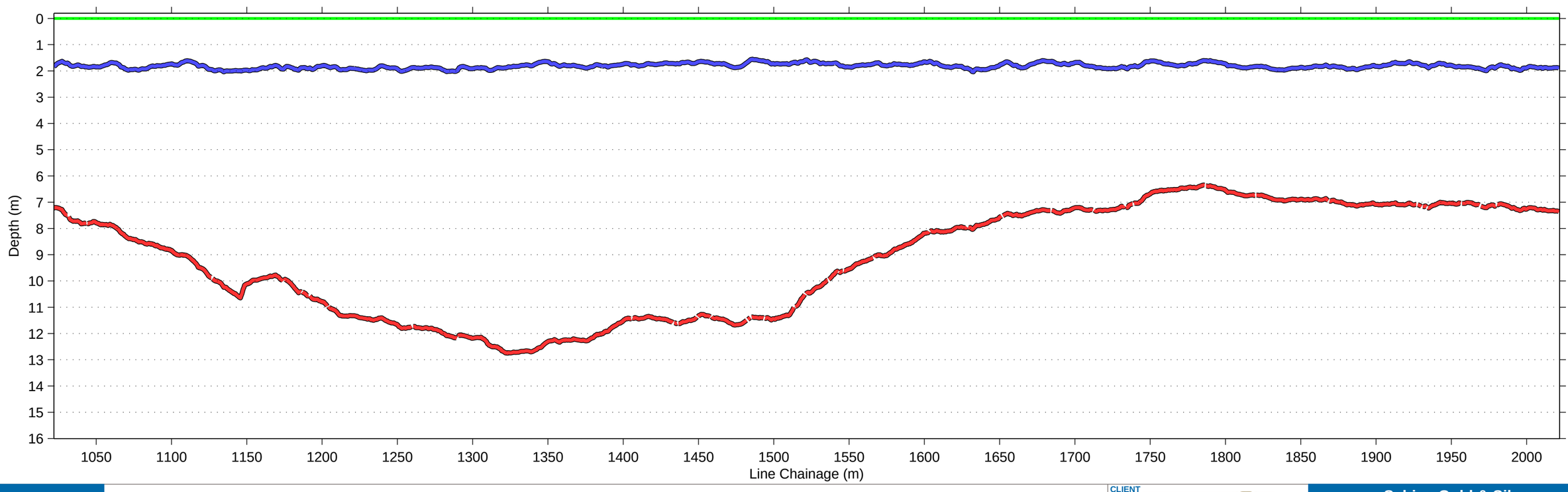
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

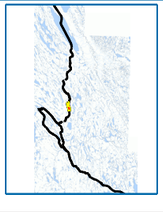
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D3.1







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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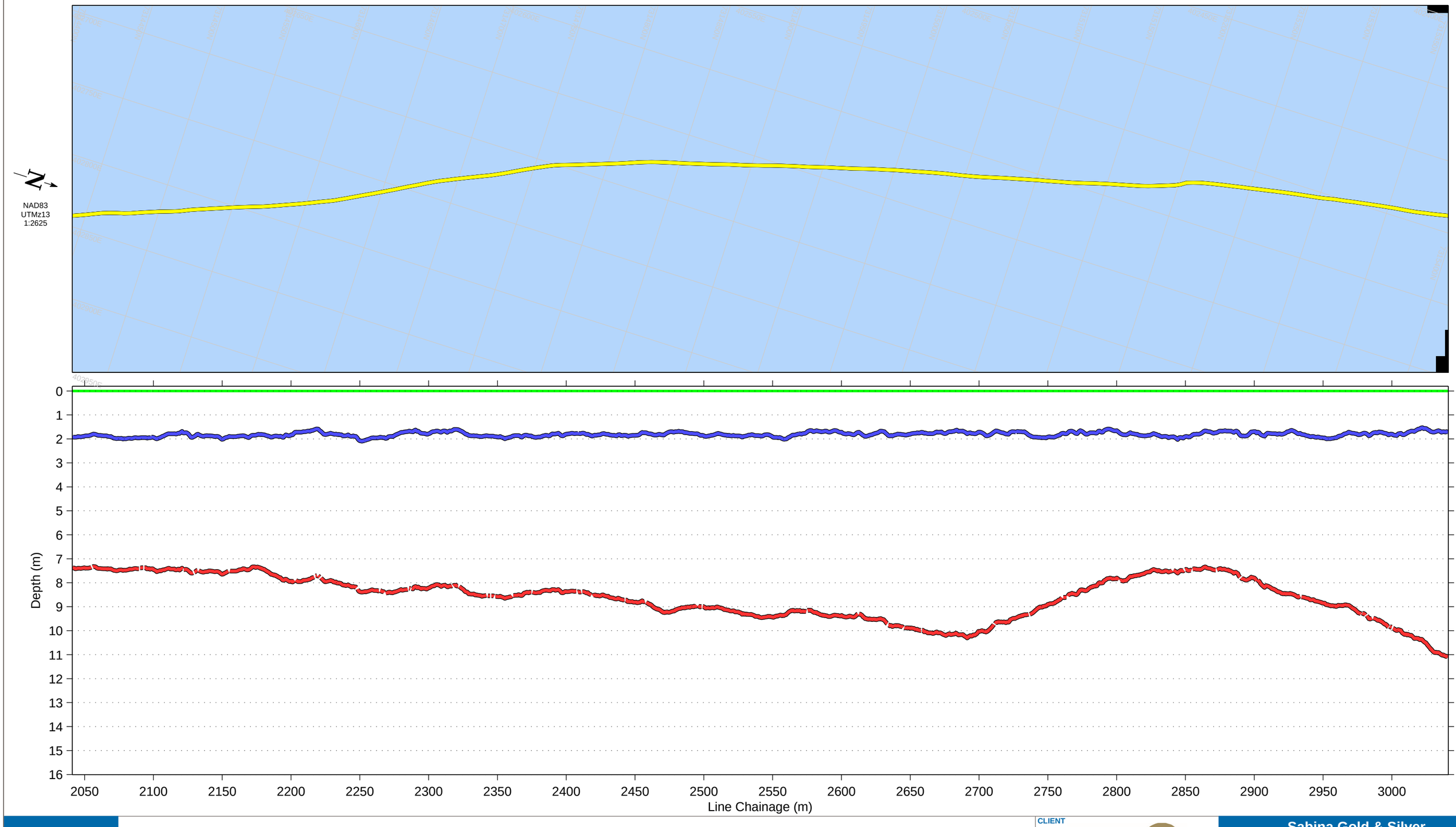
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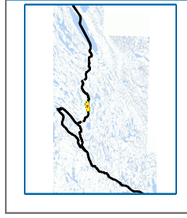
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D3.2





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

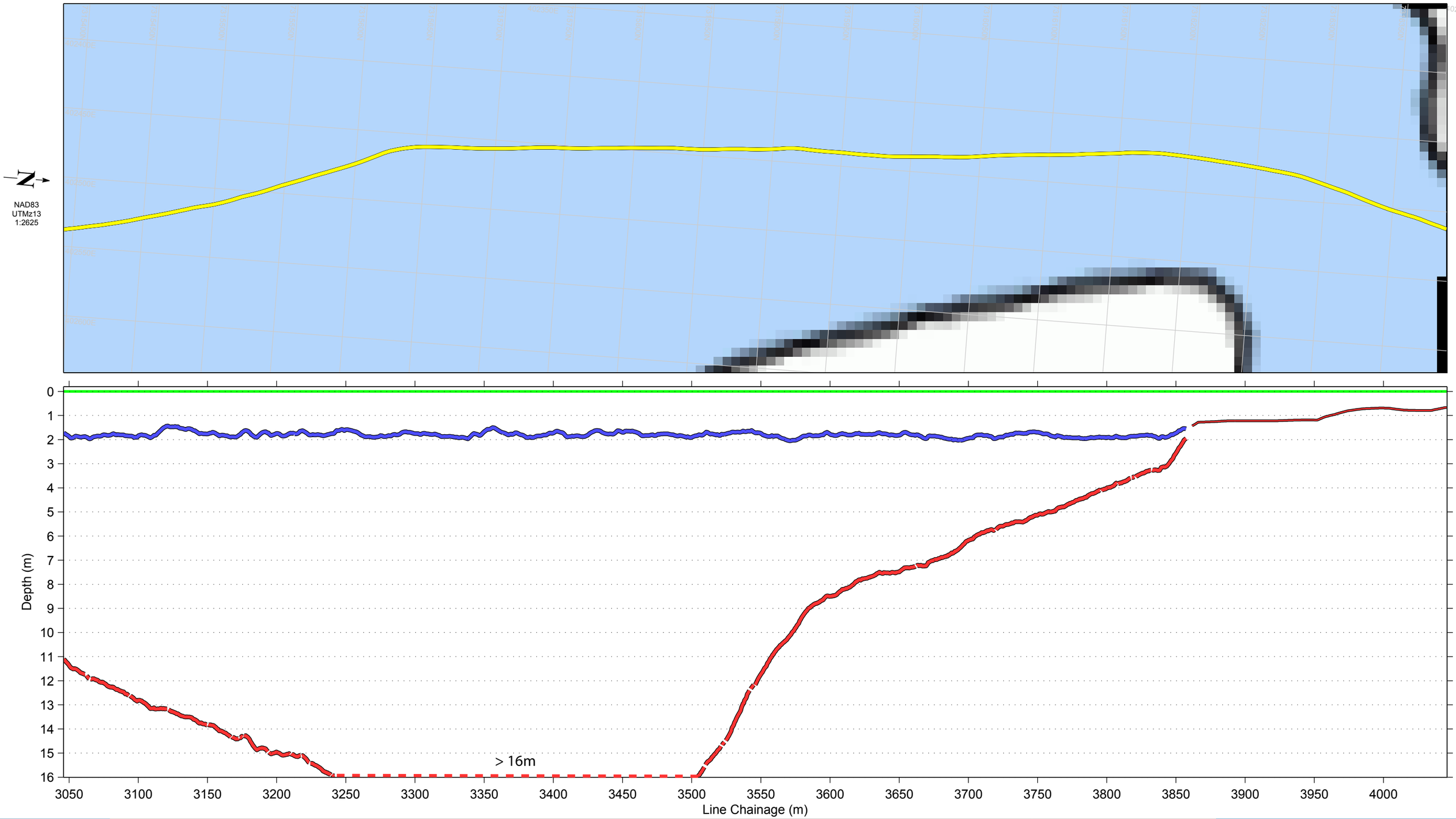
Sabina Gold & Silver
Back River Project GPR Profiling

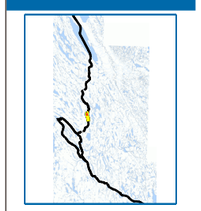
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D3.3





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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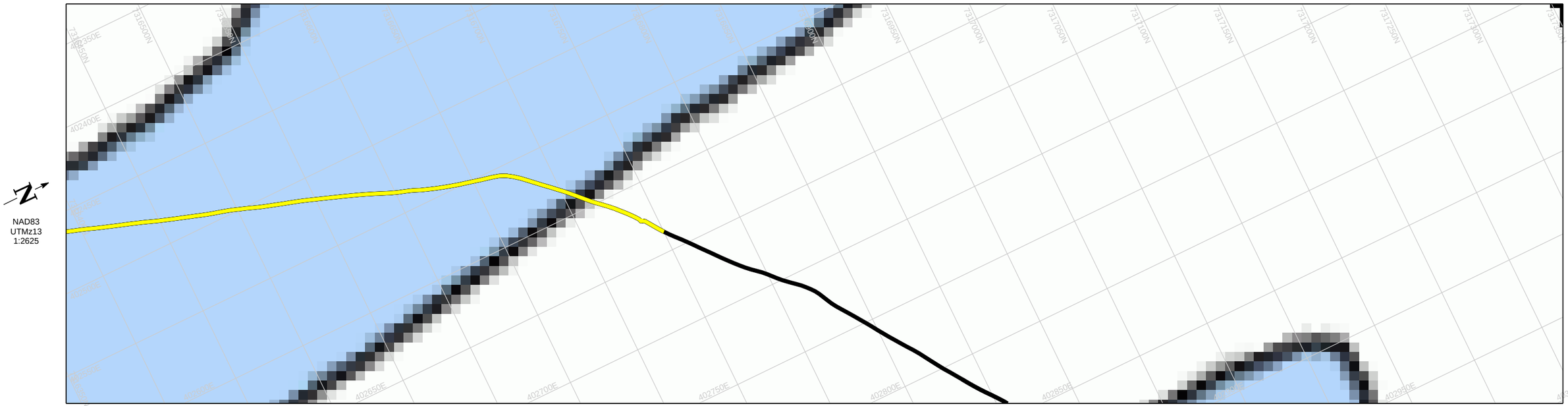
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Back River Project GPR Profiling

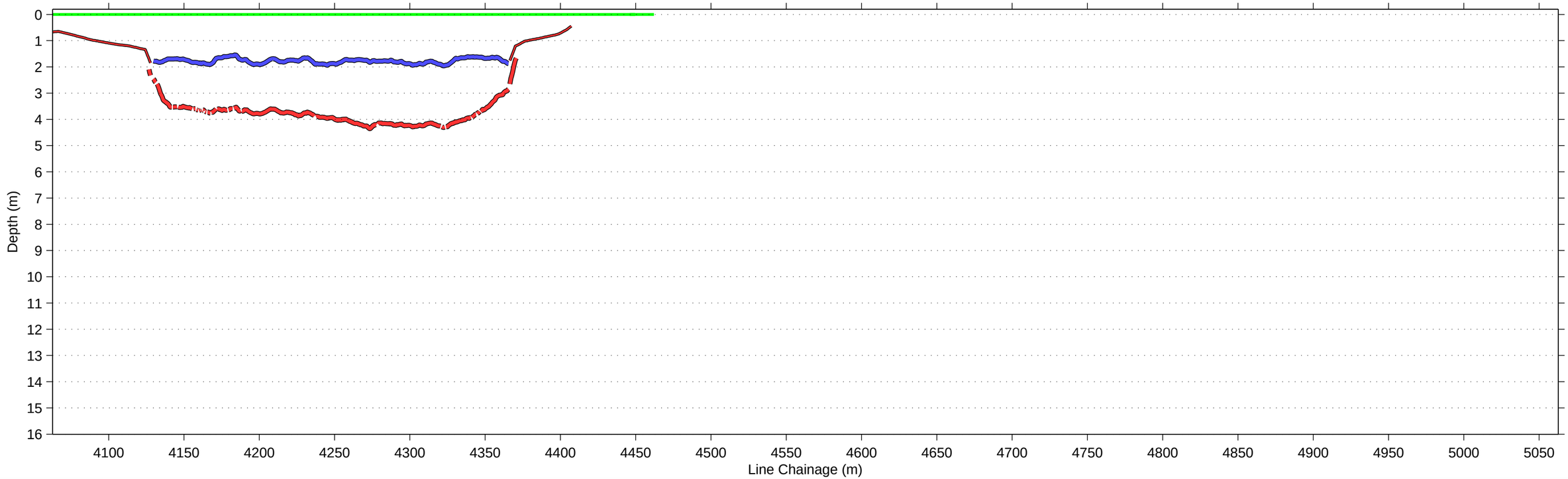
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure D3.4







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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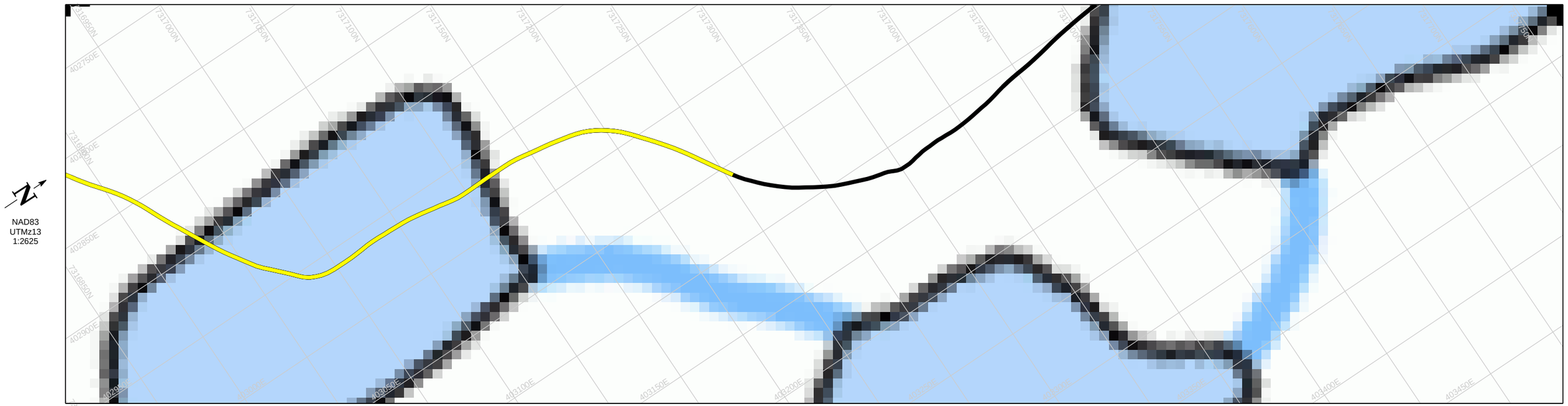
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Back River Project GPR Profiling

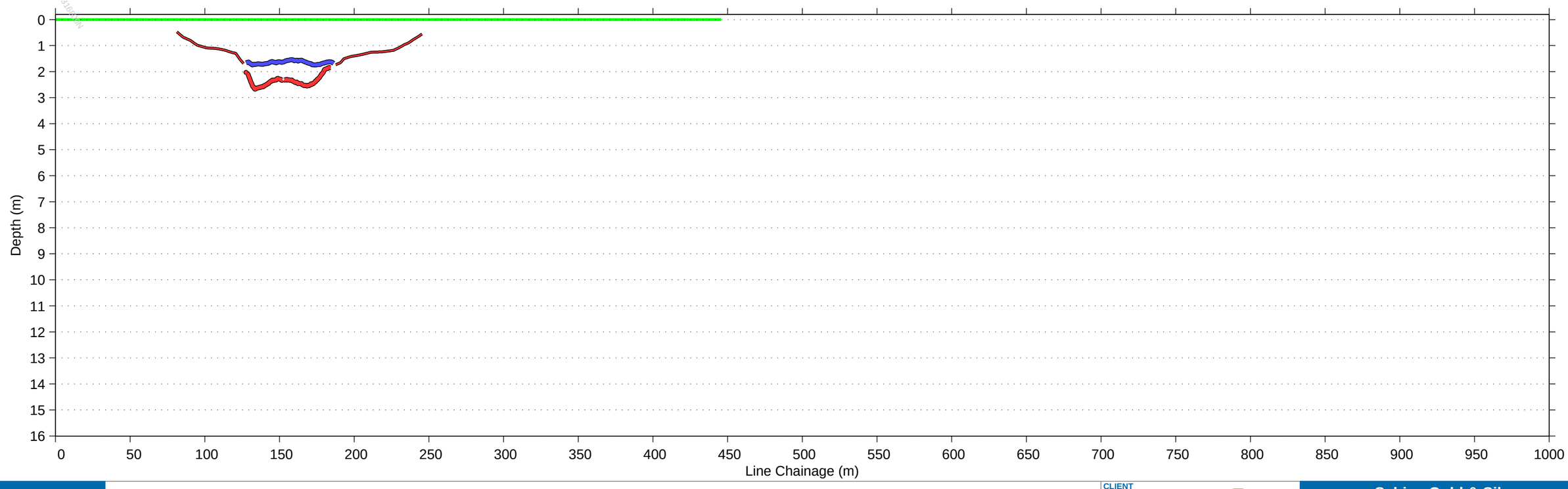
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

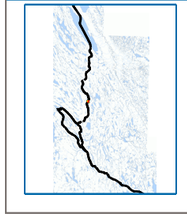
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D3.5







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

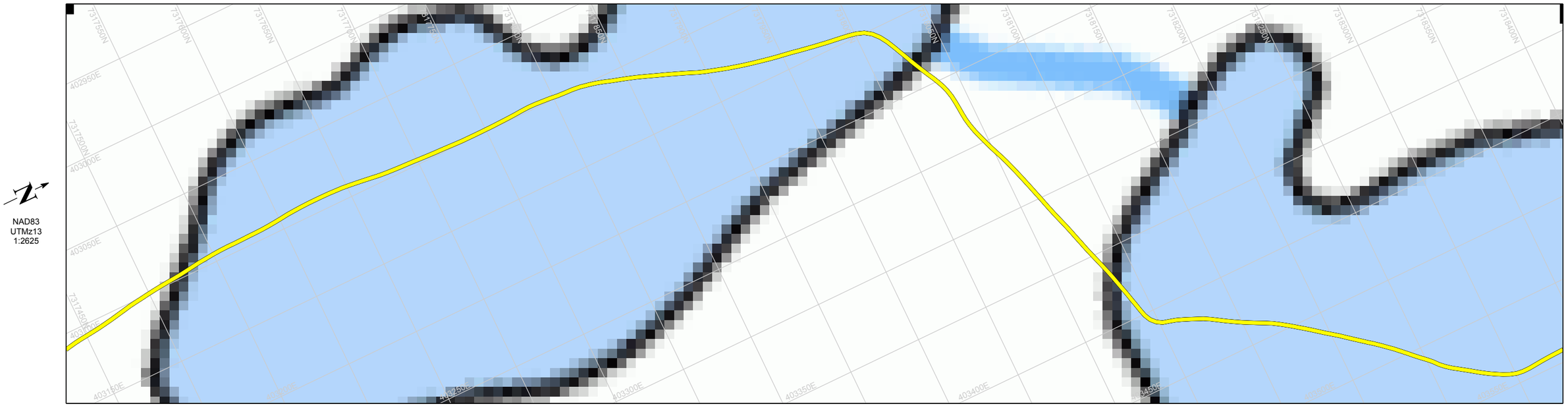
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Back River Project GPR Profiling

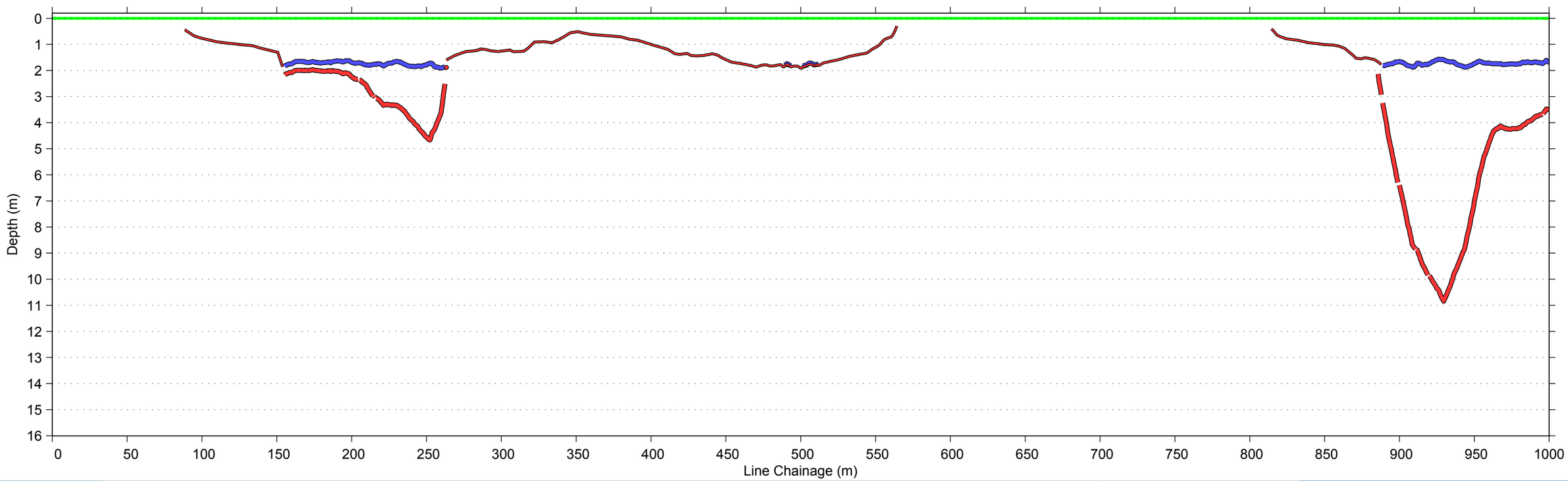
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

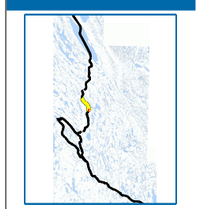
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D4







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

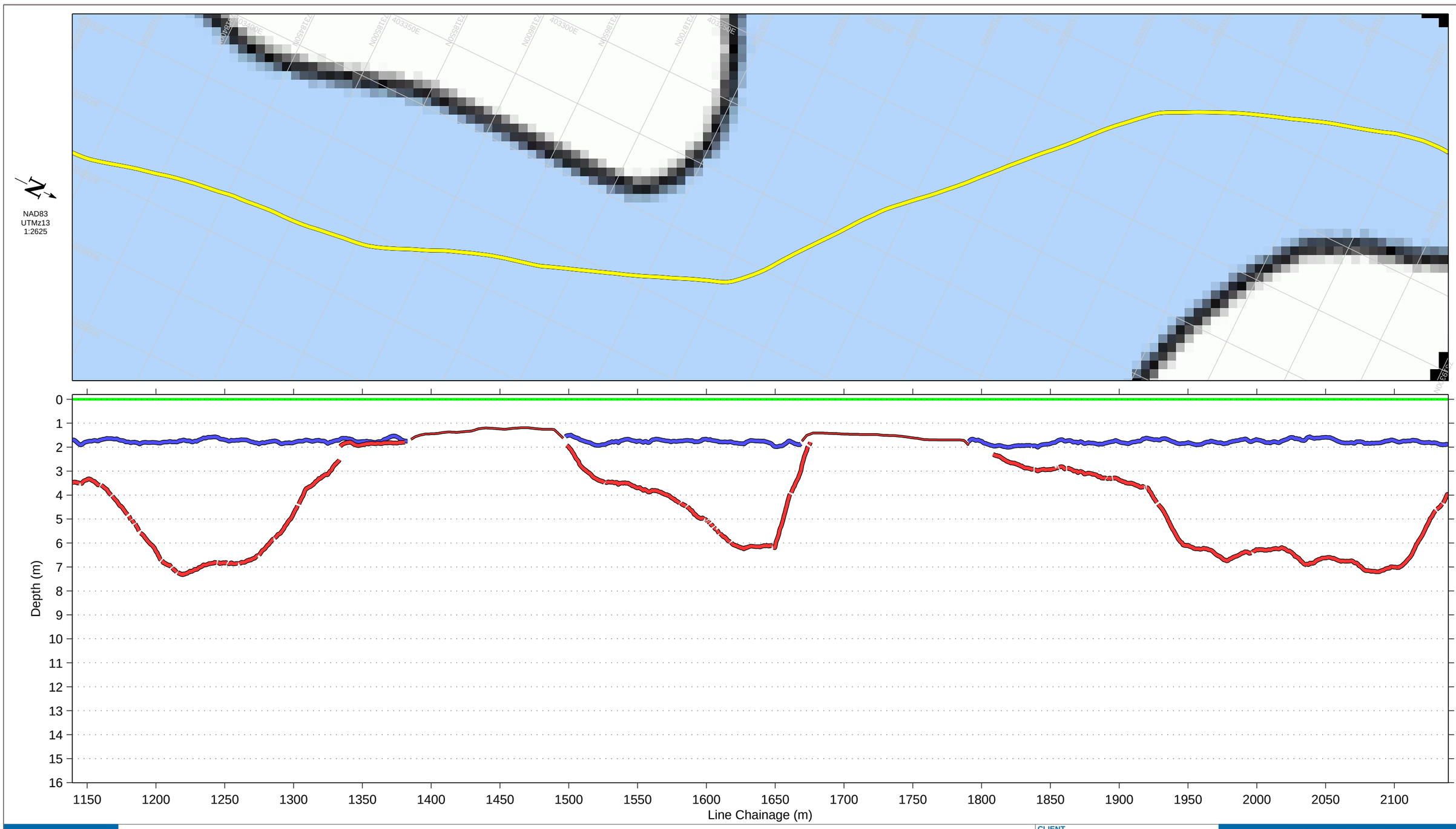
Sabina Gold & Silver
Back River Project GPR Profiling

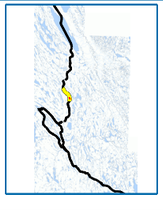
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure D5.1





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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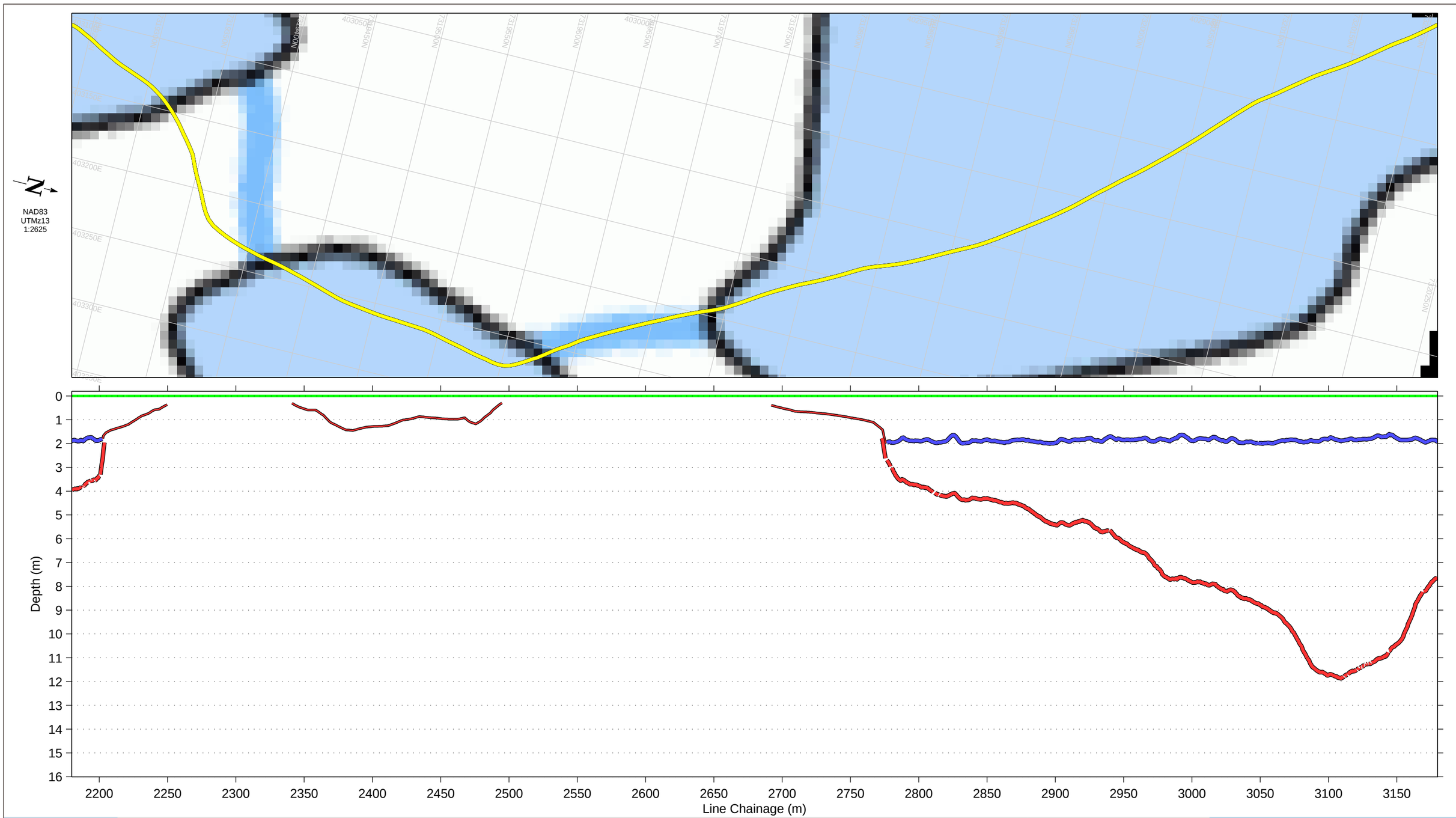
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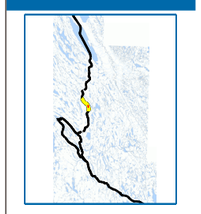
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D5.2





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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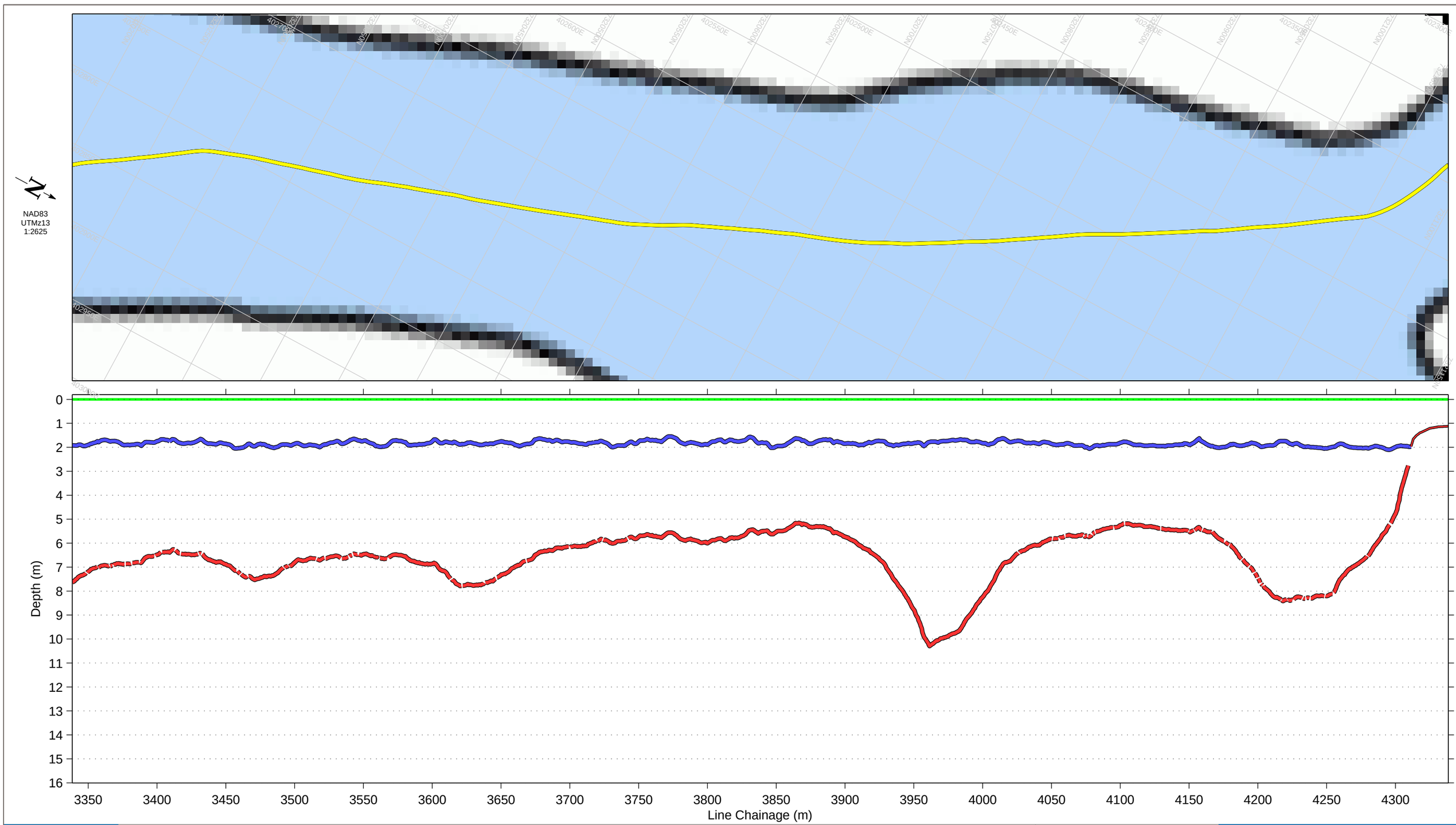
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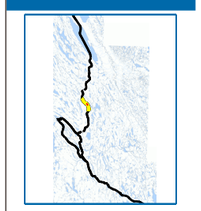
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Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0
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Figure D5.3





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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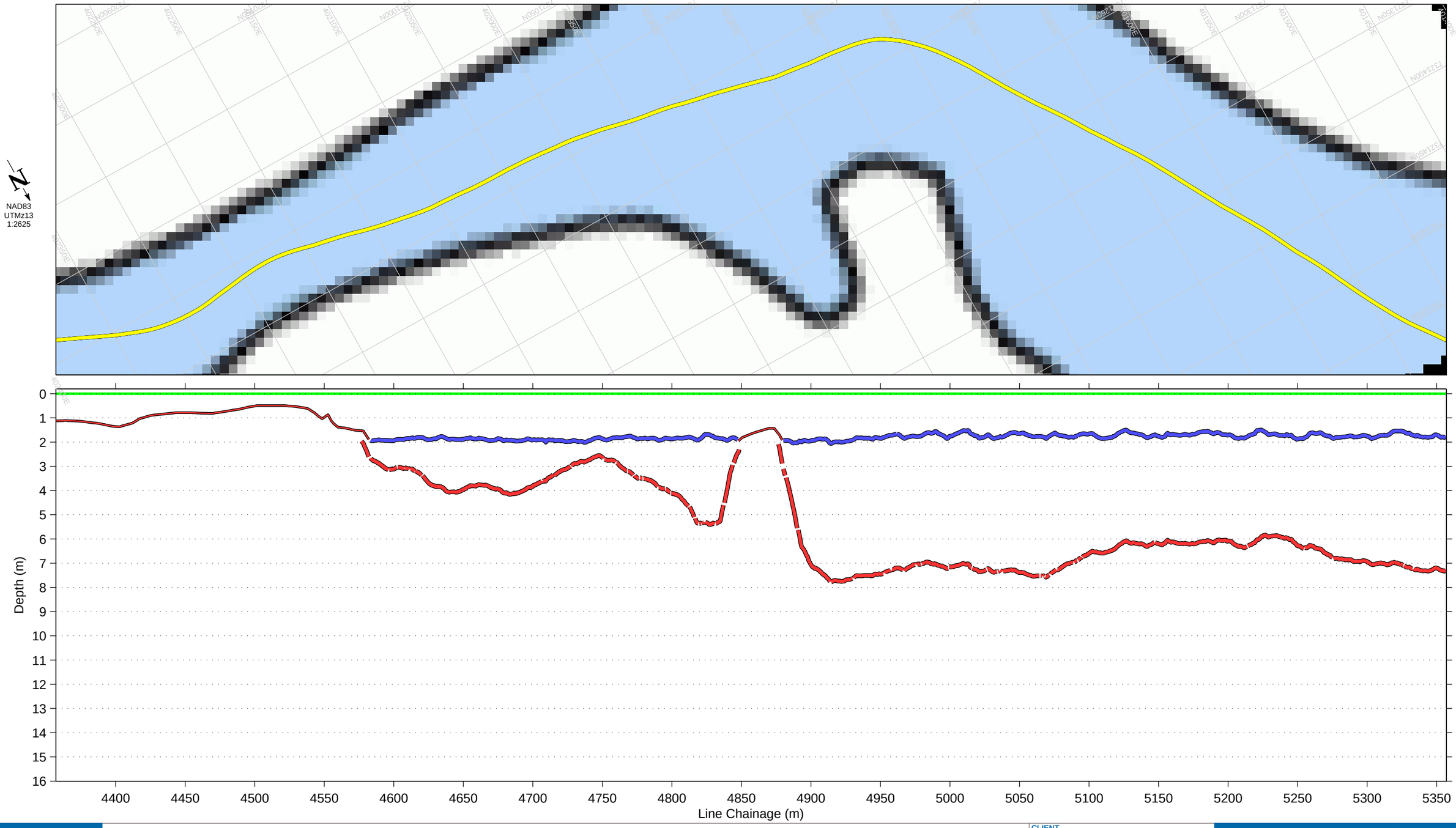
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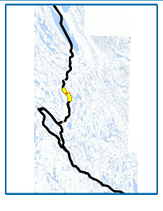
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure D5.4





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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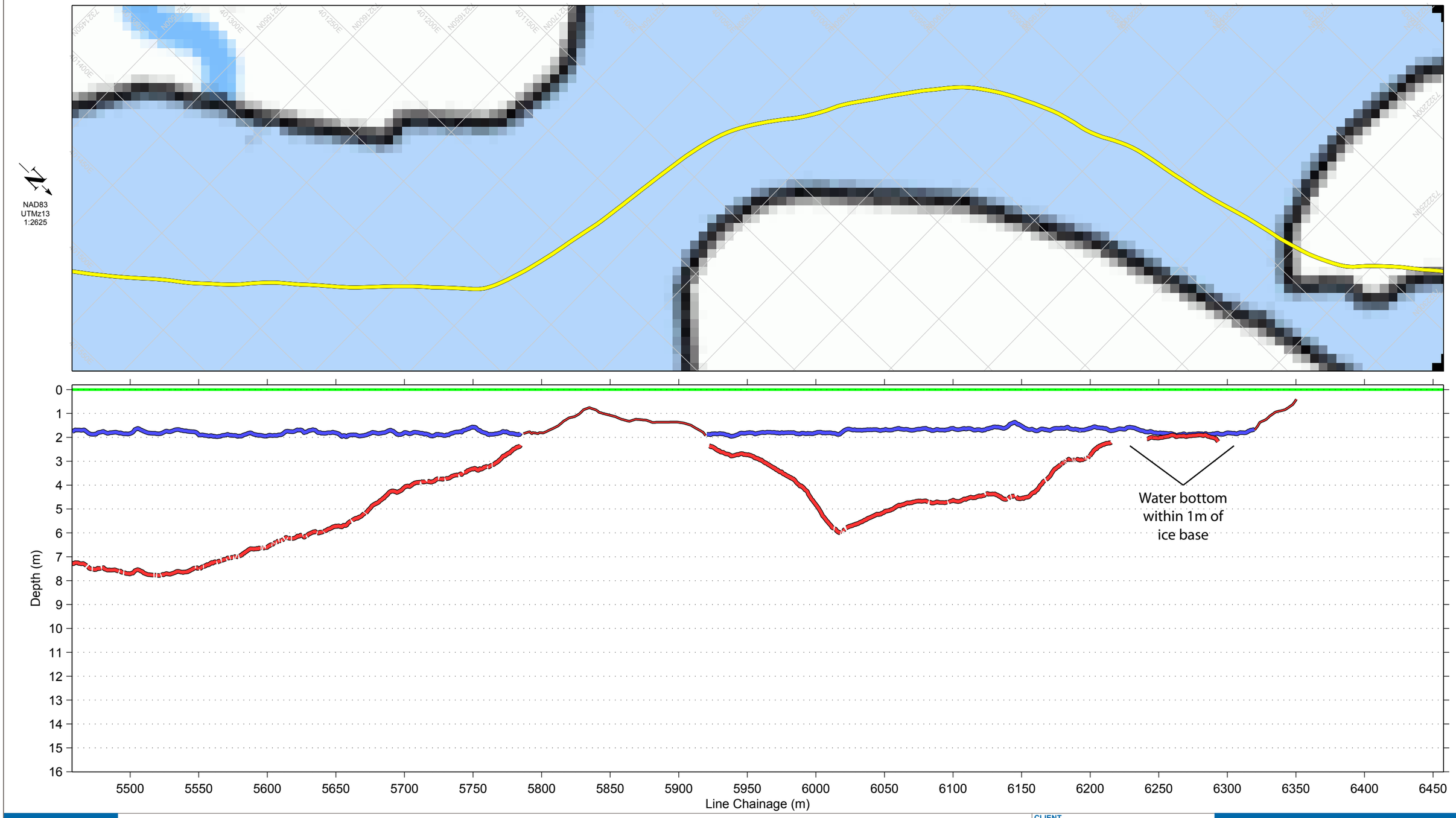
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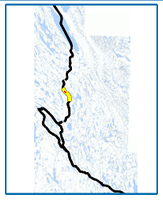
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D5.5





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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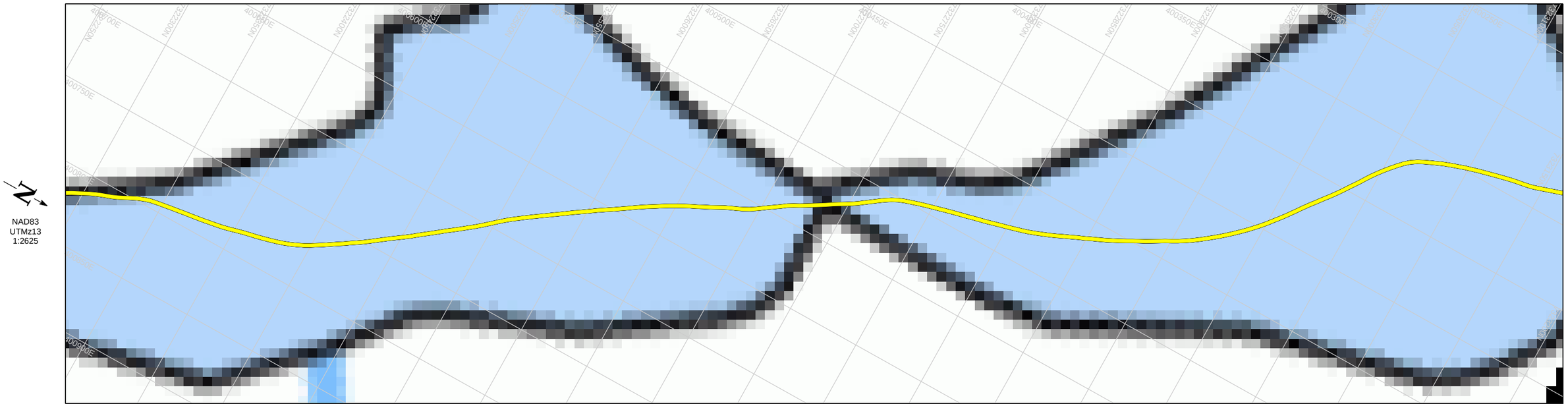
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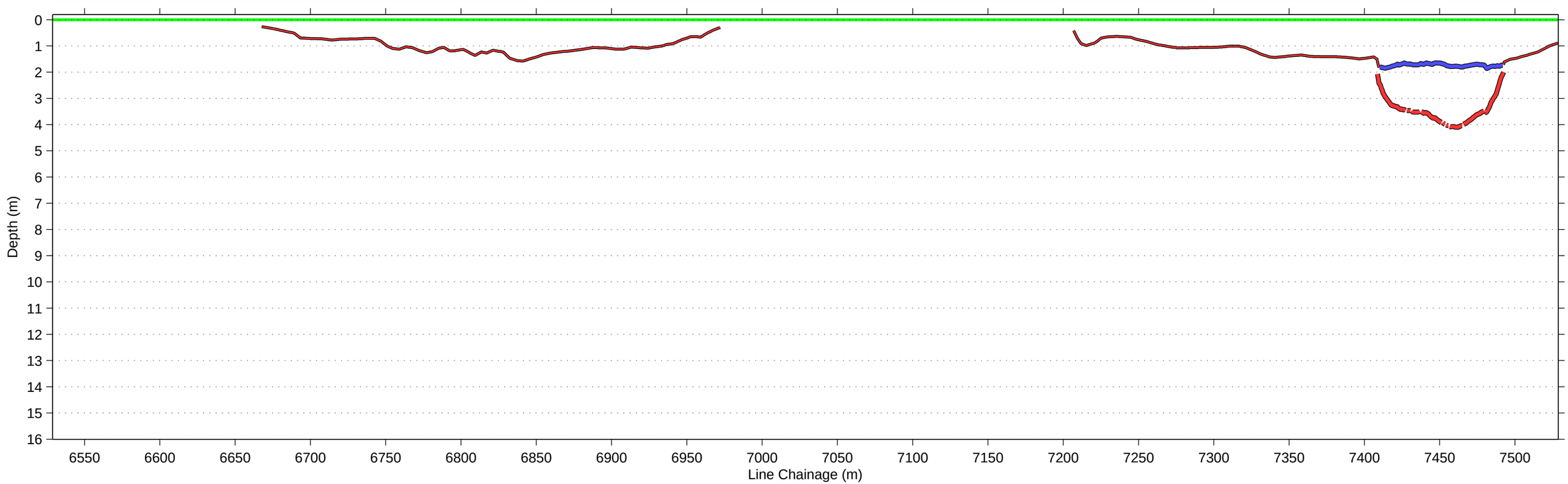
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

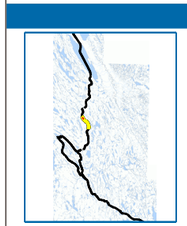
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D5.6







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

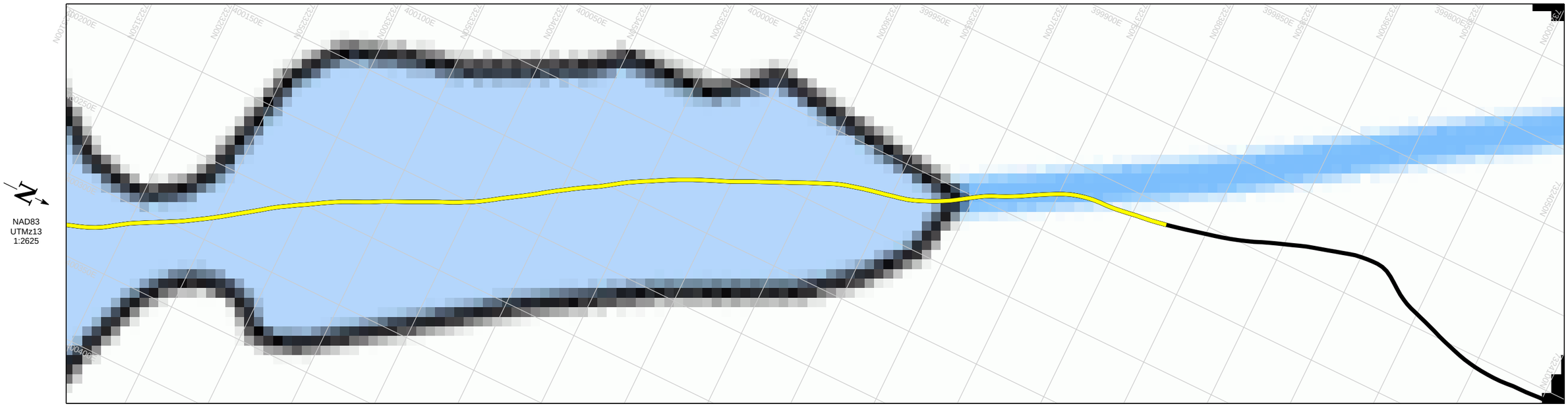
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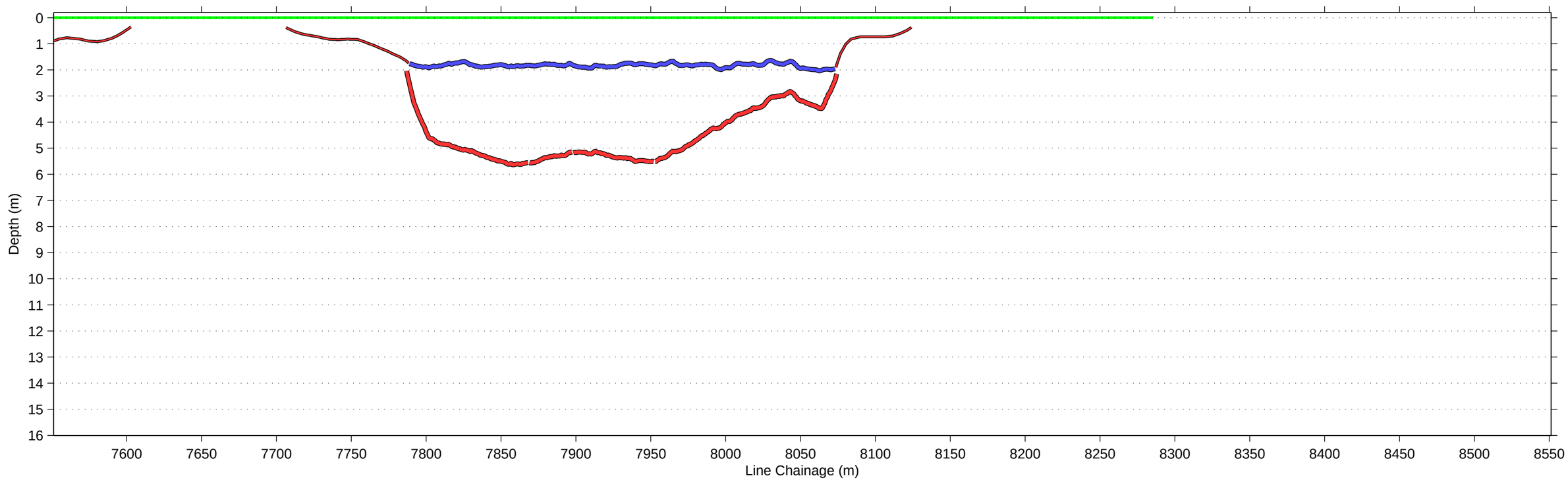
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

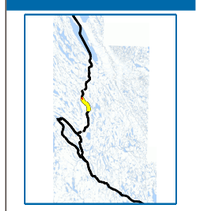
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D5.7







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

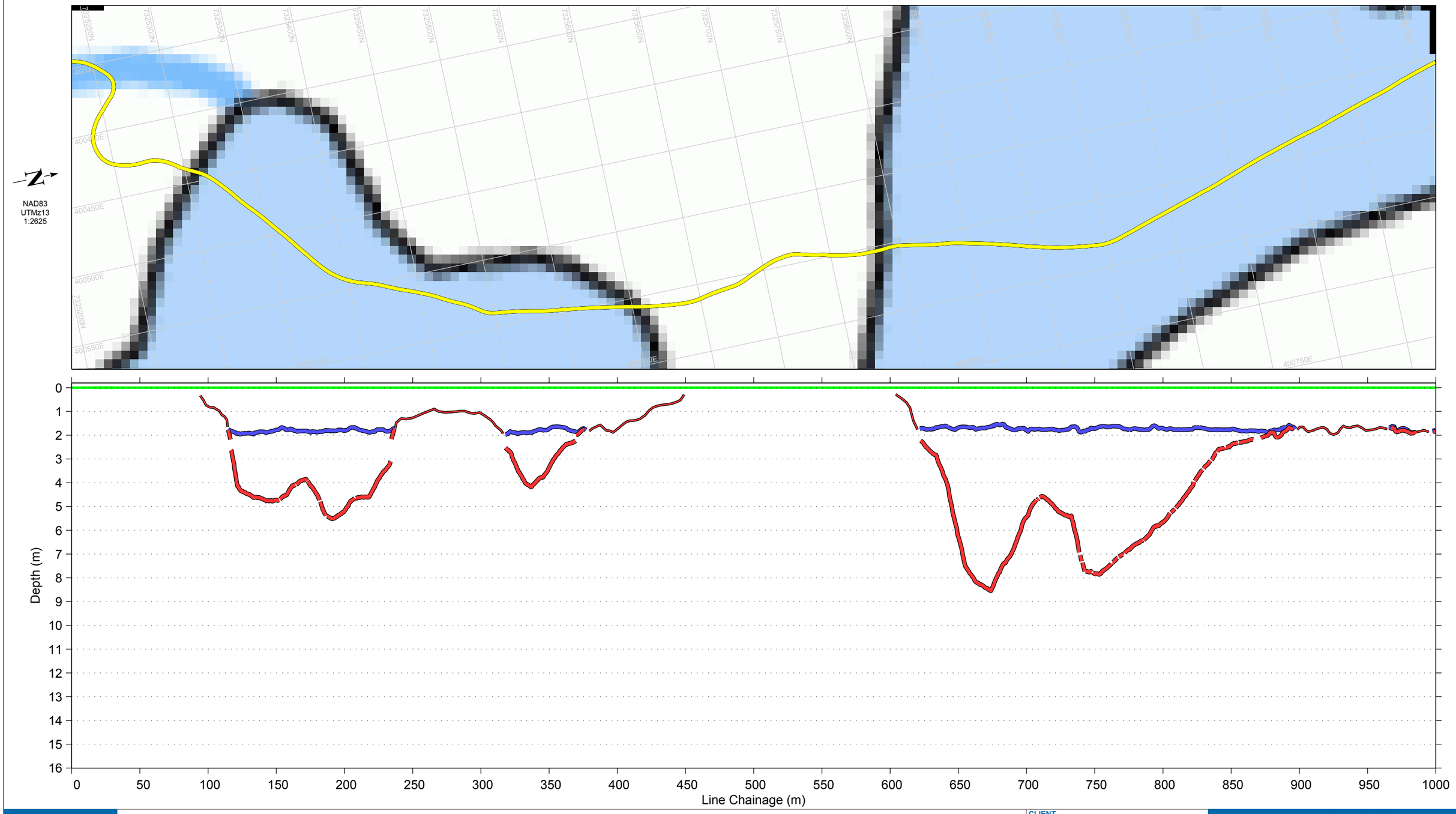
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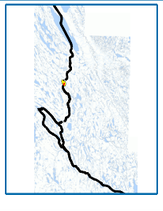
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
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Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

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Figure D5.8





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

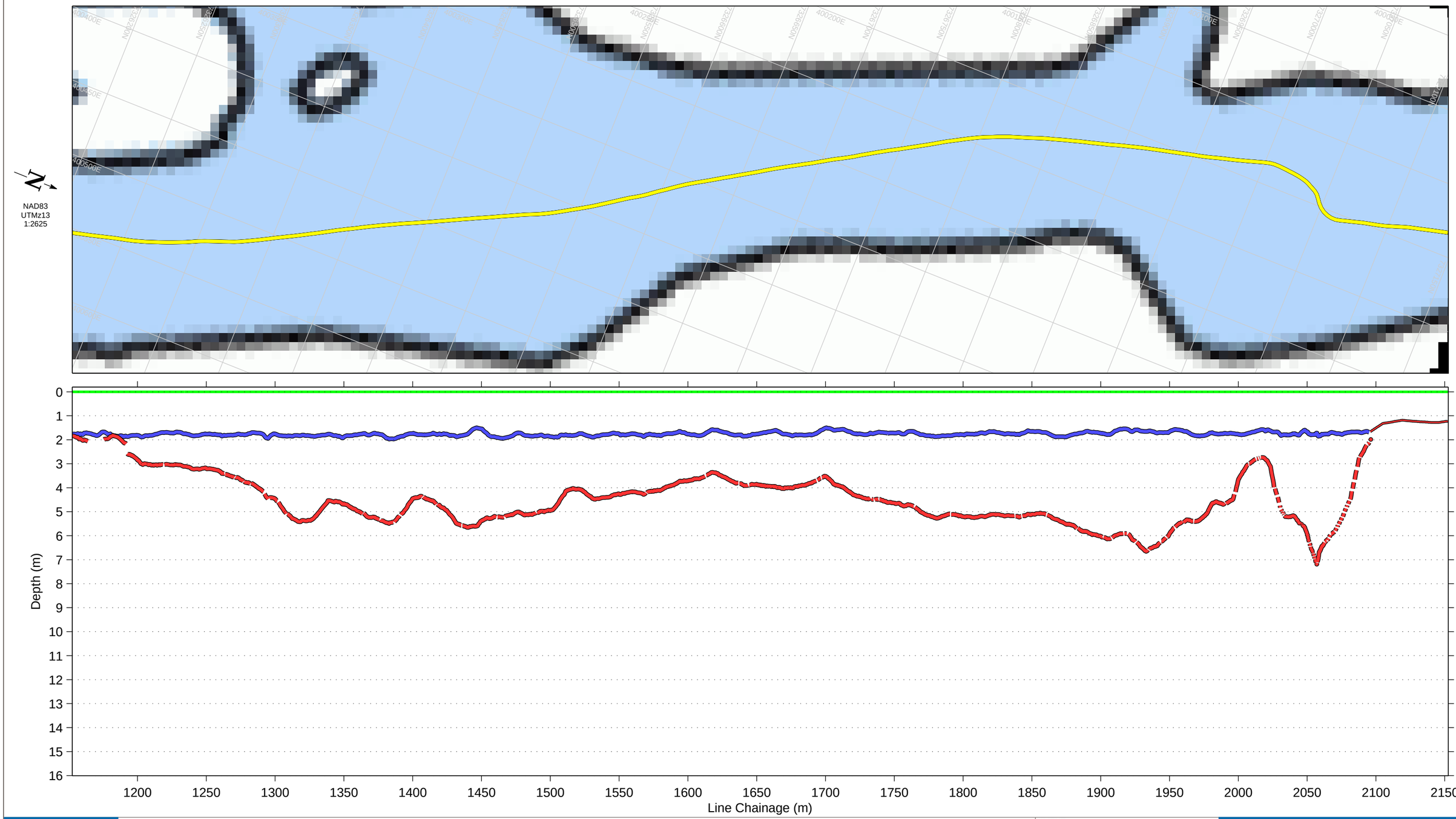
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Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D6.1





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

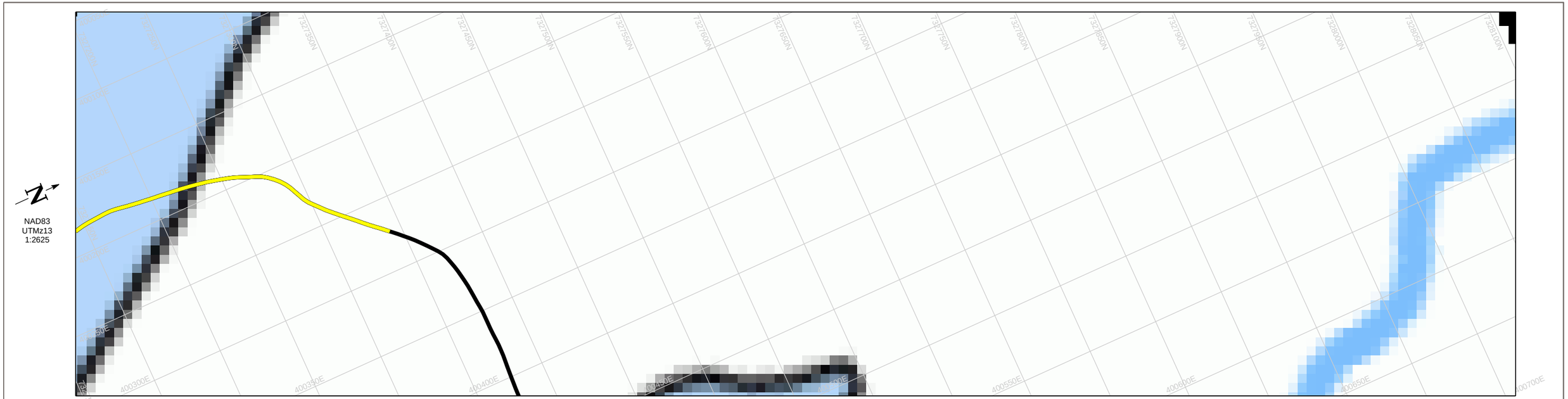
Sabina Gold & Silver
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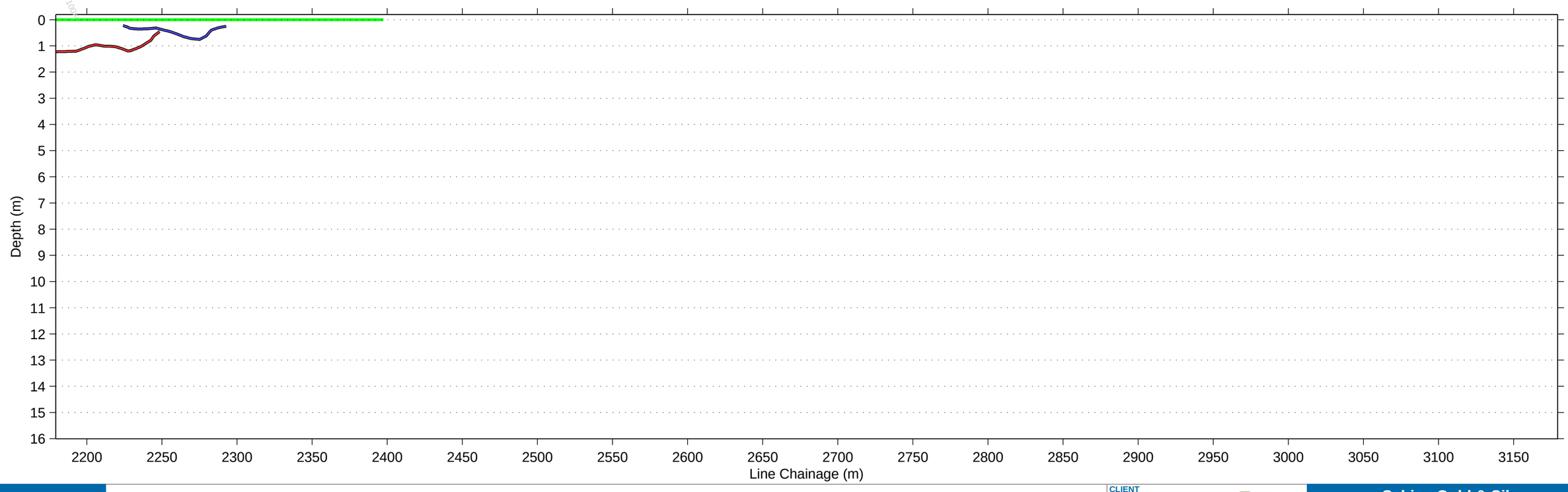
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

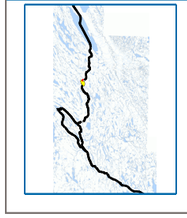
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D6.2







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

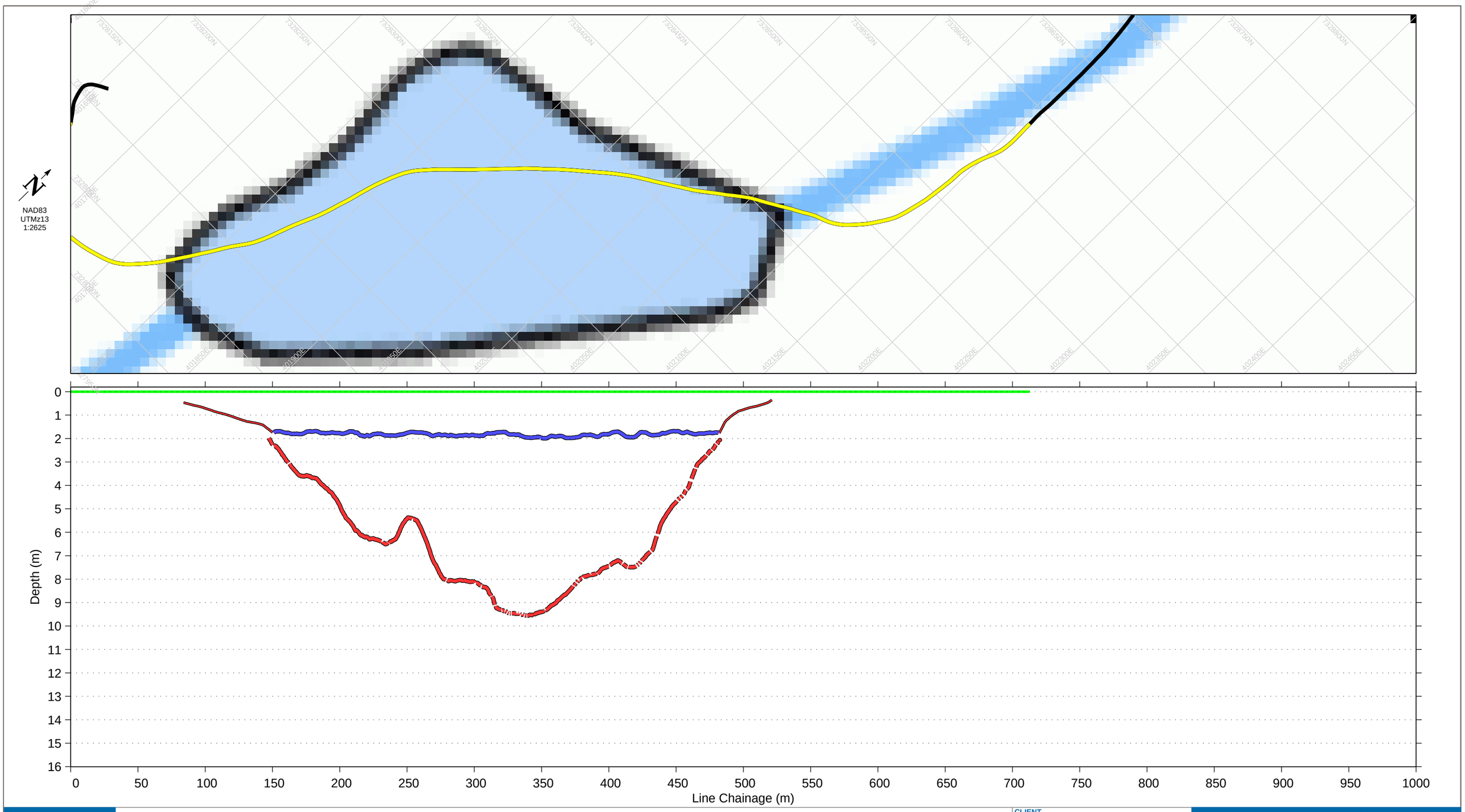
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Back River Project GPR Profiling

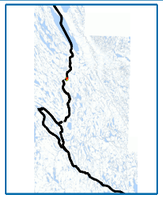
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D6.3





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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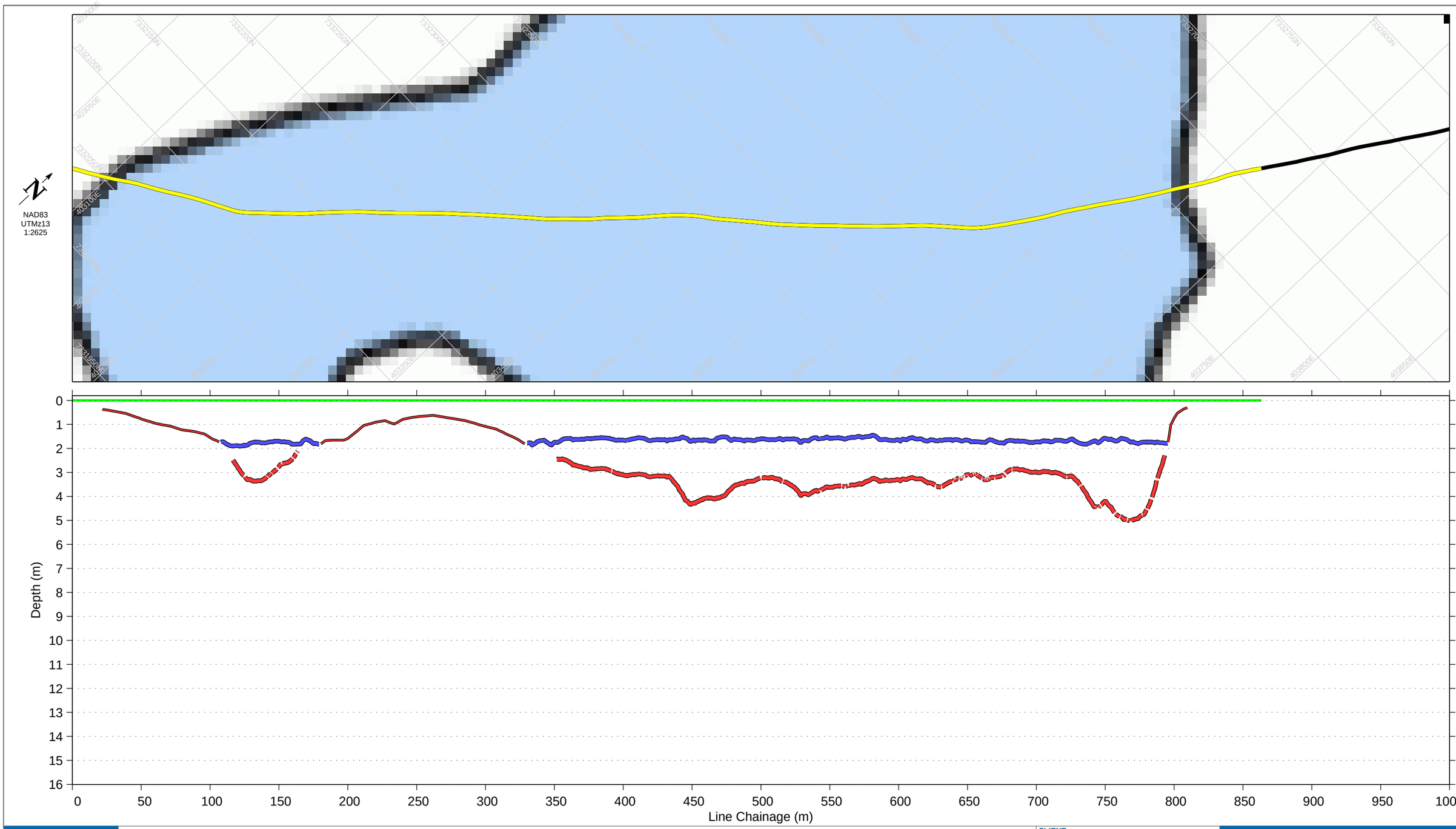
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Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D7





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

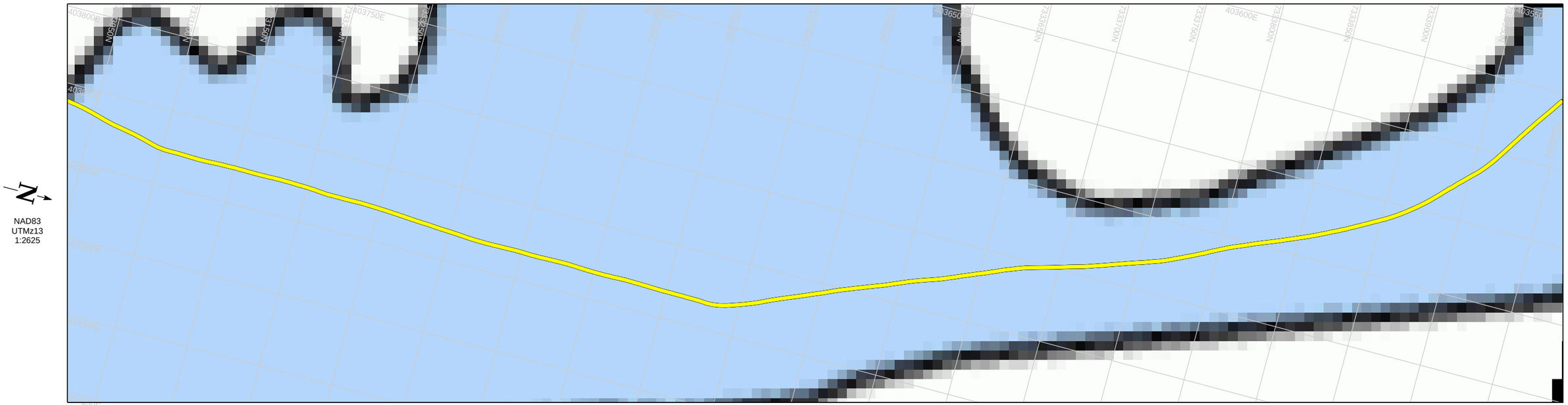
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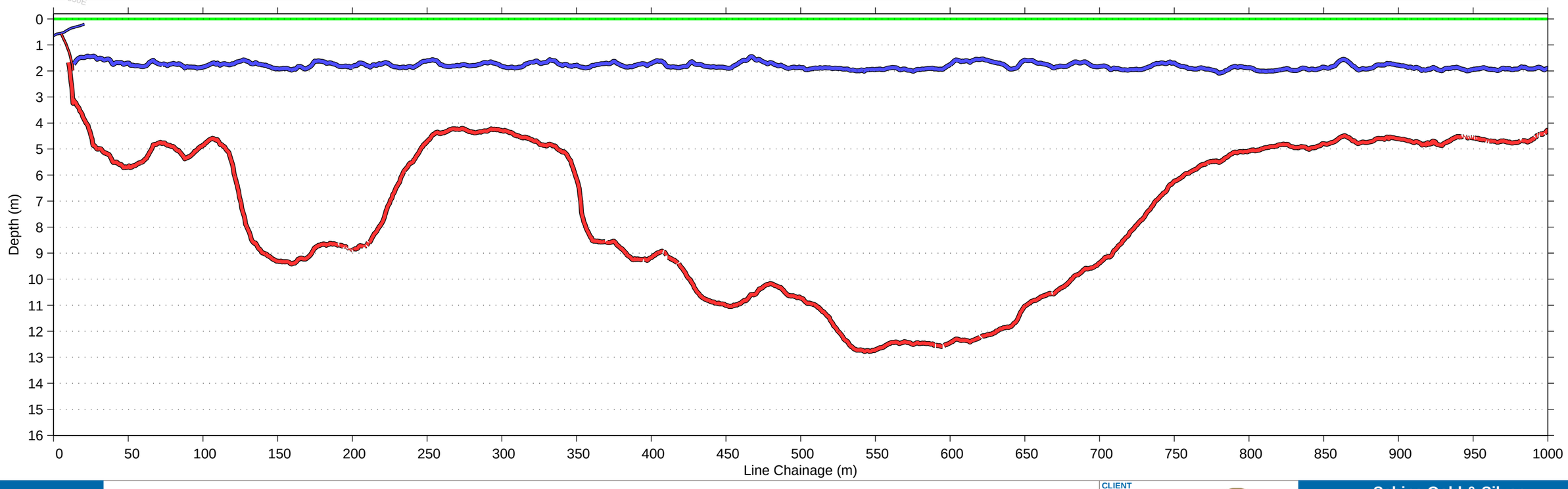
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

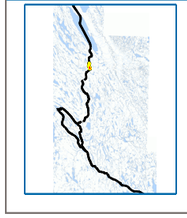
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D8







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

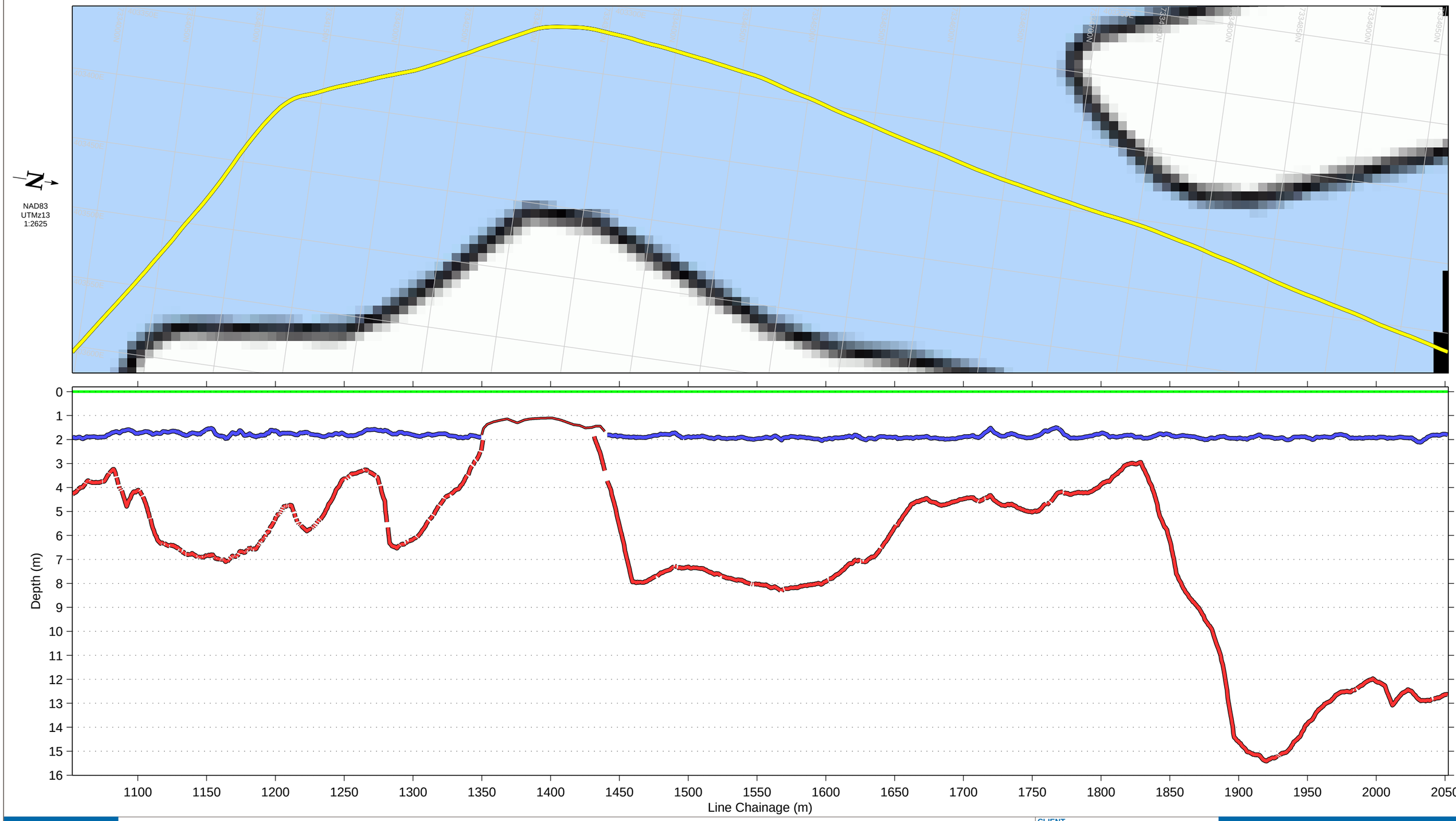
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Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D9.1





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

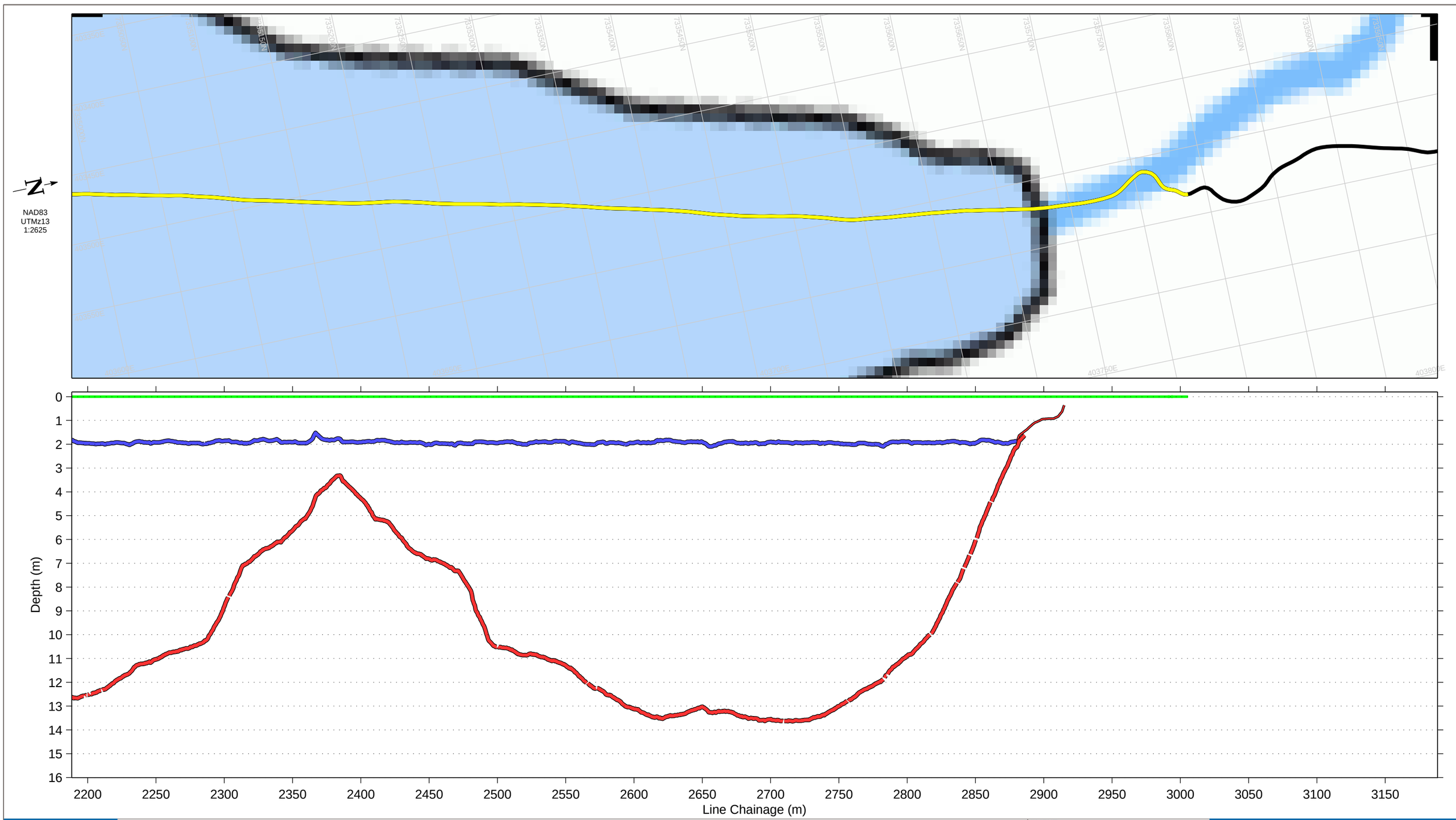
Sabina Gold & Silver
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Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D9.2





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

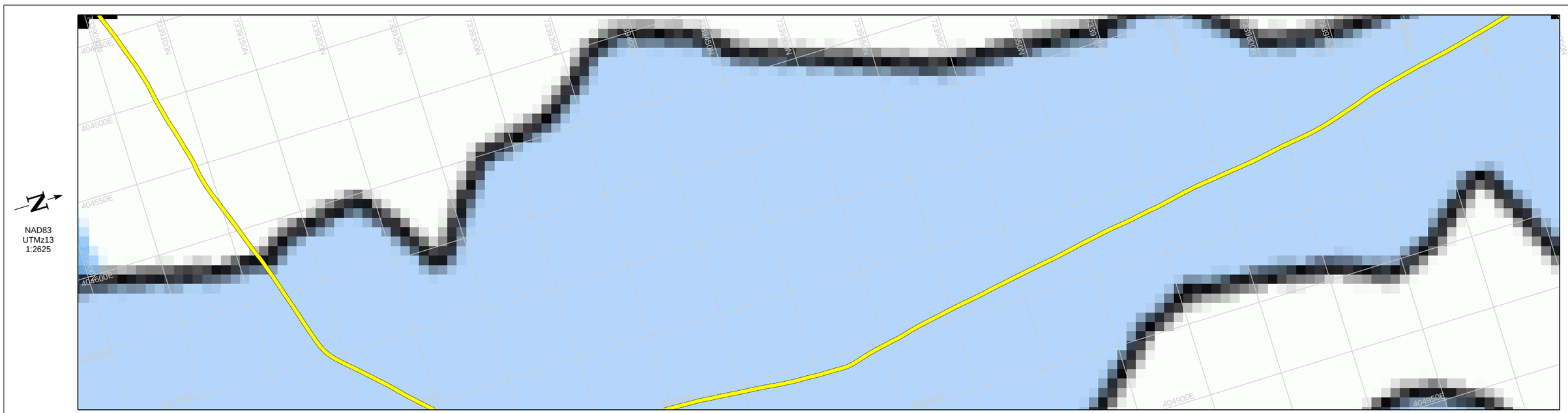
Sabina Gold & Silver
Back River Project GPR Profiling

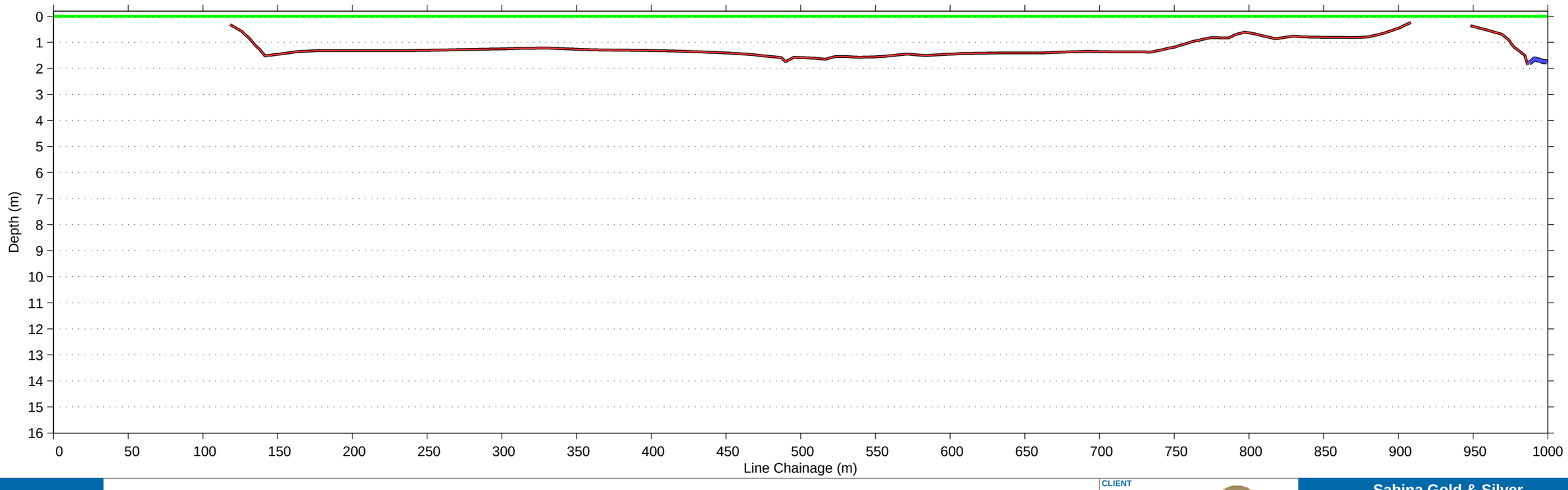
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N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

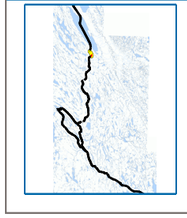
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D9.3







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

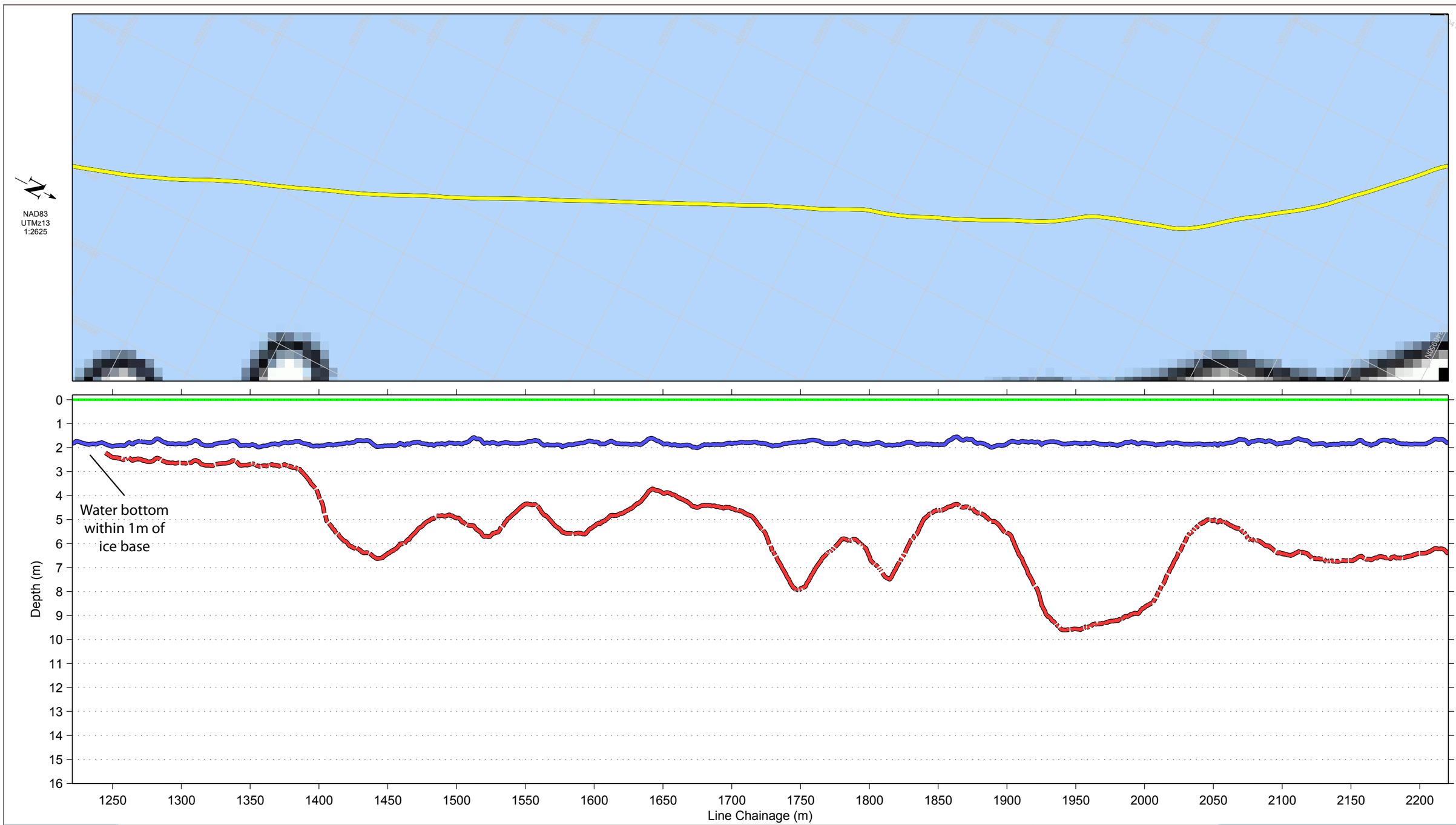
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Back River Project GPR Profiling

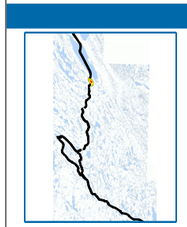
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D10.1





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

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Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

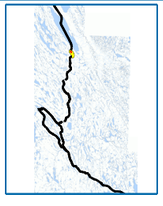
OFFICE	DATE
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Figure D10.2

NAD83
UTMz13
1:2625

Depth (m)

Line Chainage (m)



LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

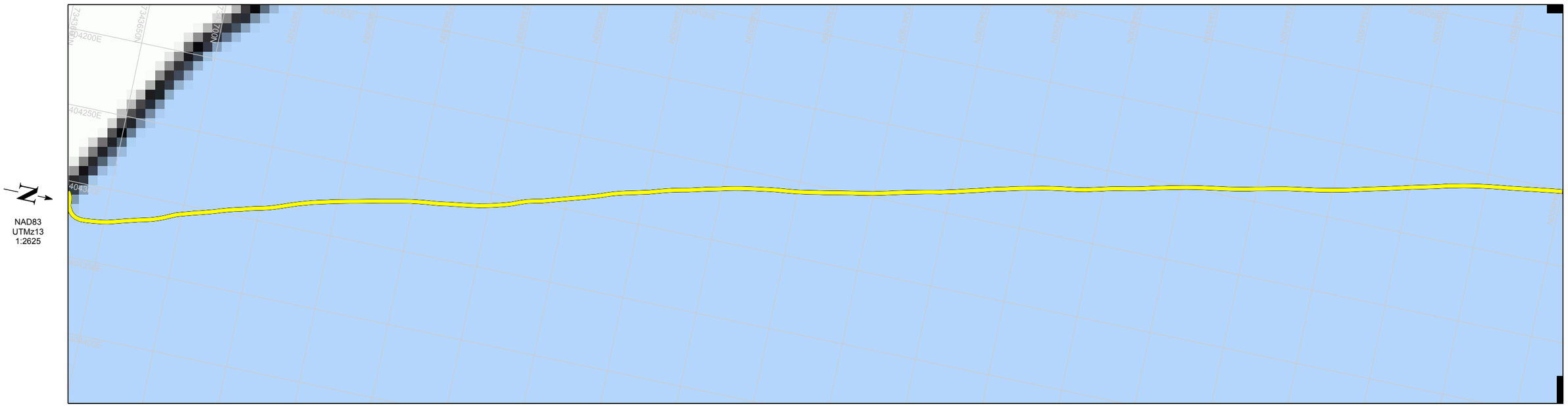
Sabina Gold & Silver
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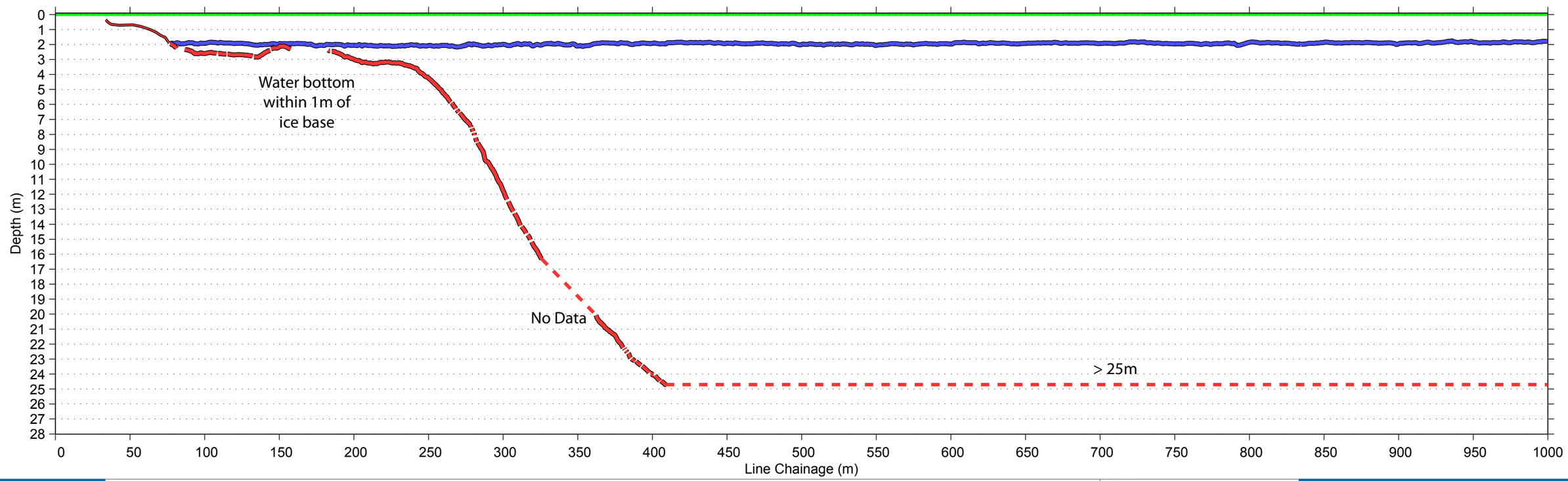
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

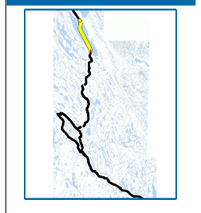
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D10.3







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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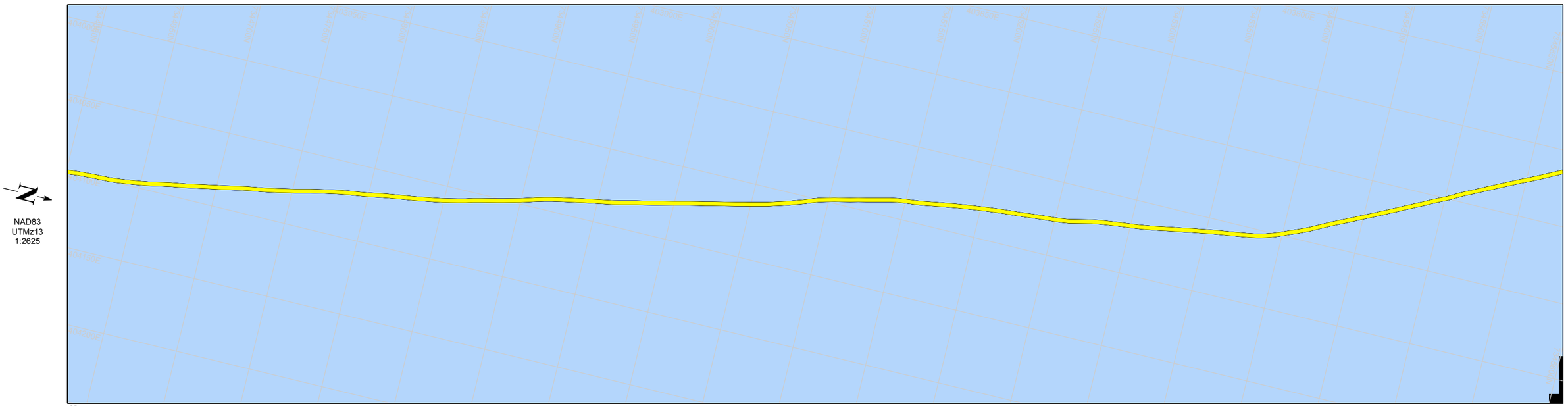
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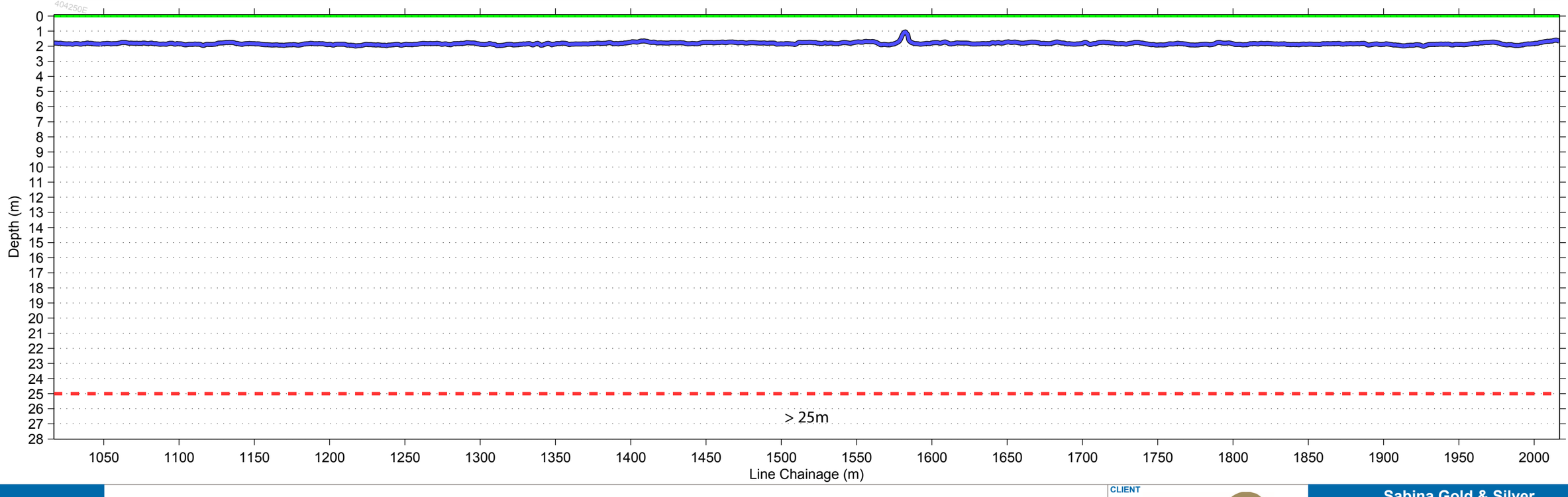
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

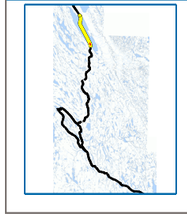
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.1







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

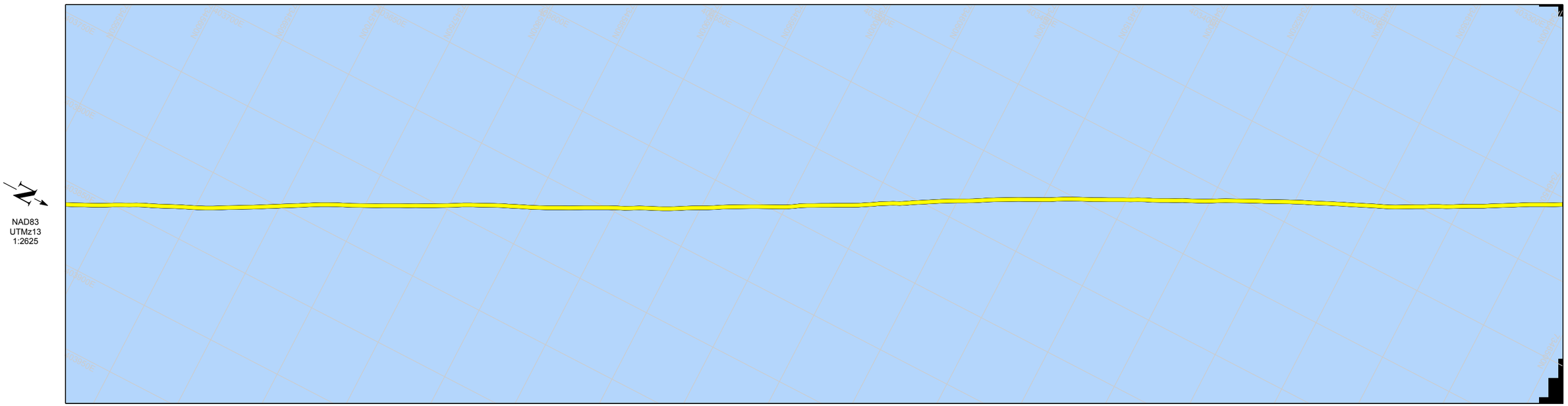
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Back River Project GPR Profiling

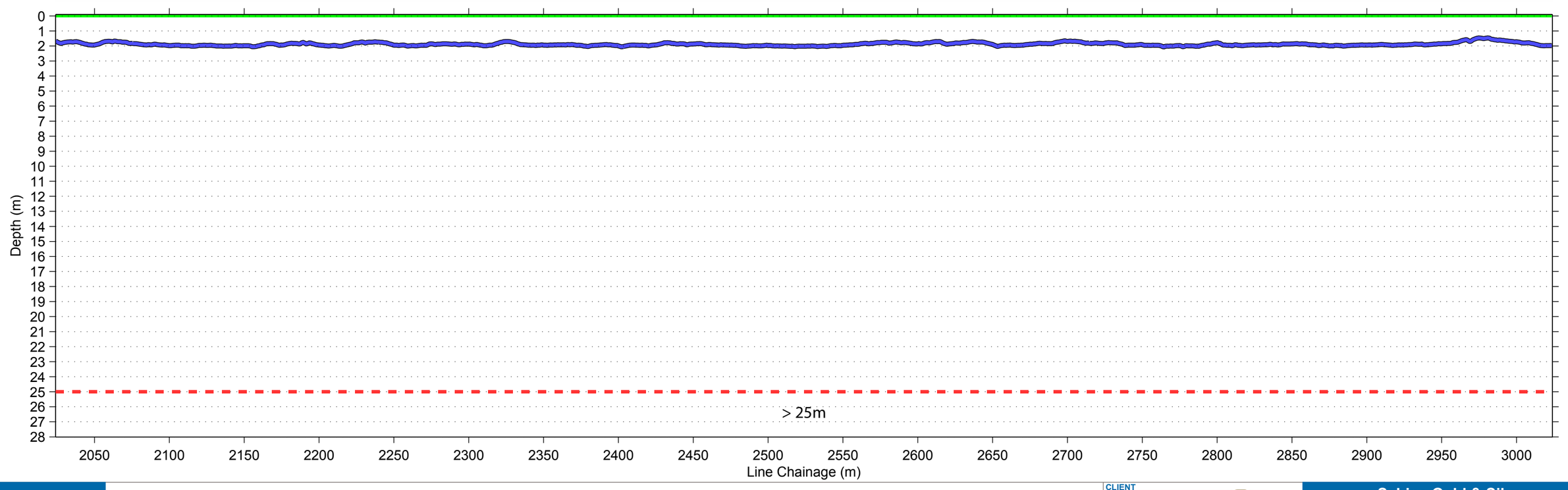
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

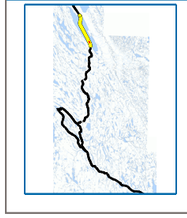
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.2







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

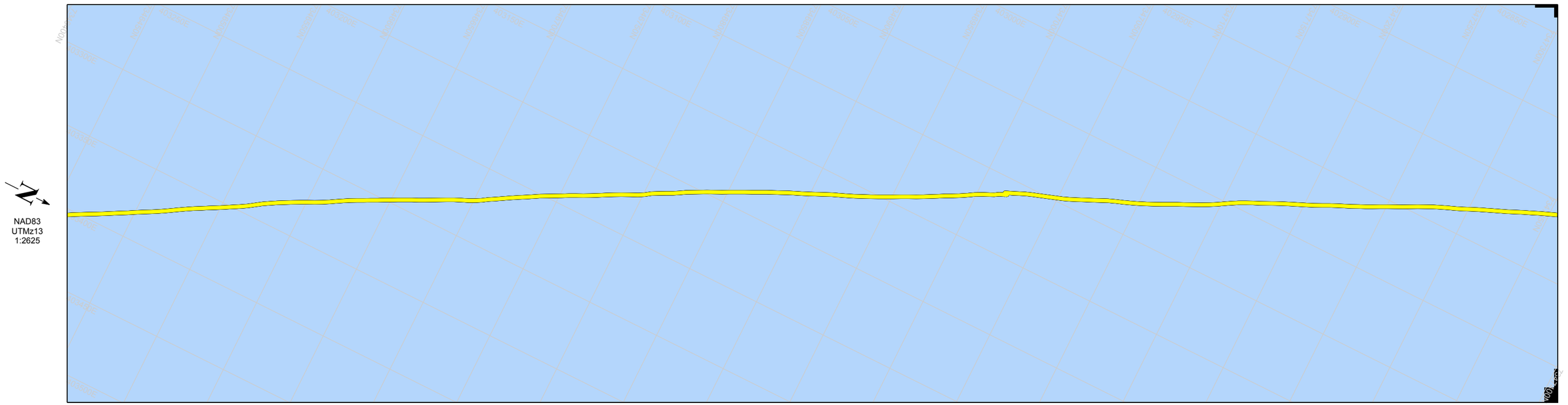
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Back River Project GPR Profiling

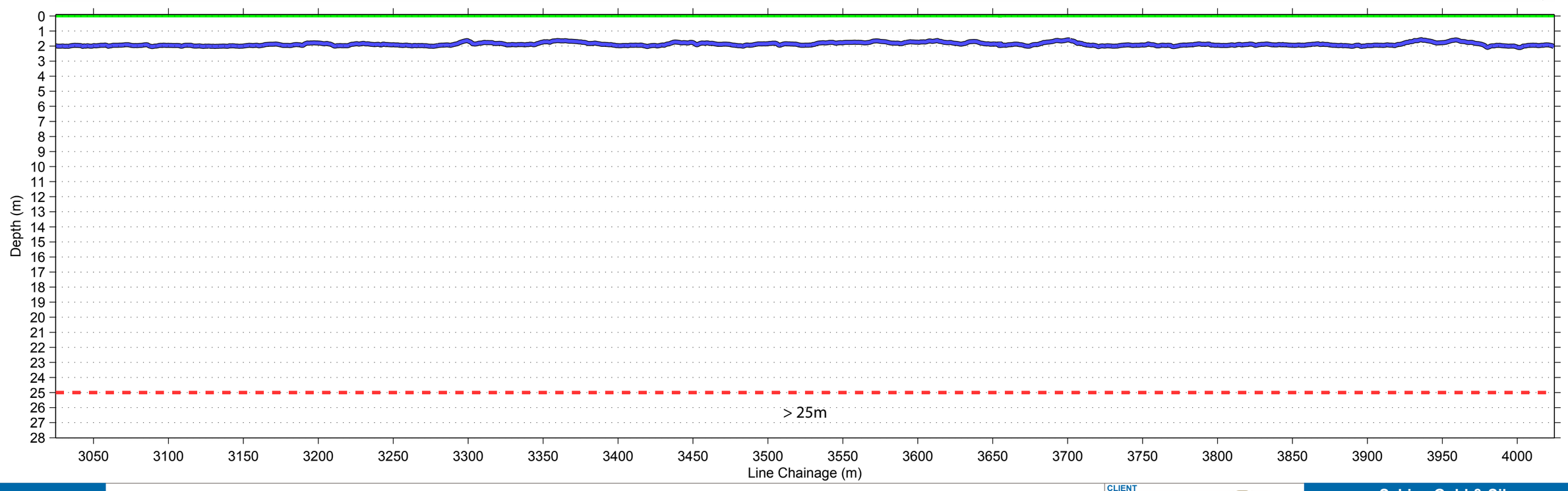
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

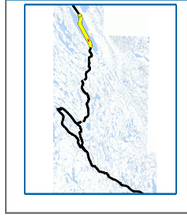
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.3







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

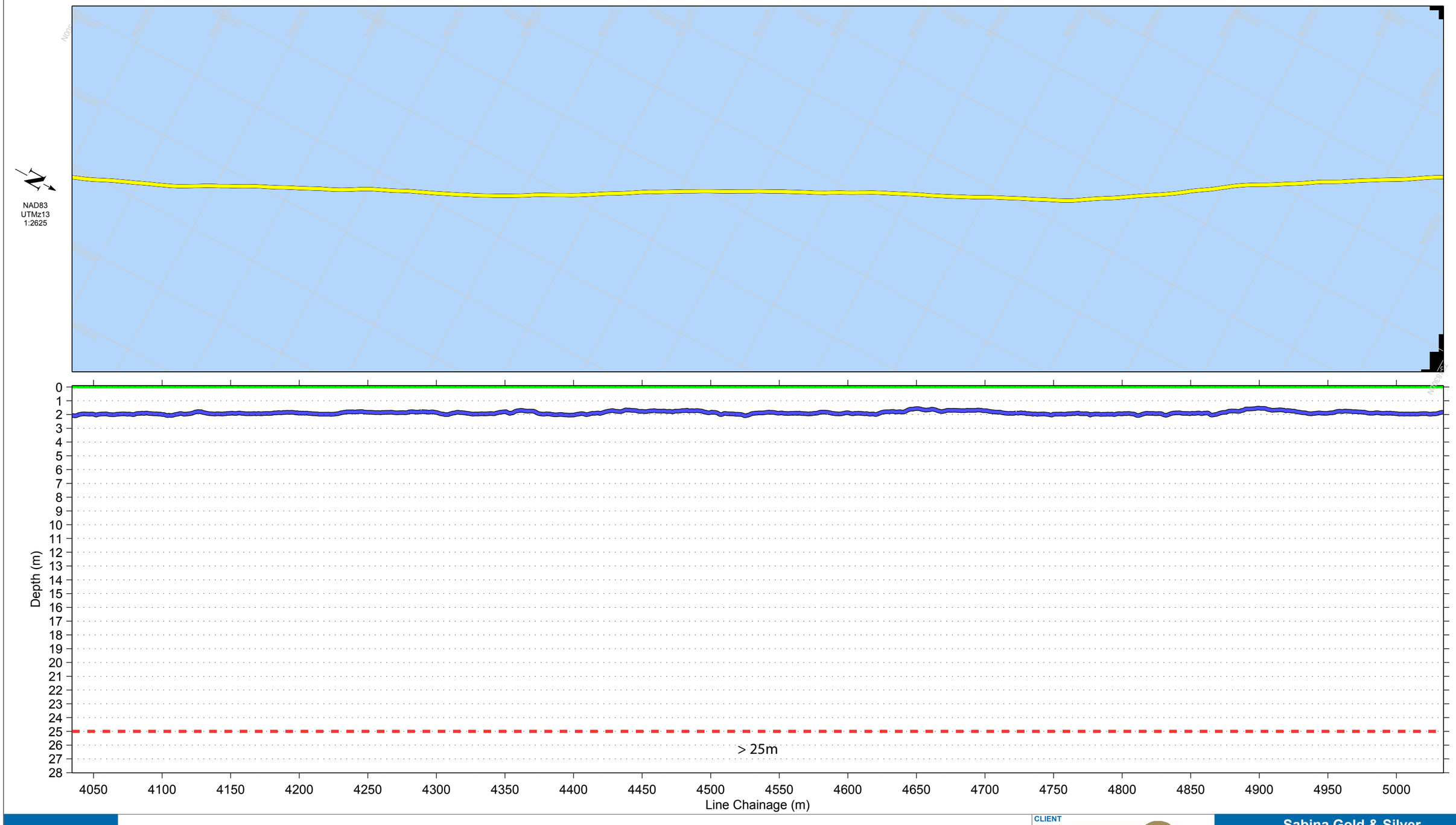
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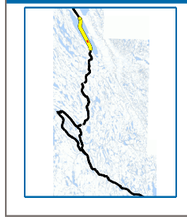
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D11.4





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

CLIENT

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TETRA TECH

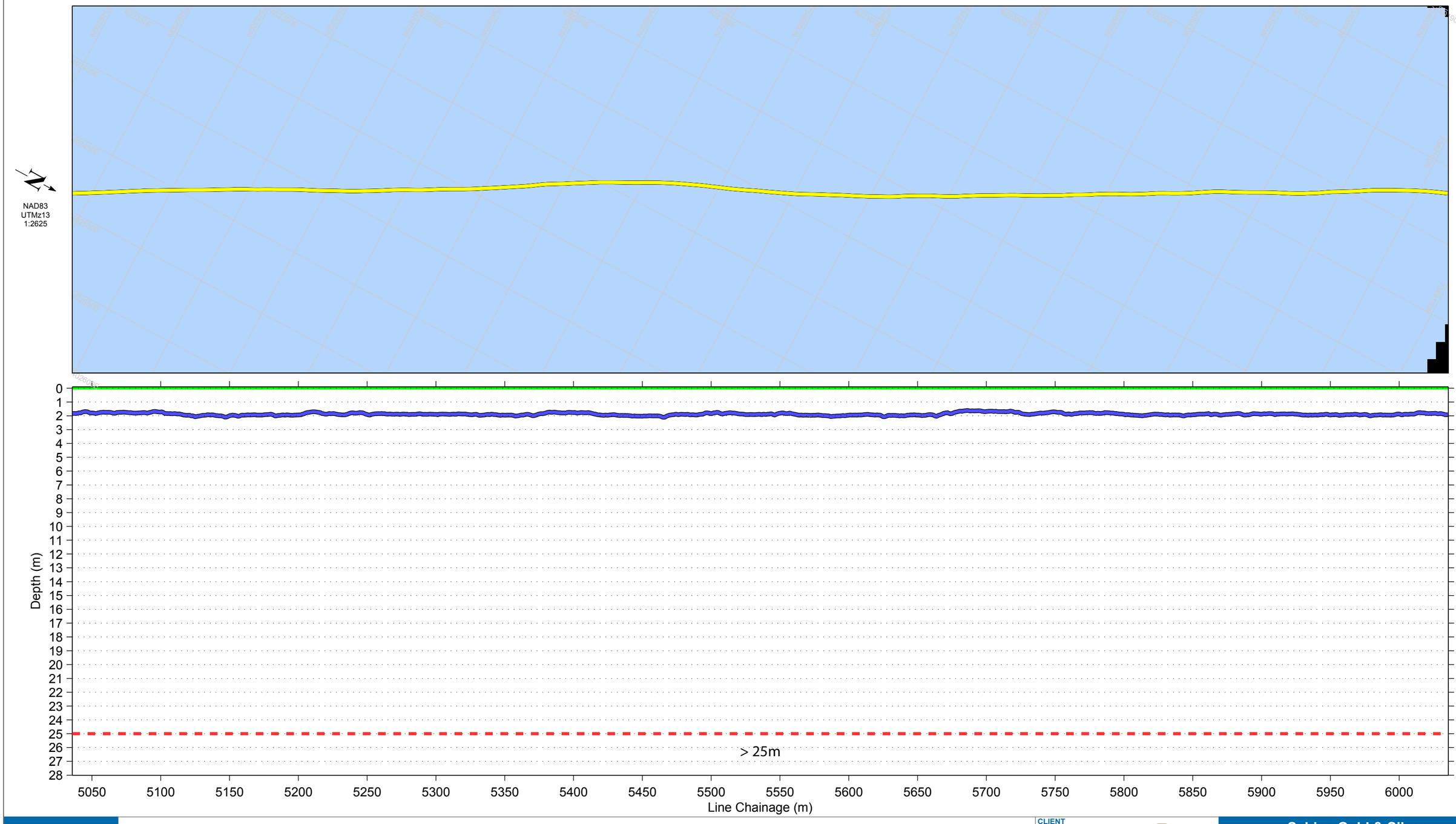
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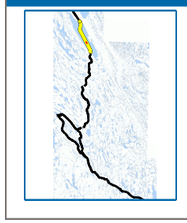
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D11.5





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

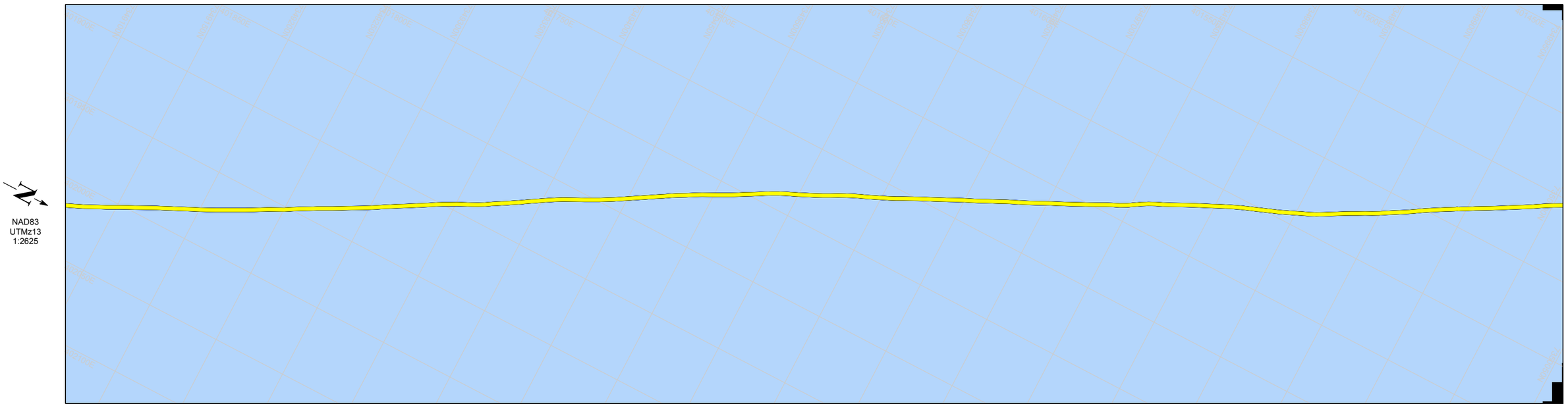
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Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

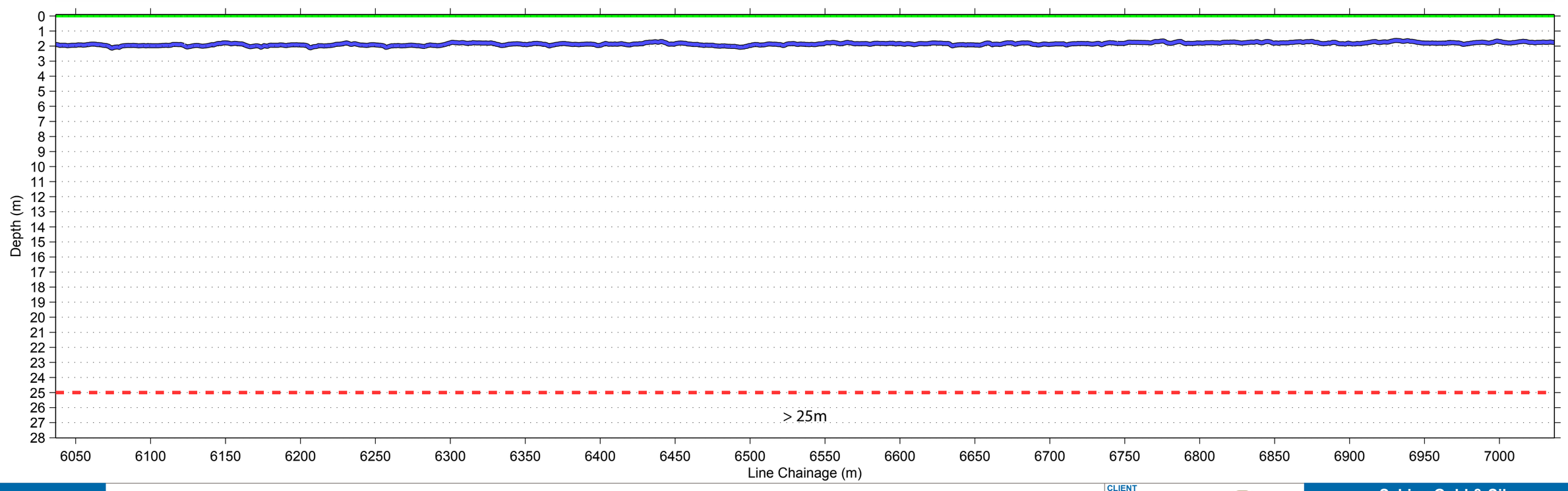
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

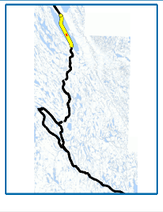
OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.6



NAD83
UTMz13
1:2625





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

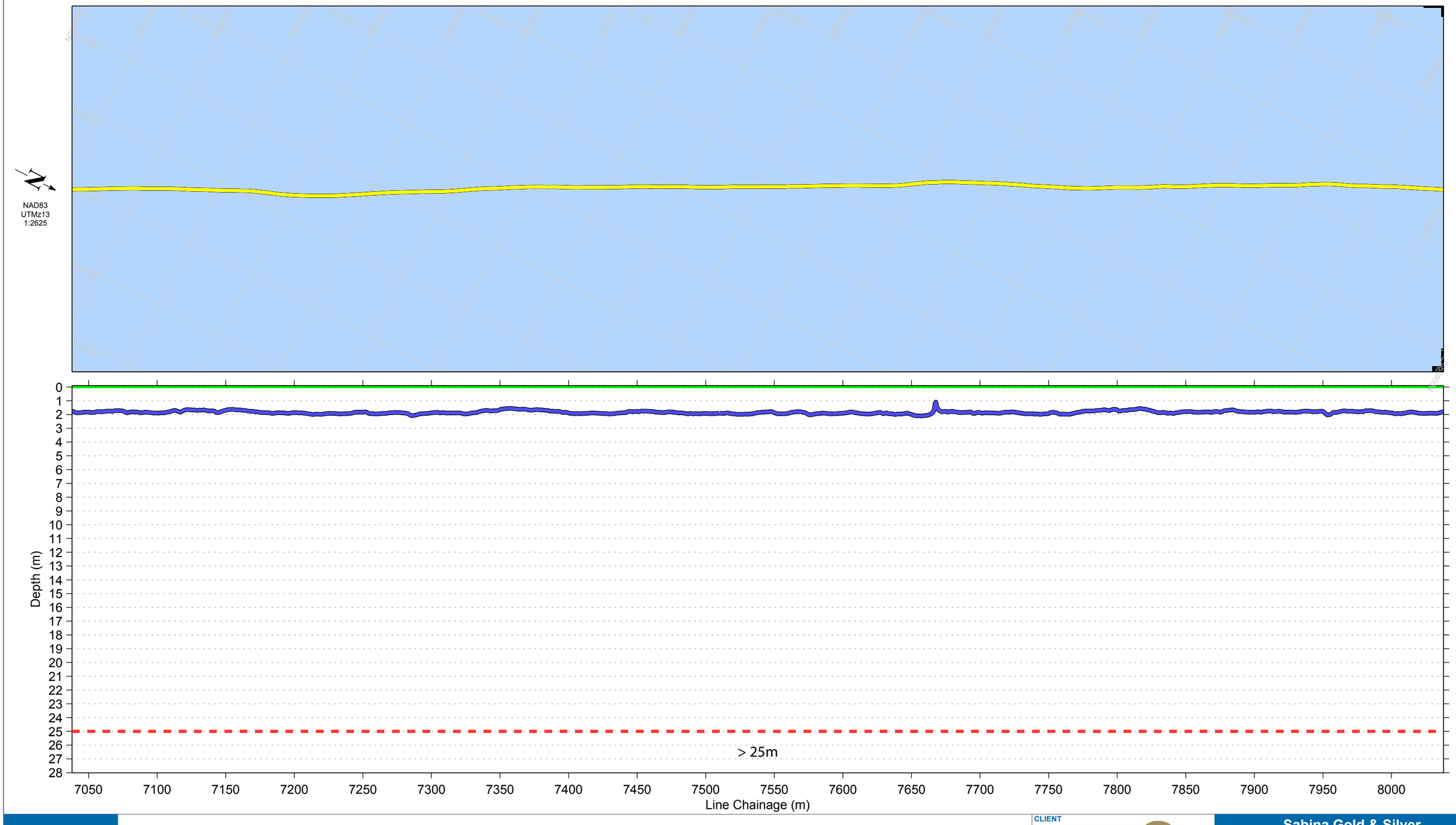
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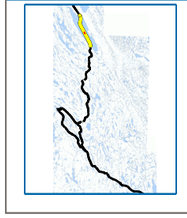
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
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Figure D11.7





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

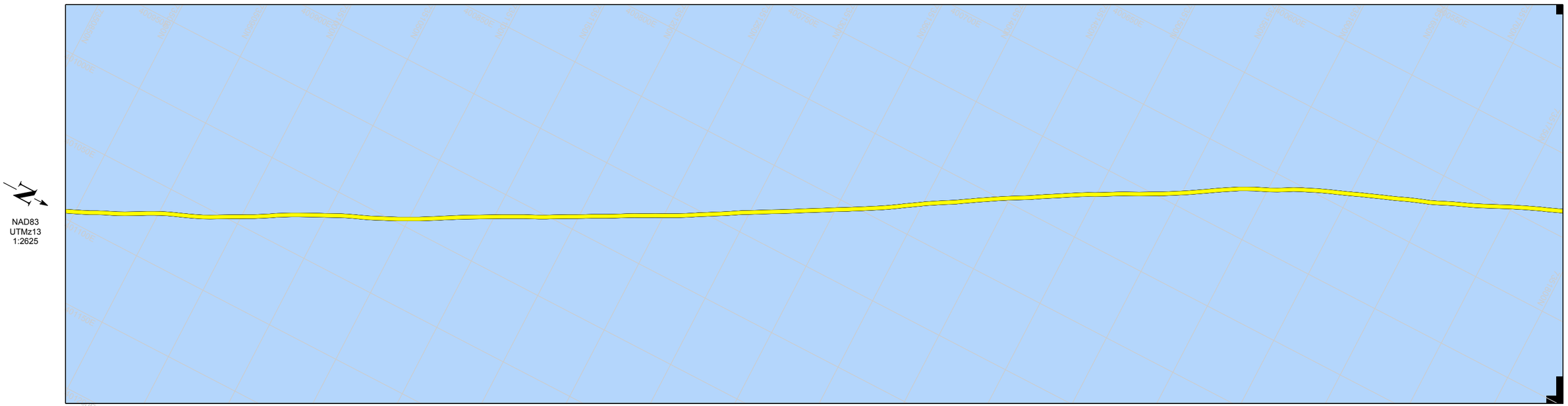
Sabina Gold & Silver
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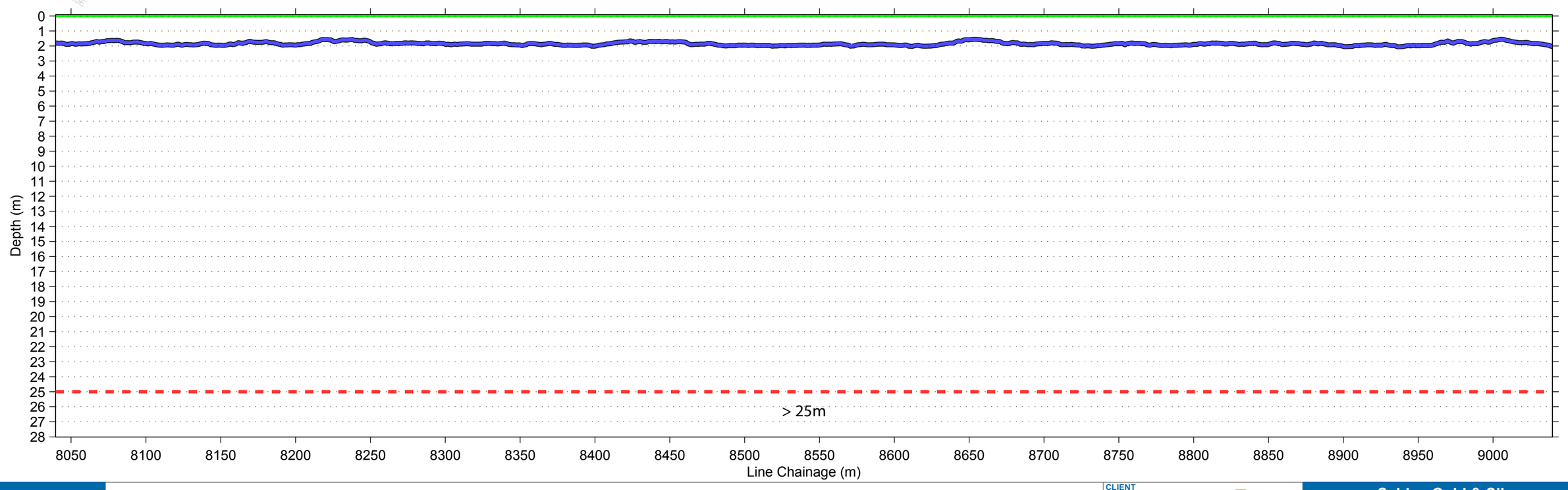
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

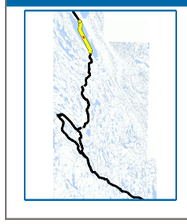
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.8







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

CLIENT

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TETRA TECH

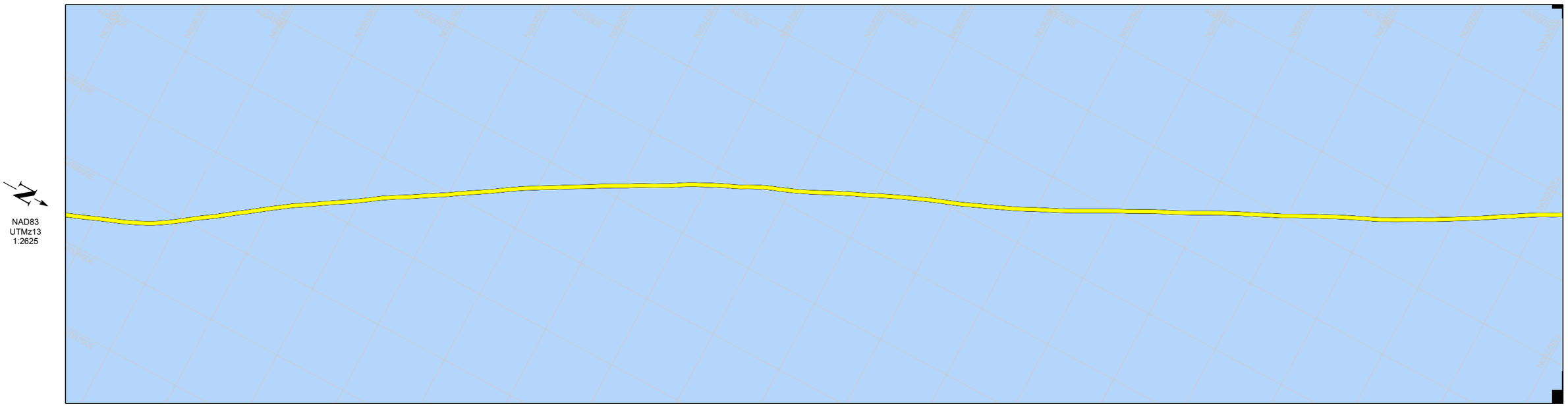
Sabina Gold & Silver
Back River Project GPR Profiling

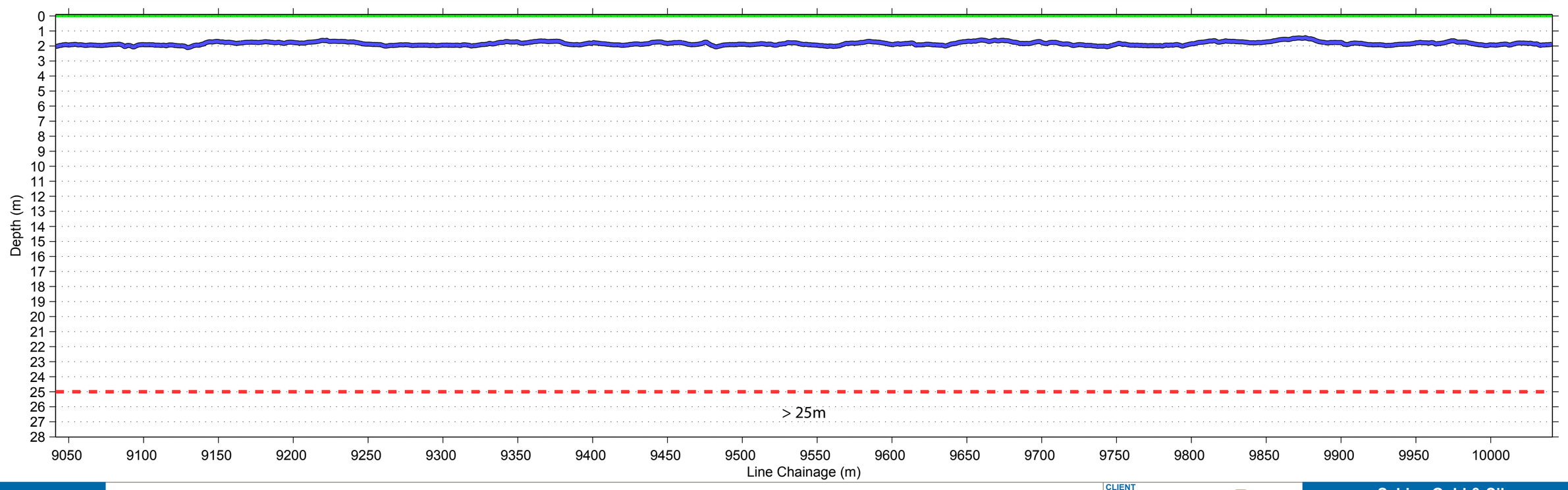
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

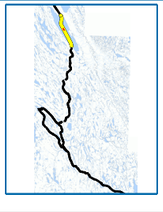
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.9







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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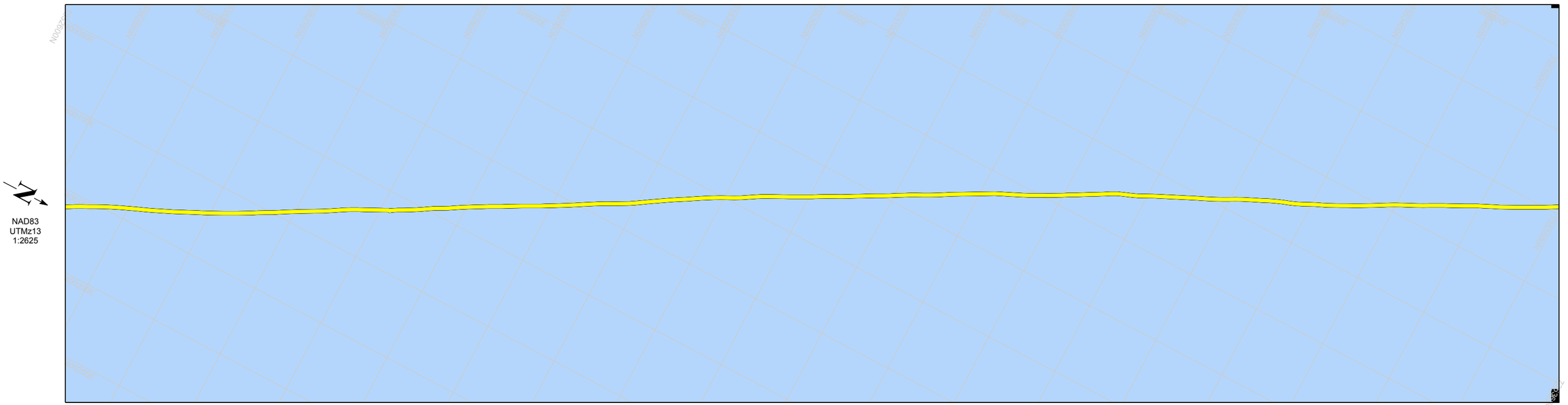
Sabina Gold & Silver
Back River Project GPR Profiling

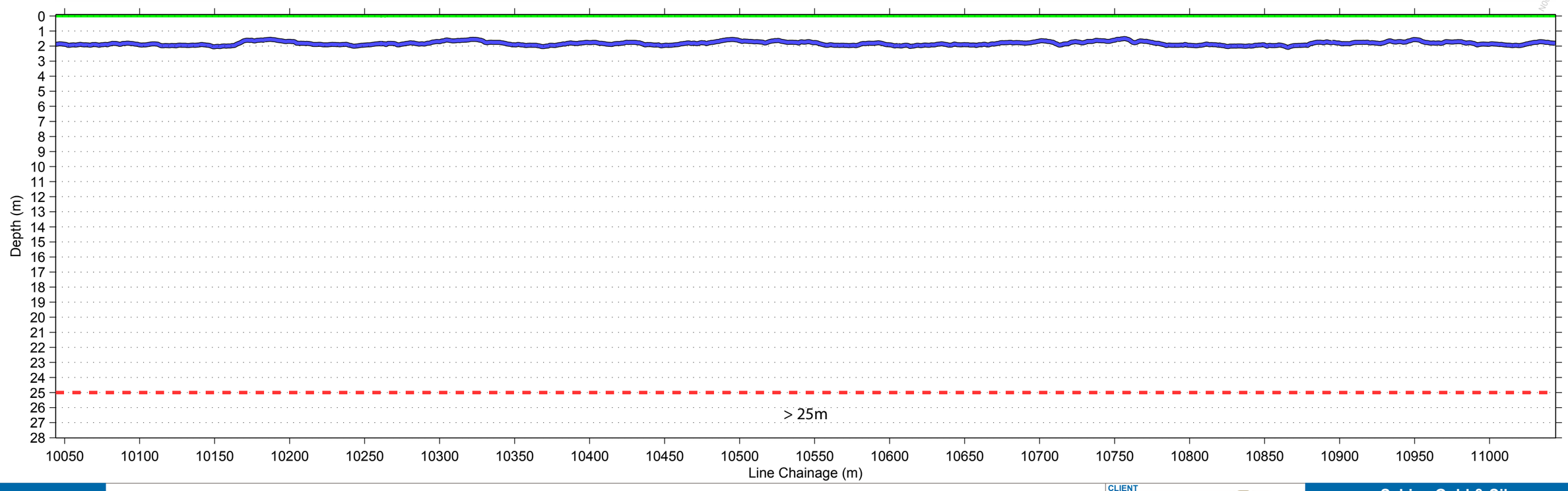
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

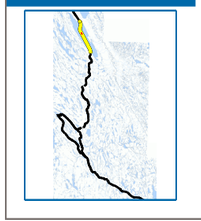
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.10







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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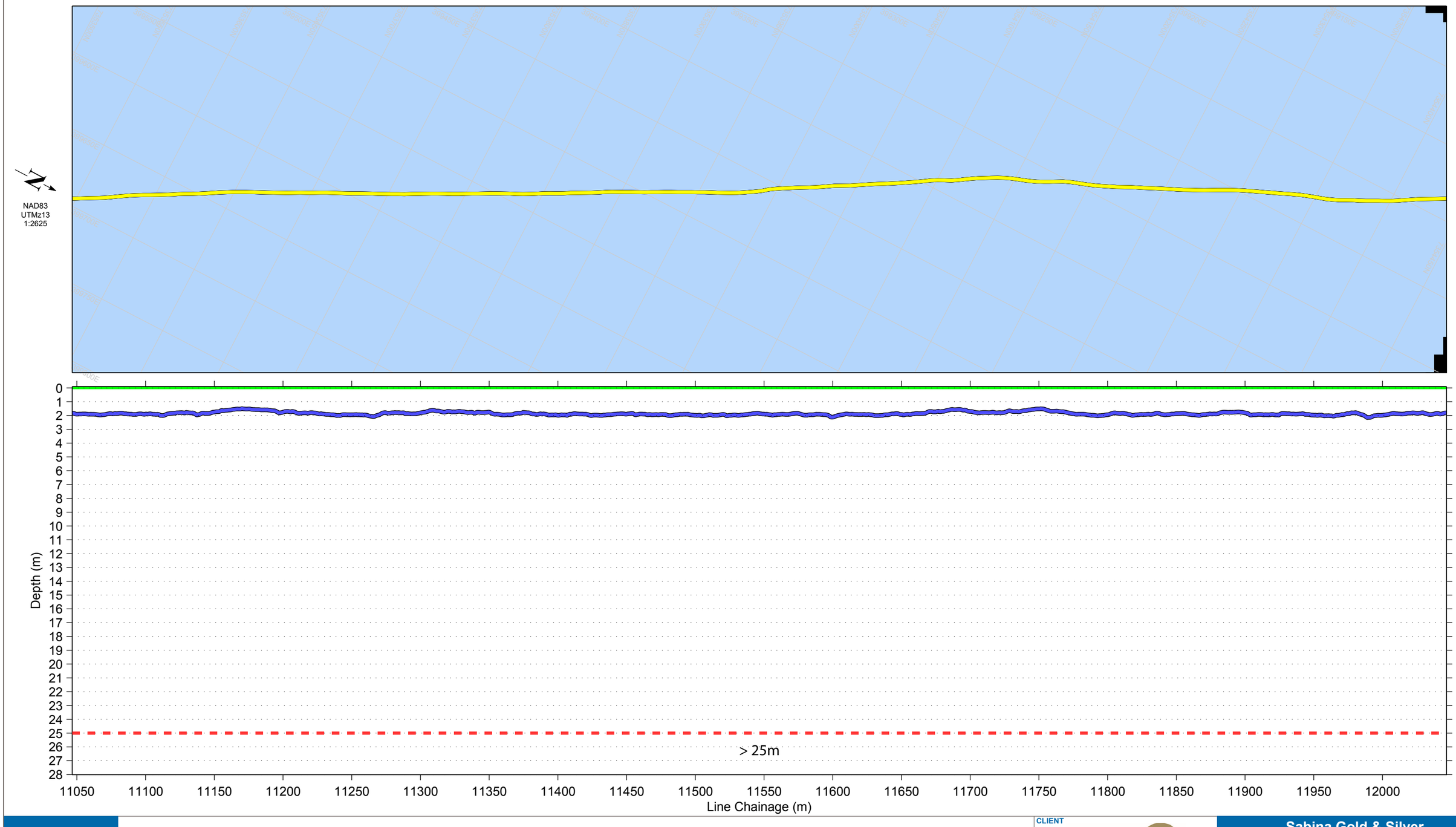
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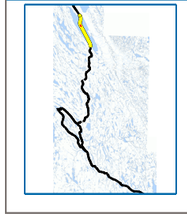
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.11





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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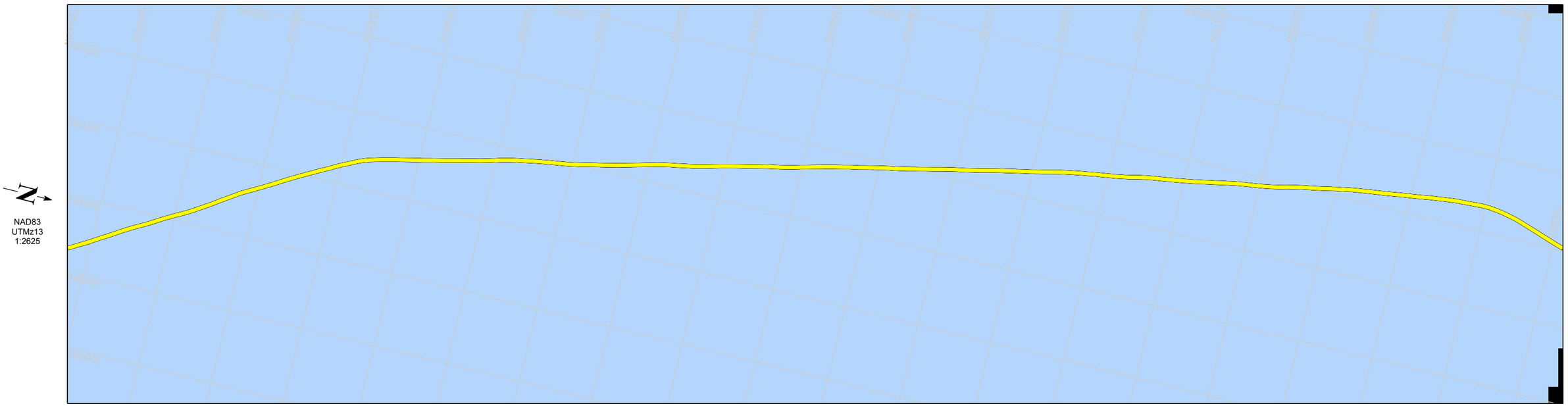
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Back River Project GPR Profiling

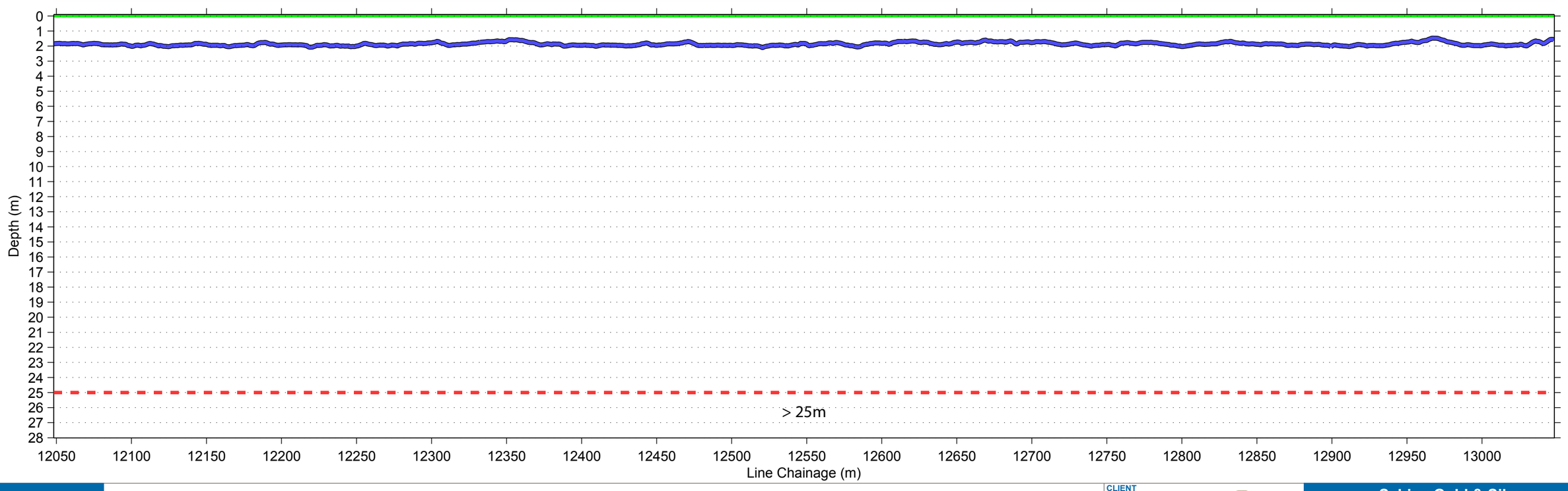
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

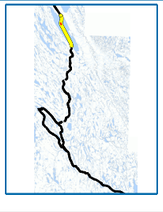
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.12







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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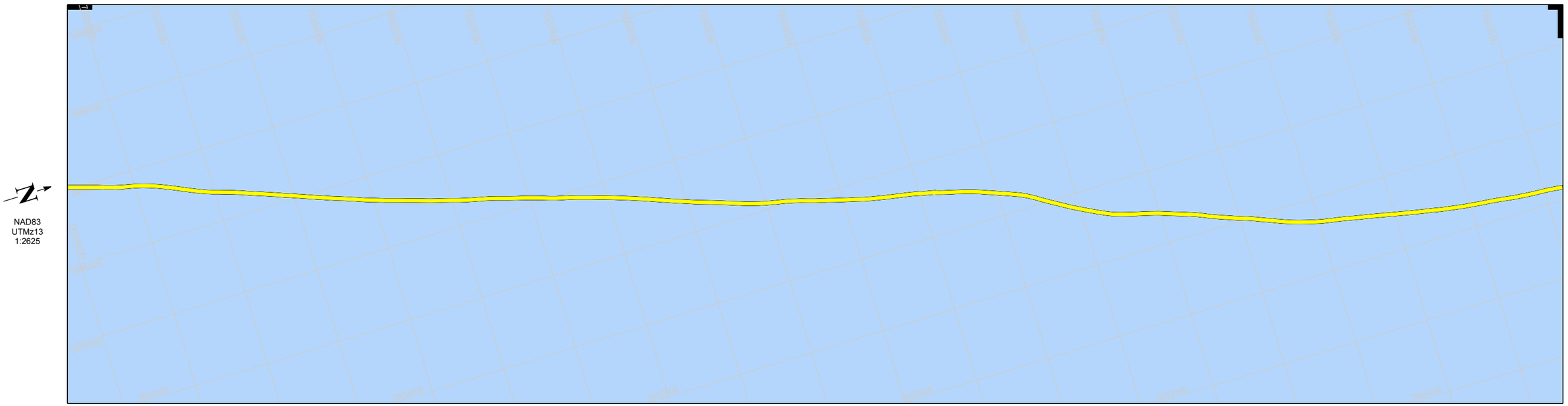
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Back River Project GPR Profiling

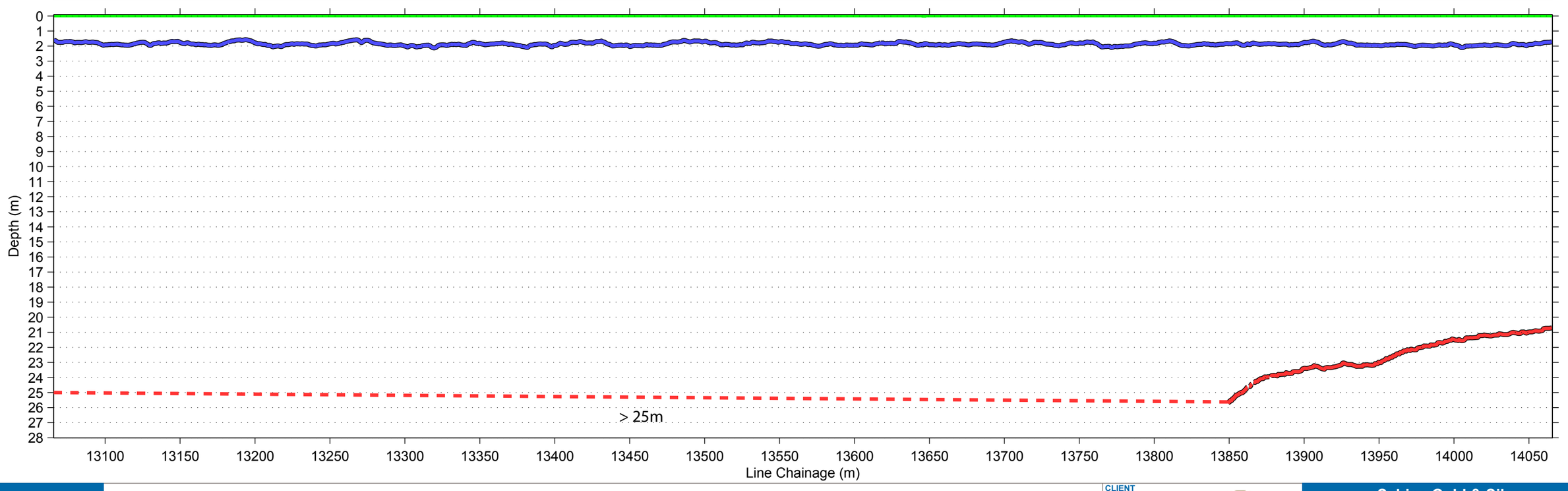
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Bathurst Lake
Collected April 25 – 28, 2013

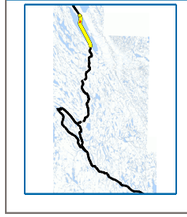
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.13







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

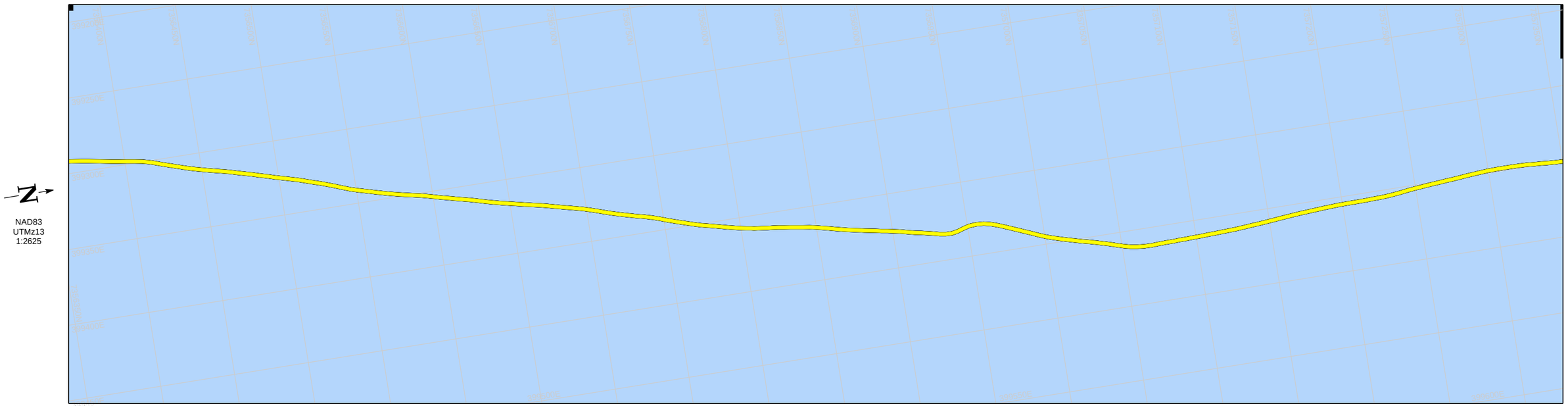
Sabina Gold & Silver
Back River Project GPR Profiling

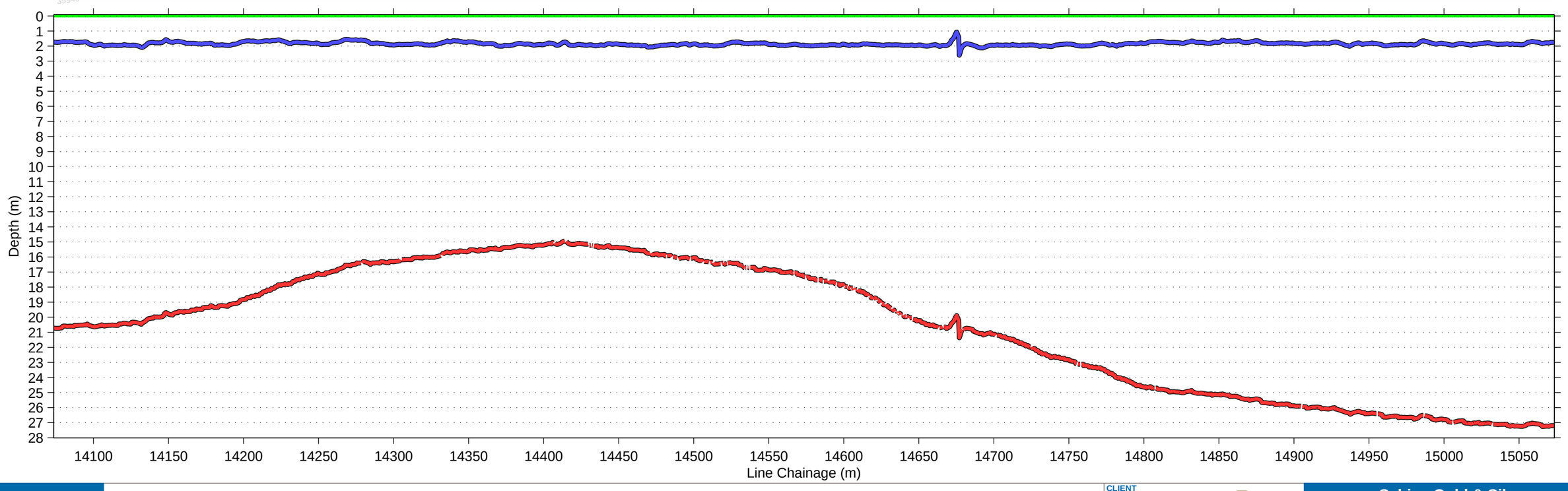
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Bathurst Lake
Collected April 25 – 28, 2013

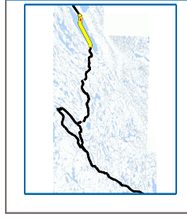
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE: Edmonton
DATE: June 14, 2013

Figure D11.14







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

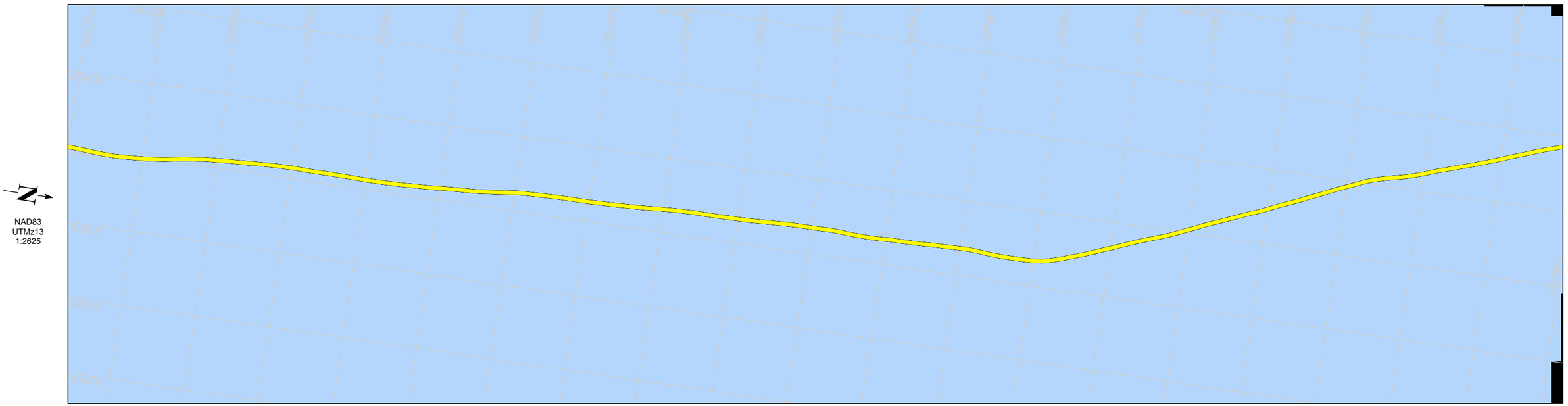
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Back River Project GPR Profiling

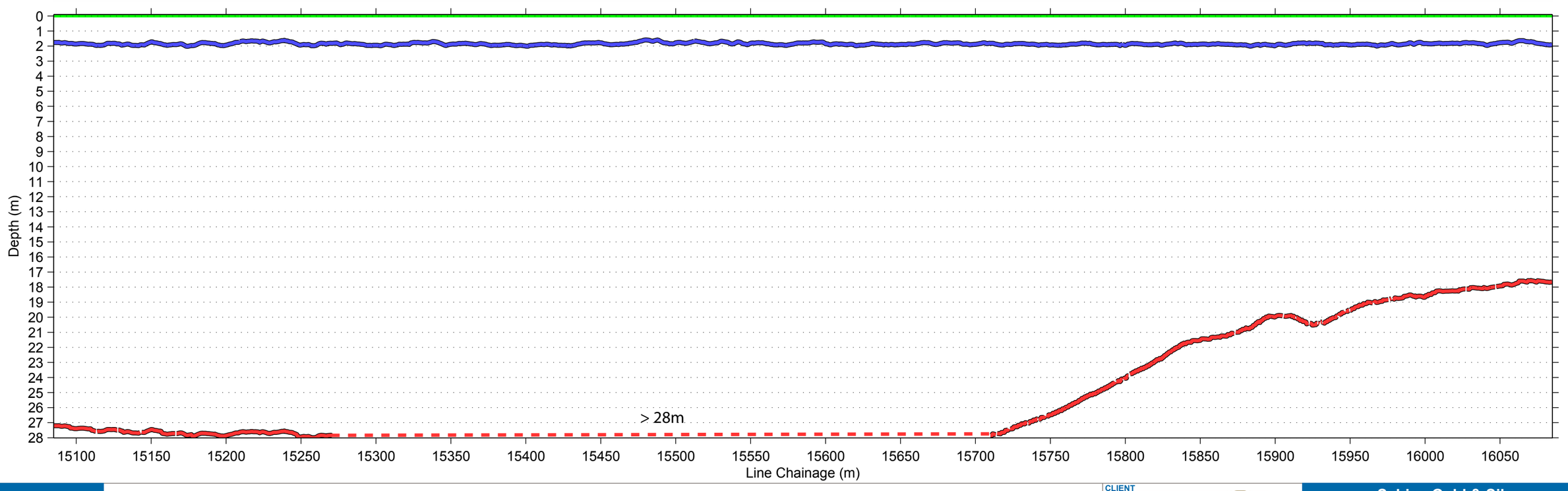
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

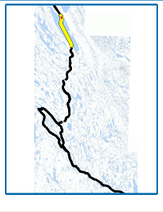
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.15







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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TETRA TECH

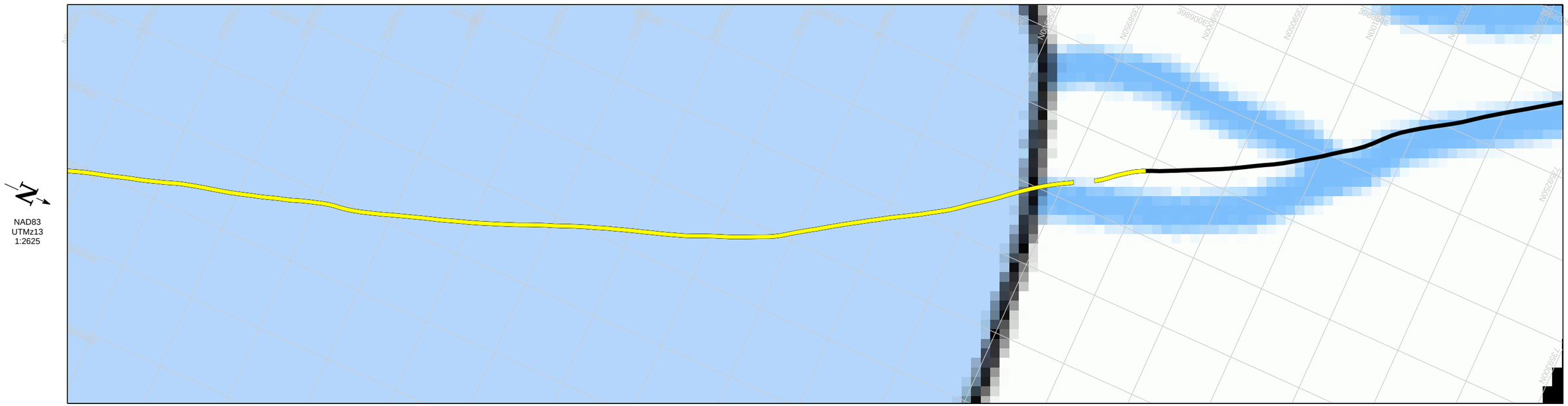
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Back River Project GPR Profiling

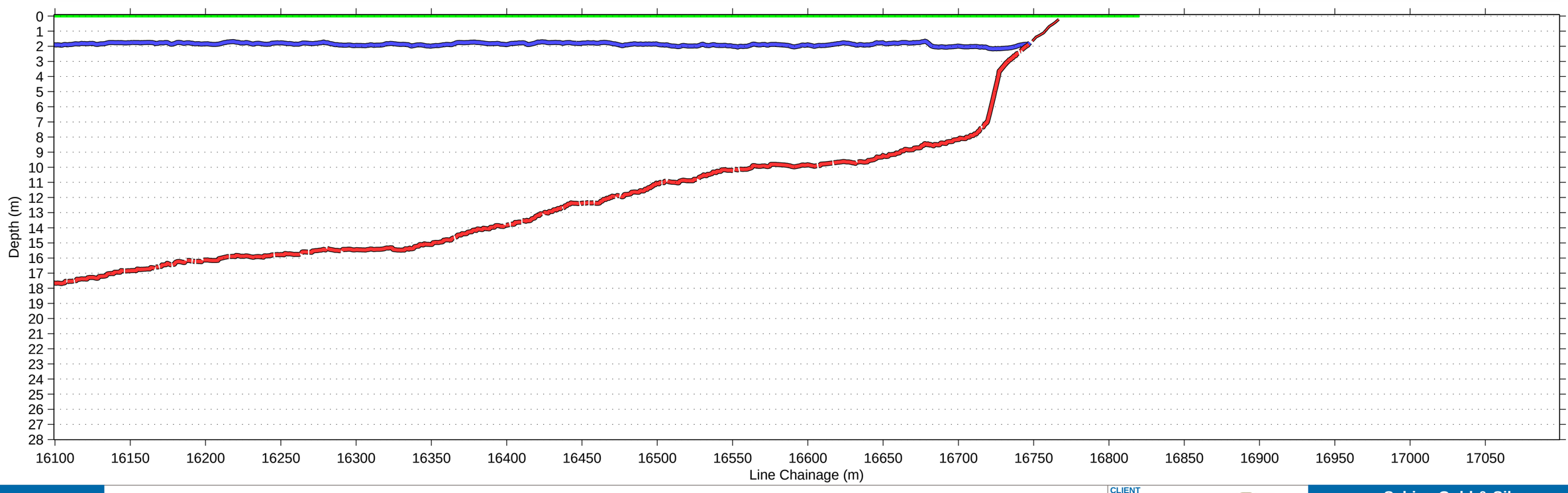
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

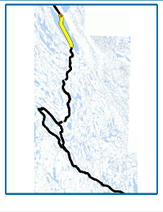
Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.16







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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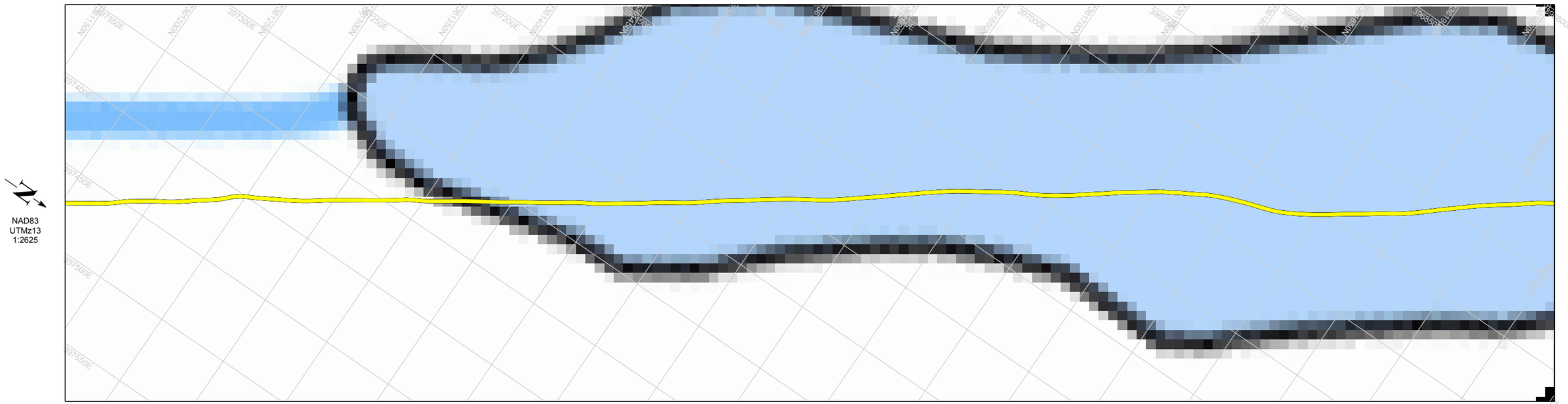
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Back River Project GPR Profiling

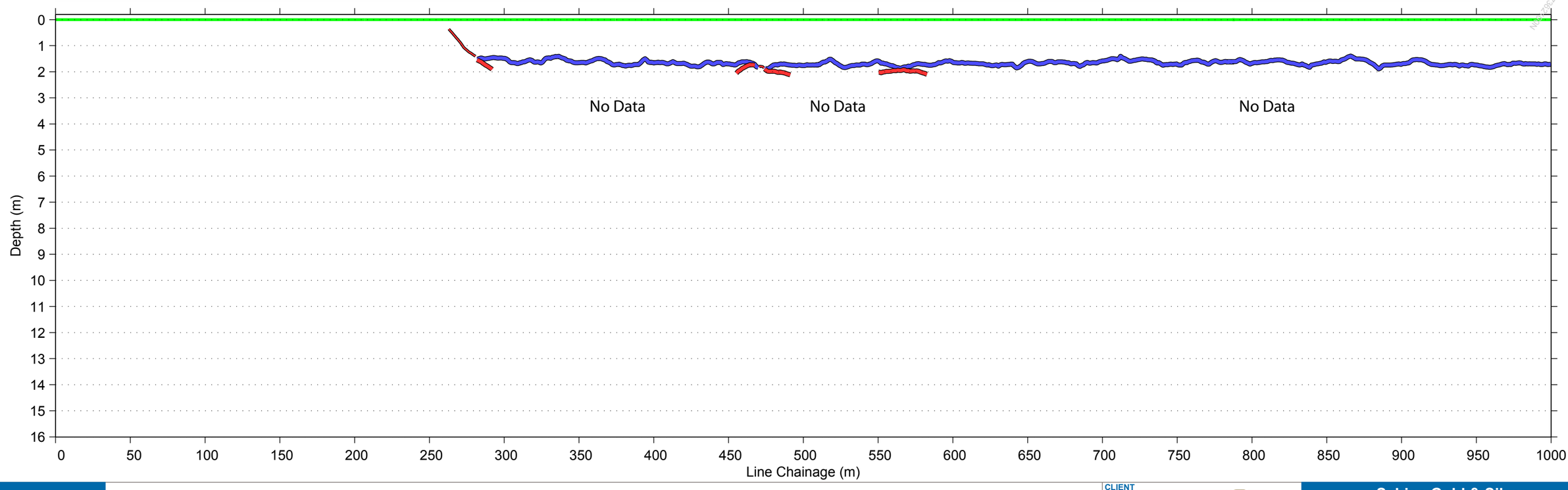
Winter Road Option – Major Lake Profiles
Bathurst Lake
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D11.17







LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D12.1

NAD83
UTMz13
1:2625

No Data

Depth (m)

Line Chainage (m)

LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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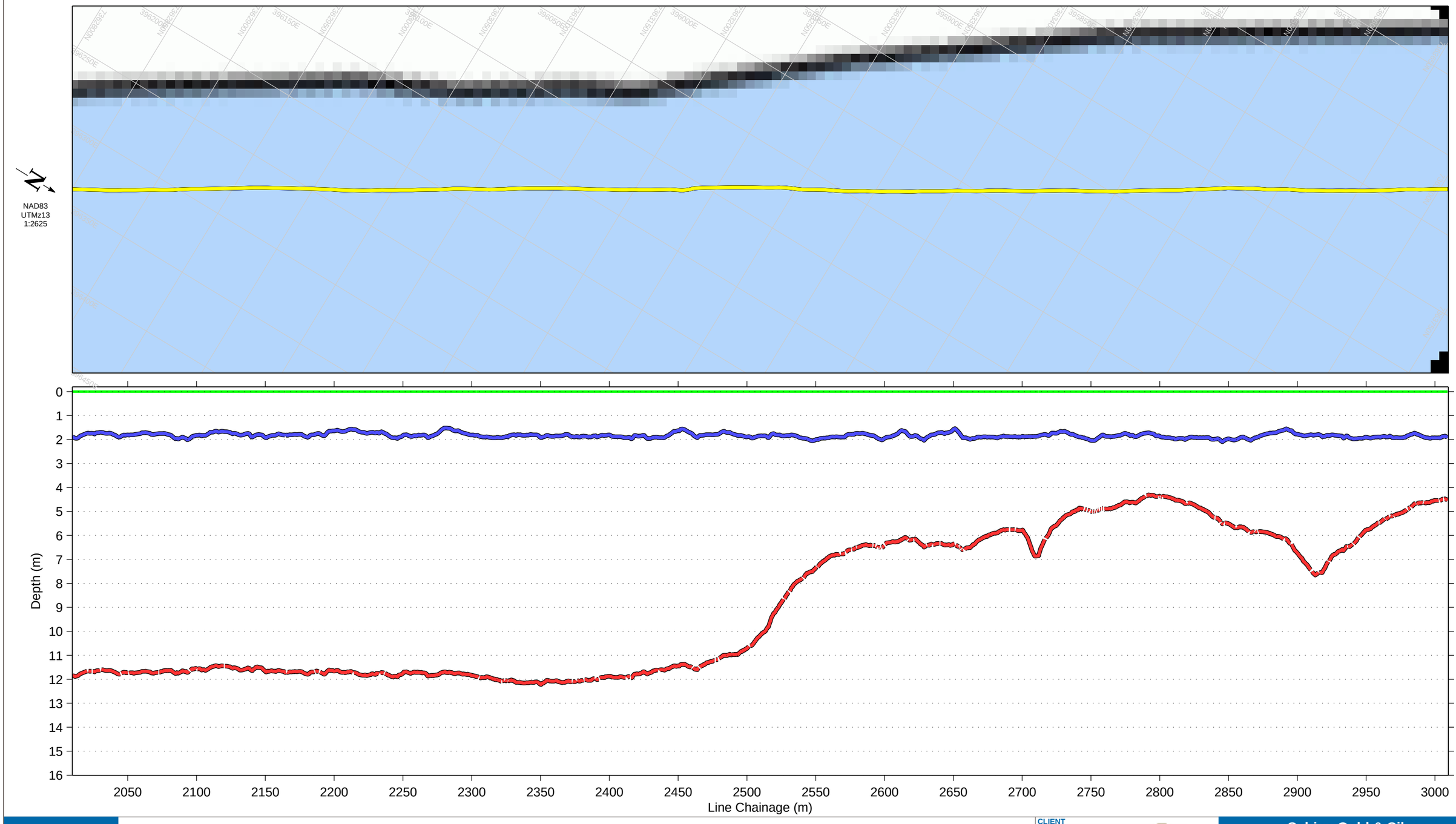
Sabina Gold & Silver
Back River Project GPR Profiling

Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D12.2





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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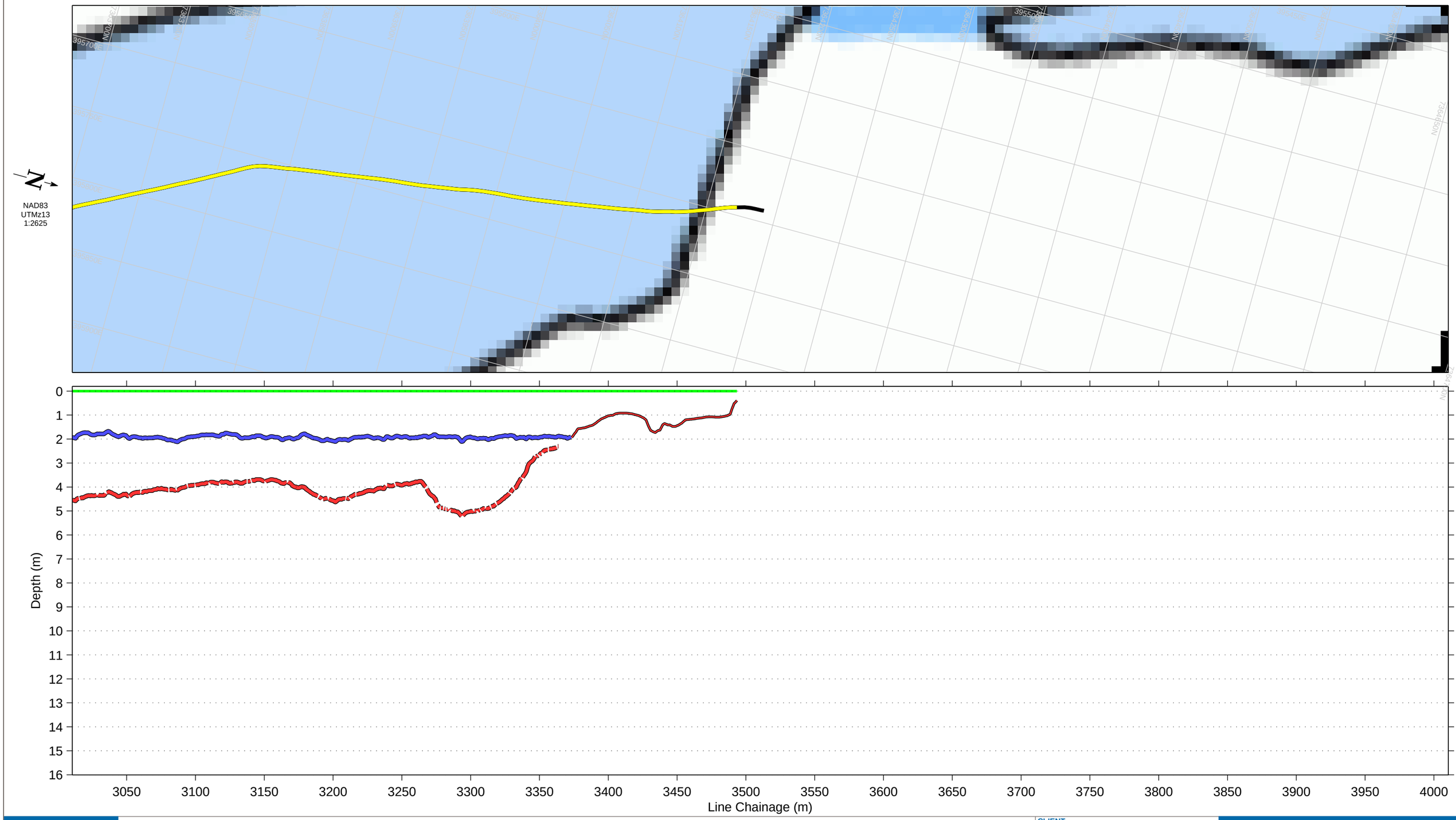
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Back River Project GPR Profiling

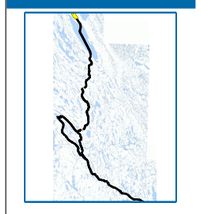
Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D12.3





LEGEND

- Plotted GPR Tracks
- Ground/Ice Surface
- Snow Drift Bottom
- Grounded Ice
- Floating Ice
- Water Bottom

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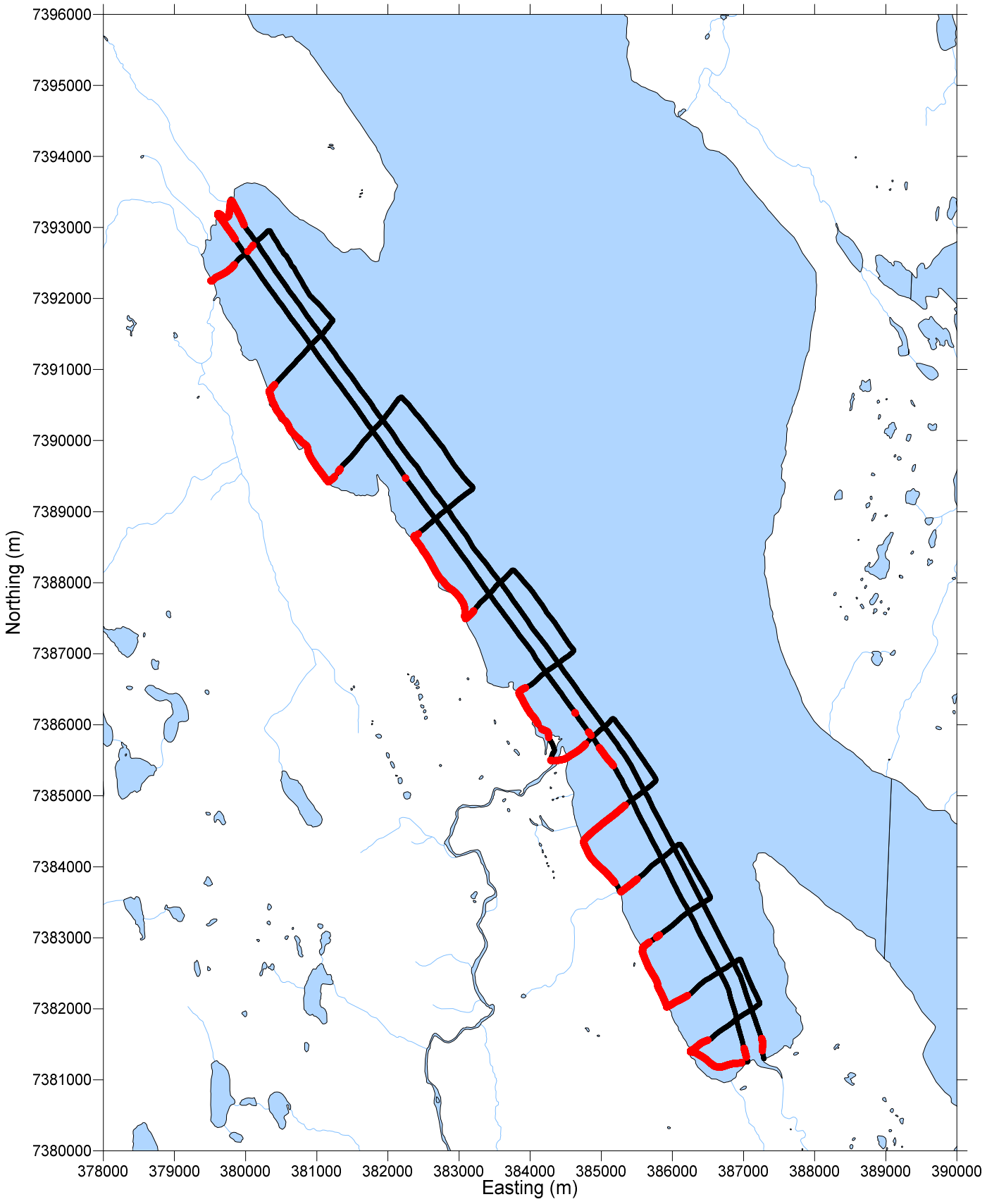
Sabina Gold & Silver
Back River Project GPR Profiling

Winter Road Option – Major Lake Profiles
N. Junction to Bathurst Inlet
Collected April 25 – 28, 2013

Project No.	DWN	CHKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
Edmonton	June 14, 2013

Figure D12.4



LEGEND

N

Grounded Ice

GPR Survey Track

SCALE 1:75,000
NAD83
UTM z13

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Bathurst Inlet
Locations of Grounded Ice

PROJECT NO.	DWN	CKD	APVD	REV
V33103008.E111	RJM	CB	RJM	0

OFFICE	DATE
EBA-EDM	June 27, 2013

Figure E

APPENDIX A: GENERAL CONDITIONS

GENERAL CONDITIONS

GEOPHYSICAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.1 USE OF REPORT

This geophysical report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of TETRA TECH’s client. TETRA TECH does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than TETRA TECH’s client unless otherwise authorized in writing by TETRA TECH. Any unauthorized use of the report is at the sole risk of the user.

This report contains figures, maps, drawings and sketches that represent processed geophysical data collected at a specific site. This processed data will have inherent interpretation assumptions and accuracies that are discussed in the report. Consequently, the report can only be considered in its entirety and individual figures, maps, drawings and sketches shall not be distributed without the text of the report unless authorized in writing by TETRA TECH.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the report, if required, may be obtained upon request.

1.2 ALTERNATE REPORT FORMAT

Where TETRA TECH submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed TETRA TECH’s instruments of professional service); the Client agrees that only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by TETRA TECH shall be deemed to be the original for the project.

Both electronic file and hard copy versions of TETRA TECH’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except TETRA TECH. TETRA TECH’s instruments of professional service will be used only and exactly as submitted by TETRA TECH.

Electronic files submitted by TETRA TECH have been prepared and submitted using specific software and hardware systems. TETRA TECH makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

1.3 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, TETRA TECH has not been retained to investigate, address, or consider and has not investigated, addressed, or considered any environmental or regulatory issues associated with the development of the site.

1.4 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgemental in nature as to both type and condition. TETRA TECH does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

1.5 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

1.6 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. TETRA TECH does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

1.7 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorological conditions; and with development activity. Interpretation of water conditions from observations and records is judgmental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

1.8 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of the report, TETRA TECH may rely on information provided by persons other than the Client. While TETRA TECH endeavours to verify the accuracy of such information when instructed to do so by the Client, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B: DFO REPORTS

1.0 INTRODUCTION

Wolf Lake is located 5.9 km south of Sabina's Goose Lake Camp at 65.49217°N, 106.42258°W. This lake is approximately 4.0 km in length along its long axis (N20°W), and 1.3 km wide at its widest point, with a total surface area of 227 ha. This lake has a maximum under-ice water depth of 2.28 m, with the deepest section being in the central portion of the lake. The attached figure, Wolf-01, is a regional area map showing the location of Wolf Lake.

2.0 SURVEY METHODOLOGY

On April 23, 2013, EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company (EBA) collected bathymetric data using a ground penetrating radar (GPR) system. The system used was MALA's Ramac CUII with a 50 MHz rough-terrain antenna. Real-time positioning was achieved using a Topcon HyperLite+ GPS/Glonass unit. Positions were recorded at 1 Hz with a typical absolute horizontal accuracy of ± 1 metre, given appropriate satellite constellations. The survey was typically conducted at a speed of approximately 15 km/h. The GPR unit was set to acquire data at a frequency of approximately 10 readings per second, giving an average horizontal resolution of approximately one GPR trace per 42 cm along survey lines.

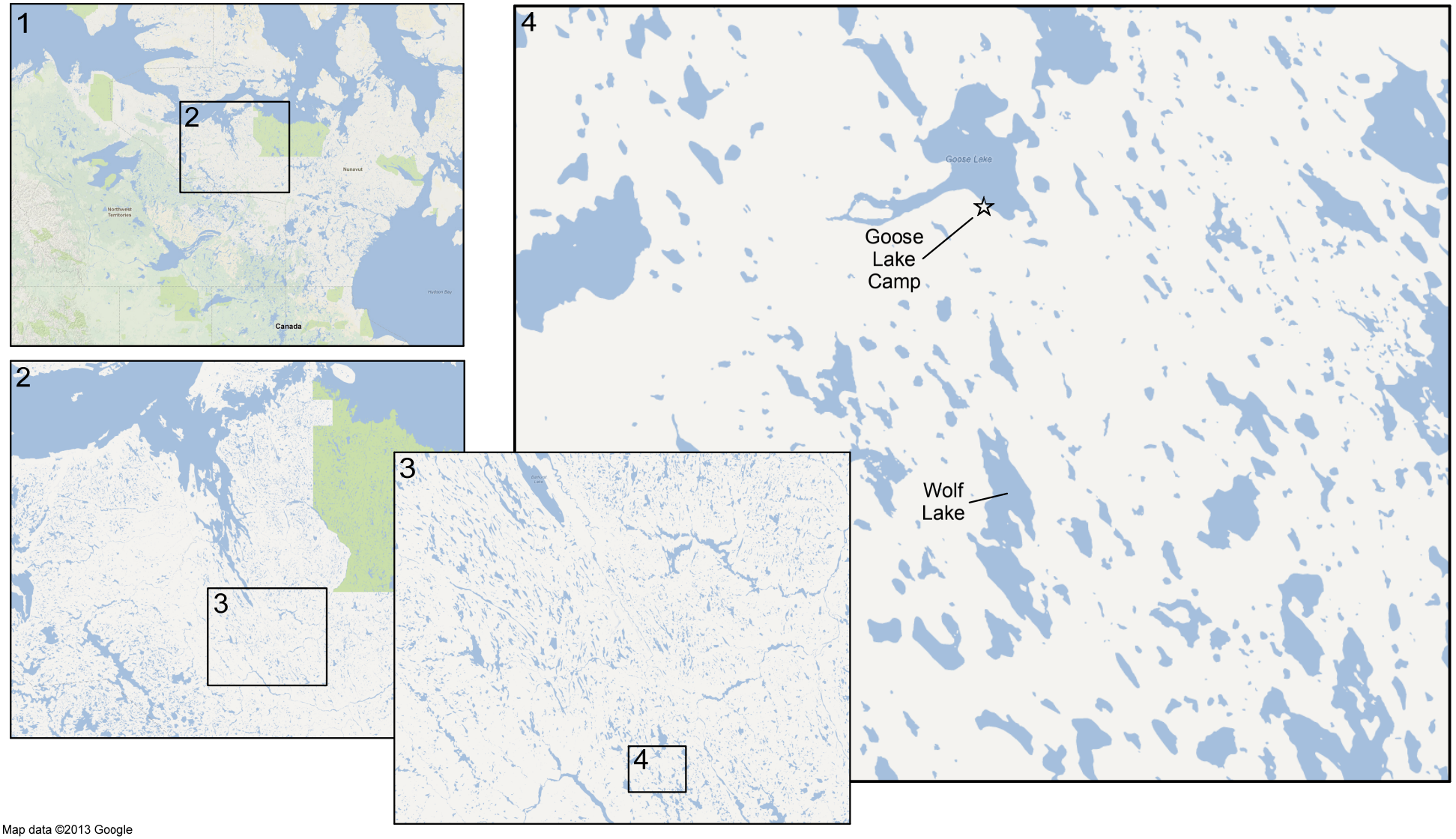
3.0 DATA REDUCTION AND RESULTS

All data has been corrected for ice thickness and GPS offsets. The Surfer 10 software contouring package from Golden Software was used to grid, contour, and calculate volumes for the dataset. Wolf Lake lies north of the tree line; thus, according to the DFO protocols, a maximum expected ice thickness of 2 m was used in the calculation of available winter water. See figure Wolf-02 for the contoured results. Surface area and volumetric values are listed in Table 1.

Of likely significance is the fact that the under-ice free water is divided into at least three distinct sections, separated by shallow areas of completely grounded ice.

Table 1: DFO Lake Calculations

Lake ID	Wolf Lake
Centre Coordinates	65.49217°N, 106.42258°W
Surface Area	227 ha
Total Lake Volume	5,148,323 m^3
Under Ice Volume	601,412 m^3
Max Expected Ice Thickness Value Used	2 m
Max Under-Ice Water Depth	2.28 m
Calculated 10% Withdrawal Volume	60,141 m^3



Map data ©2013 Google

LEGEND

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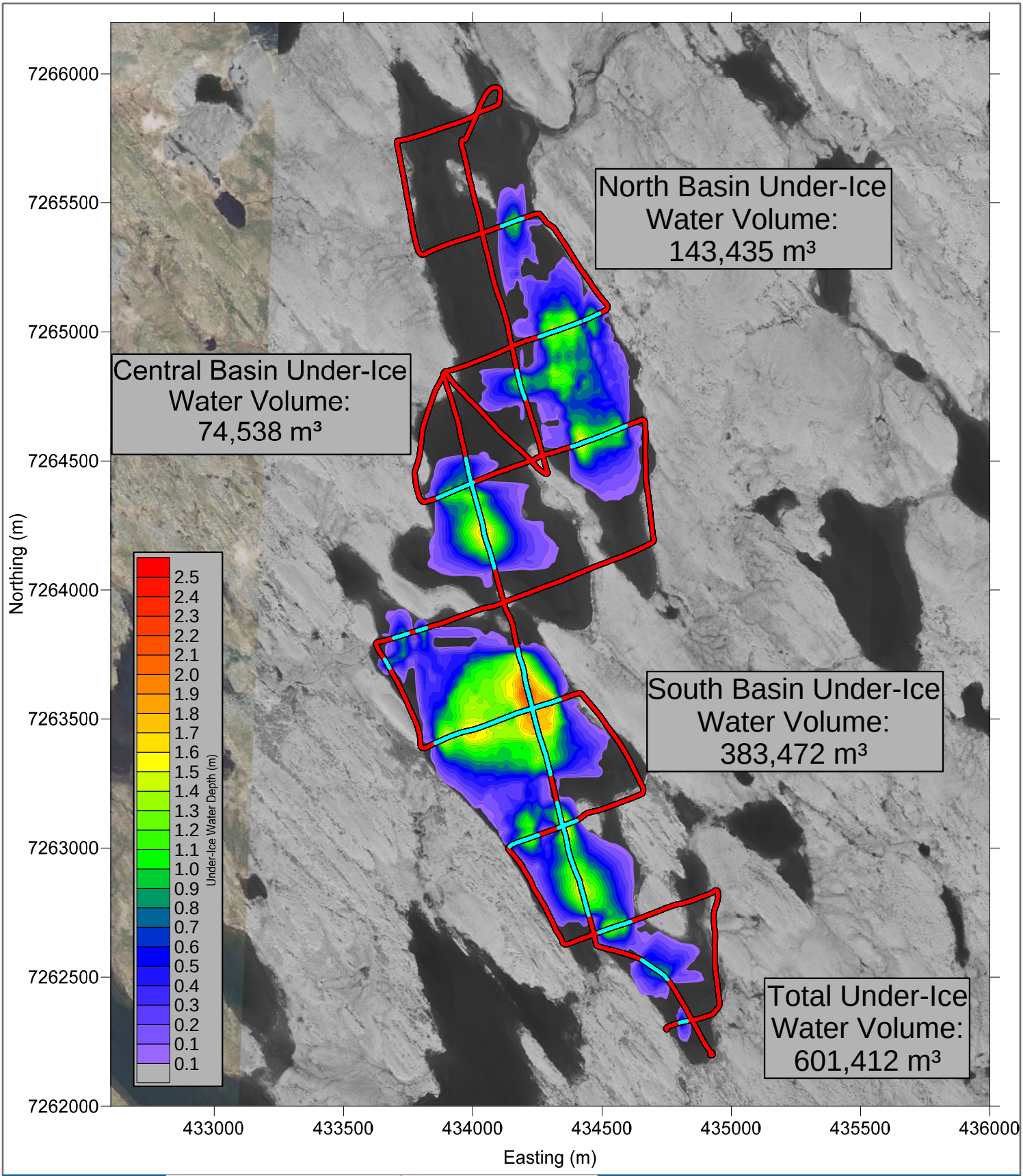
Sabina Gold & Silver
Back River GPR Bathymetry Program

Location of Wolf Lake
(65.49217°N, 106.42258°W)

PROJECT NO.	DWN	CKD	APVD	REV
V33103008-01.E111	RJM	CB	NSP	0

OFFICE	DATE
EBA-EDM	May 23, 2013

Wolf-01



LEGEND

N

Under-Ice Water

Ground / Grounded Ice

SCALE 1:20,000
NAD83
UTM z13

CLIENT

Sabina GOLD & SILVER CORP.

TETRA TECH

Sabina Gold & Silver
Back River GPR Bathymetry Program

Wolf Lake
GPR DFO Results

PROJECT NO.	DWN	CKD	APVD	REV
704-V33103008-01	RJM	CB	NSP	0

OFFICE	DATE
EBA-EDM	May 13, 2013

Wolf-02

1.0 INTRODUCTION

Propeller Lake is located 5.9 km north of Sabina's Goose Lake Camp at 65.59759°N, 106.40621°W. This lake is approximately 8.4 km in length along its long axis (N12°W), and 3.2 km wide at its widest point, with a total surface area of 1284 ha. This lake has a maximum under-ice water depth of greater than 8.96 m. The attached figure, Propeller-01, is a regional area map showing the location of Propeller Lake.

2.0 SURVEY METHODOLOGY

On April 24, 2013, EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company (EBA) collected bathymetric data using a ground penetrating radar (GPR) system. The system used was MALA's Ramac CUII with a 50 MHz rough-terrain antenna. Real-time positioning was achieved using a Topcon HyperLite+ GPS/Glonass unit. Positions were recorded at 1 Hz with a typical absolute horizontal accuracy of ± 1 metre, given appropriate satellite constellations. The survey was typically conducted at a speed of approximately 15 km/h. The GPR unit was set to acquire data at a frequency of approximately 10 readings per second, giving an average horizontal resolution of approximately one GPR trace per 42 cm along survey lines.

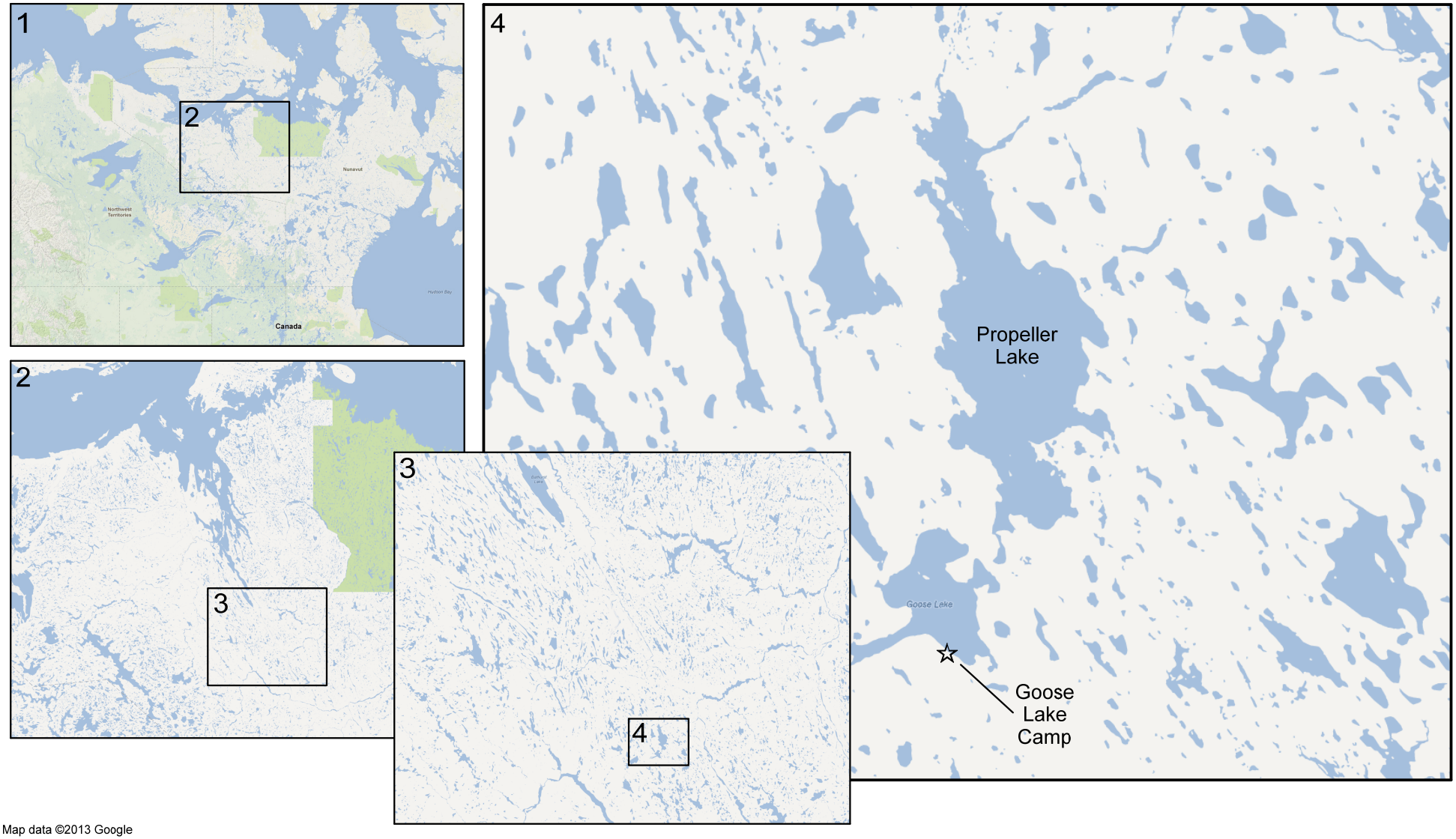
3.0 DATA REDUCTION AND RESULTS

All data has been corrected for ice thickness and GPS offsets. The Surfer 10 software contouring package from Golden Software was used to grid, contour, and calculate volumes for the dataset. Propeller Lake lies north of the tree line; thus, according to the DFO protocols, a maximum expected ice thickness of 2 m was used in the calculation of available winter water. See figure Propeller-02 for the contoured results. Surface area and volumetric values are listed in Table 1.

Information made available to EBA prior to conducting the GPR bathymetry program was that the maximum lake depth was 7.8 m, so EBA adjusted the GPR settings accordingly, to provide the maximum vertical resolution possible. However, in one region, the lake bottom unexpectedly fell off the bottom of the GPR profile (location indicated in figure Propeller-02). This wasn't noticed until several days later, when EBA personnel were out of the area, making a re-survey of these areas impractical. The area in question encompasses approximately 16.4 ha, or 1.28% of the entire surface area of the lake. Assuming an average undocumented depth of 2 m, this would represent a volume underestimate of approximately 329,000 m^3, or 1.22% of the total available water volume. The volume reported herein is the lesser amount, i.e., assuming the lake bottom to be the maximum proven depth obtained from the GPR.

Table 1: DFO Lake Calculations

Lake ID	Propeller Lake
Centre Coordinates	65.59759°N, 106.40621°W
Surface Area	1284 ha
Total Lake Volume	52,246,498 m^3
Under Ice Volume	26,558,785 m^3
Max Expected Ice Thickness Value Used	2 m
Max Under-Ice Water Depth	>8.96 m
Calculated 10% Withdrawal Volume	2,655,879 m^3



LEGEND

CLIENT

Sabina GOLD & SILVER CORP.

TETRA TECH

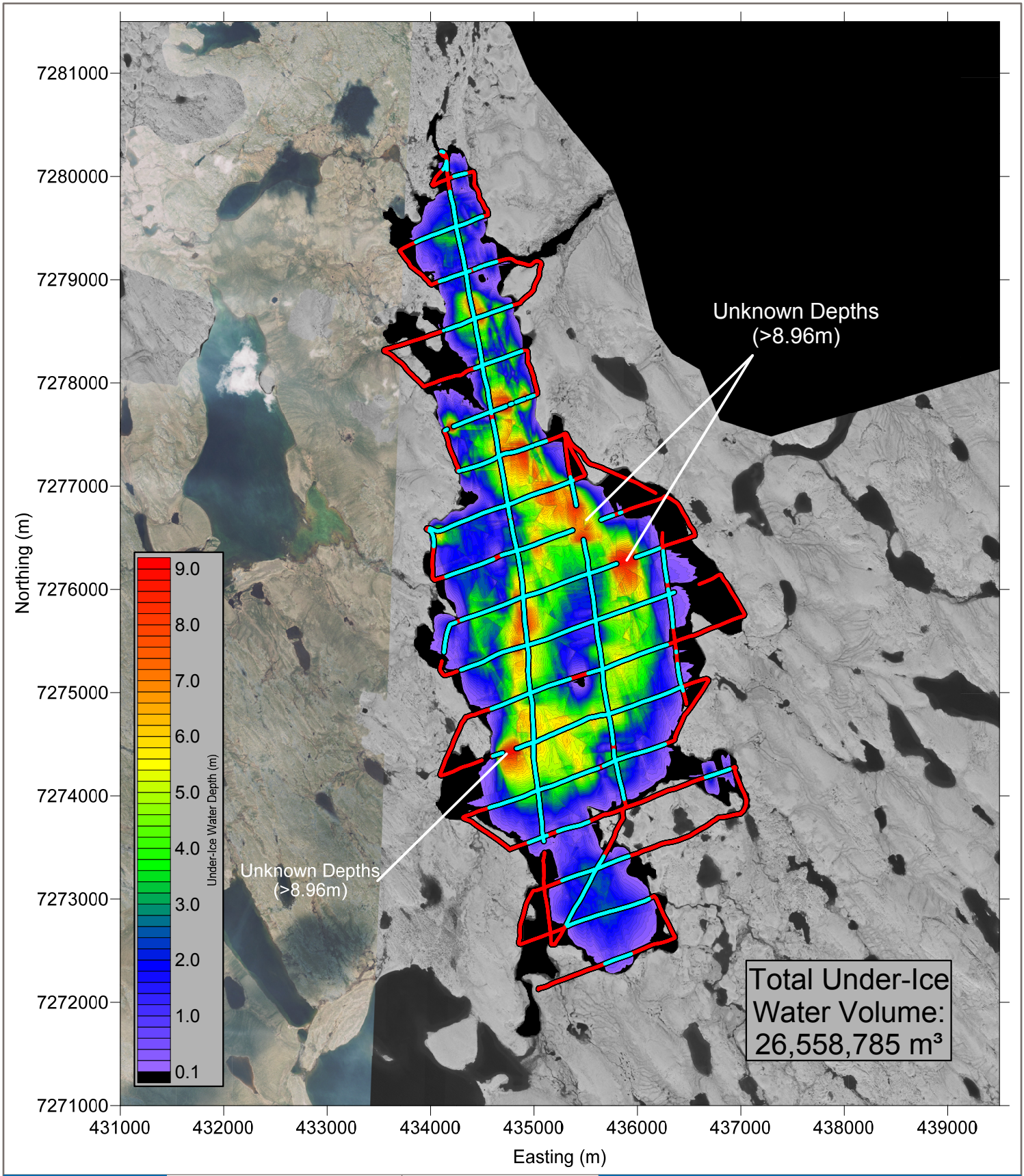
Sabina Gold & Silver
Back River GPR Bathymetry Program

Location of Propeller Lake
(65.59759°N, 106.40621°W)

PROJECT NO.	DWN	CKD	APVD	REV
V33103008-01.E111	RJM	CB	NSP	0

OFFICE	DATE
EBA-EDM	May 23, 2013

Propeller-01



LEGEND

N

Under-Ice Water

Ground / Grounded Ice

SCALE 1:50,000
NAD83
UTM z13

CLIENT

Sabina
GOLD & SILVER CORP.

TETRA TECH

Sabina Gold & Silver
Back River GPR Bathymetry Program

Propeller Lake
GPR DFO Results

PROJECT NO.	DWN	CKD	APVD	REV
704-V33103008-01	RJM	CB	NSP	0

OFFICE	DATE
EBA-EDM	May 13, 2013

Propeller-02

1.0 INTRODUCTION

Leaf Lake is located 4.3 km northwest of Sabina's Goose Lake Camp at 65.57656°N, 106.48500°W. This lake is approximately 635 m in length along its long axis (N-S), and 350 m wide at its widest point, with a total surface area of 15.6 ha. This lake has a maximum under-ice water depth of 3.87 m, with the deepest section being slightly northwest of the central portion of the lake. The attached figure, Leaf-01, is a regional area map showing the location of Leaf Lake.

2.0 SURVEY METHODOLOGY

On April 25, 2013, EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company (EBA) collected bathymetric data using a ground penetrating radar (GPR) system. The system used was MALA's Ramac CUII with a 50 MHz rough-terrain antenna. Real-time positioning was achieved using a Topcon HyperLite+ GPS/Glonass unit. Positions were recorded at 1 Hz with a typical absolute horizontal accuracy of ± 1 metre, given appropriate satellite constellations. The survey was typically conducted at a speed of approximately 15 km/h. The GPR unit was set to acquire data at a frequency of approximately 10 readings per second, giving an average horizontal resolution of approximately one GPR trace per 42 cm along survey lines.

3.0 DATA REDUCTION AND RESULTS

All data has been corrected for ice thickness and GPS offsets. The Surfer 10 software contouring package from Golden Software was used to grid, contour, and calculate volumes for the dataset. Leaf Lake lies north of the tree line; thus, according to the DFO protocols, a maximum expected ice thickness of 2 m was used in the calculation of available winter water. See figure Leaf-02 for the contoured results. Surface area and volumetric values are listed in Table 1.

Table 1: DFO Lake Calculations

Lake ID	Leaf Lake
Centre Coordinates	65.57656°N, 106.48500°W
Surface Area	15.6 ha
Total Lake Volume	367,704 m^3
Under Ice Volume	56,158 m^3
Max Expected Ice Thickness Value Used	2 m
Max Under-Ice Water Depth	3.87 m
Calculated 10% Withdrawal Volume	5,616 m^3



LEGEND

CLIENT

Sabina GOLD & SILVER CORP.

TETRA TECH

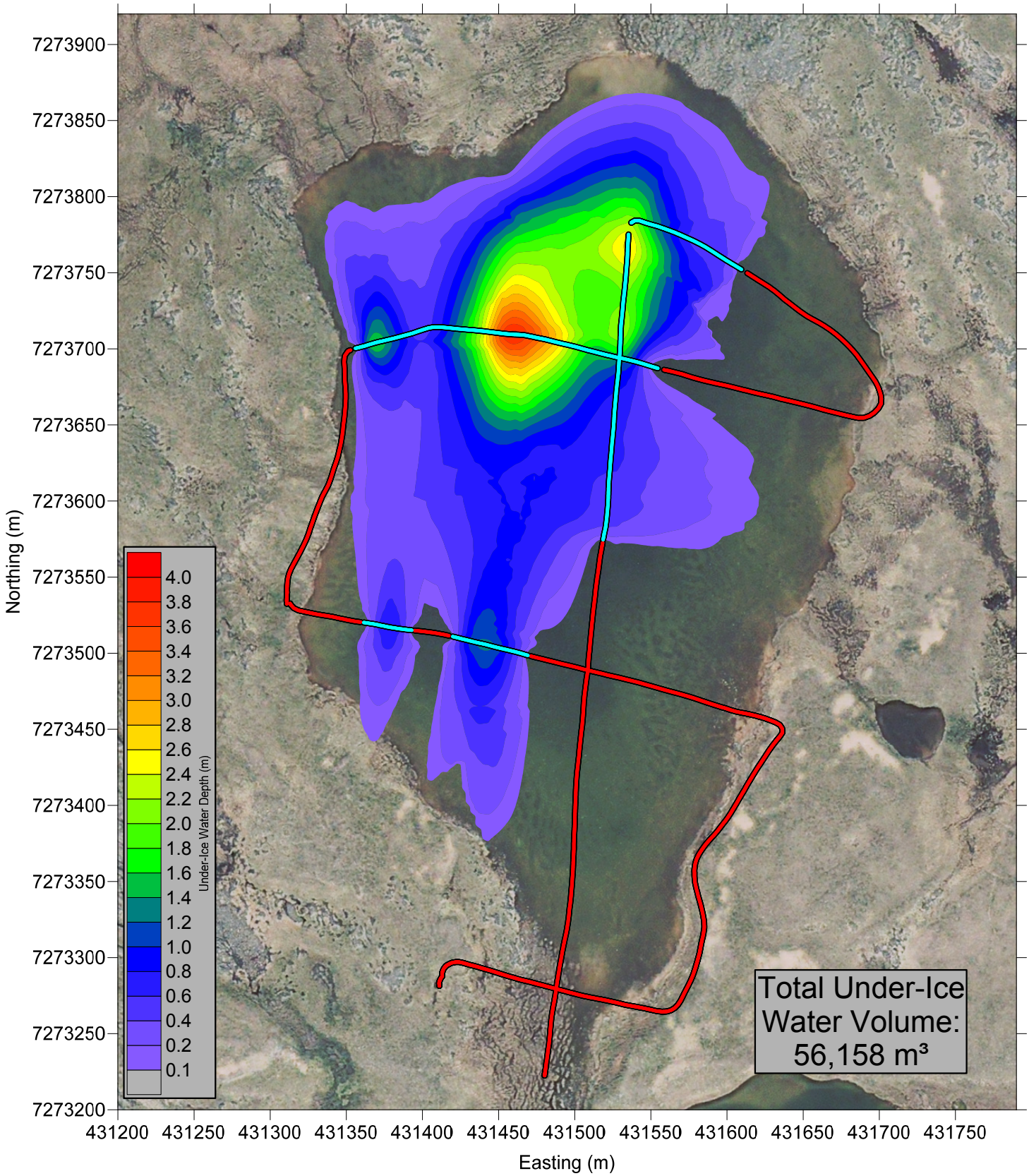
Sabina Gold & Silver
Back River GPR Bathymetry Program

Location of Leaf Lake
(65.57656°N, 106.48500°W)

PROJECT NO.	DWN	CKD	APVD	REV
V33103008-01.E111	RJM	CB	NSP	0

OFFICE	DATE
EBA-EDM	May 23, 2013

Leaf-01



LEGEND

N

SCALE 1:3500
NAD83
UTM z13

Under-Ice Water

Ground / Grounded Ice

CLIENT

Sabina GOLD & SILVER CORP.

TETRA TECH

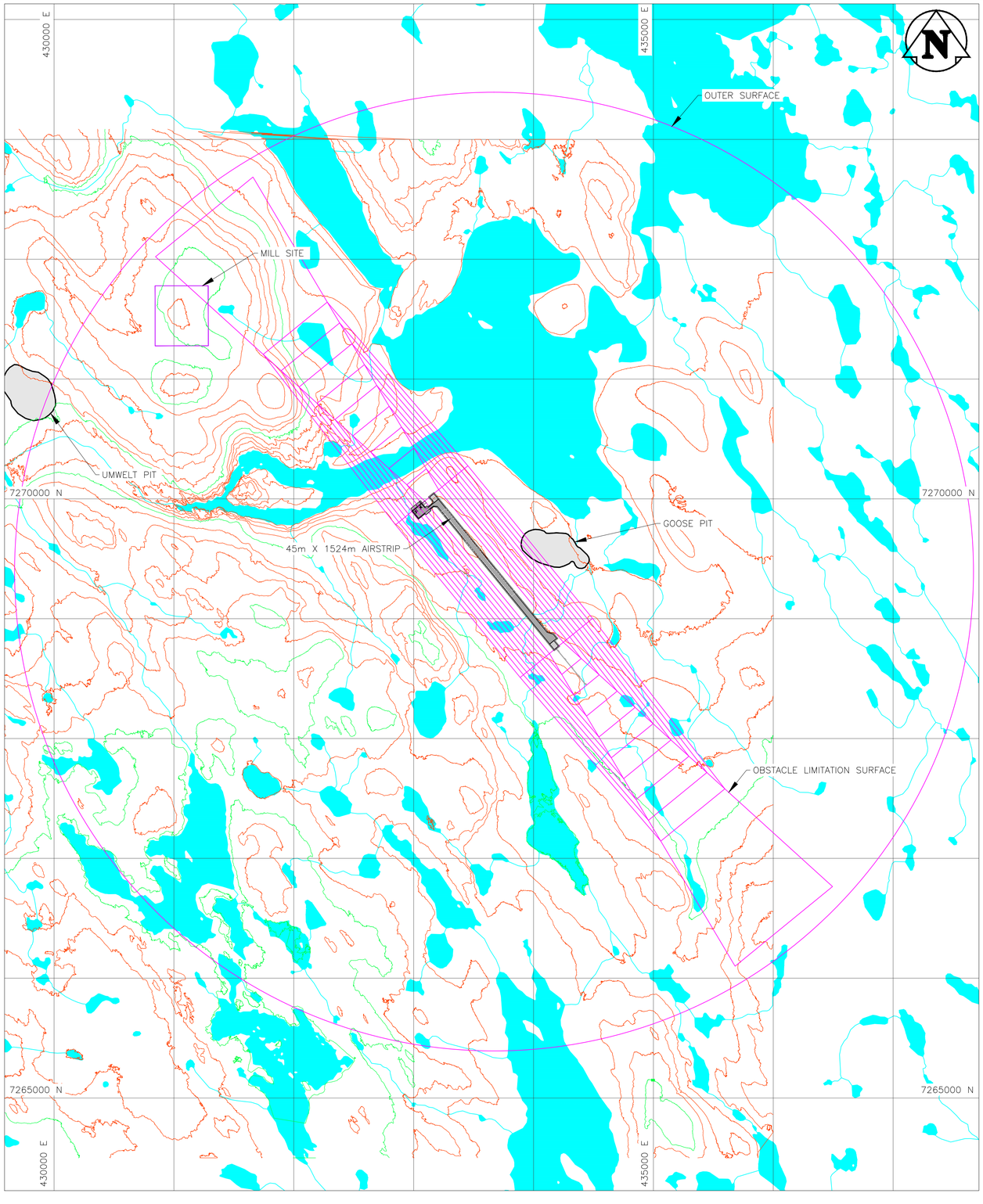
Sabina Gold & Silver
Back River GPR Bathymetry Program

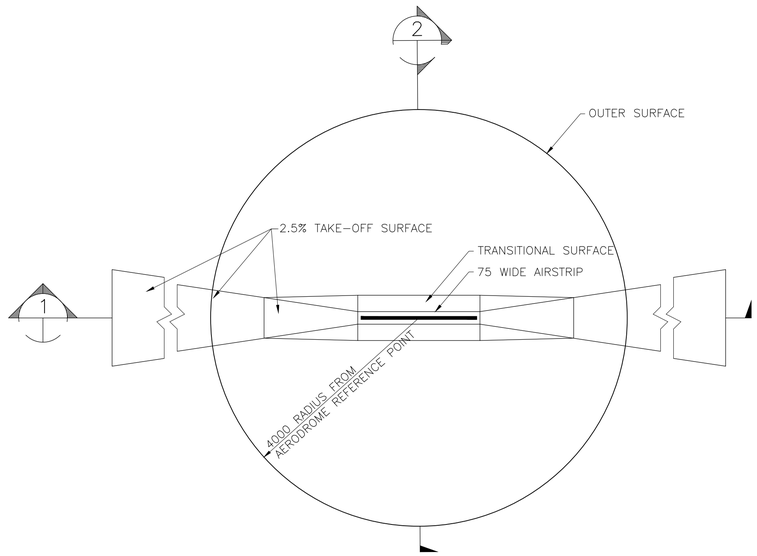
Leaf Lake
GPR DFO Results

PROJECT NO.	DWN	CKD	APVD	REV
704-V33103008-01	RJM	CB	NSP	0

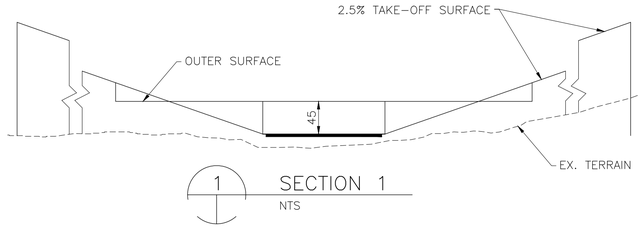
OFFICE	DATE
EBA-EDM	May 13, 2013

Leaf-02

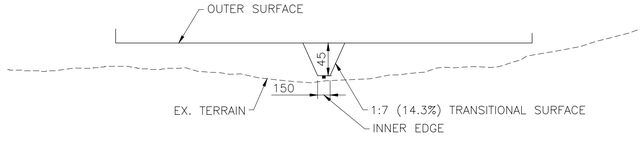




TYPICAL OBSTRUCTION SURFACES – PLAN VIEW
NTS



1 SECTION 1
NTS



2 SECTION 2
NTS

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN METRES.
2. UTM NAD83 COORDINATE SYSTEM USED FOR DRAWINGS.

500 0 500 1000 1500
METRES 1:20000

NO.	DESCRIPTION	NO.	DATE	DESCRIPTION	PREPARED	REVIEW	DESIGN	AUTHORIZE
		00	13.09.18	ISSUED FOR REVIEW	MD	JW	EH	AE
REFERENCE DRAWINGS		REVISIONS/ISSUE			DRAFTING		ENGINEERING	

SUB-CONSULTANT(S) :

PERMIT STAMP

SEAL

PRELIMINARY DRAWING

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DESIGNED BY:	PREPARED BY:	REVIEWED BY:
E. HURRELL	M. DOMINGO	J. WILLMS
AUTHORIZED BY:	DATE:	SCALE:
A. EVANS	13.09.18	AS NOTED

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Sabina GOLD & SILVER CORP.

TETRA TECH

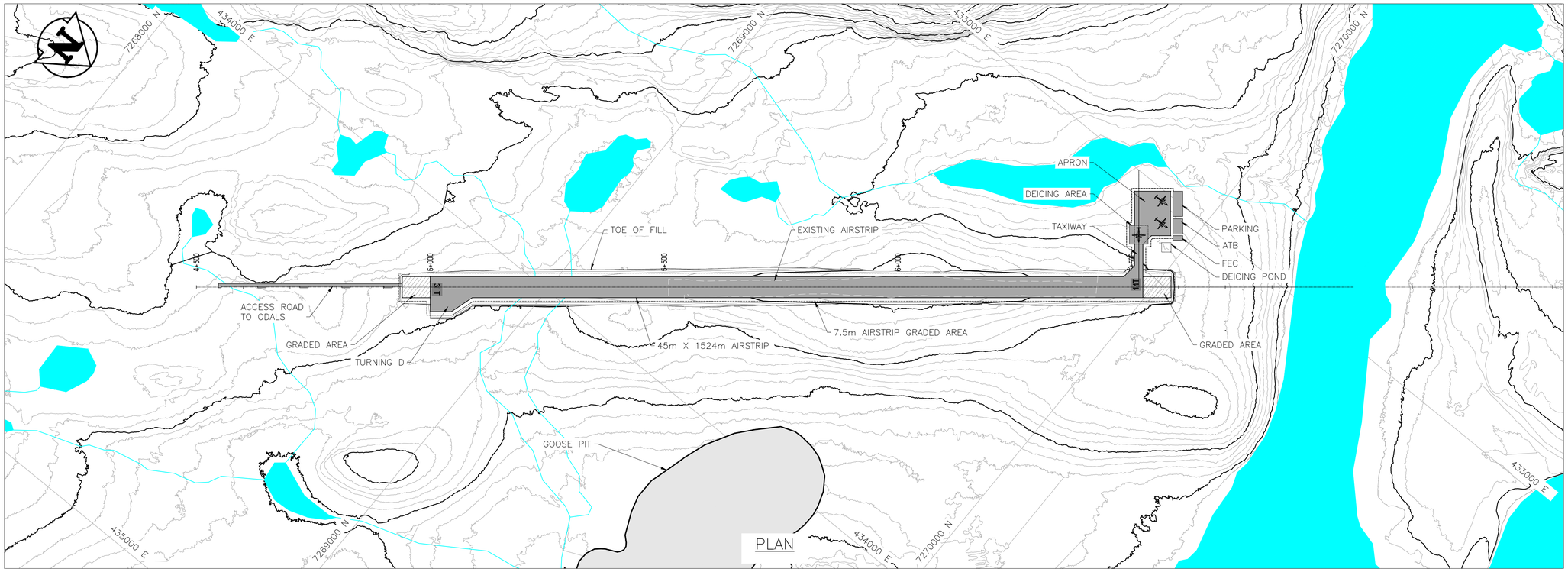
TETRA TECH DWG. No.	REV.
-	00

PROJECT NAME:
SABINA-BACKRIVER PROJECT PFS
NUNAVUT

DRAWING DESCRIPTION:
GOOSE AIRSTRIP 5000'
OBSTACLE LIMITATION SURFACE

DRAWING NO:	REV:
C1.0	00

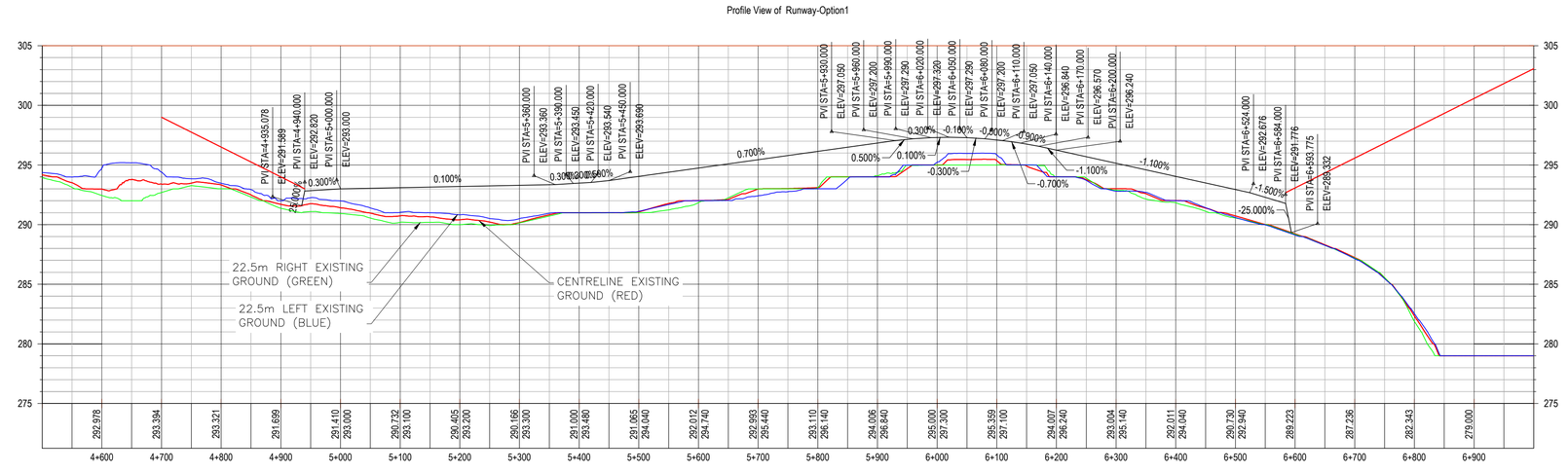
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PLAN

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN METRES.
2. UTM NAD83 COORDINATE SYSTEM USED FOR DRAWINGS.
3. 14T TRUE BEARING. "T" DENOTES TRUE BEARING NOT MAGNETIC BEARING.



PROFILE

HORIZONTAL SCALE
100 0 200 400
METRES 1:5000

VERTICAL SCALE
1000 0 2000 4000
MILLIMETRES 1:50

NO.	DESCRIPTION	NO.	DATE:	DESCRIPTION	PREPARED	REVIEW	DESIGN	AUTHORIZE
REFERENCE DRAWINGS		REVISIONS/ISSUE			DRAFTING		ENGINEERING	
		00	13.09.18	ISSUED FOR REVIEW	MD	JW	EH	AE

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E. HURRELL	M. DOMINGO	J. WILLMS
AUTHORIZED BY:	DATE:	SCALE:
A. EVANS	13.09.18	AS NOTED

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Sabina GOLD & SILVER CORP.

TETRA TECH

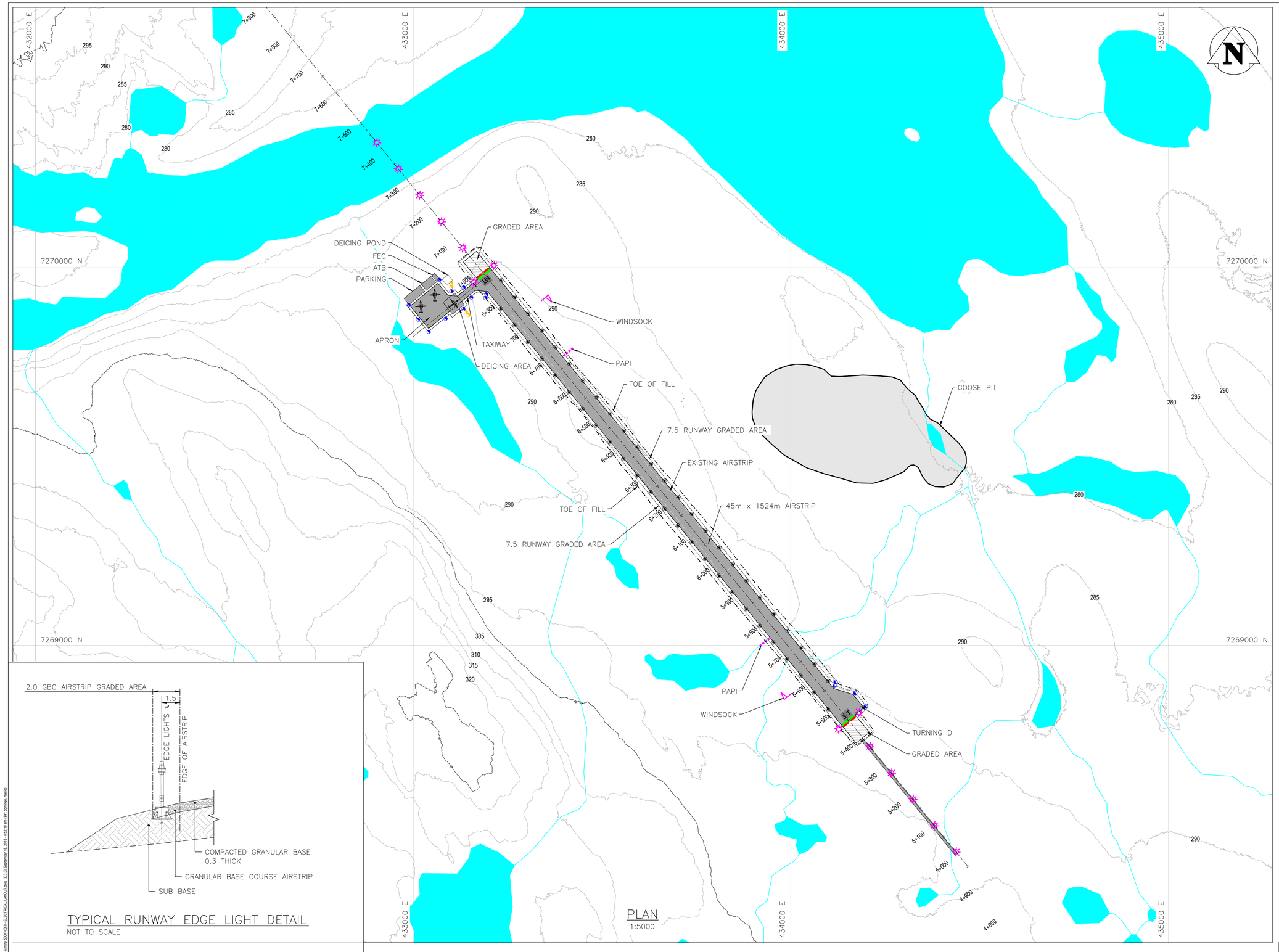
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-	00

PROJECT NAME: SABINA-BACK RIVER PROJECT PFS NUNAVUT

DRAWING DESCRIPTION: GOOSE AIRSTRIP 5000' PLAN AND PROFILE

DRAWING NO:	REV:
C2.0	00

V:\C2110\349 - Sabina Mine\Phase\Design\Goose Airstrip 5000\C2-1100\49-Goose Airstrip 5000' C2.0 - PLAN & PROFILE.dwg [C2.0], September 18, 2013 - 8:57:15 am, BY: domingo, mario



PLAN
1:5000

100 0 200 400
METRES 1:5000

TYPICAL RUNWAY EDGE LIGHT DETAIL
NOT TO SCALE

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN METRES.
2. UTM NAD83 COORDINATE SYSTEM USED FOR DRAWINGS.

LEGEND

- REILS AND ODALS
- WHITE RUNWAY EDGE LIGHT
- BLUE TAXIWAY EDGE LIGHT
- YELLOW APRON ENTRANCE LIGHT
- RUNWAY THRESHOLD LIGHT

ABBREVIATIONS

REILS	– RUNWAY END IDENTIFIER LIGHTING SYSTEM
ATB	– AIR TERMINAL BUILDING
FEC	– FIELD ELECTRICAL CENTRE
PAPI	– PRECISION APPROACH PATH INDICATOR
GBC	– GRANULAR BASE COURSE
ODALS	– OMNI–DIRECTIONAL APPROACH LIGHTING SYSTEM

NO.	DESCRIPTION	NO.	DATE	DESCRIPTION	PREPARED	REVIEW	DESIGN	AUTHORIZE
		00	13.09.18	ISSUED FOR REVIEW	MD	JW	EH	AE
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Sabina GOLD & SILVER CORP.

TETRA TECH

TETRA TECH DWG. No.: –

REV.: 00

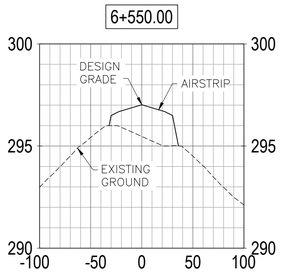
PROJECT NAME: SABINA-BACK RIVER PROJECT PFS NUNAVUT

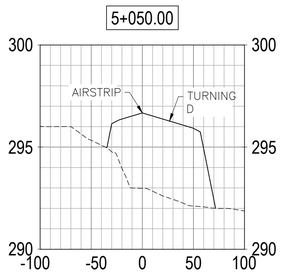
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DRAWING NO.: C3.0

REV.: 00

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CROSS SECTIONS

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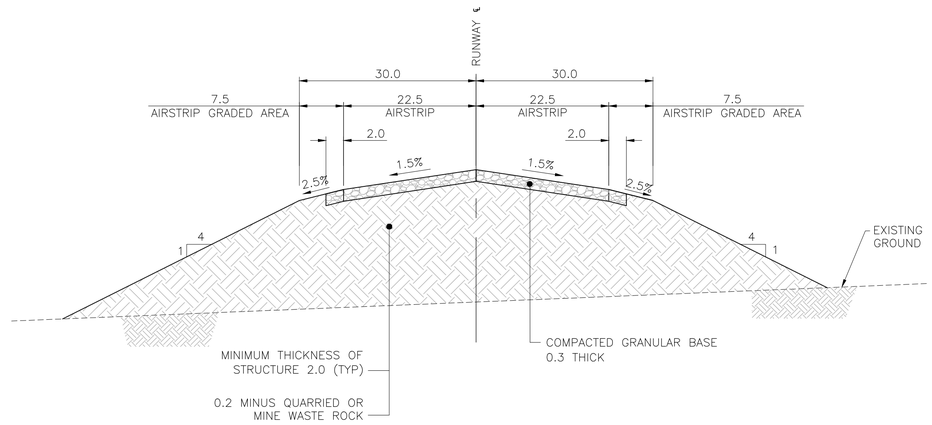
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VERTICAL SCALE

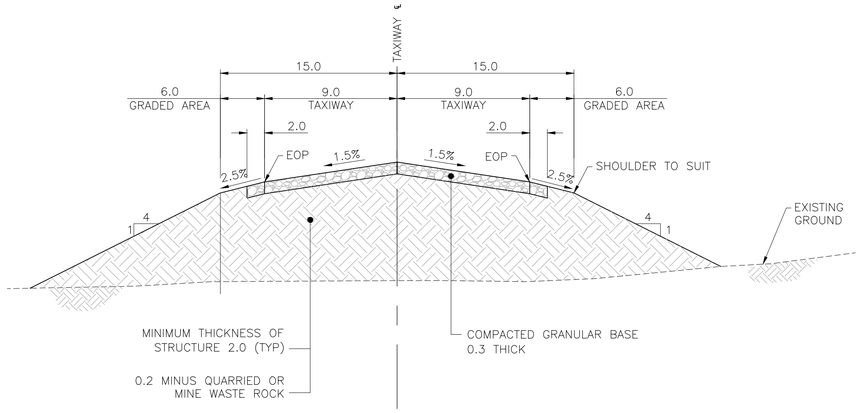
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MILLIMETRES 1:30



TYPICAL AIRSTRIP SECTION

NOT TO SCALE



TYPICAL TAXIWAY SECTION

NOT TO SCALE

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN METRES.
2. UTM NAD83 COORDINATE SYSTEM USED FOR DRAWINGS.

ABBREVIATION

EOP – EDGE OF PAVEMENT

NO.	DESCRIPTION	NO.	DATE	DESCRIPTION	PREPARED	REVIEW	DESIGN	AUTHORIZE
		00	13.09.18	ISSUED FOR REVIEW	MD	JW	EH	AE
REFERENCE DRAWINGS		REVISIONS/ISSUE			DRAFTING		ENGINEERING	

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AUTHORIZED BY:	DATE:	SCALE:
A. EVANS	13.09.18	AS NOTED

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Sabina GOLD & SILVER CORP.

TETRA TECH

TETRA TECH DWG. No.: –

REV.: 00

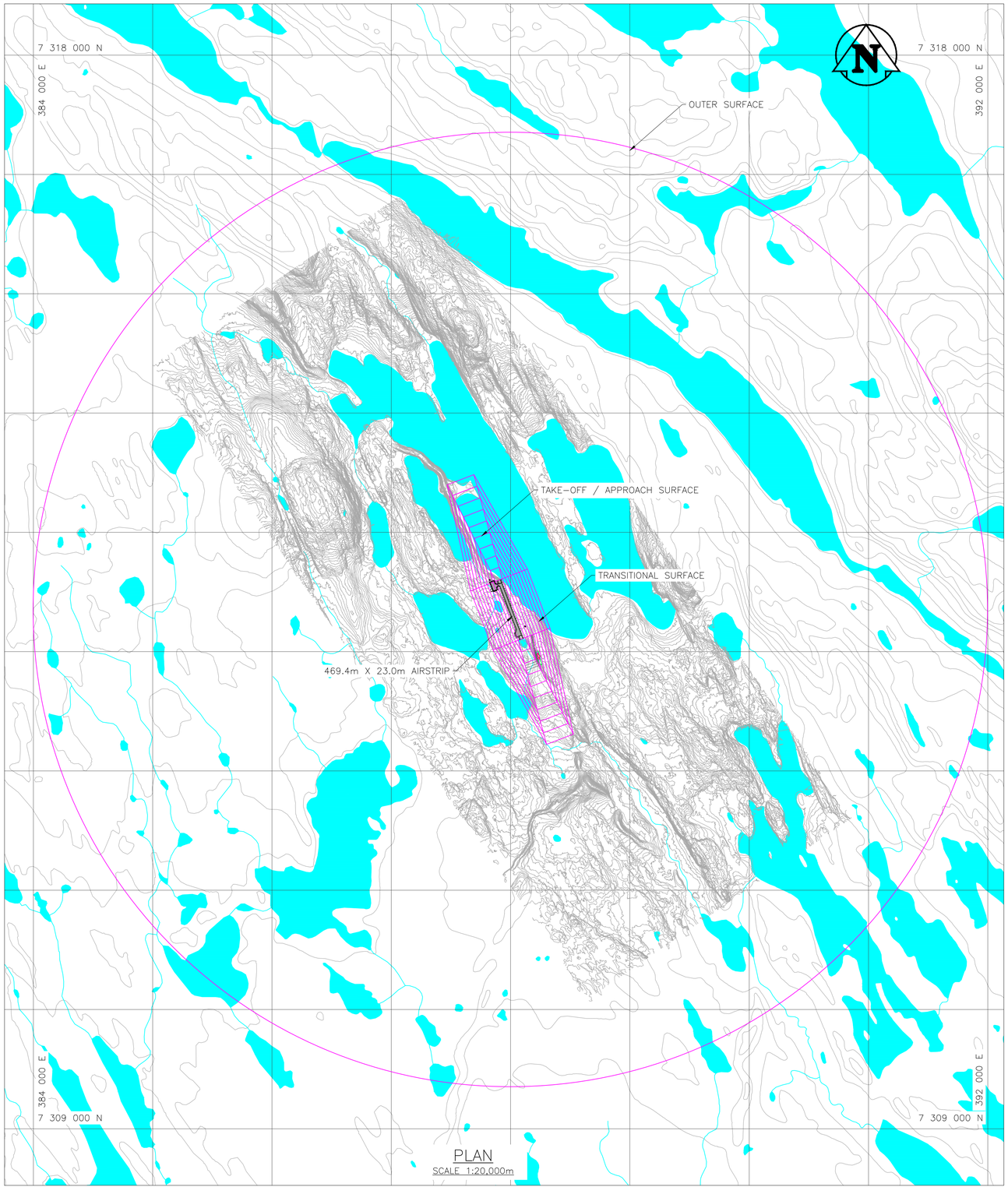
PROJECT NAME: SABINA-BACK RIVER PROJECT PFS NUNAVUT

DRAWING DESCRIPTION: GOOSE AIRSTRIP 5000' TYPICAL SECTIONS AND CROSS SECTIONS

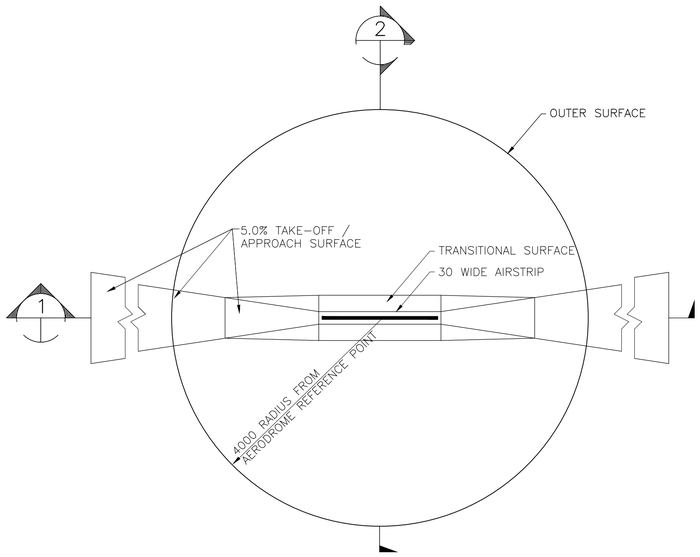
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REV.: 00

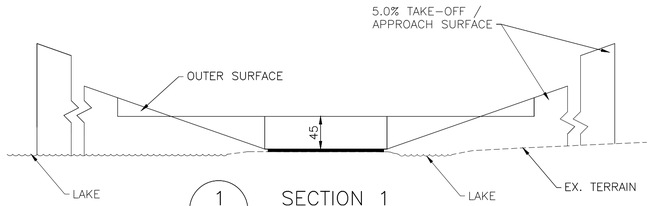
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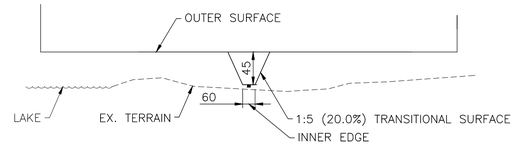
PLAN
SCALE 1:20,000m



TYPICAL OBSTRUCTION SURFACES – PLAN VIEW
NOT TO SCALE



1 SECTION 1
NOT TO SCALE



2 SECTION 2
NOT TO SCALE

SCALE
0 1 000
Scale: 1: 20 000 (metres)

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN METRES.
2. UTM NAD83 COORDINATES SYSTEM USED FOR DRAWINGS.

NO.	DESCRIPTION	NO.	DATE	DESCRIPTION	PREPARED	REVIEW	DESIGN	AUTHORIZE
REFERENCE DRAWINGS		REVISIONS/ISSUE			DRAFTING		ENGINEERING	
		00	13.09.18	ISSUED FOR REVIEW	MD	AE	EH	JW

SUB-CONSULTANT(S) :

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PRELIMINARY DRAWING

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DESIGNED BY:	PREPARED BY:	REVIEWED BY:
E. HURRELL	M. DOMINGO	A. EVANS
AUTHORIZED BY:	DATE:	SCALE:
J. WILLMS	13.09.18	AS NOTED

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Sabina GOLD & SILVER CORP.

TETRA TECH

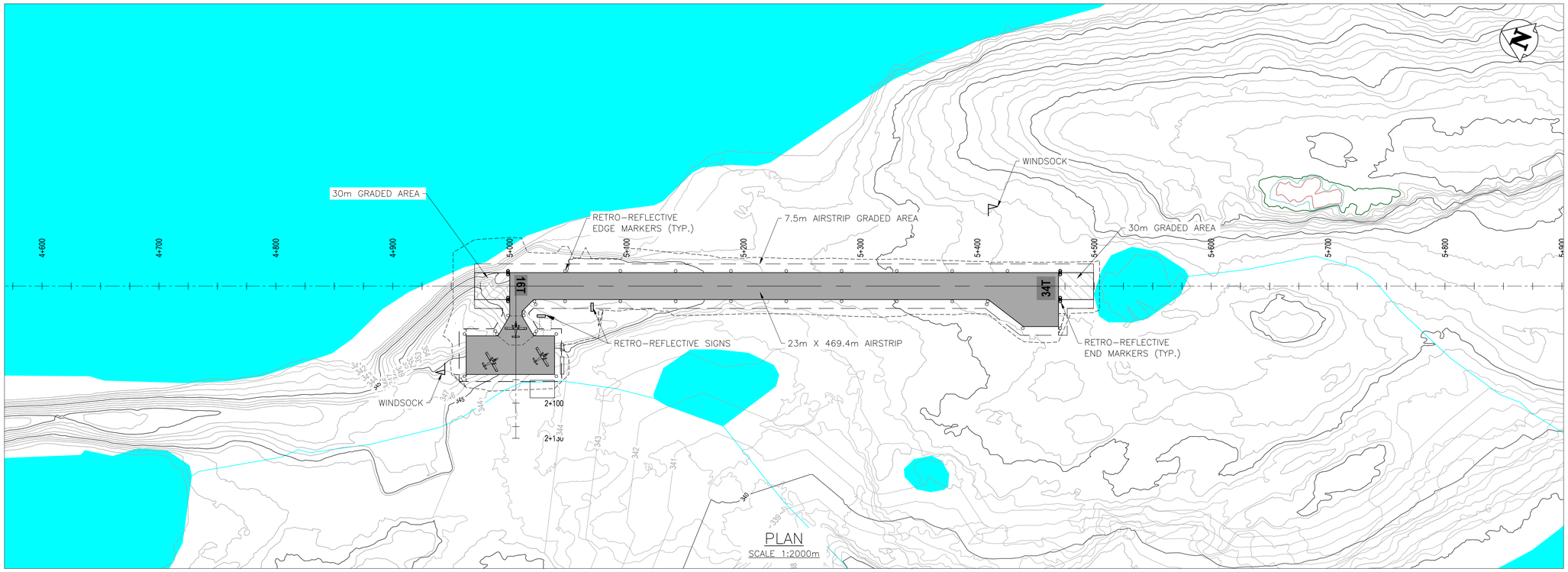
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REV.: 00

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SABINA-BACK RIVER PROJECT PFS
NUNAVUT

DRAWING DESCRIPTION:
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OBSTACLE LIMITATION SURFACE

DRAWING NO.: C5.0
REV.: 00

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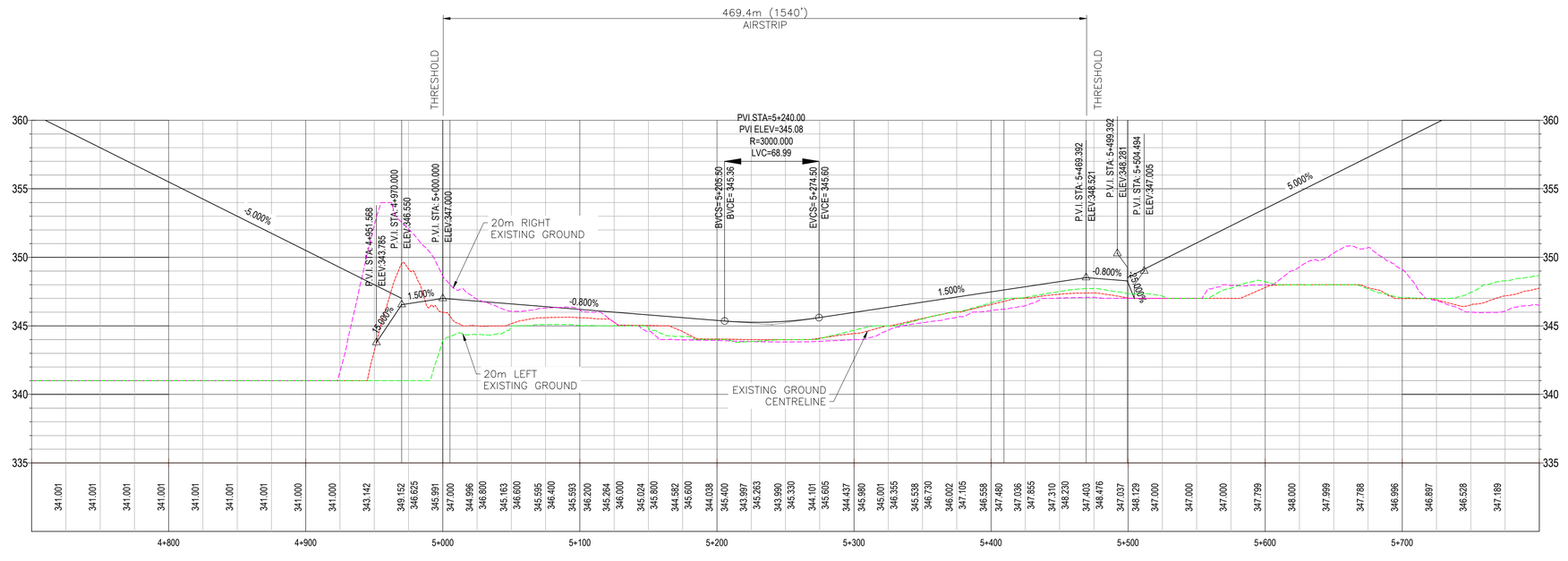
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LEGEND

- RETRO-REFLECTIVE EDGE MARKER
- RETRO-REFLECTIVE END MARKER
- WINDSOCK
- RETRO-REFLECTIVE SIGN



PROFILE
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HORIZONTAL SCALE
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VERTICAL SCALE
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Scale: 1: 200 (metres)

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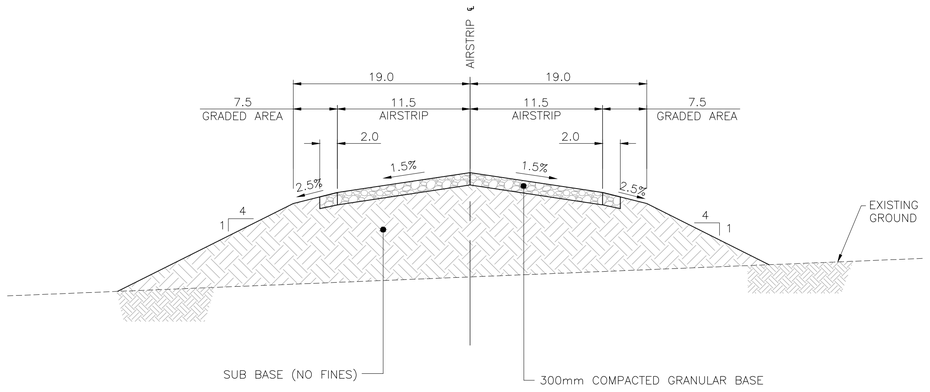
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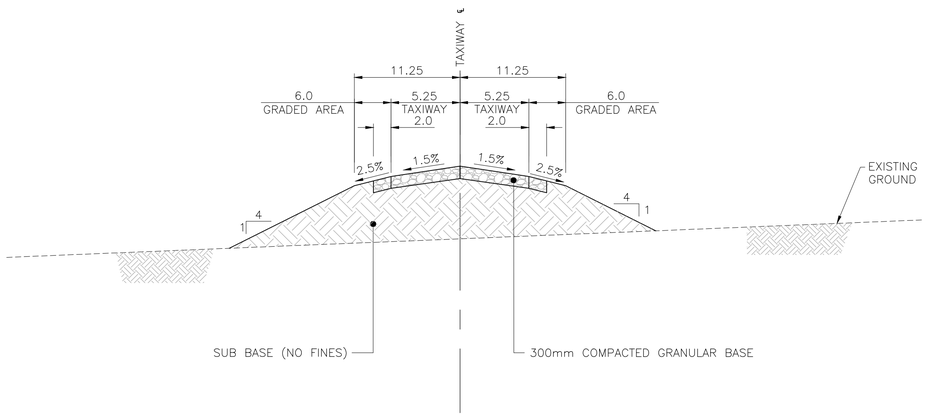
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Appendix V6-6A

Back River Project: 2010 Fish and Fish Habitat Baseline Report

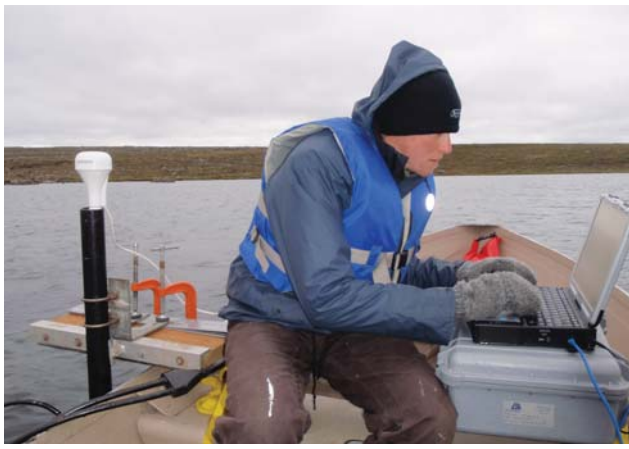
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BACK RIVER PROJECT
2010 Fish and Fish Habitat Baseline Report

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Engineers & Scientists

November 2010

BACK RIVER PROJECT
2010 FISH AND FISH HABITAT BASELINE REPORT

November 2010
Project #0833-002-04

Citation:
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Prepared for:

Sabina Gold & Silver Corp.

Prepared by:

Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

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Executive Summary

Environmental baseline studies were conducted by Rescan Environmental Services Ltd. (Rescan) on behalf of Sabina Gold and Silver Corp. (Sabina) at the Back River Project in 2010. The Back River property is located in the West Kitikmeot region of Nunavut.

The purpose of the 2010 environmental baseline program was to collect information to support future design and permitting for the Project. The objective of the 2010 fish and fish habitat baseline work was to characterize fish habitat and fish communities in selected lakes of the Project area. Fish communities were characterized in terms of species richness, relative abundance (i.e., catch-per-unit-effort), absolute abundance (only in Llama and Umwelt lakes which were surveyed by hydroacoustic gear) and biological features (e.g., length, weight, condition and age).

Fish habitat was evaluated using hydroacoustic methods at Llama and Umwelt lakes. Hydroacoustics was useful in assessing substrate in open water basins of lakes. Mixed hard substrates (e.g., cobble, boulder, bedrock) were found to be the predominant substrate type, followed by fines (e.g., sand). The majority of fine substrate was coated with periphyton. Fine substrate, such as sand or mud, was most commonly found in the open water sections of lakes. Mixed hard substrates were associated with near-shore locations.

The fish communities of Llama, Umwelt and Reference Lake B were assessed using gillnets and minnow traps. Fish communities displayed very low species richness, typical of Arctic lakes. A total of four species were identified in the Project area, including Arctic grayling, lake trout, round whitefish and ninespine stickleback. Arctic grayling and lake trout represented the majority of fish captured. Hydroacoustic gear was used to estimate fish absolute abundance at Llama and Umwelt lakes. The total number of fish in each lake was estimated as 226 and 155, respectively. Due to limitations of the hydroacoustics gear and survey timing, coupled with the shallow nature of Umwelt Lake, the fish abundance and population estimates produced for Llama and Umwelt lakes are considered conservative.

Aging analyses were conducted for Arctic grayling, lake trout and round whitefish. The ages of Arctic grayling sampled from Umwelt Lake ranged from 2 to 9 years, with a mean age of 5 years. Lake trout were the oldest fish sampled in the Project area, with ages ranging from 6 years to 26 years. Round whitefish displayed a wide range of ages, with mean age ranging from 3 to 13 years among lakes.

Acknowledgements

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Acknowledgements

This report was prepared for Sabina Gold and Silver Corp. (Sabina) by Rescan Environmental Services Ltd. The 2010 fish and fish habitat fieldwork was conducted by Kevin Esseltine (M.Sc.) and Brian Moore (B.Sc.). Rescan staff were assisted in the field by Ryan Kiayogana and Gary Kellogok of Sabina. Field-related support was provided by Elizabeth Sherlock and Dan Russell of Sabina, Northern Air Support and Discovery Mining Services. The report was prepared by K. Esseltine with support from B. Moore and Erika Genrich (B.Sc.), and reviewed by Michael McGurk (Ph.D., R.P.Bio.) and Deborah Muggli (Ph.D., M.Sc., R.P.Bio). The Back River project was managed by Deborah Muggli.

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BACK RIVER PROJECT
2010 FISH AND FISH HABITAT BASELINE REPORT

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1. Introduction

1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. The Project consists of several different properties, one of which is the Back River property (Figure 1-1). An exploration camp is located near Goose Lake (Goose Lake Camp), and Sabina conducted a drilling program out of this camp during 2010.

Several exploration targets exist in the Back River area, including the Goose deposit and the Llama deposit. For 2010, select baseline studies were conducted in the areas that could be influenced by the future development of the Llama deposit. Rescan Environmental Services Ltd. (Rescan) was contracted by Sabina, to conduct the following baseline studies in 2010:

- Hydrology Baseline Program;
- Lake Bathymetry, Water and Sediment Baseline Program;
- Fish and Fish Habitat Baseline Program;
- Archaeological Survey Program; and
- Regional Wildlife Program.

In addition, Sabina continued to operate a meteorological station on site as well as collect data on permafrost temperatures.

This report presents the results from the 2010 Fish and Fish Habitat Baseline Program. The primary objective was to characterize fish habitat and fish communities in three lakes (Llama, Umwelt and Reference B) in the Project area. Fish habitat was defined as those environmental components that are required either directly or indirectly by fish to carry out their life processes, including spawning and rearing areas, food production areas, migration routes and over-wintering areas. Fish communities were defined in terms of total number and number-by-species at each sampling location, total catch-per-unit-effort (CPUE) and species-specific CPUE for each type of assessment gear. Biological features of fish, such as length, weight, condition and age, were also measured.

Hydroacoustic methods were used to estimate absolute fish abundance (with 95% confidence intervals), estimate relative abundance for each fish species in the respective fish assemblage and describe spatial distribution of fish in Llama and Umwelt lakes. Hydroacoustics was also used to describe substrate spatial distribution and evaluate fish habitat in Llama and Umwelt lakes.

Three reference lake options (Reference option lakes A, B and C) were initially selected due to their similar size to Llama and Umwelt lakes and due to their location. These lakes are located approximately 10 km away from the Project area and geographically isolated from the Project (i.e., outside all Project area watersheds). Reference Lake B was selected from these lakes because it is fish-bearing and the species assemblage was found to be typical of Arctic lakes. Reference Lake B will be used for comparison with Llama, Umwelt and other Project area lakes for the aquatic and fish and fish habitat programs.



Figure 1-1

General Back River Project Location

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2. Materials and Methods

2. Materials and Methods

2.1 FISH HABITAT

2.1.1 Substrate Classification using Hydroacoustics and Underwater Video

2.1.1.1 Data Collection

Hydroacoustic methods were used to quantify fish habitat in Llama and Umwelt lakes in order to obtain information on lake productive capacity and habitat quality for future fish habitat compensation purposes. Hydroacoustics were used for habitat (substrate) classification (or bottom typing) at Llama and Umwelt lakes on August 10 and 11, 2010, respectively (Table 2.1-1; Figure 2.1-1). Reference Lake B was not surveyed using hydroacoustic methods because fish habitat at this lake will not be physically altered due to future Project development.

Data were collected from a 4.3 m-long aluminum boat with a low-horsepower outboard motor (Plate 2.1-1). The echo sounding system consisted of a dual-transducer, 430 kHz, 7° BioSonics DT-X digital split-beam echo sounder linked to a Garmin model 17 differential GPS. The transducers were mounted on a metal pole that was attached to the port side of the boat, with one transducer aimed downward (down-looking) and the other aimed sideways (side-looking) perpendicular to the direction of travel, tilted slightly downward. The down-looking transducer was aimed 1° to 3° sternward to aid in the identification of bubbles. The side-looking transducer was tilted 5° down from horizontal to reduce echoes from the lake surface as described by Yule (2000). The system was controlled by a laptop computer running Visual Acquisition 6 software used to display electronic echograms for monitoring sounder performance during data collection (Plate 2.1-2). Hydroacoustic data merged with geographic coordinates from the GPS were logged to the computer hard drive. Other system specifications appear in Table 2.1-2. Only data from the down-looking transducer was used for bottom typing.

Table 2.1-1. Lakes Assessed for Fish Habitat using Hydroacoustics, Back River Project, 2010

			UTM Location	
Lake	Watershed	Date Assessed	Easting	Northing
Llama	Llama	10-Aug-2010	429000	7272000
Umwelt	Llama	11-Aug-2010	429000	7270500

Sampling was performed by piloting the boat with the hydroacoustics system along parallel cross-lake transects at an average speed of 1.5 m/s. A total of 10 transects were performed at Llama Lake, while 14 transects were performed at Umwelt Lake. Supplemental transects (either between or perpendicular to original transects) were performed to capture additional data in key habitat areas.

Portions of these transects were also surveyed using underwater video to examine substrate types and to verify hydroacoustic classification of bottom type at the same locations. Video recordings of each lake bottom were conducted after the lake transects were completed. Underwater images were collected with a Sea Drop camera recording directly to the laptop hard drive. The camera was suspended from a cable held over the side of the boat with the lens aimed straight down approximately 50 to 100 cm above bottom. Video transects were performed at a boat speed of approximately 0.5 m/s. Occasionally, the boat was stopped to obtain a clear, stationary image. Parallel lasers spaced 10 cm apart were used as a reference for the distance that the camera was above bottom and as a scale for

substrate size estimates. Time and boat positions (latitude and longitude), provided by a Garmin 17 differential GPS, were continuously recorded to the video image by way of a video overlay device.



Plate 2.1-1. Boat set-up used to conduct hydroacoustics surveys of Llama and Umwelt lakes, Back River Project, 2010.

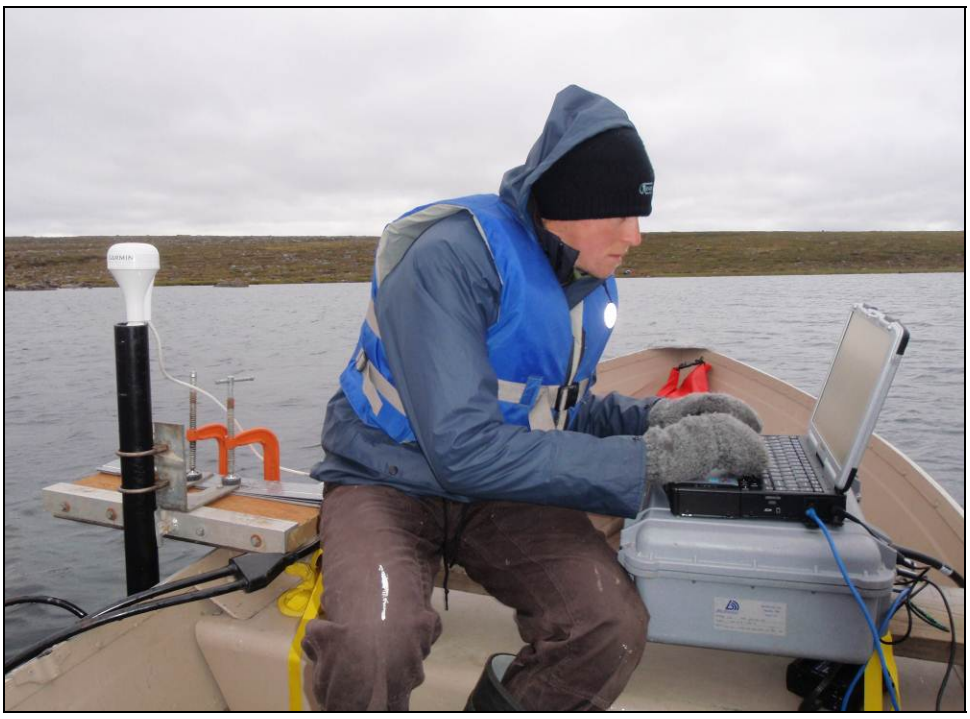


Plate 2.1-2. BioSonics hydroacoustics system used to classify substrate and estimate fish populations, Umwelt Lake, Back River Project, 2010.

PROJECT # 0833-002-03 GIS # GOO-06-004 November 16, 2010

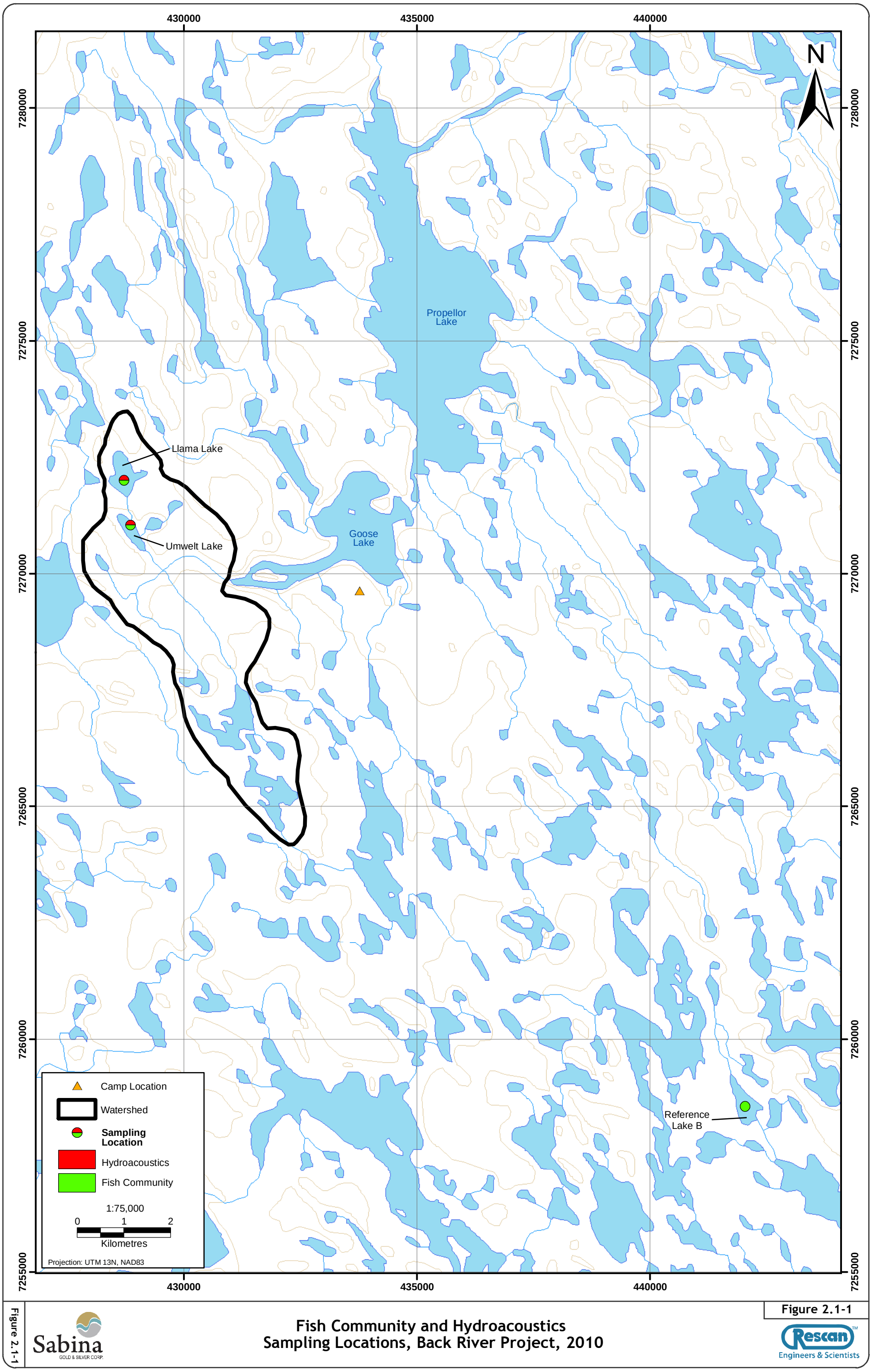


Figure 2.1-1

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Fish Community and Hydroacoustics Sampling Locations, Back River Project, 2010

Figure 2.1-1

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Table 2.1-2. Hydroacoustic System Specifications for Surveys of Llama and Umwelt Lakes, Back River Project, 2010

Project Phase	Category	Variable	Value
Data Collection	Transducers	Type	Split-beam[1]
		Sound frequency	430 kHz down-looking
			430 kHz side-looking
		Nominal beam angle	6.7° down-looking
			6.5° side-looking
		Depth of transducer face	0.6 m
	Settings (both transducers)	Pulse width	0.4 msec
		Transmit power level	low (-10.3 dB)
		Data collection threshold	-60 dB
		Minimum data range[2]	0.75 m
		Time varied threshold	40 log R
		Ping rate	8 pps/transducer
	DGPS	Type	WAAS-differential[3]
		Datum	NAD83
	Other	Transecting speed	1.4-1.9 m/s
Data Analysis	General	Calibration offset	-0.7 dB down-looking
			-0.5 dB side-looking
		Time varied gain	40 log R
		Minimum threshold[4]	-65 dB
		Maximum threshold[4]	none
		Beam pattern threshold	-6 dB
		Beam full angle	6.7° down-looking
			6.5° side-looking
		Single target filters	0.8-1.5 @ -6 dB
		Range processed[2]	0.75-20 m down-looking
			0.75-20 m side-looking
	Fish tracking, per fish	Minimum number of echoes	1 down-looking
			2 side-looking
		Maximum range change	0.2 m
		Maximum ping gap	1

[1] *BioSonics DT-X split-beam digital echo sounder.*
[2] *Range from transducer.*
[3] *A WAAS satellite signal was received during sampling with typical nominal position accuracy 2 to 3 m.*
[4] *Processing threshold after application of calibration offset.*

2.1.1.2 Data Processing and Analysis

Substrate composition was determined from hydroacoustic data using the RoxAnn method (Chivers et. al. 1990), which was implemented through BioSonics Visual Bottom Typing (VBT) version 1.12 software (Burczynski 2007). This method uses the ratio of first and second bottom echo energy levels to distinguish bottom types. Energy from the first echo (E1) represents substrate roughness, while energy from the second echo (E2) represents hardness. Scatter plots (not shown) of these variables are used to characterize

substrate types through a form of cluster analysis. Because E1 and E2 can vary from ping to ping, even at a single location with a homogeneous bottom type, VBT estimates bottom type by averaging values from groups of contiguous pings (or reports). Additional processing settings are shown in Table 2.1-3.

Table 2.1-3. Visual Bottom Typing (VBT) Processing Settings used to Distinguish Bottom Types of Llama and Umwelt Lakes, Back River Project, 2010

Item	Setting
Data processing threshold	-130 dB
TVG	30 log R
Bottom Sampling Windows	
First bottom, first part	16 samples
First bottom, second part	48 samples
Second bottom	100 samples
Sediment layer	42 samples
Bottom Tracker Settings	
Peak threshold	-40 to -50 dB (typically -45 dB)
Peak width	5 samples
Bottom detection threshold	-60 dB
Above bottom blanking	1 samples
Alarm limit	8 samples
Tracking window	66 samples
Tracking domain	20 log R
Bottom typing method	B4 (E1/FD)
Depth normalization	yes
Pings per report	10
Energy filter	60%

The substrate classification scheme used for Llama and Umwelt lakes was developed using data from reference transect sites (i.e., underwater video locations). Echograms from these transects were examined with Echoview software to identify distinct bottom echo patterns that might represent different types of substrate. Three main types were recognized: strong, moderate and weak second bottom echo. One or more data segments representing each pattern were then chosen from reference sites and processed in VBT.

Video recordings were analyzed in the field and the lab by playing them back on a computer using Windows Media Player, and visually observing the substrate type and degree of aquatic plant coverage. Substrate size classes followed the modified Wentworth scale for particle size: <2 mm = fines, 2 to 64 mm = gravel, 64 to 256 mm = cobble, >256 mm = boulder (Orth 1983). Plant coverage was classed as sparse (0 to 25% of the bottom covered), intermediate (25 to 50% covered), or extensive (75 to 100% covered). A screen-capture that included sampling time and geo-coordinates was taken at the end of each segment.

The physical composition of these hydroacoustic categories (e.g., mud or rock) was mainly determined by comparing them to the video classifications within several reference transect segments where video indicated that the substrate type was uniform for some distance. A total of five hydroacoustic categories were developed as shown in Table 2.1-4. Category 2 corresponds to a mix of rocky substrates such as gravel, cobble, boulder and bedrock, occasionally interspersed with fines.

Table 2.1-4. Hydroacoustic Substrate Categories Developed for Llama and Umwelt Lakes, Back River Project, 2010

Hydroacoustic Substrate Category	Description
1	Sand with periphyton
2	Mixed rock
3	Mud
4	Cobble/boulder
5	Sand without periphyton
0	No type

2.2 FISH COMMUNITY

2.2.1 Field Sample Collection and Processing

The fish communities of Llama, Umwelt and Reference lakes were sampled in August 2010. These lakes were sampled using a combination of sinking and floating gillnets and minnow traps. Fishing effort with gillnets and minnow traps was spread over the entirety of each lake to ensure that all habitat types were sampled and to capture fish of different ages and species with varying habitat preferences. The fish community studies were conducted for one of two purposes: 1) to estimate relative fish abundance and species-specific population sizes in Llama and Umwelt lakes; and 2) to collect general fish community data (i.e., community composition and fish biological data) at Reference Lake B for baseline reporting.

Table 2.2-1 shows the lakes sampled in the Project area in 2010. Appendices 2.2-1 and 2.2-2 present the set and retrieval times, and locations for gillnets and minnow traps, respectively. Figures 2.2-1 to 2.2-3 show the set locations of gillnets and minnow traps for each lake.

Table 2.2-1. Fish Community Sampling Locations, Back River Project, 2010

		UTM Location		Method		
Location	Watershed	Easting	Northing	AC	GN	MT
Llama Lake	Llama	429000	7272000	X	X	X
Umwelt Lake	Llama	429000	7270500	X	X	X
Reference Lake B	Reference	442000	7258500	-	X	X

Method codes: AC = hydroacoustics, GN = gillnet, MT = minnow trap.
Dashes indicate no data were collected.

Lakes were sampled using three forms of monofilament gillnet gangs. Standard RISC (floating and sinking forms) gillnet gangs consisted of six panels, ranging from 25 to 89 mm stretched mesh. Each RISC gillnet gang was tied in the following order: Panel 1 – 25 mm; Panel 2 – 76 mm; Panel 3 – 51 mm; Panel 4 – 89 mm; Panel 5 – 38 mm; and Panel 6 – 64 mm. Each panel measured 15.2 m long by 2.4 m deep for an area of 36.48 m^2 and a total area of 218.88 m^2 per gang. A shorter, small mesh sinking gillnet was also used to target juvenile or small-bodied fish at Llama and Umwelt lakes to augment hydroacoustic assessments. This gillnet consisted of three panels of 19 mm stretched mesh. Each panel measured 15.2 m long by 2.4 m deep for an area of 36.48 m^2, with a total area of 109.44 m^2. All gillnets consisted of a lead line at the bottom and a floating line at the top of the net. Sinking nets were designed to fish at the bottom of the lake, while floating nets were designed to fish at the lake surface.

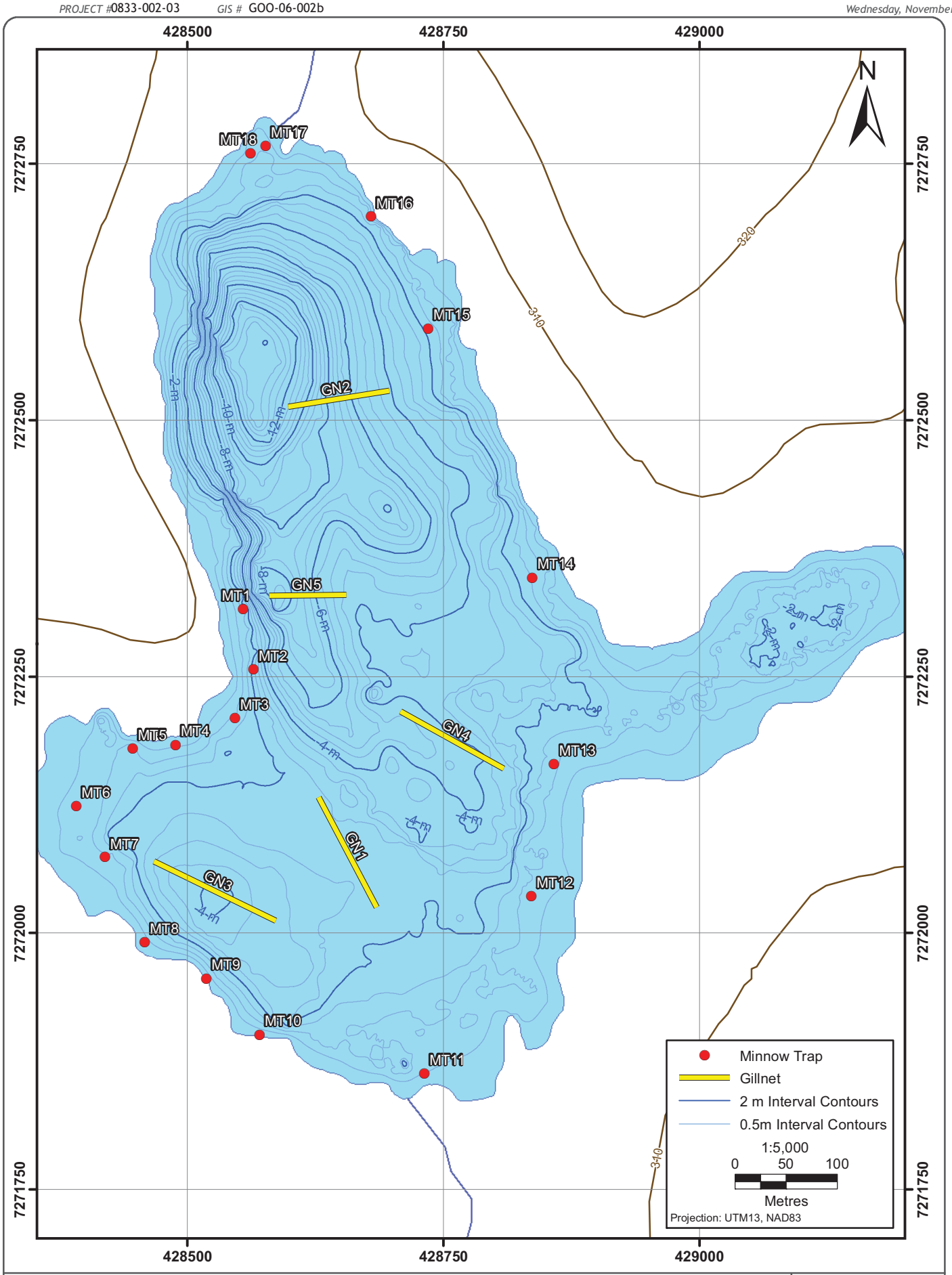
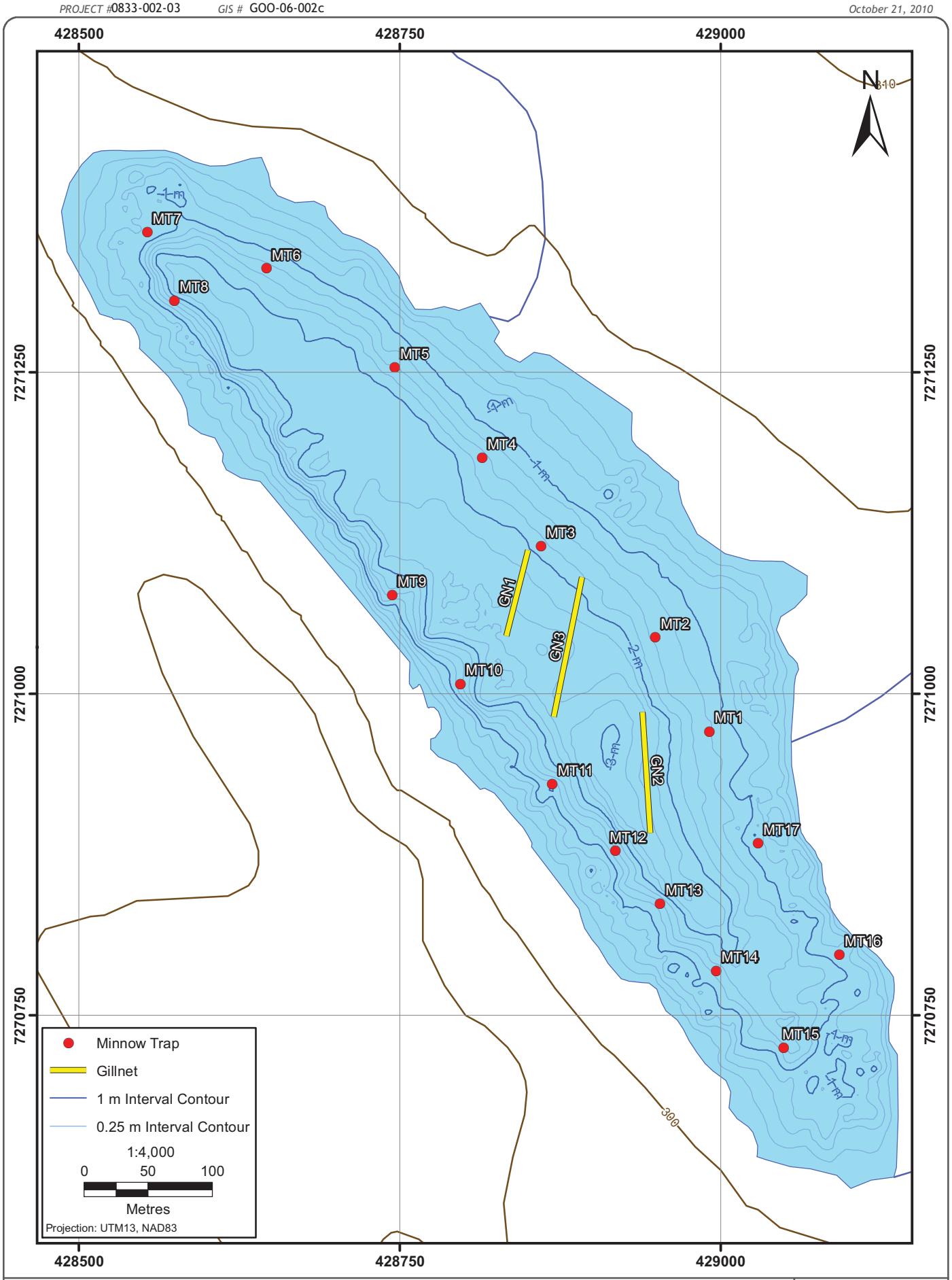


Figure 2.2-1

Gillnet and Minnow Trap Set Locations on Llama Lake, Back River Project Area, 2010

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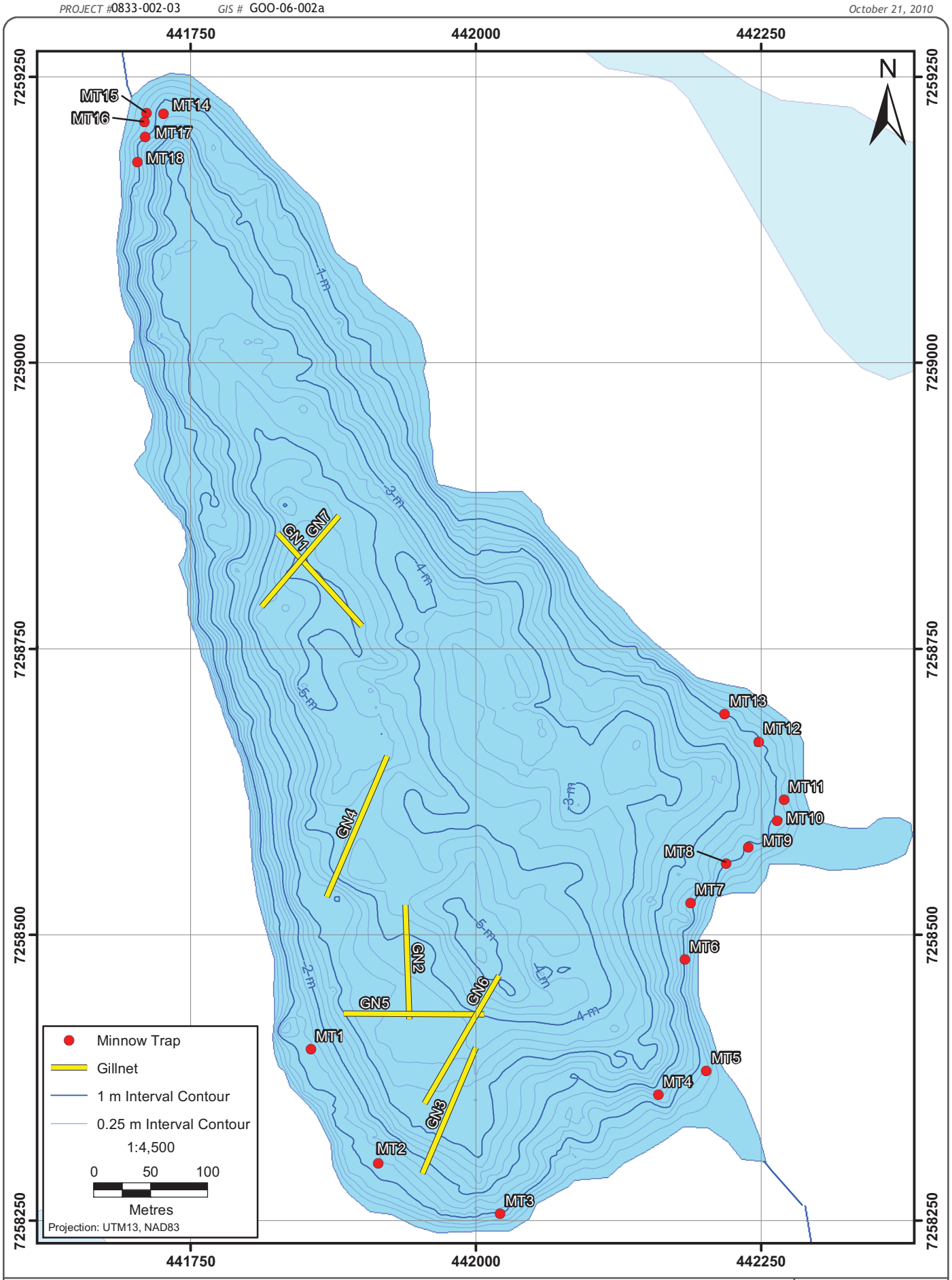


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Gillnet and Minnow Trap Set Locations on Umwelt Lake, Back River Project Area, 2010

Figure 2.2-2

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Gillnet and Minnow Trap Set Locations on Reference Lake B, Back River Project Area, 2010

Figure 2.2-3

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Minnow traps consisted of two, 4 mm wire mesh cylinders that were locked together using a clip attached to a rope and marker buoy. Each minnow trap was baited with a small amount of dry crab bait. Minnow traps were then placed along the shore of lakes so that the trap was resting on the substrate.

Captured fish were identified to species, measured for fork length to the nearest 1 mm and weighed to the nearest 1 g. Fish were sampled for various structures (scales, fin rays and otoliths) used to determine their age. Otoliths were only collected from incidental mortalities. Scales were collected with a knife below the posterior margin of the dorsal fin on the left side of the fish. Two to three rays of the left pelvic fin were collected with scissors or pliers (Plate 2.2-1). Aging structures were placed in envelopes (Plate 2.2-2) labelled with the site, date, species and sample number.



Plate 2.2-1. Field sampling equipment used to collect fish biological samples, Back River Project, 2010.

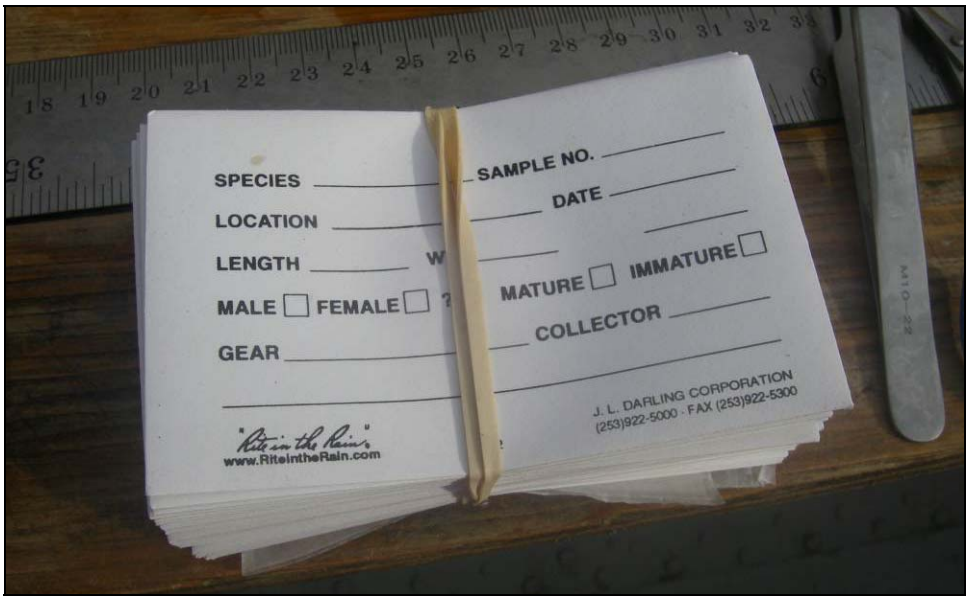


Plate 2.2-2. Envelopes used for the storage of fish aging structures, Back River Project, 2010.

Fish were released live back to their lake of residence unless they had already been killed by capture or handling, in which case otoliths were removed and sex and sexual maturity were determined from the size, colour and texture of the gonads. Stomachs were removed and dissected and observations of general stomach contents were recorded.

All aging analysis of scales, fin rays and otoliths was performed by John Tost of North Shore Environmental Services, Thunder Bay, Ontario. Age was estimated by counting the number of annuli (or yearly rings) in each structure. Scales were attached to plastic fiches and annuli were counted with a microfiche reader. The fin rays were air-dried and then mounted in a 50:50 epoxy medium. Microsections were cut using a Beuler Isomet diamond saw and mounted on slides and annuli were counted with a compound microscope. Otoliths were air-dried, cracked and passed over a flame to increase the visibility of annuli. Otoliths were then mounted in Plasticine and immersed in oil for better inspection using a compound microscope. When more than one structure was used for aging, the one with the highest confidence in the annuli count was used.

2.2.2 Hydroacoustics

2.2.2.1 General

Mobile hydroacoustic surveys were conducted in August 2010 to describe fish population characteristics of Llama and Umwelt lakes. Survey methods generally followed protocols for the sampling of fish populations with hydroacoustics described in Thorne (1983), MacLennan and Simmonds (1992), Brandt (1996) and Beauchamp et al. (2009).

2.2.2.2 Data Collection

In most situations, night is the preferred time for hydroacoustic sampling to determine fish abundance (Thorne 1983); however, due to the remote location of the lakes all surveys were conducted during the day. Wind and wave conditions were not ideal for hydroacoustic surveys during the day, thus data from the side-looking transducer was not used in the population estimates.

Hydroacoustic sampling was conducted from a 4.3 m-long power boat travelling approximately 1.5 m/s along the same transect lines used for bottom-typing. The echo sounding system consisted of the same dual-transducer, 430 kHz, BioSonics DT-X split-beam echo sounder linked to a Garmin model 17 differential GPS. Full beam angles of the transducers (at the half power point) were 6.7° (down-looking) and 6.5° (side-looking). Other system specifications are shown in Table 2.1-2. The sounder was controlled by a laptop computer that displayed electronic echograms for monitoring system performance during data collection. Hydroacoustic data merged with geo-coordinates from the GPS were logged to the computer hard disk to await processing at a later date.

The transducers were mounted on a metal pole that was attached to the boats port side (Plate 2.1-1), with one transducer aimed downward (down-looking) and the other aimed sideways (side-looking) perpendicular to the boat's direction of travel, tilted slightly downward. The down-looking transducer was aimed 1° to 3° sternward to aid in the identification of bubbles. The side-looking transducer was tilted 5° down from horizontal to reduce echoes from the lake surface as described by Yule (2000). The side-looking transducer was necessary to obtain an adequate sampling volume in the many shallow parts of the lakes and to minimize boat avoidance by fish, as recommended by Kubecka et al. (1994) and Kubecka and Wittingerova (1998). During sampling, pings (sound transmissions) alternated between transducers, giving a rate per transducer of ten pings per second. Because the lakes were relatively shallow, all data were collected using a low transmit power setting (-10.3 dB) to avoid signal saturation. Also, a pulse width of 0.4 m/s and a data collection threshold of -65 dB were used for all sampling. Other settings used for data collection are shown in Table 2.1-2.

Each lake was sampled using 10 to 14 transects spaced approximately 100 m apart, perpendicular to the long axis of the lake using a systematic sampling design according to Cochran (1977). Transects covered all parts of the lakes, including shallow bays and flats, although it was expected that data from the shallowest areas would not be usable for fish abundance estimates. In the field, crews sampled to a minimum bottom depth of approximately 1 m and to within a few metres of shore where possible.

2.2.2.3 Data Processing and Analysis

Hydroacoustic data files were processed using Myriax Echoview software (version 4.9) to count fish, measure target strength (TS, the hydroacoustic size of fish), and determine sampling volumes according to standard split-beam trace counting and TS methods (Thorne 1983; MacLennan and Simmonds 1992; Brandt 1996). The side-looking transducer represented the upper 5 m of the water column, so, considering the transducer deployment depth (0.6 m), beam angle (6.5°), and downward tilt (5°), data 2 to 20 m from the transducer were processed. From the down-looking transducer, data from the 2 to 15 m range were processed.

Fish tracks were recognized on echograms by their shape, cohesiveness and TS. For down-looking data, at least one echo with a TS ≥ -65 dB was required for acceptance as a fish track. At least two echoes with a minimum TS of -65 dB were required for acceptance as a side-looking fish track. Additionally, only echoes within the main portion of the hydroacoustic beam (6.7° or 6.5°) were accepted. No bubbles were observed during any of the surveys, so no correction for their presence was necessary.

The accuracy of hydroacoustic measurements was verified by BioSonics and field calibration tests. The echo sounder was calibrated by BioSonics prior to the study, and in-situ TS measurements of a standard sphere were made during the survey. Results of field tests were 0.7 dB greater than the expected value (-39.5 dB) for the down-looking transducer and 0.5 dB greater than the expected value for the side-looking transducer. Corrections for these deviations were applied during processing in Echoview.

Fish densities were summarized as fish/m^2 or fish/ha for population estimates and spatial analysis. For each spatial cell of interest, fish/m^3 was calculated as the total number of fish counted divided by the volume sampled. The volume sampled in each spatial cell was calculated according to the wedge model (Keiser and Mulligan 1984) using the hydroacoustic beam angle, distance transected and a correction for bottom intrusion. The effective beam angle for each depth interval was modelled considering the transducer half-power beam angle (6.7° down-looking, 6.5° side-looking), boat speed and ping rate, and the sampling volume was adjusted accordingly at ranges where the effective beam angle was less than the half-power angle. Under the conditions of the survey, the effective beam angle was never less than 6.1° for the ranges used.

Each transect pass provided one replicate of each depth interval that it included (shallow transects did not contain all intervals). For each spatial cell (depth interval x lake section), mean fish density was expanded in proportion to total cell volume, and resulting abundance estimates were summed to obtain a total population estimate for all species combined expressed as an areal density (fish/m^2 or fish/ha) (Beauchamp et al. 2009). Variance and 95% confidence intervals of the population estimates were calculated for a random sample (Cochran 1977).

Because hydroacoustics cannot differentiate fish species, gillnetting was conducted one day after the hydroacoustic surveys to estimate species composition and other biological characteristics of the fish community (e.g., age composition). The relative catches of each species (see Section 2.4) was used as an estimate of its relative abundance for apportioning the hydroacoustic estimate. This method was

only effective for fish large enough to be captured in the mesh sizes that were used (19 to 89 mm stretched mesh), and it assumes equal selectivity for all sizes and species of fish that were present.

2.3 QUALITY ASSURANCE / QUALITY CONTROL

For all fish habitat and community surveys, data sheets and electronic hydroacoustic data files were reviewed at the end of each field day to ensure data were complete and collected properly. Field notes were transcribed onto electronic spreadsheets once in the office and all transcriptions were checked visually against the field forms and any errors corrected. The data were also plotted to identify any outliers that may have resulted from transcription errors that occurred in the field.

2.4 DATA ANALYSIS

The variables used to assess the fish community included: relative species abundance, length, weight, condition and catch-per-unit-effort (CPUE). Data analysis and interpretation for these variables followed Guy and Brown (2007). Several of these variables required calculation. A description of the calculations undertaken is presented below.

The CPUE statistic is used as an estimate of relative abundance of fish (Hubert and Fabrizio 2007). A key factor that allows comparison of CPUE data is the standardization (type of net, mesh size, etc.) of sampling devices. The same nets, traps and amount of bait were used at all sites allowing comparisons of CPUE data to be made.

For gillnets, CPUE was the number of fish caught per 100 m^2 of net per 1 hour.

$$\text{CPUE} = \text{number of fish caught per net} \times [100/\text{total net area } (m^2)] \times [1/\text{set time (h)}]$$

For minnow traps, CPUE was calculated from the number of fish caught per trap per day.

$$\text{CPUE} = \text{number of fish} \times [\text{set time (h)}/24 \text{ h (day)}]$$

Condition and weight-length regressions are indicators of the relative health of fish. Condition factor was based on the following formula from Ricker (1975):

$$\text{Condition} = \text{weight (g)} \times 10^5/\text{length}^3 \text{ (mm)}$$

Weight was multiplied by 10^5 to avoid fractional values, and a weight-length exponent of exactly 3 was assumed to apply to all species of fish. Weight-length relationships (Pope and Kruse 2007) were calculated for fish species captured in significant numbers (e.g., greater than 8). Logarithmic transformations were performed on the data prior to conducting the regression.

$$\ln(\text{weight}) = \ln(a) + b[\ln(\text{length})]$$

Weight is in grams, a is a coefficient, b is the slope of the regression, and length is in mm.

Length-age relationships were described with the von Bertalanffy growth model (Isley and Grabowski 2007):

$$L_t = L_\infty(1 - \exp(-K(t - t_0)))$$

where L_t = length at age (mm), L_∞ = asymptotic length (mm) (i.e., length at infinite age), K = growth rate ($year^{-1}$) and t_0 = age (years) at L = 0 mm. Where length and age data was limited for small and/or

young fish, t_0 was fixed at zero to force the x-intercept through the graph origin and create a more realistic model of juvenile growth.

All statistics were conducted according to Zar (1984) using SYSTAT (2004). All linear regressions were reported with the appropriate sample size (n), coefficient of determination (r^2, the fraction of variation in the independent parameter that was explained by the dependent parameter) and P value. Only n and r^2 were reported for non-linear regressions. All r^2 for linear or non-linear regressions were not adjusted for the degrees of freedom of the regression.

3. Results and Discussion

3. Results and Discussion

3.1 FISH HABITAT

3.1.1 Llama Lake

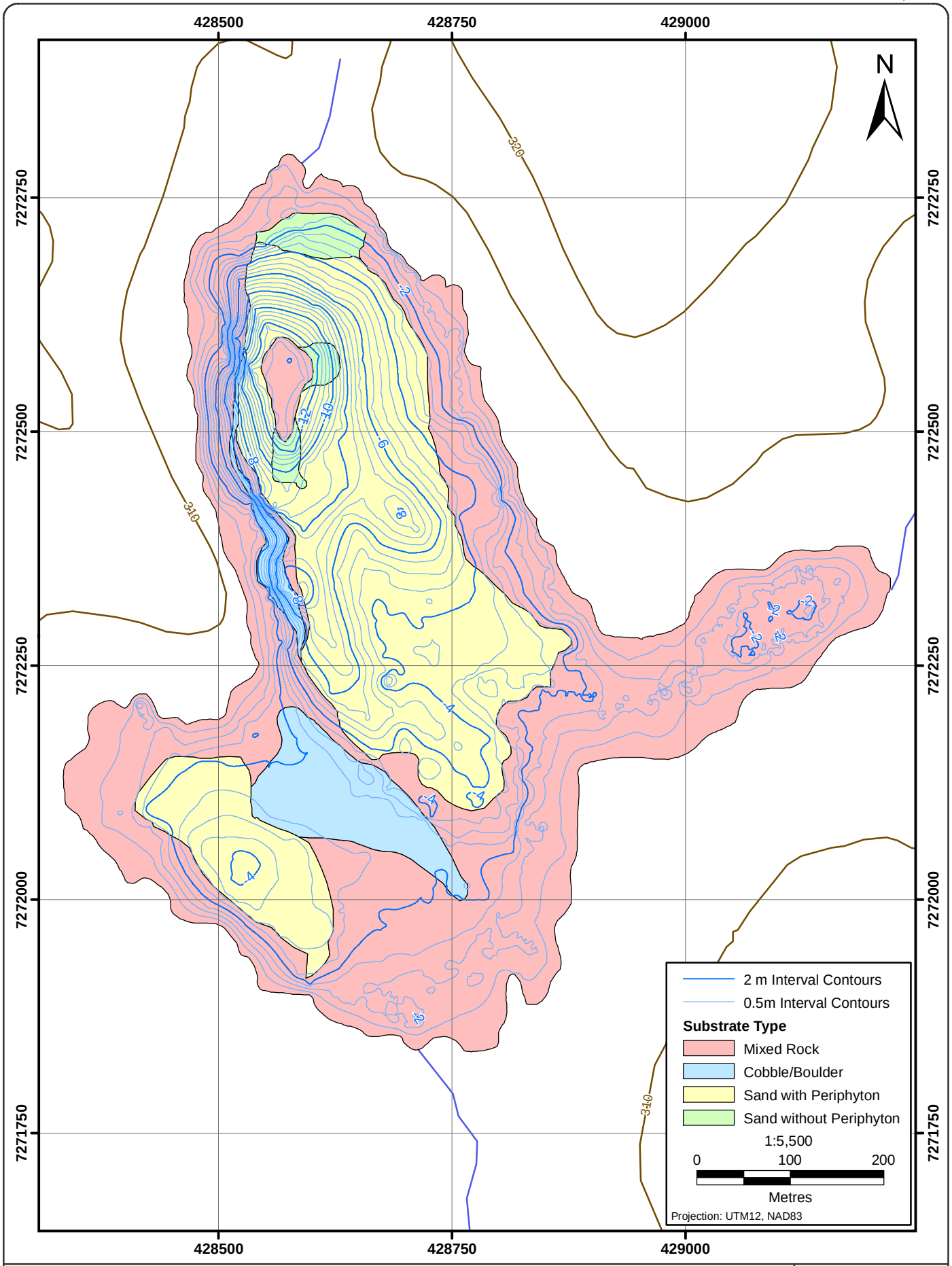
Appendix 3.1-1 presents substrate data collected from hydroacoustics surveys of Llama Lake. Figure 3.1-1 and Table 3.1-1 show the distribution of substrate. The predominant substrate category found at Llama Lake was mixed rock (Plate 3.1-1), representing 57% of the overall bottom area. The subdominant bottom type was sand with periphyton (Plate 3.1-2), which represented 35% of the overall bottom type. Cobble/boulder (Plate 3.1-3) and sand without periphyton accounted for the remaining percentage of substrate distribution. Mud was not found in Llama Lake. Sand with and without periphyton were generally associated with the deep water sections of Llama Lake. Mixed hard substrates, such as bedrock, cobble and boulder were associated with near-shore locations.

Table 3.1-1. Substrate Composition of Llama Lake Derived from Hydroacoustics and Underwater Video, Back River Project, 2010

Lake	Substrate Type	Hydroacoustic Substrate Category	Area (ha)	Percent
Llama	Sand with periphyton	1	12.74	35
	Mixed rock	2	20.85	57
	Cobble/Boulder	3	2.30	6
	Mud	4	0	0
	Sand without periphyton	5	0.70	2
	Total		**36.59**	**100**



Plate 3.1-1. 'Mixed rock' observed using underwater video at Llama Lake, Back River Project, 2010.



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Substrate Composition of Llama Lake Derived from Hydroacoustic and Underwater Video Surveys, Back River Project, 2010

Figure 3.1-1

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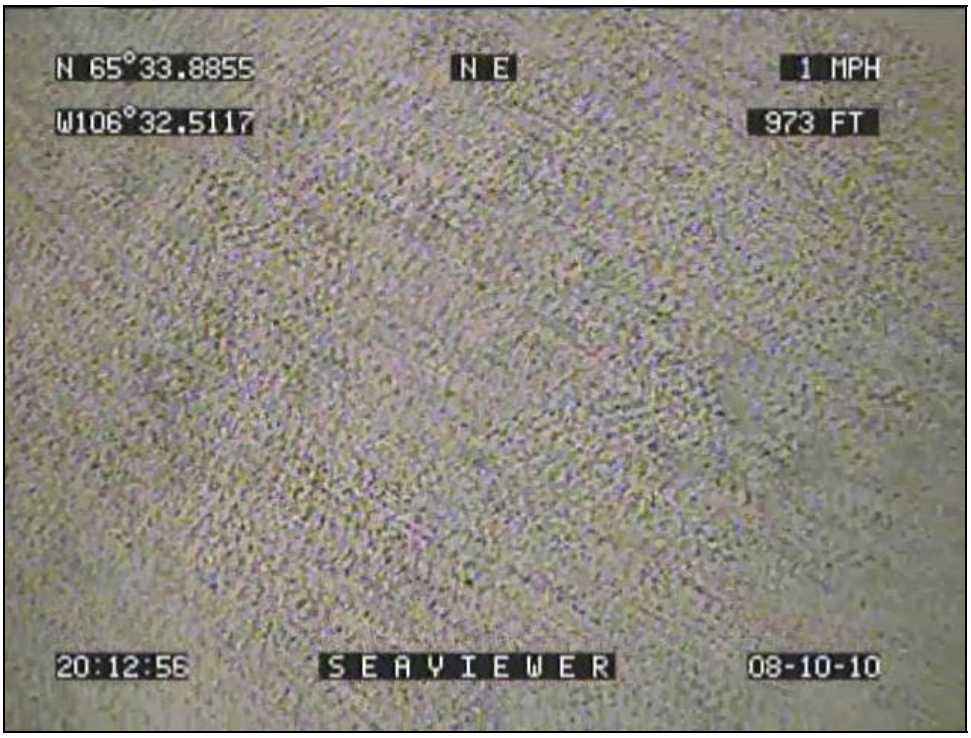


Plate 3.1-2. 'Sand with periphyton' observed using underwater video at Llama Lake, Back River Project, 2010.

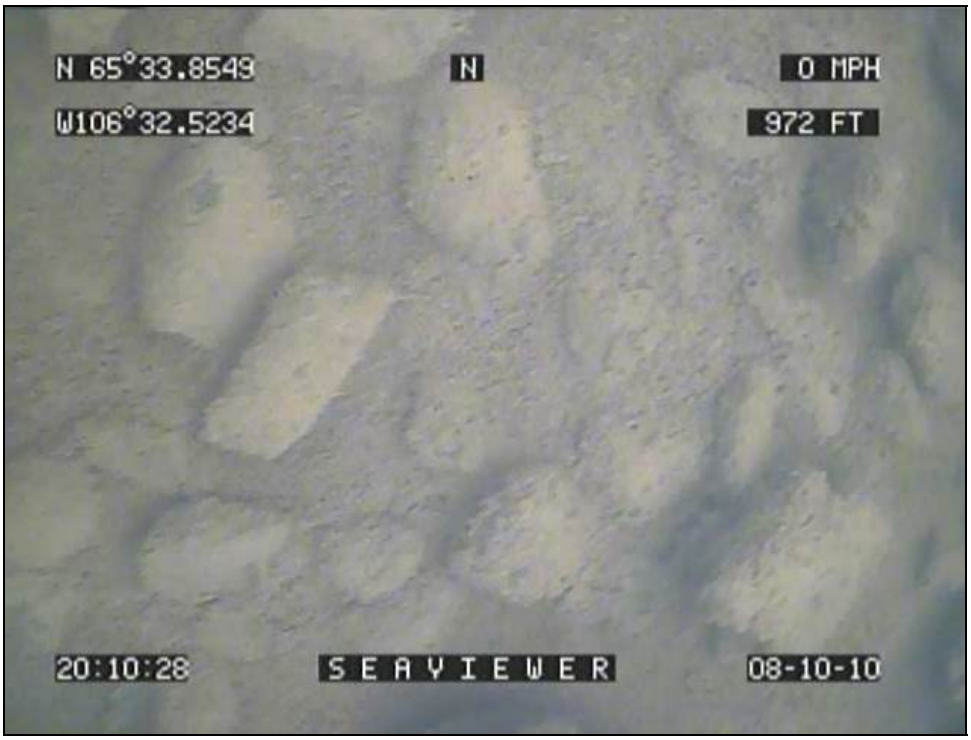


Plate 3.1-3. 'Cobble/boulder' observed using underwater video at Llama Lake, Back River Project, 2010.

Underwater video footage showed substrates ranging from fines (<2 mm) to boulders (>256 mm), including some >1 m in diameter in Llama Lake. Video footage confirmed that fines predominated in deeper parts of the lake (Figure 3.1-1). Rocky substrates (e.g., cobble, boulder) occurred near shore and in deep water portions of Llama Lake. In many locations, rocky substrates were coated with silt or periphyton or embedded with fines, especially in off-shore locations. Underwater video also showed that gravel, cobble and boulders were often mixed together or occurred in patches. In many cases fine sediment was interspersed with hard substrates.

3.1.2 Umwelt Lake

Appendix 3.1-2 presents substrate data collected from hydroacoustics surveys of Umwelt Lake. Figure 3.1-2 and Table 3.1-2 shows the distribution of substrate. As with Llama Lake, the predominant substrate category found at Umwelt Lake was mixed rock, representing 67% of the overall bottom area. The subdominant bottom type was sand with periphyton, accounting for 20% of the total bottom area. Fines, such as sand without periphyton and mud (Plate 3.1-4), and cobble/boulder represented the remainder of substrates in Umwelt Lake. Mixed hard substrates were generally associated with near-shore locations, while sand was found in the open water section of Umwelt Lake.

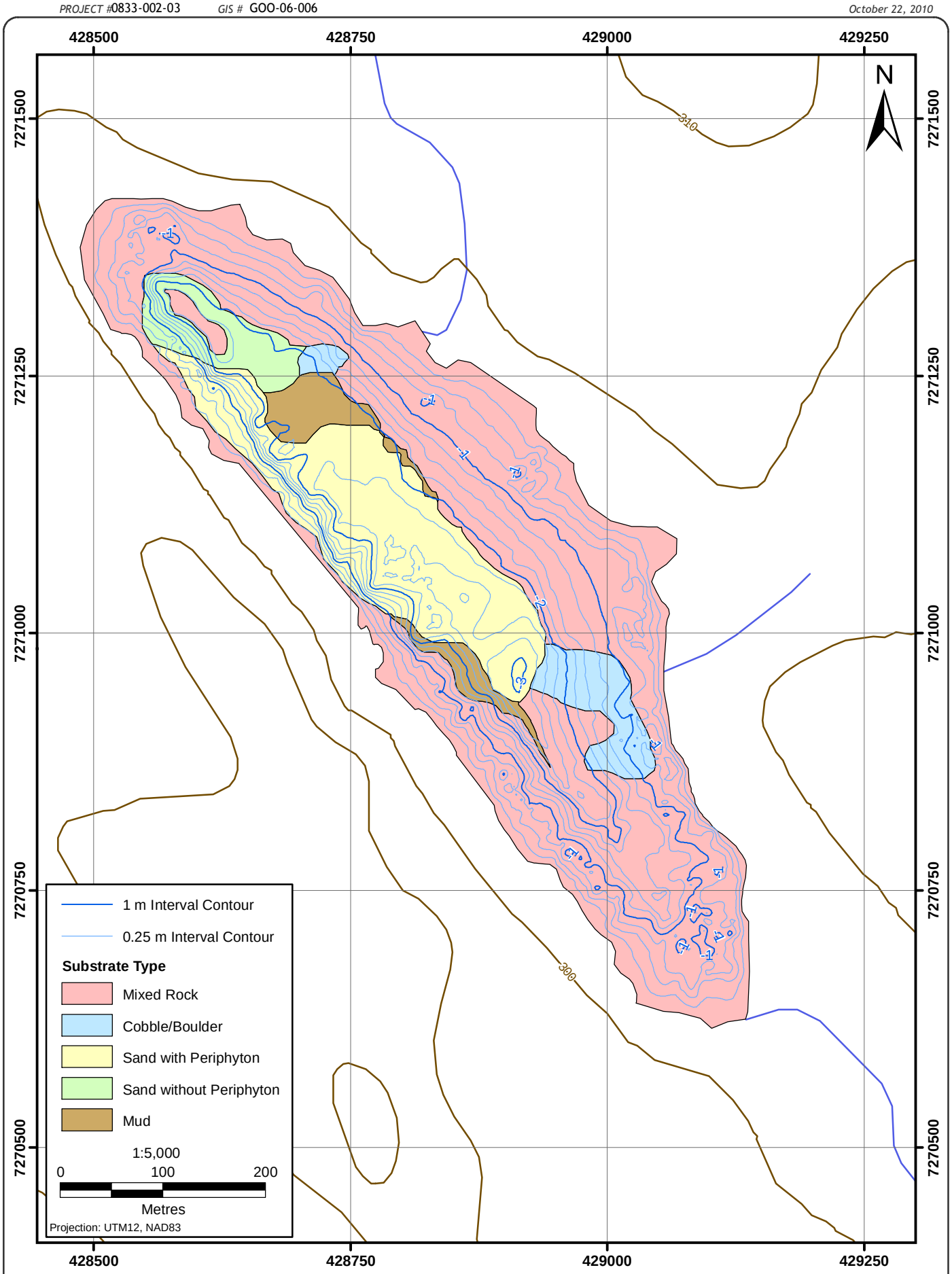
Table 3.1-2. Substrate Composition of Umwelt Lake Derived from Hydroacoustics and Underwater Video, Back River Project, 2010

Lake	Substrate Type	Hydroacoustic Substrate Category	Area (ha)	Percent
Umwelt	Sand with periphyton	1	3.81	20
	Mixed rock	2	13.04	67
	Mud	3	0.81	4
	Cobble/Boulder	4	0.89	5
	Sand without periphyton	5	0.81	4
	Total		**19.36**	**100**



Plate 3.1-4. 'Mud' observed using underwater video at Umwelt Lake, Back River Project, 2010.

PROJECT #0833-002-03 GIS # GOO-06-006 October 22, 2010



Substrate Composition of Umwelt Lake Derived from Hydroacoustic and Underwater Video Surveys, Back River Project, 2010

Figure 3.1-2

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3.2 FISH COMMUNITY

3.2.1 Composition and CPUE

Biological data for fish sampled from lakes in the Project area are presented in Appendix 3.2-1. The fish assemblages of Llama, Umwelt and Reference B lakes displayed very low diversity, typical of Arctic lakes (Scott and Crossman 1973). Most lakes contained only two or three species, including: Arctic grayling (Plate 3.2-1), lake trout (Plate 3.2-2), round whitefish (Plate 3.2-3) and ninespine stickleback (Plate 3.2-4). Arctic grayling were only captured from Umwelt Lake.



Plate 3.2-1. Arctic grayling (Thymallus arcticus) captured by gillnetting from Umwelt Lake, Back River Project, 2010.



Plate 3.2-2. Lake trout (Salvelinus namaycush) captured by gillnetting from Reference Lake B, Back River Project, 2010.



Plate 3.2-3. Round whitefish (Prosopium cylindraceum) captured by gillnetting from Llama Lake, Back River Project, 2010.



Plate 3.2-4. Ninespine stickleback (Pungitius pungitius) captured by minnow trapping from Umwelt Lake, Back River Project, 2010.

A total of 62 fish were captured using gillnets from three lakes (Llama and Umwelt and Reference B) in the Project area. Of this number, 27 (43%) were lake trout, 20 (32%) were Arctic grayling and 15 (24%) were round whitefish. One ninespine stickleback was also observed in the stomach of a lake trout captured using gillents at Llama Lake.

Table 3.2-1 summarizes the total number of gillnet sets, total catch and mean CPUE by species per lake. The total number of RISC standard gillnets set per lake ranged from 2 at Llama to 7 at Reference B Lake. All gillnet set locations are shown in Section 2.2.

Table 3.2-1. Summary of RISC Standard Gillnet Total Effort, Catch and CPUE, Back River Project, 2010

Lake	Watershed	Number of Nets Set	Total Effort (hrs)	Catch per Species			Total Catch	Mean Total CPUE	SE
				ARGR	LKTR	RDWH			
Llama	Llama	3	22.25	0	15	4	19	0.22	0.11
Umwelt	Llama	2	39.17	20	0	6	26	0.30	0.21
Reference B	Reference	7	7.12	0	12	5	17	1.19	0.32
Totals		12	68.54	20	27	15	62	0.80	0.23

Species codes: ARGR = Arctic grayling, LKTR = lake trout, RDWH = round whitefish, SE = standard error.

Figure 3.2-1 shows mean RISC standard gillnet CPUE for each fish species for all lakes assessed in the Project area. Reference Lake B displayed the highest total CPUE for lake trout as well as for round whitefish. Umwelt Lake had the highest catch of Arctic grayling.

Table 3.2-2 summarizes the total effort, total catch and CPUE for minnow traps used at lakes in the Project area. Only one ninespine stickleback was captured from Umwelt Lake using minnow traps.

Table 3.2-2. Summary of Minnow Trap Effort, Catch and CPUE, Back River Project, 2010

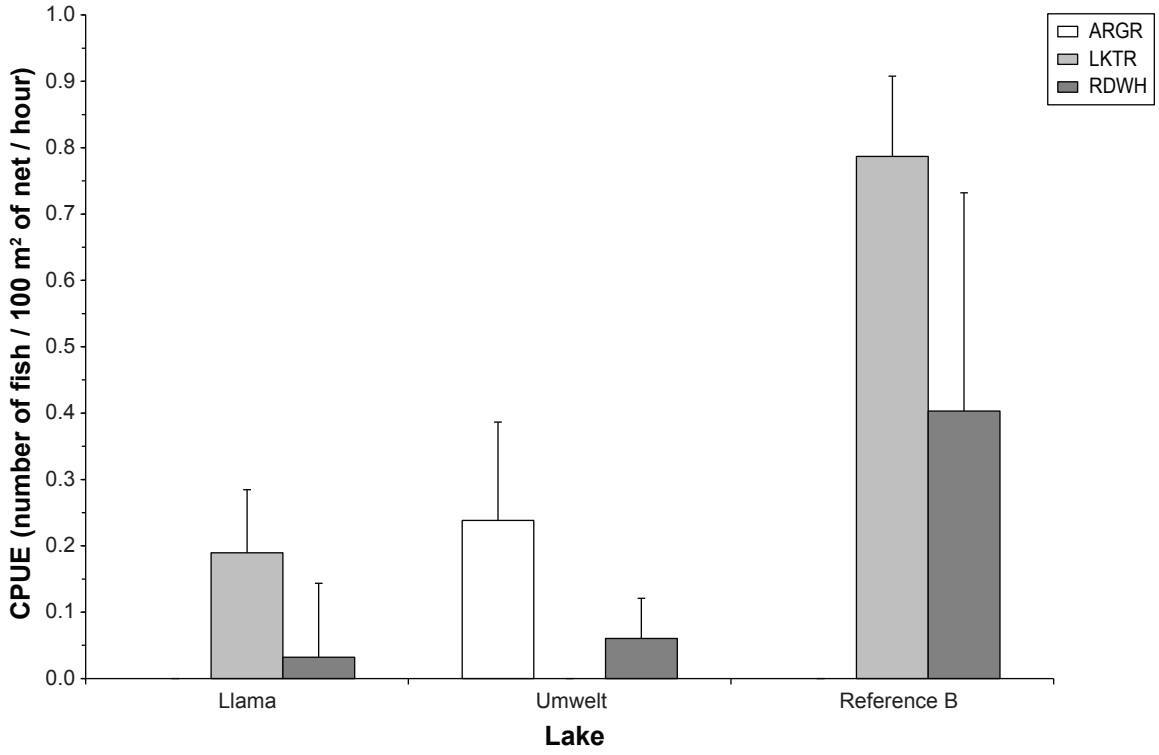
Lake	Watershed	Number of Traps Set	Total Effort	Catch per Species	Total Catch	Mean Total CPUE	SE
				NSSB			
Llama	Llama	18	342.0	0	0	0	0
Umwelt	Llama	17	340.0	1	1	0.003	0.0029
Reference B	Reference	18	385.5	0	0	0	0
Totals		**53**	**1,067.5**	**1**	**1**	**0.0009**	**0.0009**

Species code: NSSB = ninespine stickleback, SE = standard error.

3.2.2 Hydroacoustics

3.2.2.1 Llama Lake

Appendix 3.2-2 shows fish track data collected during hydroacoustic surveys of Llama Lake. Table 3.2-3 shows the estimated absolute abundance of fish in Llama Lake. The total number of fish in Llama Lake was estimated at 226 with 95% confidence limits ranging from 4 to 1,794. The relatively large 95% confidence interval of this abundance estimate was attributed to the very low number of fish tracks detected by the hydroacoustics gear. Due to the very low number of fish observations, geo-referenced fish density data was unable to be mapped to illustrate the spatial distribution of fish in Llama Lake.



Note: error bars are SE of the mean.

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Mean CPUE for All Species Captured from Lakes using RISC Standard Gillnets, Back River Project, 2010

Figure 3.2-1

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Table 3.2-3. Fish Density and Estimate of Absolute Abundance (All Species Combined) Derived from Hydroacoustics Data for Llama and Umwelt Lakes, Back River Project, 2010

Lake	Mean Fish Density (fish / ha)	Lake Area (m^2)	Total Number	SD	95% CL	
					Lower	Upper
Llama	0.02260	367,076	226	800	4	1,794
Umwelt	0.01550	202,158	155	362	5	864

SD = standard deviation of absolute abundance, CL = confidence limit.

The low number of fish tracks may be partially explained by the fact that surveys were conducted during the day rather than night. During the day, fish tend to orient tight to the lake bottom, and therefore are indistinguishable from the bottom echo envelope (Kubecka and Wittengerova 1998). Fish may also exhibit active boat avoidance when surveys are conducted during daylight hours. As previously stated, night is the ideal time for hydroacoustics surveys; however, due to the remoteness of Llama Lake and other logistical restrictions, a night survey was not possible.

Table 3.2-4 shows the population estimates for lake trout and round whitefish in Llama Lake. The species composition and proportions were derived from gillnet catches. Using these proportions, the lake trout population of Llama Lake was estimated as 176, while the round whitefish population was estimated as 50. Due to aforementioned limitations of the hydroacoustics survey, the fish abundance and population estimates produced for Llama Lake are considered conservatively low.

Table 3.2-4. Relative Abundance and Population Estimate for Individual Fish Species Derived from Gillnetting and Hydroacoustics Data for Llama and Umwelt Lakes, Back River Project, 2010

Lake	Percent Catch by Species			Population Estimate by Species			Total Number
	ARGR	LKTR	RDWH	ARGR	LKTR	RDWH	
Llama	0	78	22	0	176	50	226
Umwelt	77	0	23	119	0	36	155

Species codes: ARGR = Arctic grayling, LKTR = lake trout; RDWH = round whitefish

3.2.2.2 Umwelt Lake

Appendix 3.2-3 presents fish track data collected during hydroacoustic surveys of Umwelt Lake. The total number of fish in Umwelt Lake was estimated at 155 with 95% confidence limits ranging from 5 to 864 (Table 3.2-3). The relatively large 95% confidence interval of this abundance estimate was attributed to the very low number of fish tracks detected by the hydroacoustics gear. Due to the very low number of fish observations, geo-referenced fish density data was unable to be mapped to illustrate the spatial distribution of fish in Umwelt Lake.

The low number of fish tracks was attributed to the fact that Umwelt Lake is very shallow (mean depth approximately 2 m). Hydroacoustics surveys using down-looking transducers are often not effective in such shallow water due to an unfocused acoustic signal in the near-field zone, boat avoidance and the small cross section of the acoustic beam (Beauchamp et al. 2009). In addition, the conditions during the day-time survey of Umwelt Lake were less than ideal due to wind and wave activity. The use of a side-looking transducer requires smooth water conditions (Thorne 1998). For this reason, fish track data collected with the side-looking transducer was not usable. Thus, hydroacoustics was not an ideal method to estimate fish abundance at Umwelt Lake.

Table 3.2-4 shows the population estimates for Arctic grayling and round whitefish in Umwelt Lake. The species composition and proportions were derived from gillnet catches. Using these proportions, the Arctic grayling population of Umwelt Lake was estimated as 119, while the round whitefish population was estimated as 36. Due to aforementioned limitations of the hydroacoustics gear coupled with the bathymetric features of Umwelt Lake, the fish abundance and population estimates produced are considered conservative.

3.2.3 Biological Characteristics

3.2.3.1 Length, Weight and Condition

Length, weight and condition of fish captured in the Project area are summarized in Table 3.2-5. Figures 3.2-2 to 3.2-4 show the length-frequency distributions for lake trout, round whitefish and Arctic grayling sampled from lakes, respectively.

Table 3.2-5. Summary of Length, Weight and Condition Data for Sampled Fish, Back River Project, 2010

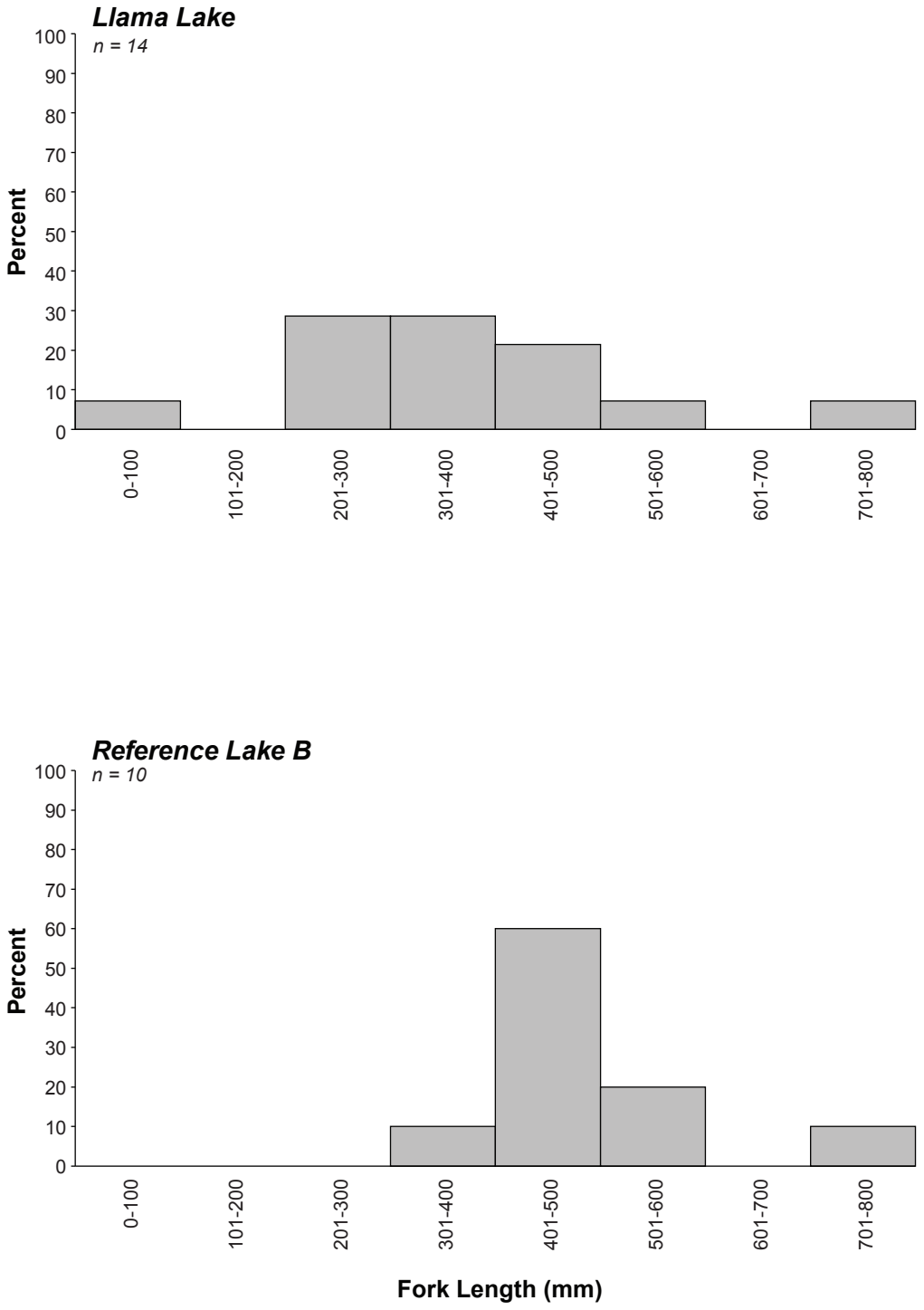
			Length (mm)				Weight (g)				Condition (g/mm^3)			
Lake	Watershed	Species	n	Range	Mean	SE	n	Range	Mean	SE	n	Range	Mean	SE
Llama	Llama	LKTR	14	97 - 724	363	11	14	11 - 3,625	772	68	14	0.91 -1.93	1.12	0.02
		RDWH	4	290 - 404	371	14	4	292 - 809	648	60	4	1.18 - 1.26	1.21	0.01
Umwelt	Llama	ARGR	20	134 - 354	261	3	20	25 - 478	238	6	20	1.01 - 1.34	1.18	0.00
		RDWH	6	220 - 295	258	5	6	93 - 325	195	14	6	0.87 - 1.23	1.07	0.02
Reference B	Reference	LKTR	10	378 - 780	503	11	10	522 - 2,044	1,035	43	10	0.77 - 1.21	0.95	0.01
		RDWH	5	373 - 404	391	3	5	597 - 785	701	16	5	1.13 - 1.19	1.17	0.01

Species codes: ARGR = Arctic grayling, LKTR = lake trout, RDWH = round whitefish
n = number, SE = standard error

Lake trout were the largest fish species with mean lengths ranging from 363 mm (Llama Lake) to 503 mm (Reference Lake B). The dominant size classes of lake trout at Reference Lake B were between 401 to 500 mm. The dominant size classes of lake trout from Llama Lake ranged from 201 to 400 mm. Round whitefish were the second largest fish caught, with mean lengths ranging from 258 mm (Umwelt Lake) to 371 mm (Reference Lake B). The dominant size classes in Llama and Reference lakes fell between 381 to 420 mm, while the dominant size class at Umwelt Lake was much lower (201 to 240 mm). The mean length of Arctic grayling at Umwelt Lake was 261 mm and the dominant size class was between 281 to 320 mm.

Lake trout was also the heaviest species. Lake trout mean weights ranged from 772 g (Llama Lake) to 1,035 g (Reference Lake B). Round whitefish mean weight ranged from 195 g (Umwelt Lake) to 701 g (Reference Lake B). Arctic grayling mean weight in Umwelt Lake was 238 g.

Figure 3.2-5 shows weight-length regressions for all species for which more than eight individuals were sampled from a lake. The weight-length regression of lake trout sampled from Llama Lake was highly significant ($P<0.001$) and explained 98% of the variation in ln(weight). Similarly, the regression for Arctic grayling from Umwelt Lake was highly significant ($P<0.001$) and explained 99% of the variation in ln(weight). The weight-length regression for lake trout from Reference Lake B was also significant ($P<0.001$) and explained 87% of the variation in ln(weight).

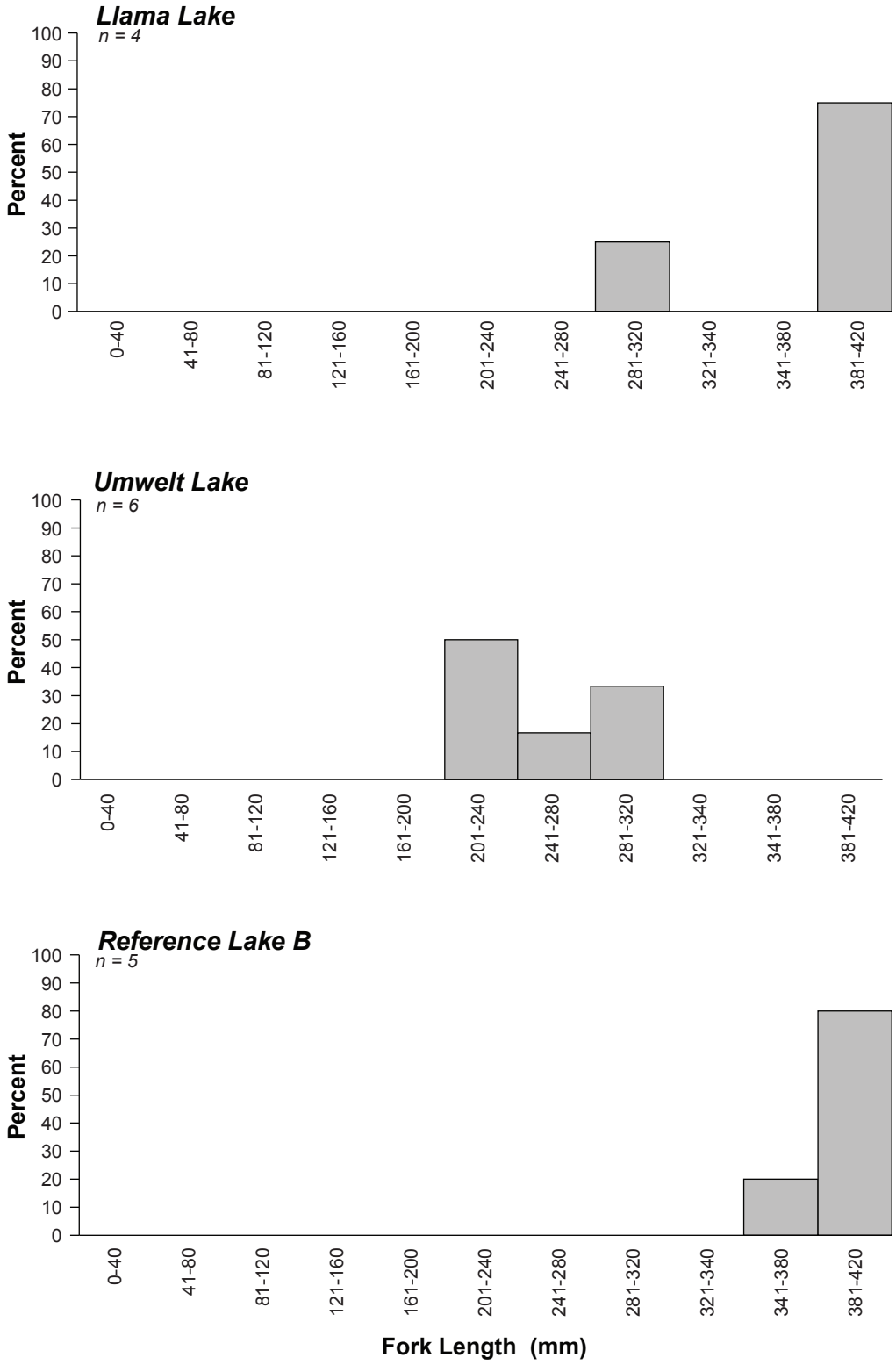


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Length-Frequency Distributions for Lake Trout Sampled from Lakes, Back River Project, 2010

Figure 3.2-2

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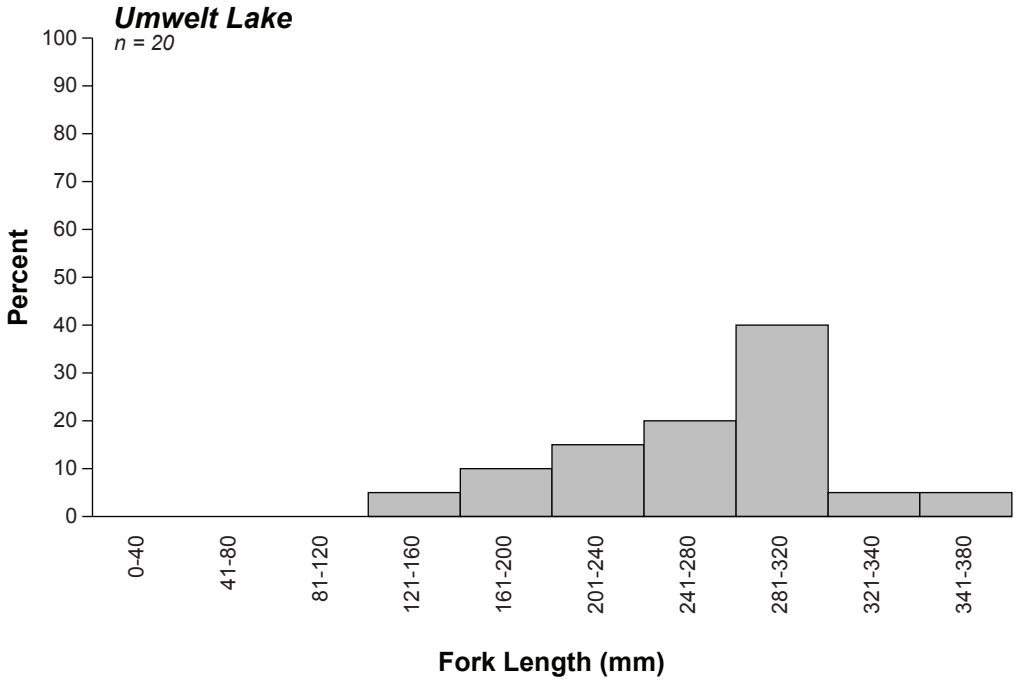


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Length-Frequency Distributions for Round Whitefish Sampled from Lakes, Back River Project, 2010

Figure 3.2-3

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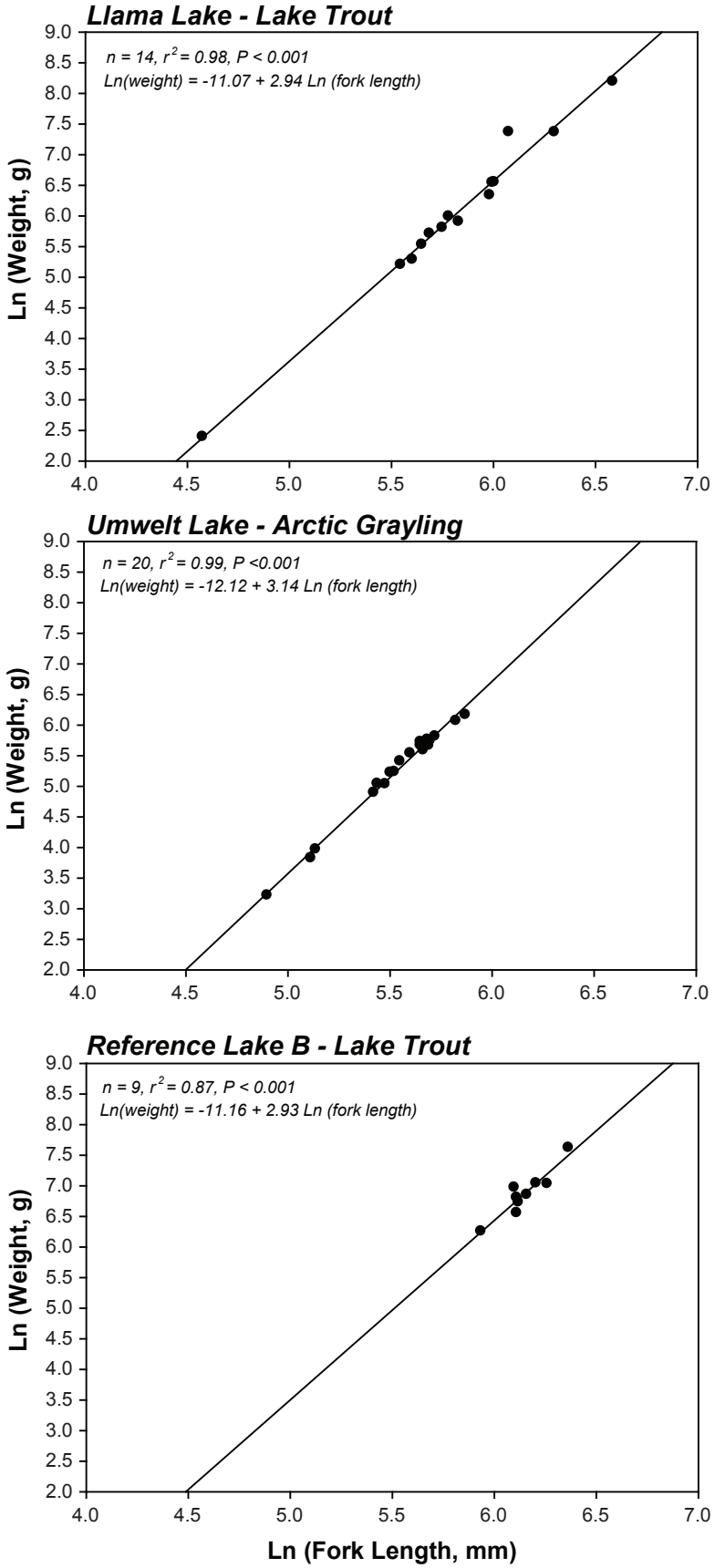


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Length-Frequency Distribution for Arctic Grayling Sampled from Umwelt Lake, Back River Project, 2010

Figure 3.2-4

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Weight-Length Regressions for Fish Sampled from Lakes, Back River Project, 2010

Figure 3.2-5

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Fork length and weight were also used to calculate condition values for each fish species per lake. Condition data are presented in Figure 3.2-6. Round whitefish showed the highest condition of the fish species sampled. Round whitefish mean condition ranged from 1.07 g/mm^3 (Umwelt Lake) to 1.21 g/mm^3 (Llama Lake). Lake trout condition ranged from 0.95 g/mm^3 (Reference Lake B) to 1.12 g/mm^3 (Llama Lake). Arctic grayling also displayed relatively high condition values in Umwelt Lake (mean 1.18 g/mm^3).

3.2.3.2 Age and Growth

Table 3.2-6 summarizes the age of fish species sampled in 2010. Arctic grayling, lake trout and round whitefish were sampled for age structures. The mean age of lake trout ranged from 12 years at Llama Lake to 16 years at Reference Lake B. The oldest lake trout was 26 years old, sampled from Llama Lake. Round whitefish displayed a wide range of mean ages between the lakes sampled. The mean age of round whitefish ranged from 3 years at Umwelt Lake to 13 years at Reference Lake B. Arctic grayling from Umwelt Lake ranged from 2 to 9 years, with a mean age of 5 years.

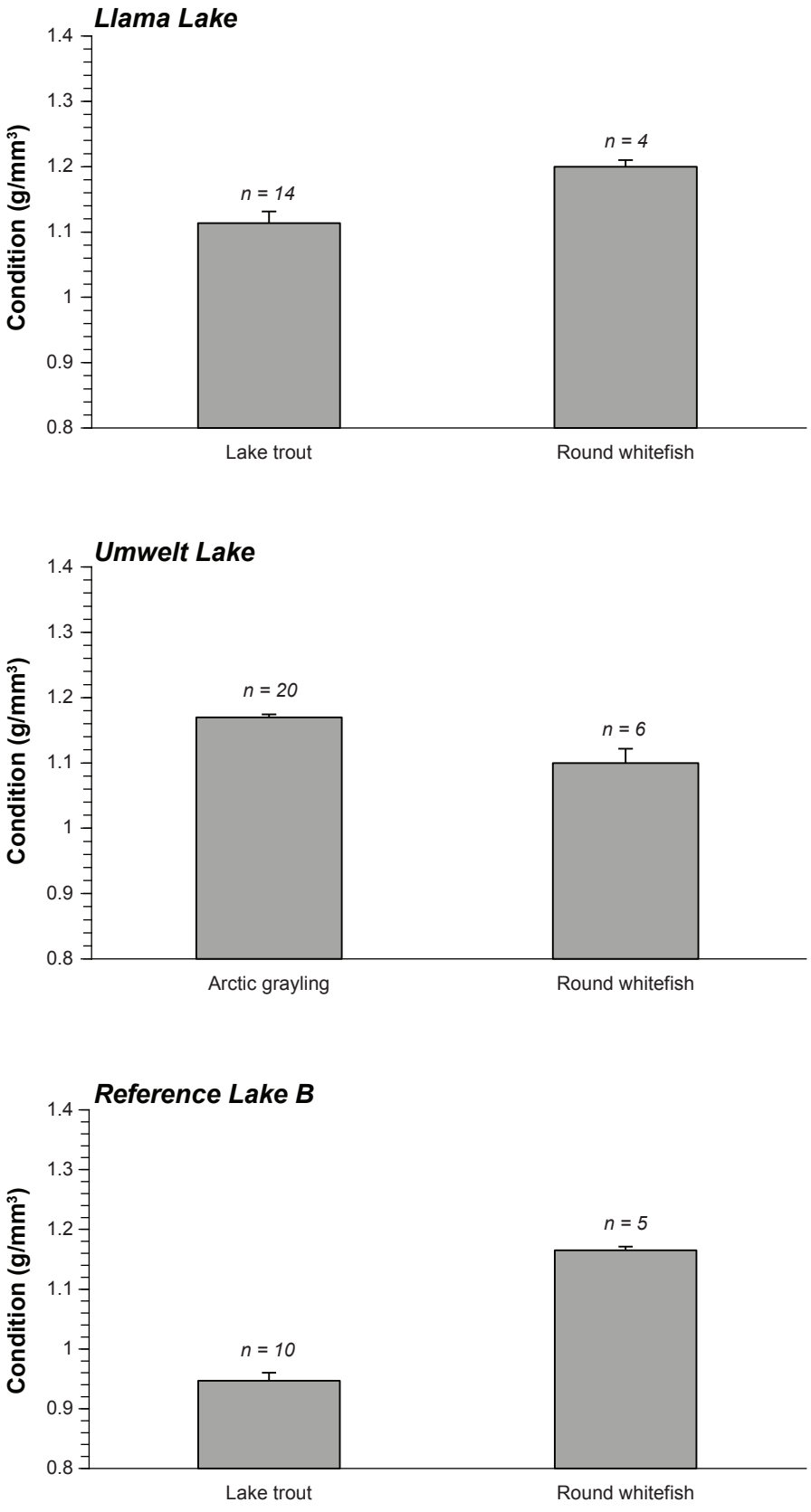
Table 3.2-6. Summary of Age Data for Sampled Fish, Back River Project, 2010

			Age (years)				
Lake	**Watershed**	**Species**	**n**	**Mean**	**SE**	**Min**	**Max**
Llama	Llama	LKTR	12	12	2.0	6	26
		RDWH	4	10	1.8	4	12
Umwelt	Llama	ARGR	14	5	0.6	2	9
		RDWH	5	3	0.4	2	4
Reference B	Reference	LKTR	8	16	1.4	8	22
		RDWH	5	13	0.3	12	14

Species codes: ARGR = Arctic grayling, LKTR = lake trout, RDWH = round whitefish
n = number, SE = standard error, min = minimum, max = maximum

Figures 3.2-7 to 3.2-9 show age-frequency distributions for lake trout, round whitefish and Arctic grayling, respectively. The age-frequency distributions for lake trout sampled from Llama and Reference Lake B show dominant age classes ranging from 5 to 9 years and 15 to 19 years, respectively. The age-frequency distributions for round whitefish sampled from Llama and Reference B lakes showed dominant age classes of 10 to 14 years, while the dominant age class for round whitefish sampled from Umwelt Lake was 0 to 4 years. The population of Arctic grayling sampled from Umwelt Lake is skewed toward younger fish, with the dominant age classes split between 0 to 4 and 5 to 9 years.

Figures 3.2-10 and 3.2-11 show von Bertalanffy growth models for lake trout and Arctic grayling, respectively. The von Bertalanffy growth models explained between 58 and 81% of the variation in length-at-age for lake trout sampled from Reference B and Llama lakes, respectively. Lake trout growth coefficients (K) varied from 0.100 year^{-1} (Llama Lake) to 0.193 year^{-1} (Reference Lake B). The von Bertalanffy growth model for Arctic grayling sampled from Umwelt Lake explained 94% of the variation in length-at-age, with a growth coefficient of 0.284 year^{-1}. von Bertalanffy growth models were not developed for round whitefish due to the low sample sizes for each lake.

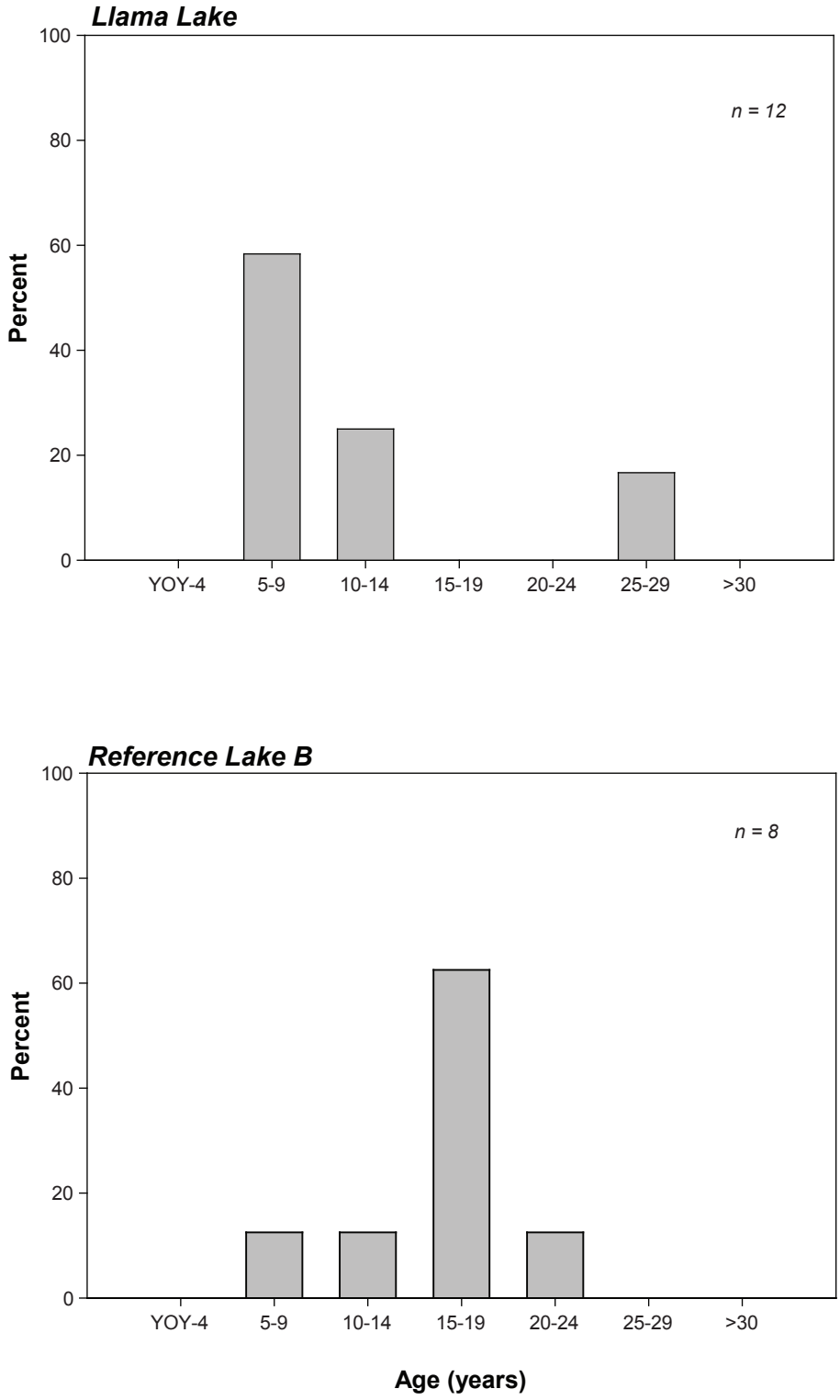


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Mean Condition of Fish Sampled from Lakes, Back River Project, 2010

Figure 3.2-6

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Age-Frequency Distributions for Lake Trout Sampled from Lakes, Back River Project, 2010

Figure 3.2-7

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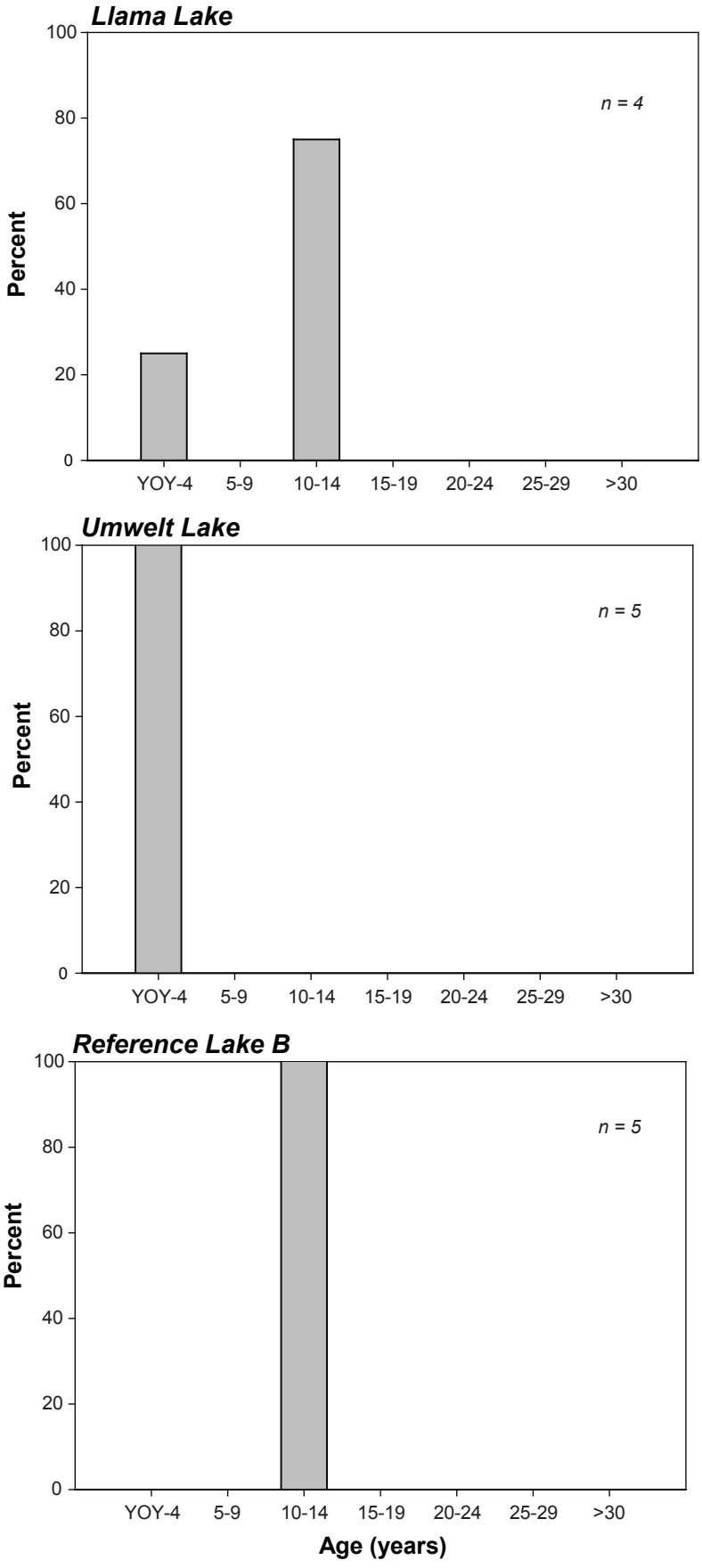
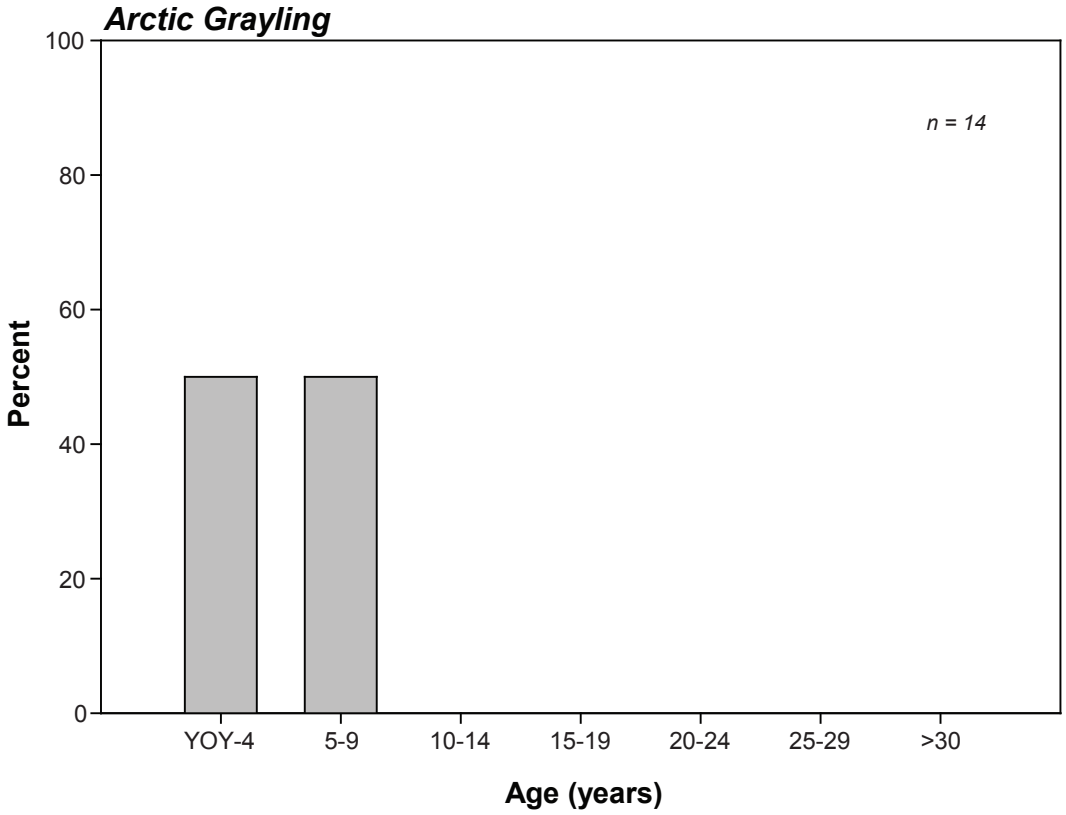


Figure 3.2-8

Age-Frequency Distributions for Round Whitefish Sampled from Lakes,Back River Project, 2010

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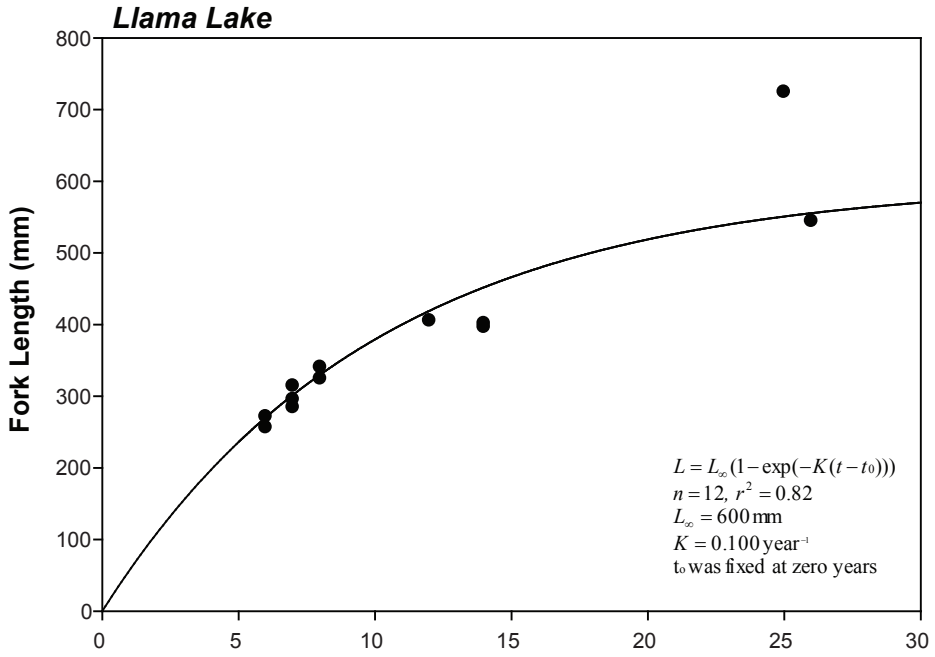


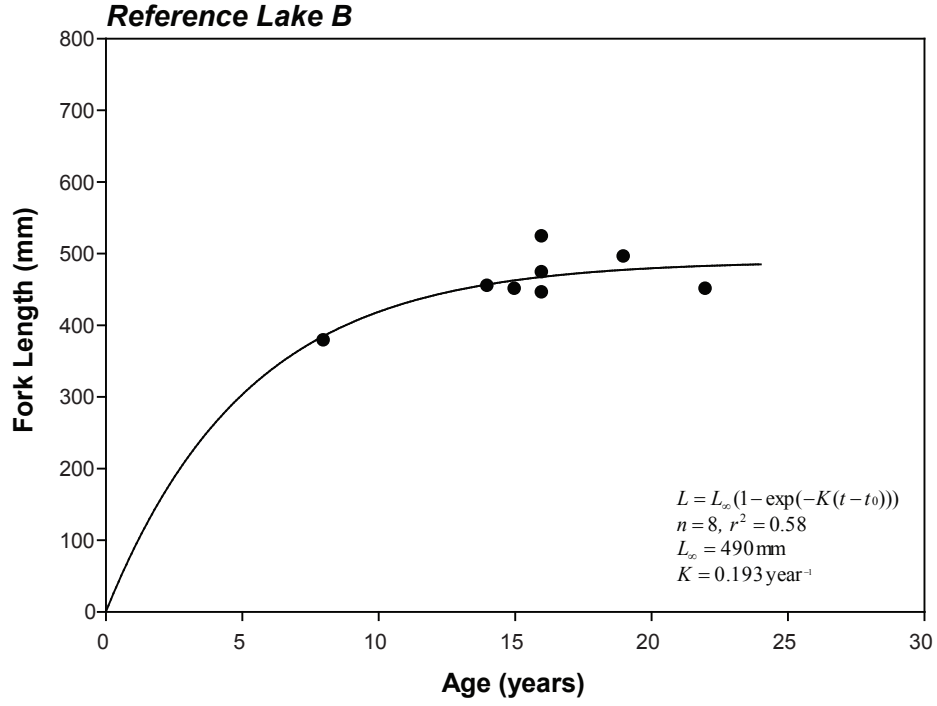
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Age-Frequency Distribution for Arctic Grayling Sampled from Umwelt Lake,Back River Project, 2010

Figure 3.2-9

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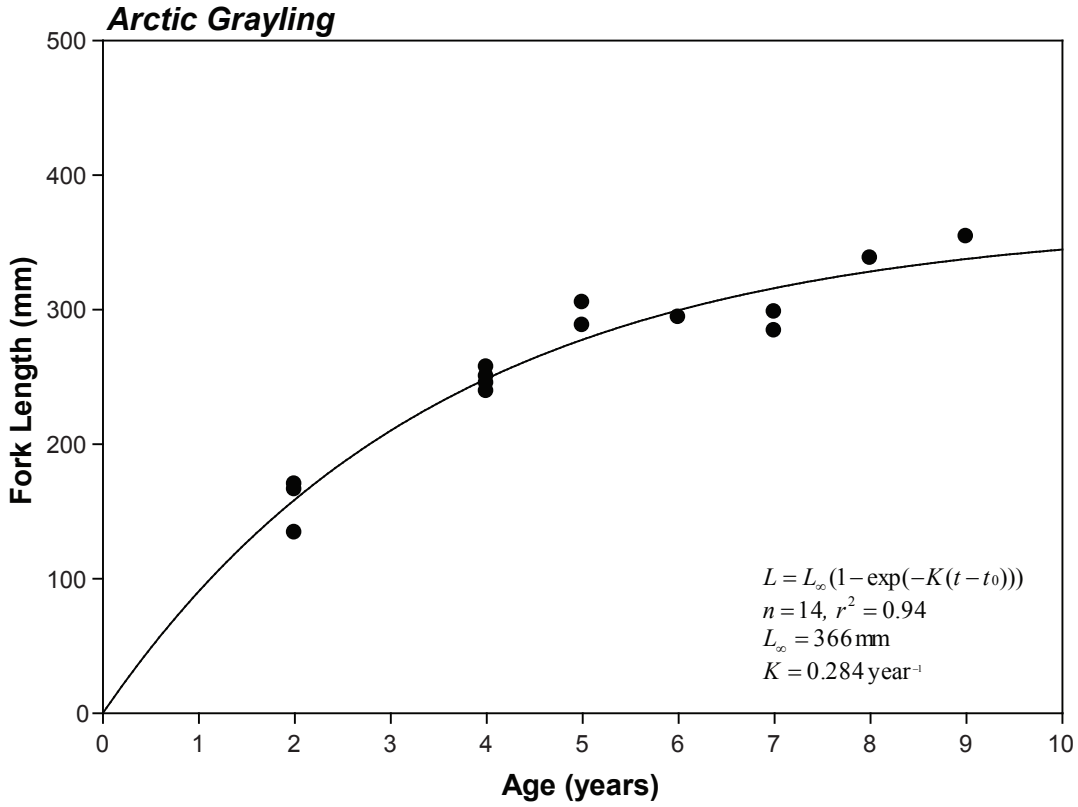


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von Bertalanffy Growth Models for Lake Trout Sampled from Lakes, Back River Project, 2010

Figure 3.2-10

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von Bertalanffy Growth Model for Arctic Grayling Sampled from Umwelt Lake, Back River Project, 2010

Figure 3.2-11

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4. Summary

4. Summary

4.1 FISH HABITAT

Habitat was evaluated using hydroacoustic methods at Llama and Umwelt lakes. Hydroacoustics was useful in assessing substrate in open water basins of lakes. Mixed hard substrates (e.g., cobble, boulder, bedrock) were found to be the predominant substrate type in lakes in the Project area, followed by fines (e.g., sand). The majority of fine substrate was coated with periphyton. Fine substrate such as sand or mud was most commonly found in the open water sections of lakes, while mixed hard substrates were associated with near-shore locations.

4.2 FISH COMMUNITY

The fish communities of three lakes (Llama, Umwelt and Reference B) were assessed in 2010. Fish communities were assessed using monofilament gillnets and minnow traps. A total of 15 gillnet sets were conducted, equalling approximately 90 hours of gillnetting effort. Minnow traps were used to assess the small-bodied fish community. A total of 53 minnow traps were deployed, which resulted in a total of 1,068 hours of minnow trapping effort exerted in the Project area.

This fishing effort resulted in the capture and sampling of 63 fish from the three water bodies surveyed. Fish communities of the Project area displayed very low species richness. A total of four species were identified, including Arctic grayling, lake trout, round whitefish and ninespine stickleback. Lake trout and Arctic grayling represented the majority of fish captured.

Hydroacoustic gear was used to estimate fish absolute abundance in Llama and Umwelt lakes. The total number of fish in Llama Lake was estimated at 226 with the 95% confidence limits ranging from 4 to 1,794. The total number of fish in Umwelt Lake was estimated at 155 with 95% confidence limits ranging from 5 to 864. Due to limitations of the hydroacoustics gear and survey timing, coupled with the shallow nature of Umwelt Lake, the fish abundance and population estimates produced for Llama and Umwelt lakes are considered conservative.

Aging analyses were conducted for Arctic grayling, lake trout and round whitefish. The ages of Arctic grayling sampled from Umwelt Lake ranged from 2 to 9 years, with a mean age of 5 years. Lake trout were the oldest fish sampled in the Project area, with ages ranging from 6 years to 26 years. Round whitefish displayed a wide range of ages, with mean age ranging from 3 to 13 years between lakes.

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Appendix 2.2-1

Set Times, Retrieval Times and Locations for Gillnets, Back River Project, 2010

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Appendix 2.2-1. Set Times, Retrieval Times and Locations for Gillnets, Back River Project, 2010

	Net	Net	Set		Retrieval		UTM 1		UTM 2		Catch per Species			
Water Body	Number	Type	Time	Date	Time	Date	Easting	Northing	Easting	Northing	ARGR	LKTR	RDWH	Total
Reference B	1	SGN	11:26	10-Aug-10	12:20	10-Aug-10	441826	7258851	441900	7258770	0	2	0	2
Reference B	2	SGN	12:30	10-Aug-10	13:26	10-Aug-10	441938	7258526	442000	7256423	0	2	1	3
Reference B	3	SGN	13:50	10-Aug-10	14:40	10-Aug-10	442000	7258401	441953	7258291	0	2	0	2
Reference B	4	FGN	14:40	10-Aug-10	16:40	10-Aug-10	441922	7258656	441869	7258533	0	1	0	1
Reference B	5	SGN	15:00	10-Aug-10	15:47	10-Aug-10	442007	7258430	441884	7258431	0	1	4	5
Reference B	6	SGN	16:00	10-Aug-10	16:55	10-Aug-10	442020	7258464	441955	7258352	0	2	0	2
Reference B	7	SGN	9:30	11-Aug-10	10:15	11-Aug-10	441880	7258866	441812	7258787	0	1	0	1
Llama	1	FGN	13:50	11-Aug-10	15:30	11-Aug-10	428685	7272025	428628	7272132	0	0	0	0
Llama	2	SMGN	14:20	11-Aug-10	15:50	11-Aug-10	428697	7272529	428231	7272454	0	0	0	0
Llama	3	SGN	15:20	11-Aug-10	16:50	11-Aug-10	428586	7272012	428467	7272070	0	1	0	1
Llama	4	FGN	15:40	11-Aug-10	9:45	12-Aug-10	428708	7272216	428809	7272160	0	11	4	15
Llama	5	SMGN	16:00	11-Aug-10	9:15	12-Aug-10	428655	7272330	428580	7272329	0	4	0	4
Umwelt	1	SMGN	13:15	12-Aug-10	16:20	12-Aug-10	428850	7271112	428833	7271045	0	0	0	0
Umwelt	2	FGN	13:30	12-Aug-10	9:45	13-Aug-10	428945	7270892	428939	7270986	4	0	0	4
Umwelt	3	SGN	14:20	12-Aug-10	9:15	13-Aug-10	428870	7270982	428892	7271091	16	0	6	22

Species codes: ARGR = Arctic grayling, LKTR = lake trout, RDWH = round whitefish

SGN = RISC standard sinking gillnet, FGN = RISC standard floating gillnet, SMGN = 19 mm mesh, 3-panel sinking gillnet

Sex: F=female, M=male, U=unknown; Maturity: M=mature, IM=immature

Dashes (-) indicate data not collected

Appendix 2.2-2

Set Times, Retrieval Times and Locations for Minnow Traps, Back River Project, 2010

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Appendix 2.2-2. Set Times, Retrieval Times and Locations for Minnow Traps, Back River Project, 2010

	Set	Set		Retrieval		UTM 1		Catch per
Water Body	Number	Time	Date	Time	Date	Easting	Northing	Species
Reference B	1	11:36	10-Aug-10	9:13	10-Aug-10	441855	7258400	No catch
Reference B	2	11:40	10-Aug-10	9:15	10-Aug-10	441914	7258300	No catch
Reference B	3	11:45	10-Aug-10	9:15	10-Aug-10	442021	7258256	No catch
Reference B	4	11:47	10-Aug-10	9:15	10-Aug-10	442160	7258360	No catch
Reference B	5	11:49	10-Aug-10	9:15	10-Aug-10	442202	7258381	No catch
Reference B	6	11:50	10-Aug-10	9:15	10-Aug-10	442183	7258478	No catch
Reference B	7	11:52	10-Aug-10	9:15	10-Aug-10	442188	7258528	No catch
Reference B	8	11:53	10-Aug-10	9:15	10-Aug-10	442214	7258459	No catch
Reference B	9	11:54	10-Aug-10	9:15	10-Aug-10	442239	7258577	No catch
Reference B	10	11:55	10-Aug-10	9:15	10-Aug-10	442264	7258600	No catch
Reference B	11	11:56	10-Aug-10	9:15	10-Aug-10	442270	7258618	No catch
Reference B	12	11:59	10-Aug-10	9:15	10-Aug-10	442248	7258669	No catch
Reference B	13	12:02	10-Aug-10	9:15	10-Aug-10	442218	7258693	No catch
Reference B	14	12:10	10-Aug-10	9:25	10-Aug-10	441726	7259218	No catch
Reference B	15	12:11	10-Aug-10	9:25	10-Aug-10	441711	7259219	No catch
Reference B	16	12:12	10-Aug-10	9:25	10-Aug-10	441709	7259211	No catch
Reference B	17	12:15	10-Aug-10	9:25	10-Aug-10	441710	7259198	No catch
Reference B	18	12:16	10-Aug-10	9:25	10-Aug-10	441703	7259176	No catch
Llama	1	16:01	11-Aug-10	11:00	11-Aug-10	428554	7272316	No catch
Llama	2	16:01	11-Aug-10	11:00	11-Aug-10	428564	7272257	No catch
Llama	3	16:01	11-Aug-10	11:00	11-Aug-10	428546	7272210	No catch
Llama	4	16:01	11-Aug-10	11:00	11-Aug-10	428488	7272184	No catch
Llama	5	16:01	11-Aug-10	11:00	11-Aug-10	428446	7272180	No catch
Llama	6	16:01	11-Aug-10	11:00	11-Aug-10	428391	7272124	No catch
Llama	7	16:01	11-Aug-10	11:00	11-Aug-10	428419	7272074	No catch
Llama	8	16:01	11-Aug-10	11:00	11-Aug-10	428458	7271991	No catch
Llama	9	16:01	11-Aug-10	11:00	11-Aug-10	428518	7271956	No catch
Llama	10	16:01	11-Aug-10	11:00	11-Aug-10	428570	7271901	No catch
Llama	11	16:01	11-Aug-10	11:00	11-Aug-10	428731	7271863	No catch
Llama	12	16:01	11-Aug-10	11:00	11-Aug-10	428836	7272036	No catch
Llama	13	16:01	11-Aug-10	11:00	11-Aug-10	428858	7272165	No catch
Llama	14	16:01	11-Aug-10	11:00	11-Aug-10	428837	7272347	No catch
Llama	15	16:01	11-Aug-10	11:00	11-Aug-10	428735	7272590	No catch
Llama	16	16:01	11-Aug-10	11:00	11-Aug-10	428679	7272699	No catch
Llama	17	16:01	11-Aug-10	11:00	11-Aug-10	428576	7272768	No catch
Llama	18	16:01	11-Aug-10	11:00	11-Aug-10	428561	7272761	No catch
Umwelt	1	13:00	12-Aug-10	9:00	12-Aug-10	428991	7270971	No catch
Umwelt	2	13:00	12-Aug-10	9:00	12-Aug-10	428949	7271044	No catch
Umwelt	3	13:00	12-Aug-10	9:00	12-Aug-10	428860	7271115	No catch
Umwelt	4	13:00	12-Aug-10	9:00	12-Aug-10	428814	7271184	No catch
Umwelt	5	13:00	12-Aug-10	9:00	12-Aug-10	428746	7271254	No catch
Umwelt	6	13:00	12-Aug-10	9:00	12-Aug-10	428646	7271331	No catch
Umwelt	7	13:00	12-Aug-10	9:00	12-Aug-10	428553	7271359	1 NSSB
Umwelt	8	13:00	12-Aug-10	9:00	12-Aug-10	428574	7271306	No catch
Umwelt	9	13:00	12-Aug-10	9:00	12-Aug-10	428744	7271077	No catch
Umwelt	10	13:00	12-Aug-10	9:00	12-Aug-10	428797	7271008	No catch
Umwelt	11	13:00	12-Aug-10	9:00	12-Aug-10	428869	7270930	No catch
Umwelt	12	13:00	12-Aug-10	9:00	12-Aug-10	428918	7270878	No catch
Umwelt	13	13:00	12-Aug-10	9:00	12-Aug-10	428953	7270837	No catch
Umwelt	14	13:00	12-Aug-10	9:00	12-Aug-10	428025	7270792	No catch
Umwelt	15	13:00	12-Aug-10	9:00	12-Aug-10	428022	7270730	No catch
Umwelt	16	13:00	12-Aug-10	9:00	12-Aug-10	428664	7270729	No catch
Umwelt	17	13:40	12-Aug-10	9:00	12-Aug-10	429029	7270884	No catch

Species codes: NSSB = ninespine stickleback

Dashes (-) indicate data not collected

Appendix 3.1-1

Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Goose Project, 2010

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Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.56608	-106.5465567	7.03	2
8/10/2010	65.5684283	-106.5484317	3.52	1
8/10/2010	65.5650917	-106.5478933	1.71	2
8/10/2010	65.56313	-106.5506467	2.21	5
8/10/2010	65.5641933	-106.5405217	1.35	2
8/10/2010	65.56168	-106.5475417	2.22	2
8/10/2010	65.5650667	-106.54784	5.32	5
8/10/2010	65.5616933	-106.5449233	1.03	2
8/10/2010	65.5660917	-106.5465583	7.05	4
8/10/2010	65.5684367	-106.5484467	3.35	5
8/10/2010	65.56509	-106.54788	2.05	4
8/10/2010	65.5631317	-106.550625	2.24	1
8/10/2010	65.564185	-106.5405283	1.18	2
8/10/2010	65.56168	-106.547515	2.22	2
8/10/2010	65.5650667	-106.54784	5.25	2
8/10/2010	65.5617067	-106.5449233	1.03	2
8/10/2010	65.5661017	-106.5465617	7.12	2
8/10/2010	65.5684433	-106.5484617	3.28	1
8/10/2010	65.5650883	-106.547865	2.19	2
8/10/2010	65.5631317	-106.5506033	2.28	1
8/10/2010	65.5641767	-106.5405383	1.11	4
8/10/2010	65.56168	-106.5474883	2.28	2
8/10/2010	65.5650767	-106.547835	5.32	4
8/10/2010	65.56172	-106.5449233	1.08	2
8/10/2010	65.5661117	-106.5465633	7.17	2
8/10/2010	65.5684517	-106.5484767	3.13	1
8/10/2010	65.5650883	-106.54785	3.2	4
8/10/2010	65.5631333	-106.5505817	2.31	1
8/10/2010	65.5641717	-106.5405517	1.04	2
8/10/2010	65.5616833	-106.5474633	2.28	2
8/10/2010	65.5650767	-106.547835	5.32	5
8/10/2010	65.5617333	-106.544925	1.2	2
8/10/2010	65.5661217	-106.5465667	7.25	2
8/10/2010	65.5684583	-106.5484933	2.79	5
8/10/2010	65.56509	-106.5478317	3.52	2
8/10/2010	65.5631367	-106.5505583	2.38	1
8/10/2010	65.5641667	-106.5405683	1.03	2
8/10/2010	65.5616867	-106.5474367	2.28	2
8/10/2010	65.5650883	-106.5478317	5.42	5
8/10/2010	65.5617467	-106.5449267	1.2	2
8/10/2010	65.5661317	-106.54657	7.31	2
8/10/2010	65.568465	-106.5485083	2.7	5
8/10/2010	65.5661167	-106.5484833	1.27	2
8/10/2010	65.5650917	-106.547815	3.83	2
8/10/2010	65.56314	-106.550535	2.41	1
8/10/2010	65.5641617	-106.5405867	1.13	4
8/10/2010	65.56169	-106.54741	2.29	2
8/10/2010	65.5650883	-106.5478317	5.53	5
8/10/2010	65.5617617	-106.5449267	1.2	2
8/10/2010	65.5661433	-106.546575	7.34	2
8/10/2010	65.5684717	-106.548525	2.57	5
8/10/2010	65.5661133	-106.5484667	1.59	2
8/10/2010	65.565095	-106.5477967	4.4	4
8/10/2010	65.563145	-106.5505117	2.38	1
8/10/2010	65.5641583	-106.5406067	1.04	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.561695	-106.547385	2.29	2
8/10/2010	65.5650983	-106.5478283	5.63	5
8/10/2010	65.561775	-106.5449267	1.16	2
8/10/2010	65.5661533	-106.5465783	7.39	2
8/10/2010	65.5684783	-106.5485417	2.51	5
8/10/2010	65.56611	-106.5484483	1.95	2
8/10/2010	65.5650983	-106.5477783	4.59	2
8/10/2010	65.56315	-106.5504867	2.4	1
8/10/2010	65.5617	-106.5473583	2.31	2
8/10/2010	65.5650983	-106.5478283	5.68	5
8/10/2010	65.5617883	-106.5449283	1.27	4
8/10/2010	65.566165	-106.5465833	7.44	2
8/10/2010	65.568485	-106.5485583	2.36	2
8/10/2010	65.5661083	-106.5484283	2.07	4
8/10/2010	65.5651033	-106.54776	5.51	4
8/10/2010	65.5631533	-106.5504633	2.38	1
8/10/2010	65.5641533	-106.54065	1.09	2
8/10/2010	65.561705	-106.54733	2.33	5
8/10/2010	65.5650983	-106.5478283	5.61	5
8/10/2010	65.5618017	-106.5449283	1.27	0
8/10/2010	65.5661767	-106.5465867	7.39	2
8/10/2010	65.5684917	-106.548575	2.24	0
8/10/2010	65.566105	-106.54841	2.81	4
8/10/2010	65.5651067	-106.54774	5.35	2
8/10/2010	65.5631583	-106.5504383	2.36	1
8/10/2010	65.56415	-106.5406717	1.08	2
8/10/2010	65.56171	-106.5473017	2.33	5
8/10/2010	65.5651083	-106.5478283	5.71	5
8/10/2010	65.561815	-106.5449283	1.28	2
8/10/2010	65.5661867	-106.54659	7.51	2
8/10/2010	65.5684983	-106.5485933	2.04	2
8/10/2010	65.567665	-106.5443267	1.11	2
8/10/2010	65.5661033	-106.5483917	3.11	2
8/10/2010	65.5651117	-106.54772	5.94	4
8/10/2010	65.563165	-106.5504133	2.34	1
8/10/2010	65.561715	-106.5472733	2.34	2
8/10/2010	65.5651083	-106.5478283	5.94	5
8/10/2010	65.56183	-106.54493	1.27	2
8/10/2010	65.5661983	-106.5465933	7.58	2
8/10/2010	65.5685033	-106.5486117	1.75	2
8/10/2010	65.56766	-106.5443433	1.47	2
8/10/2010	65.5661033	-106.5483717	3.83	2
8/10/2010	65.565115	-106.5476983	6.12	4
8/10/2010	65.56317	-106.5503883	2.31	1
8/10/2010	65.5641433	-106.5407167	1.13	0
8/10/2010	65.5617217	-106.5472467	2.34	2
8/10/2010	65.5651083	-106.5478283	5.83	5
8/10/2010	65.5618433	-106.5449317	1.3	0
8/10/2010	65.5662083	-106.5465983	7.63	2
8/10/2010	65.5676567	-106.54436	1.86	2
8/10/2010	65.5661017	-106.54835	4.76	4
8/10/2010	65.5651183	-106.5476783	6.54	4
8/10/2010	65.5631767	-106.5503633	2.31	1
8/10/2010	65.56414	-106.54074	1.18	2
8/10/2010	65.5617267	-106.5472183	2.36	5

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5651083	-106.5478283	5.99	4
8/10/2010	65.5618567	-106.5449333	1.32	2
8/10/2010	65.56622	-106.5466017	7.65	2
8/10/2010	65.5676533	-106.5443783	2.26	4
8/10/2010	65.5661017	-106.5483283	5.15	4
8/10/2010	65.5659883	-106.54259	1.04	2
8/10/2010	65.5651233	-106.5476583	6.59	2
8/10/2010	65.5631817	-106.5503367	2.31	1
8/10/2010	65.5641383	-106.5407617	1.16	2
8/10/2010	65.5617333	-106.54719	2.36	2
8/10/2010	65.5651083	-106.5478283	6.01	0
8/10/2010	65.56187	-106.5449333	1.4	2
8/10/2010	65.56623	-106.5466067	7.66	2
8/10/2010	65.5676517	-106.544395	2.67	4
8/10/2010	65.5661017	-106.5483083	5.8	2
8/10/2010	65.56599	-106.5426117	1.44	0
8/10/2010	65.5651283	-106.5476383	6.76	4
8/10/2010	65.5631867	-106.5503117	2.29	1
8/10/2010	65.564135	-106.540785	1.16	0
8/10/2010	65.5617383	-106.5471617	2.36	2
8/10/2010	65.5651083	-106.5478283	5.9	2
8/10/2010	65.5618833	-106.544935	1.4	0
8/10/2010	65.56624	-106.54661	7.68	2
8/10/2010	65.5676517	-106.5444117	3.18	2
8/10/2010	65.5661017	-106.5482867	5.85	2
8/10/2010	65.56599	-106.5426117	2.24	4
8/10/2010	65.5651333	-106.5476183	6.79	2
8/10/2010	65.5631917	-106.5502867	2.28	1
8/10/2010	65.56413	-106.5408083	1.16	2
8/10/2010	65.561745	-106.5471333	2.4	2
8/10/2010	65.5651083	-106.5478283	6.01	5
8/10/2010	65.5618967	-106.544935	1.35	2
8/10/2010	65.5662517	-106.5466133	7.68	2
8/10/2010	65.56765	-106.54443	3.46	2
8/10/2010	65.5661033	-106.5482633	6.64	2
8/10/2010	65.5659933	-106.5426533	2.38	2
8/10/2010	65.5651383	-106.5475967	6.86	4
8/10/2010	65.5631983	-106.5502617	2.26	1
8/10/2010	65.5641267	-106.5408317	1.15	2
8/10/2010	65.56175	-106.547105	2.38	5
8/10/2010	65.5651083	-106.5478283	6.12	2
8/10/2010	65.56191	-106.5449367	1.39	2
8/10/2010	65.5662617	-106.5466167	7.66	2
8/10/2010	65.56765	-106.5444483	3.61	2
8/10/2010	65.566105	-106.54824	7.05	2
8/10/2010	65.565995	-106.542675	3.01	2
8/10/2010	65.5651417	-106.547575	6.89	4
8/10/2010	65.5632033	-106.5502367	2.24	1
8/10/2010	65.5641217	-106.540855	1.18	4
8/10/2010	65.561755	-106.5470783	2.4	5
8/10/2010	65.5651083	-106.5478283	6.16	5
8/10/2010	65.5619233	-106.5449367	1.39	0
8/10/2010	65.5662717	-106.54662	7.65	2
8/10/2010	65.56765	-106.5444667	3.63	2
8/10/2010	65.566105	-106.54824	7.2	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.565995	-106.5426967	3.15	2
8/10/2010	65.5651467	-106.5475533	7.01	4
8/10/2010	65.5632083	-106.5502117	2.19	1
8/10/2010	65.56412	-106.5408767	1.25	2
8/10/2010	65.56176	-106.5470517	2.4	2
8/10/2010	65.5651083	-106.5478283	6.11	5
8/10/2010	65.5619367	-106.5449383	1.44	2
8/10/2010	65.5662833	-106.5466233	7.54	2
8/10/2010	65.5676517	-106.5444867	3.66	2
8/10/2010	65.5661067	-106.548195	7.78	2
8/10/2010	65.5659967	-106.5427183	3.13	2
8/10/2010	65.5651533	-106.5475333	7	4
8/10/2010	65.5632133	-106.5501867	2.17	1
8/10/2010	65.5641167	-106.5409017	1.27	4
8/10/2010	65.561765	-106.547025	2.41	1
8/10/2010	65.5651083	-106.5478283	6.12	4
8/10/2010	65.56195	-106.54494	1.47	4
8/10/2010	65.5662933	-106.5466267	7.6	2
8/10/2010	65.5676533	-106.5445067	3.64	2
8/10/2010	65.5661067	-106.5481717	7.78	2
8/10/2010	65.566	-106.5427383	3.17	2
8/10/2010	65.5651583	-106.5475133	7.07	4
8/10/2010	65.56322	-106.5501617	2.14	1
8/10/2010	65.564115	-106.540925	1.3	0
8/10/2010	65.5617717	-106.5469983	2.4	1
8/10/2010	65.5651083	-106.5478283	6.09	5
8/10/2010	65.5619633	-106.5449433	1.49	2
8/10/2010	65.566305	-106.54663	7.54	2
8/10/2010	65.5676533	-106.5445267	3.75	2
8/10/2010	65.5661083	-106.54815	8.42	4
8/10/2010	65.5660017	-106.54276	3.17	2
8/10/2010	65.565165	-106.5474917	7.31	0
8/10/2010	65.563225	-106.5501367	2.12	1
8/10/2010	65.5641117	-106.5409483	1.3	0
8/10/2010	65.5617767	-106.5469717	2.45	5
8/10/2010	65.5651083	-106.5478283	5.8	4
8/10/2010	65.5619783	-106.544945	1.49	4
8/10/2010	65.566315	-106.5466333	7.53	2
8/10/2010	65.5676533	-106.5445467	3.71	2
8/10/2010	65.5661083	-106.5481267	8.83	4
8/10/2010	65.5660017	-106.5427817	3.17	2
8/10/2010	65.56517	-106.5474717	7.46	4
8/10/2010	65.5632317	-106.5501133	2.07	2
8/10/2010	65.56411	-106.5409717	1.32	4
8/10/2010	65.5617817	-106.5469433	2.43	5
8/10/2010	65.5651083	-106.5478283	6.02	2
8/10/2010	65.5619917	-106.5449467	1.45	0
8/10/2010	65.5663267	-106.546635	7.44	2
8/10/2010	65.5676533	-106.54457	3.68	2
8/10/2010	65.5661117	-106.5481033	8.88	2
8/10/2010	65.5660033	-106.542805	3.17	2
8/10/2010	65.56517	-106.5474717	7.65	4
8/10/2010	65.5632367	-106.5500883	2.07	2
8/10/2010	65.5641067	-106.5409967	1.28	0
8/10/2010	65.5617867	-106.5469167	2.46	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5651217	-106.54783	6.02	2
8/10/2010	65.562005	-106.5449483	1.44	2
8/10/2010	65.5663367	-106.5466383	7.46	2
8/10/2010	65.567655	-106.5445917	3.68	2
8/10/2010	65.566115	-106.54808	9.02	1
8/10/2010	65.566005	-106.5428267	3.18	2
8/10/2010	65.56518	-106.5474317	7.72	4
8/10/2010	65.5632433	-106.550065	2.07	2
8/10/2010	65.5641033	-106.5410217	1.33	0
8/10/2010	65.5617917	-106.54689	2.45	1
8/10/2010	65.5651333	-106.5478317	5.78	2
8/10/2010	65.56202	-106.54495	1.33	2
8/10/2010	65.5663483	-106.54664	7.41	2
8/10/2010	65.567655	-106.5446133	3.71	1
8/10/2010	65.5661183	-106.5480583	9.05	1
8/10/2010	65.5660067	-106.5428517	3.13	2
8/10/2010	65.5651867	-106.5474117	7.84	2
8/10/2010	65.5632483	-106.55004	2.05	2
8/10/2010	65.5641017	-106.541045	1.25	2
8/10/2010	65.5617967	-106.5468633	2.46	1
8/10/2010	65.565145	-106.547835	5.8	4
8/10/2010	65.5620333	-106.5449517	1.39	2
8/10/2010	65.5663583	-106.5466433	7.41	2
8/10/2010	65.567655	-106.544635	3.71	0
8/10/2010	65.5661217	-106.5480367	9.12	1
8/10/2010	65.5660083	-106.5428733	3.17	2
8/10/2010	65.5651917	-106.54739	7.84	4
8/10/2010	65.5632533	-106.5500167	2.07	2
8/10/2010	65.5640983	-106.54107	1.28	0
8/10/2010	65.5618033	-106.5468367	2.48	1
8/10/2010	65.5651567	-106.5478367	5.68	4
8/10/2010	65.5620467	-106.5449533	1.47	4
8/10/2010	65.56637	-106.546645	7.31	2
8/10/2010	65.567655	-106.544655	3.75	2
8/10/2010	65.5661233	-106.5480167	9.15	1
8/10/2010	65.56601	-106.542895	3.22	2
8/10/2010	65.5651983	-106.54737	7.97	4
8/10/2010	65.5635917	-106.55066	1.03	4
8/10/2010	65.56326	-106.5499917	2.07	1
8/10/2010	65.5640967	-106.541095	1.32	4
8/10/2010	65.5618083	-106.54681	2.5	1
8/10/2010	65.5651667	-106.5478383	5.68	2
8/10/2010	65.56206	-106.544955	1.49	2
8/10/2010	65.56638	-106.5466483	7.34	2
8/10/2010	65.567655	-106.544675	3.75	0
8/10/2010	65.5661267	-106.5479967	9.17	1
8/10/2010	65.5660117	-106.5429167	3.22	2
8/10/2010	65.5652033	-106.54735	7.96	4
8/10/2010	65.5635817	-106.5506617	1.04	2
8/10/2010	65.5632667	-106.5499667	2.12	1
8/10/2010	65.5640933	-106.54112	1.39	2
8/10/2010	65.561815	-106.5467833	2.5	1
8/10/2010	65.5651783	-106.54784	5.59	4
8/10/2010	65.5620733	-106.5449567	1.56	2
8/10/2010	65.5663917	-106.5466517	7.31	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5676533	-106.544695	3.76	1
8/10/2010	65.5661283	-106.5479767	9.19	1
8/10/2010	65.566015	-106.5429383	3.23	2
8/10/2010	65.56521	-106.54733	8.02	4
8/10/2010	65.5632733	-106.5499417	2.19	1
8/10/2010	65.56409	-106.5411433	1.21	2
8/10/2010	65.5618217	-106.5467567	2.51	1
8/10/2010	65.5651883	-106.5478433	5.47	0
8/10/2010	65.5620867	-106.5449583	1.49	2
8/10/2010	65.5664033	-106.5466567	7.31	2
8/10/2010	65.5676533	-106.5447167	3.78	1
8/10/2010	65.5661317	-106.547955	9.17	1
8/10/2010	65.5660183	-106.54296	3.25	2
8/10/2010	65.565215	-106.5473083	8.06	4
8/10/2010	65.5632783	-106.5499183	2.22	1
8/10/2010	65.5640883	-106.5411683	1.35	0
8/10/2010	65.5618267	-106.54673	2.53	1
8/10/2010	65.5651967	-106.5478467	5.17	4
8/10/2010	65.5621	-106.54496	1.49	2
8/10/2010	65.5664133	-106.54666	7.32	2
8/10/2010	65.5676533	-106.5447383	3.75	5
8/10/2010	65.5661367	-106.5479333	9.07	1
8/10/2010	65.56602	-106.5429817	3.28	2
8/10/2010	65.5652217	-106.5472867	8.09	2
8/10/2010	65.5656417	-106.5424467	1.33	2
8/10/2010	65.563285	-106.5498933	2.22	1
8/10/2010	65.5640867	-106.5411933	1.08	2
8/10/2010	65.5618333	-106.5467033	2.51	1
8/10/2010	65.5652067	-106.5478517	5.18	4
8/10/2010	65.5621133	-106.5449617	1.52	0
8/10/2010	65.566425	-106.5466633	7.24	2
8/10/2010	65.5676533	-106.5447617	3.75	1
8/10/2010	65.56614	-106.5479117	9	3
8/10/2010	65.5660217	-106.5430033	3.28	2
8/10/2010	65.5652267	-106.547265	8.13	0
8/10/2010	65.56564	-106.5424667	1.47	2
8/10/2010	65.56329	-106.5498683	2.21	1
8/10/2010	65.564085	-106.5412167	1.06	2
8/10/2010	65.5618417	-106.546675	2.51	1
8/10/2010	65.565215	-106.547855	5.3	4
8/10/2010	65.5621267	-106.5449633	1.42	2
8/10/2010	65.566435	-106.5466683	7.27	2
8/10/2010	65.5676533	-106.5447833	3.78	1
8/10/2010	65.566145	-106.54789	8.93	1
8/10/2010	65.5660233	-106.5430267	3.28	2
8/10/2010	65.5652317	-106.5472417	8.14	2
8/10/2010	65.5656383	-106.5424867	1.73	2
8/10/2010	65.5635333	-106.5506717	1.03	0
8/10/2010	65.563295	-106.549845	2.19	1
8/10/2010	65.5640833	-106.5412417	1.18	2
8/10/2010	65.5618483	-106.5466483	2.53	1
8/10/2010	65.565225	-106.5478567	5.27	2
8/10/2010	65.5621417	-106.544965	1.61	0
8/10/2010	65.5664467	-106.5466717	7.27	2
8/10/2010	65.5676517	-106.544805	3.78	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5661467	-106.5478683	8.86	3
8/10/2010	65.5660267	-106.5430483	3.3	2
8/10/2010	65.5652367	-106.54722	8.09	0
8/10/2010	65.5656367	-106.5425067	1.76	2
8/10/2010	65.5635233	-106.5506733	1.04	2
8/10/2010	65.5633	-106.54982	2.19	1
8/10/2010	65.56408	-106.5412667	1.15	2
8/10/2010	65.561855	-106.5466217	2.53	1
8/10/2010	65.5652333	-106.5478583	5.2	4
8/10/2010	65.562155	-106.5449667	1.61	4
8/10/2010	65.5664567	-106.5466767	7.25	2
8/10/2010	65.5676517	-106.5448267	3.85	1
8/10/2010	65.56615	-106.5478467	8.79	3
8/10/2010	65.5660283	-106.54307	3.32	2
8/10/2010	65.5652433	-106.5472	8.02	1
8/10/2010	65.565635	-106.5425267	1.73	2
8/10/2010	65.563515	-106.550675	1.06	4
8/10/2010	65.5633067	-106.549795	2.19	1
8/10/2010	65.5640783	-106.54129	1.2	2
8/10/2010	65.5618617	-106.5465933	2.55	5
8/10/2010	65.5652417	-106.5478583	5.05	4
8/10/2010	65.5621683	-106.54497	1.59	4
8/10/2010	65.5664683	-106.54668	7.25	2
8/10/2010	65.5676517	-106.5448483	3.83	1
8/10/2010	65.5661533	-106.547825	8.73	3
8/10/2010	65.56603	-106.5430917	3.34	2
8/10/2010	65.56525	-106.5471783	7.9	1
8/10/2010	65.565635	-106.5425467	1.52	2
8/10/2010	65.563505	-106.5506767	1.08	4
8/10/2010	65.5633117	-106.5497717	2.17	1
8/10/2010	65.5640767	-106.5413133	1.15	2
8/10/2010	65.5618683	-106.5465667	2.57	1
8/10/2010	65.56525	-106.5478567	5.24	4
8/10/2010	65.5621817	-106.5449717	1.54	2
8/10/2010	65.56648	-106.5466833	7.25	2
8/10/2010	65.5676517	-106.54487	3.87	1
8/10/2010	65.5661567	-106.547805	8.64	1
8/10/2010	65.5660333	-106.5431133	3.28	2
8/10/2010	65.5652567	-106.5471567	7.84	0
8/10/2010	65.565635	-106.5425667	1.73	2
8/10/2010	65.563495	-106.5506783	1.08	0
8/10/2010	65.5633167	-106.5497467	2.17	1
8/10/2010	65.561875	-106.5465383	2.55	1
8/10/2010	65.5652567	-106.547855	5.18	2
8/10/2010	65.562195	-106.5449733	1.64	2
8/10/2010	65.56649	-106.5466867	7.29	2
8/10/2010	65.56765	-106.54489	3.9	1
8/10/2010	65.56616	-106.547785	8.59	3
8/10/2010	65.566035	-106.543135	3.37	2
8/10/2010	65.5652617	-106.547135	7.77	0
8/10/2010	65.565635	-106.5425883	1.68	4
8/10/2010	65.563485	-106.55068	1.06	2
8/10/2010	65.5633217	-106.5497233	2.14	1
8/10/2010	65.5640717	-106.54136	1.08	2
8/10/2010	65.5618817	-106.54651	2.48	5

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.565265	-106.547855	5.2	2
8/10/2010	65.5622083	-106.5449767	1.63	2
8/10/2010	65.5665017	-106.5466917	7.22	2
8/10/2010	65.56765	-106.54489	3.88	1
8/10/2010	65.566165	-106.547765	8.52	3
8/10/2010	65.5660367	-106.543155	3.42	2
8/10/2010	65.5652683	-106.5471133	7.65	1
8/10/2010	65.5656333	-106.54261	1.75	4
8/10/2010	65.563475	-106.5506833	1.08	4
8/10/2010	65.5633267	-106.5497	2.14	1
8/10/2010	65.56407	-106.5413833	1.08	4
8/10/2010	65.5618883	-106.5464833	2.33	4
8/10/2010	65.565265	-106.547855	5.32	0
8/10/2010	65.5622217	-106.5449783	1.59	0
8/10/2010	65.5665133	-106.546695	7.31	2
8/10/2010	65.56765	-106.5449333	3.87	1
8/10/2010	65.56617	-106.5477433	8.43	1
8/10/2010	65.56604	-106.5431767	3.42	2
8/10/2010	65.5652733	-106.5470917	7.51	1
8/10/2010	65.5656333	-106.54263	1.85	4
8/10/2010	65.5634667	-106.5506883	1.08	2
8/10/2010	65.5633317	-106.5496767	2.12	1
8/10/2010	65.5640667	-106.5414067	1.03	0
8/10/2010	65.5618967	-106.5464567	2.29	4
8/10/2010	65.565265	-106.547855	5.44	4
8/10/2010	65.562235	-106.54498	1.57	2
8/10/2010	65.566525	-106.5466983	7.31	2
8/10/2010	65.56765	-106.5449333	3.9	1
8/10/2010	65.566175	-106.5477217	8.37	1
8/10/2010	65.5660417	-106.5431983	3.46	2
8/10/2010	65.5652783	-106.54707	7.41	1
8/10/2010	65.5656317	-106.5426483	2.04	4
8/10/2010	65.5634583	-106.5506933	1.15	2
8/10/2010	65.5633367	-106.5496517	2.1	1
8/10/2010	65.564065	-106.5414317	1.2	2
8/10/2010	65.5619033	-106.5464283	2.19	2
8/10/2010	65.565265	-106.547855	5.42	4
8/10/2010	65.5622483	-106.5449833	1.69	4
8/10/2010	65.566535	-106.5467017	7.34	2
8/10/2010	65.5676467	-106.5449733	3.87	1
8/10/2010	65.56618	-106.5477	8.3	1
8/10/2010	65.566045	-106.5432183	3.46	2
8/10/2010	65.565285	-106.5470483	7.27	1
8/10/2010	65.56563	-106.5426683	2.05	2
8/10/2010	65.56345	-106.5506983	1.15	2
8/10/2010	65.5633417	-106.5496283	2.09	1
8/10/2010	65.5640617	-106.541455	1.3	2
8/10/2010	65.56191	-106.5464017	2.21	2
8/10/2010	65.565265	-106.547855	5.44	0
8/10/2010	65.5622617	-106.544985	1.51	2
8/10/2010	65.5665467	-106.5467067	7.39	2
8/10/2010	65.5676467	-106.544995	3.85	1
8/10/2010	65.566185	-106.54768	8.25	1
8/10/2010	65.5660467	-106.5432383	3.4	1
8/10/2010	65.56529	-106.5470267	7.13	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.56563	-106.5426883	2.31	2
8/10/2010	65.5634417	-106.5507033	1.16	2
8/10/2010	65.5633467	-106.5496033	2.07	1
8/10/2010	65.56406	-106.54148	1.25	2
8/10/2010	65.5619167	-106.546375	2.22	4
8/10/2010	65.565265	-106.547855	5.44	0
8/10/2010	65.562275	-106.5449883	1.75	4
8/10/2010	65.5665583	-106.5467117	7.43	2
8/10/2010	65.5676467	-106.545015	3.87	1
8/10/2010	65.5661883	-106.54766	8.21	1
8/10/2010	65.5660483	-106.54326	3.35	5
8/10/2010	65.5652967	-106.547005	7.05	0
8/10/2010	65.5656283	-106.5427067	2.24	2
8/10/2010	65.5634333	-106.5507083	1.2	0
8/10/2010	65.5633517	-106.5495783	2.09	1
8/10/2010	65.5640567	-106.541505	1.21	2
8/10/2010	65.5619233	-106.5463483	2.24	2
8/10/2010	65.565265	-106.547855	5.39	4
8/10/2010	65.5622867	-106.54499	1.71	2
8/10/2010	65.56657	-106.546715	7.44	2
8/10/2010	65.5676467	-106.545035	3.9	1
8/10/2010	65.5661933	-106.5476383	8.16	1
8/10/2010	65.56605	-106.54328	3.3	2
8/10/2010	65.5653017	-106.5469833	6.95	2
8/10/2010	65.56563	-106.5427267	2.26	2
8/10/2010	65.563425	-106.5507117	1.23	2
8/10/2010	65.5633567	-106.549555	2.05	1
8/10/2010	65.564055	-106.5415283	1.15	2
8/10/2010	65.56193	-106.54632	2.21	4
8/10/2010	65.565265	-106.547855	5.18	2
8/10/2010	65.5623	-106.5449933	1.78	4
8/10/2010	65.5665817	-106.54672	7.48	2
8/10/2010	65.567645	-106.5450533	3.93	1
8/10/2010	65.5661967	-106.5476167	8.14	1
8/10/2010	65.5660517	-106.5433017	3.25	2
8/10/2010	65.5653083	-106.5469617	6.83	1
8/10/2010	65.5656283	-106.5427467	2.19	0
8/10/2010	65.563415	-106.5507133	1.21	2
8/10/2010	65.5633617	-106.54953	2.05	1
8/10/2010	65.5640517	-106.5415533	1.15	2
8/10/2010	65.5619383	-106.5462933	2.14	4
8/10/2010	65.565265	-106.547855	5.18	2
8/10/2010	65.5623133	-106.544995	1.76	2
8/10/2010	65.5665933	-106.5467233	7.56	2
8/10/2010	65.5685933	-106.5481583	1.49	4
8/10/2010	65.567645	-106.545075	3.97	1
8/10/2010	65.5662017	-106.547595	8.11	1
8/10/2010	65.566055	-106.5433233	3.18	2
8/10/2010	65.5653133	-106.5469383	6.71	1
8/10/2010	65.5656283	-106.5427667	2.19	2
8/10/2010	65.5634067	-106.5507133	1.3	4
8/10/2010	65.5633667	-106.5495067	2.05	1
8/10/2010	65.5640483	-106.5415783	1.21	4
8/10/2010	65.561945	-106.5462667	2.16	2
8/10/2010	65.565265	-106.547855	5.08	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5623267	-106.5449983	1.73	4
8/10/2010	65.5666033	-106.5467283	7.54	2
8/10/2010	65.5685917	-106.5481383	1.57	4
8/10/2010	65.567645	-106.5450967	3.95	1
8/10/2010	65.566205	-106.5475733	8.06	0
8/10/2010	65.5660567	-106.5433417	3.15	2
8/10/2010	65.5653183	-106.5469167	6.66	1
8/10/2010	65.5656283	-106.542785	2.14	2
8/10/2010	65.5633967	-106.550715	1.21	4
8/10/2010	65.5633733	-106.5494833	2.04	1
8/10/2010	65.5640467	-106.5416033	1.23	2
8/10/2010	65.5619517	-106.54624	2.31	0
8/10/2010	65.565265	-106.547855	5.05	4
8/10/2010	65.56234	-106.5450017	1.73	0
8/10/2010	65.566615	-106.5467317	7.61	2
8/10/2010	65.56859	-106.5481183	1.68	2
8/10/2010	65.5676433	-106.5451183	3.97	1
8/10/2010	65.5662083	-106.54755	7.99	1
8/10/2010	65.56606	-106.5433617	3.05	2
8/10/2010	65.5653233	-106.546895	6.59	1
8/10/2010	65.5656283	-106.5428033	2.22	4
8/10/2010	65.5633867	-106.550715	1.27	4
8/10/2010	65.56338	-106.5494583	2.02	1
8/10/2010	65.564045	-106.5416267	1.25	2
8/10/2010	65.5619583	-106.5462133	2.34	2
8/10/2010	65.565265	-106.547855	5.08	4
8/10/2010	65.5623533	-106.5450033	1.76	2
8/10/2010	65.5666267	-106.5467367	7.61	2
8/10/2010	65.5685883	-106.5480967	1.93	2
8/10/2010	65.5676417	-106.5451383	3.99	1
8/10/2010	65.5662133	-106.5475283	7.92	1
8/10/2010	65.5660617	-106.5433817	2.96	2
8/10/2010	65.5653283	-106.5468733	6.45	1
8/10/2010	65.5656283	-106.54282	2.22	2
8/10/2010	65.5633783	-106.5507167	1.28	2
8/10/2010	65.563385	-106.549435	2	1
8/10/2010	65.5640433	-106.5416517	1.2	0
8/10/2010	65.561965	-106.5461867	2.02	4
8/10/2010	65.5652717	-106.547855	4.76	0
8/10/2010	65.5623667	-106.5450067	1.75	0
8/10/2010	65.5666383	-106.5467417	7.6	4
8/10/2010	65.5685883	-106.548075	2	5
8/10/2010	65.56764	-106.54516	3.99	1
8/10/2010	65.5662167	-106.5475067	7.89	1
8/10/2010	65.5660633	-106.5434033	2.89	2
8/10/2010	65.565335	-106.5468533	6.38	1
8/10/2010	65.5656283	-106.54284	2.19	4
8/10/2010	65.5633683	-106.5507183	1.37	4
8/10/2010	65.56339	-106.5494117	1.92	1
8/10/2010	65.5640417	-106.5416767	1.16	2
8/10/2010	65.5619717	-106.5461583	1.88	4
8/10/2010	65.5652717	-106.547855	5.01	4
8/10/2010	65.56238	-106.54501	1.75	2
8/10/2010	65.56665	-106.546745	7.77	2
8/10/2010	65.5685867	-106.5480533	1.68	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.56764	-106.54518	4	1
8/10/2010	65.5662217	-106.547485	7.82	1
8/10/2010	65.566065	-106.543425	2.91	2
8/10/2010	65.56534	-106.5468333	6.3	1
8/10/2010	65.5656283	-106.5428583	2.14	4
8/10/2010	65.5633583	-106.5507183	1.37	2
8/10/2010	65.563395	-106.5493867	1.98	1
8/10/2010	65.56404	-106.5417017	1.27	2
8/10/2010	65.5619783	-106.54613	1.85	2
8/10/2010	65.5652717	-106.547855	5.01	4
8/10/2010	65.5623933	-106.5450133	1.73	2
8/10/2010	65.56666	-106.54675	7.85	2
8/10/2010	65.5685867	-106.5480317	2.12	4
8/10/2010	65.5676383	-106.5452017	4	5
8/10/2010	65.5662267	-106.5474633	7.72	2
8/10/2010	65.5660683	-106.543445	2.91	2
8/10/2010	65.5653467	-106.5468133	6.21	1
8/10/2010	65.5656283	-106.54288	2.26	0
8/10/2010	65.5633483	-106.5507183	1.73	5
8/10/2010	65.5634	-106.5493633	1.95	1
8/10/2010	65.56404	-106.5417267	1.33	2
8/10/2010	65.5619833	-106.5461033	1.76	2
8/10/2010	65.5652717	-106.547855	4.59	4
8/10/2010	65.5624067	-106.5450167	1.78	4
8/10/2010	65.5666717	-106.5467533	7.9	2
8/10/2010	65.5685867	-106.54801	2.24	5
8/10/2010	65.5676367	-106.5452217	4.04	1
8/10/2010	65.56623	-106.54744	7.7	2
8/10/2010	65.56607	-106.5434683	2.96	2
8/10/2010	65.5653517	-106.5467933	6.14	1
8/10/2010	65.5656267	-106.5429	2.22	2
8/10/2010	65.56334	-106.5507167	1.97	5
8/10/2010	65.5634067	-106.54934	1.95	1
8/10/2010	65.5640383	-106.54175	1.25	2
8/10/2010	65.56199	-106.546075	1.8	2
8/10/2010	65.5652717	-106.547855	4.64	2
8/10/2010	65.56242	-106.5450183	1.86	2
8/10/2010	65.5666833	-106.5467567	8.02	2
8/10/2010	65.568585	-106.5479883	2.26	5
8/10/2010	65.567635	-106.5452433	4.04	1
8/10/2010	65.566235	-106.5474167	7.65	2
8/10/2010	65.5660717	-106.5434917	3.01	2
8/10/2010	65.5653567	-106.5467733	6.06	1
8/10/2010	65.565625	-106.54292	2.26	4
8/10/2010	65.56333	-106.5507167	2.02	1
8/10/2010	65.5634117	-106.5493167	1.95	1
8/10/2010	65.5640367	-106.5417733	1.39	2
8/10/2010	65.5619967	-106.5460467	1.76	4
8/10/2010	65.5652717	-106.547855	5.01	4
8/10/2010	65.5624333	-106.5450217	1.9	4
8/10/2010	65.5666933	-106.5467617	8.08	2
8/10/2010	65.568585	-106.5479683	2.36	4
8/10/2010	65.567635	-106.545265	4.02	1
8/10/2010	65.5662383	-106.547395	7.61	2
8/10/2010	65.5660733	-106.5435133	3.13	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5653617	-106.5467517	5.99	1
8/10/2010	65.5656233	-106.5429417	2.24	2
8/10/2010	65.56332	-106.5507167	2.04	1
8/10/2010	65.5634167	-106.5492933	1.93	1
8/10/2010	65.5640367	-106.5417967	1.35	4
8/10/2010	65.5620033	-106.54602	1.76	4
8/10/2010	65.5652717	-106.547855	5.1	4
8/10/2010	65.5624467	-106.545025	1.75	4
8/10/2010	65.566705	-106.5467667	8.06	2
8/10/2010	65.568585	-106.5479467	2.45	2
8/10/2010	65.5676333	-106.545285	4.05	1
8/10/2010	65.5662433	-106.5473733	7.58	2
8/10/2010	65.5660767	-106.5435333	3.37	4
8/10/2010	65.5653683	-106.5467317	5.94	1
8/10/2010	65.5656233	-106.5429633	2.24	4
8/10/2010	65.56331	-106.5507183	2.1	1
8/10/2010	65.5634233	-106.54927	1.92	1
8/10/2010	65.564035	-106.5418217	1.35	2
8/10/2010	65.56201	-106.5459933	1.73	0
8/10/2010	65.5652717	-106.547855	5.17	0
8/10/2010	65.5624617	-106.5450267	1.88	0
8/10/2010	65.5667167	-106.5467717	8.16	2
8/10/2010	65.568585	-106.5479233	2.46	5
8/10/2010	65.5676317	-106.545305	4.04	1
8/10/2010	65.5662467	-106.5473517	7.58	2
8/10/2010	65.5660783	-106.5435517	3.54	2
8/10/2010	65.5653733	-106.54671	5.87	1
8/10/2010	65.5656217	-106.542985	2.26	2
8/10/2010	65.5633	-106.5507217	2.12	1
8/10/2010	65.5634283	-106.5492483	1.92	1
8/10/2010	65.564035	-106.5418467	1.45	2
8/10/2010	65.5620167	-106.545965	1.71	4
8/10/2010	65.5652717	-106.547855	5.13	2
8/10/2010	65.562475	-106.54503	1.85	0
8/10/2010	65.5667283	-106.546775	7.9	2
8/10/2010	65.5685833	-106.5479017	2.53	5
8/10/2010	65.5676317	-106.545325	4.04	1
8/10/2010	65.56625	-106.5473283	7.54	5
8/10/2010	65.5660817	-106.5435717	3.66	4
8/10/2010	65.5653783	-106.54669	5.73	1
8/10/2010	65.5656217	-106.543005	2.31	2
8/10/2010	65.5632917	-106.5507233	2.17	1
8/10/2010	65.5634333	-106.5492233	1.86	1
8/10/2010	65.5640333	-106.5418717	1.42	2
8/10/2010	65.5620217	-106.5459383	1.68	2
8/10/2010	65.5652717	-106.547855	5.18	2
8/10/2010	65.5624883	-106.5450333	1.83	2
8/10/2010	65.5667383	-106.54678	8.37	2
8/10/2010	65.56858	-106.54788	2.53	5
8/10/2010	65.56763	-106.5453467	4.07	1
8/10/2010	65.566255	-106.547305	7.56	5
8/10/2010	65.566085	-106.5435917	3.8	2
8/10/2010	65.565385	-106.5466683	5.63	1
8/10/2010	65.5656217	-106.5430283	2.46	4
8/10/2010	65.5632817	-106.5507267	2.22	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.56344	-106.5492	1.85	1
8/10/2010	65.5640333	-106.541895	1.42	2
8/10/2010	65.5620283	-106.54591	1.64	2
8/10/2010	65.5652817	-106.5478567	5.24	4
8/10/2010	65.5625017	-106.5450367	1.81	0
8/10/2010	65.56675	-106.5467833	8.45	2
8/10/2010	65.5685783	-106.54786	2.43	4
8/10/2010	65.5676283	-106.5453683	4.07	1
8/10/2010	65.5662583	-106.5472817	7.56	5
8/10/2010	65.5660883	-106.5436117	3.87	2
8/10/2010	65.5653883	-106.5466467	5.59	1
8/10/2010	65.56562	-106.54305	2.57	2
8/10/2010	65.5632733	-106.5507283	2.26	1
8/10/2010	65.563445	-106.549175	1.81	1
8/10/2010	65.5640317	-106.5419167	1.35	2
8/10/2010	65.562035	-106.5458833	1.66	2
8/10/2010	65.5652917	-106.5478567	5.24	4
8/10/2010	65.562515	-106.54504	1.73	2
8/10/2010	65.56676	-106.5467883	8.49	2
8/10/2010	65.5685767	-106.5478367	2.57	5
8/10/2010	65.5676283	-106.5453683	4.05	1
8/10/2010	65.5662617	-106.5472583	7.54	1
8/10/2010	65.5660917	-106.5436317	3.95	2
8/10/2010	65.5653917	-106.546625	5.44	1
8/10/2010	65.56562	-106.54307	2.77	2
8/10/2010	65.5632633	-106.5507317	2.28	1
8/10/2010	65.56345	-106.5491517	1.83	1
8/10/2010	65.5640317	-106.5419417	1.4	2
8/10/2010	65.5620417	-106.5458567	1.66	2
8/10/2010	65.5652983	-106.5478567	5.37	4
8/10/2010	65.5625283	-106.545045	1.64	2
8/10/2010	65.5667717	-106.5467933	8.5	2
8/10/2010	65.568575	-106.547815	2.58	5
8/10/2010	65.5676267	-106.5454117	4.04	1
8/10/2010	65.566265	-106.547235	7.54	5
8/10/2010	65.566095	-106.5436517	4	2
8/10/2010	65.5653967	-106.5466033	5.35	1
8/10/2010	65.56562	-106.5430883	2.93	2
8/10/2010	65.563255	-106.5507333	2.29	1
8/10/2010	65.563455	-106.5491267	1.81	1
8/10/2010	65.56403	-106.541965	1.33	2
8/10/2010	65.5620467	-106.5458283	1.66	0
8/10/2010	65.5652983	-106.5478567	5.46	2
8/10/2010	65.5625417	-106.54505	1.76	4
8/10/2010	65.5667833	-106.5467983	8.67	2
8/10/2010	65.568575	-106.547795	2.62	5
8/10/2010	65.5676233	-106.5454317	4.05	1
8/10/2010	65.5662683	-106.5472117	7.54	5
8/10/2010	65.5660983	-106.5436717	4.05	2
8/10/2010	65.5654017	-106.5465833	5.27	1
8/10/2010	65.5656183	-106.5431083	3.01	2
8/10/2010	65.5632467	-106.550735	2.31	1
8/10/2010	65.56346	-106.5491033	1.78	1
8/10/2010	65.5640283	-106.5419883	1.51	4
8/10/2010	65.5620533	-106.5458	1.78	4

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5652983	-106.5478567	5.47	4
8/10/2010	65.562555	-106.5450533	1.76	2
8/10/2010	65.5667933	-106.5468033	8.59	2
8/10/2010	65.5685733	-106.5477733	2.62	1
8/10/2010	65.5676217	-106.54545	4.07	1
8/10/2010	65.5662717	-106.5471883	7.56	5
8/10/2010	65.5661	-106.5436917	4.07	2
8/10/2010	65.5654067	-106.5465633	5.17	5
8/10/2010	65.5656167	-106.5431283	3.1	2
8/10/2010	65.5632367	-106.550735	2.33	1
8/10/2010	65.563465	-106.5490817	1.78	1
8/10/2010	65.5640267	-106.5420117	1.57	0
8/10/2010	65.56206	-106.5457733	1.63	2
8/10/2010	65.5652983	-106.5478567	5.29	4
8/10/2010	65.56257	-106.54506	1.63	2
8/10/2010	65.566805	-106.5468083	8.88	2
8/10/2010	65.5685733	-106.5477533	2.65	5
8/10/2010	65.5676217	-106.5454717	4.16	1
8/10/2010	65.5662767	-106.5471667	7.58	5
8/10/2010	65.5661033	-106.5437117	4.02	2
8/10/2010	65.5654133	-106.5465417	5.05	5
8/10/2010	65.5656167	-106.54315	3.1	4
8/10/2010	65.5632283	-106.5507367	2.29	1
8/10/2010	65.56347	-106.5490583	1.76	1
8/10/2010	65.564025	-106.5420333	1.61	4
8/10/2010	65.5620667	-106.5457467	1.61	2
8/10/2010	65.5652983	-106.5478567	5.42	2
8/10/2010	65.5625833	-106.545065	1.66	2
8/10/2010	65.566815	-106.5468133	8.83	2
8/10/2010	65.5685717	-106.5477333	2.67	5
8/10/2010	65.5676217	-106.5454917	4.14	1
8/10/2010	65.56628	-106.5471433	7.58	1
8/10/2010	65.566105	-106.5437317	4.09	2
8/10/2010	65.5654183	-106.5465233	4.98	2
8/10/2010	65.565615	-106.54317	3.25	4
8/10/2010	65.5632183	-106.550735	2.31	1
8/10/2010	65.5634767	-106.549035	1.75	1
8/10/2010	65.5640233	-106.5420567	1.54	2
8/10/2010	65.5620667	-106.5457467	1.61	0
8/10/2010	65.5652983	-106.5478567	5.59	2
8/10/2010	65.5625983	-106.54507	1.73	2
8/10/2010	65.5668267	-106.54682	8.95	0
8/10/2010	65.5685717	-106.5477133	2.69	5
8/10/2010	65.56762	-106.54551	4.12	1
8/10/2010	65.5662833	-106.54712	7.63	1
8/10/2010	65.5661083	-106.5437533	4.11	2
8/10/2010	65.565425	-106.5465033	4.96	2
8/10/2010	65.565615	-106.5431917	3.23	2
8/10/2010	65.5632083	-106.5507333	2.28	1
8/10/2010	65.5634817	-106.5490117	1.73	1
8/10/2010	65.5640217	-106.54208	1.61	0
8/10/2010	65.5620783	-106.54569	1.66	4
8/10/2010	65.5652983	-106.5478567	5.39	4
8/10/2010	65.5626133	-106.545075	1.73	2
8/10/2010	65.5668367	-106.546825	9.12	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5685717	-106.5476933	2.7	5
8/10/2010	65.5676183	-106.54553	4.14	1
8/10/2010	65.5662867	-106.5470983	7.65	1
8/10/2010	65.5661117	-106.5437733	4.14	2
8/10/2010	65.56543	-106.5464817	4.88	2
8/10/2010	65.565615	-106.5432133	3.32	4
8/10/2010	65.5632	-106.5507317	2.26	1
8/10/2010	65.5634867	-106.5489883	1.73	1
8/10/2010	65.56402	-106.5421033	1.63	2
8/10/2010	65.5620833	-106.5456633	1.68	0
8/10/2010	65.5652983	-106.5478567	5.54	2
8/10/2010	65.5626283	-106.54508	1.66	2
8/10/2010	65.5668467	-106.5468317	9.17	2
8/10/2010	65.5685717	-106.5476717	2.7	5
8/10/2010	65.5676167	-106.54555	4.14	1
8/10/2010	65.5662917	-106.5470767	7.68	1
8/10/2010	65.566115	-106.5437933	4.16	1
8/10/2010	65.565435	-106.54646	4.76	2
8/10/2010	65.565615	-106.5432333	3.4	2
8/10/2010	65.56319	-106.5507317	2.22	5
8/10/2010	65.5634933	-106.5489667	1.68	1
8/10/2010	65.5640183	-106.542125	1.93	4
8/10/2010	65.56209	-106.5456367	1.56	2
8/10/2010	65.5652983	-106.5478567	5.53	4
8/10/2010	65.5626433	-106.5450867	1.71	2
8/10/2010	65.5668583	-106.5468383	9.29	2
8/10/2010	65.5685717	-106.5476533	2.74	5
8/10/2010	65.567615	-106.54557	4.16	1
8/10/2010	65.5662967	-106.547055	7.72	1
8/10/2010	65.5661167	-106.5438133	4.16	1
8/10/2010	65.5654383	-106.5464383	4.72	5
8/10/2010	65.5656133	-106.5432533	3.49	2
8/10/2010	65.5631817	-106.5507317	2.22	5
8/10/2010	65.5634983	-106.548945	1.64	1
8/10/2010	65.564015	-106.5421467	1.75	2
8/10/2010	65.5620967	-106.5456083	1.59	2
8/10/2010	65.5652983	-106.5478567	5.46	2
8/10/2010	65.5626583	-106.5450917	1.71	2
8/10/2010	65.5668683	-106.546845	9.36	4
8/10/2010	65.5685717	-106.5476333	2.75	5
8/10/2010	65.5676133	-106.5455917	4.17	1
8/10/2010	65.5663	-106.5470317	7.77	5
8/10/2010	65.56612	-106.5438333	4.21	1
8/10/2010	65.5654433	-106.5464167	4.65	2
8/10/2010	65.5656117	-106.5432717	3.52	2
8/10/2010	65.563175	-106.5507333	2.19	1
8/10/2010	65.5635033	-106.5489233	1.68	1
8/10/2010	65.5640133	-106.5421683	1.59	2
8/10/2010	65.5621033	-106.5455817	1.54	2
8/10/2010	65.5652983	-106.5478567	5.44	2
8/10/2010	65.5626733	-106.5450967	1.68	2
8/10/2010	65.56688	-106.5468533	9.41	2
8/10/2010	65.56857	-106.5476133	2.75	1
8/10/2010	65.5676133	-106.5456133	4.23	1
8/10/2010	65.5663033	-106.54701	7.82	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5661233	-106.5438533	4.21	1
8/10/2010	65.5654483	-106.5463983	4.6	1
8/10/2010	65.5656117	-106.5432917	3.63	2
8/10/2010	65.5631667	-106.550735	2.16	1
8/10/2010	65.5635083	-106.5489	1.64	0
8/10/2010	65.5640117	-106.5421917	1.81	2
8/10/2010	65.5621083	-106.5455533	1.59	0
8/10/2010	65.5652983	-106.5478567	5.51	2
8/10/2010	65.5626867	-106.5451033	1.63	2
8/10/2010	65.56689	-106.5468617	9.51	2
8/10/2010	65.56857	-106.5475933	2.77	5
8/10/2010	65.5676117	-106.5456333	4.23	1
8/10/2010	65.5663083	-106.546985	7.84	5
8/10/2010	65.566125	-106.5438733	4.26	2
8/10/2010	65.565455	-106.5463783	4.53	1
8/10/2010	65.56561	-106.5433133	3.66	2
8/10/2010	65.56316	-106.550735	2.12	5
8/10/2010	65.563515	-106.5488767	1.59	2
8/10/2010	65.5640083	-106.5422167	1.68	2
8/10/2010	65.562115	-106.5455267	1.56	2
8/10/2010	65.5652983	-106.5478567	5.42	2
8/10/2010	65.5627017	-106.54511	1.69	2
8/10/2010	65.5669017	-106.5468717	9.6	2
8/10/2010	65.56857	-106.547575	2.81	5
8/10/2010	65.56761	-106.5456533	4.26	1
8/10/2010	65.5663117	-106.5469633	7.89	1
8/10/2010	65.566125	-106.5438733	4.26	1
8/10/2010	65.56546	-106.5463583	4.52	1
8/10/2010	65.5656083	-106.5433333	3.71	4
8/10/2010	65.5631517	-106.5507317	2.09	1
8/10/2010	65.56352	-106.5488517	1.63	1
8/10/2010	65.5640083	-106.54224	1.57	2
8/10/2010	65.56212	-106.5455	1.64	4
8/10/2010	65.5652983	-106.5478567	5.42	2
8/10/2010	65.5627167	-106.5451167	1.71	2
8/10/2010	65.5669117	-106.54688	9.67	2
8/10/2010	65.5685683	-106.5475533	2.81	5
8/10/2010	65.5676083	-106.545675	4.28	1
8/10/2010	65.5663167	-106.5469417	7.89	1
8/10/2010	65.56613	-106.543915	4.29	1
8/10/2010	65.565465	-106.5463383	4.48	1
8/10/2010	65.565605	-106.5433517	3.8	2
8/10/2010	65.563145	-106.5507267	2.07	5
8/10/2010	65.563525	-106.5488283	1.63	1
8/10/2010	65.5640067	-106.542265	1.88	2
8/10/2010	65.5621267	-106.5454717	1.54	2
8/10/2010	65.5652983	-106.5478567	5.61	4
8/10/2010	65.5627317	-106.5451233	1.64	4
8/10/2010	65.5669217	-106.5468883	9.73	2
8/10/2010	65.5685667	-106.5475317	2.81	5
8/10/2010	65.567605	-106.545695	4.29	1
8/10/2010	65.56632	-106.54692	7.96	1
8/10/2010	65.5661317	-106.543935	4.29	1
8/10/2010	65.5654717	-106.54632	4.41	1
8/10/2010	65.5656033	-106.5433717	3.82	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.56314	-106.55072	2.07	5
8/10/2010	65.5635317	-106.548805	1.63	1
8/10/2010	65.5640067	-106.5422883	1.76	2
8/10/2010	65.5621333	-106.5454433	1.61	2
8/10/2010	65.5652983	-106.5478567	5.61	0
8/10/2010	65.5627467	-106.54513	1.73	2
8/10/2010	65.5669333	-106.5468967	9.82	2
8/10/2010	65.5685667	-106.54751	2.81	5
8/10/2010	65.5676033	-106.5457167	4.35	1
8/10/2010	65.56632	-106.54692	7.96	1
8/10/2010	65.5661317	-106.5439567	4.36	1
8/10/2010	65.5654783	-106.5463	4.38	5
8/10/2010	65.5656017	-106.5433933	3.85	2
8/10/2010	65.563135	-106.5507117	2.09	5
8/10/2010	65.5635367	-106.54878	1.59	1
8/10/2010	65.564005	-106.5423117	1.71	4
8/10/2010	65.5621383	-106.545415	1.57	2
8/10/2010	65.5652983	-106.5478567	5.71	4
8/10/2010	65.5627617	-106.5451367	1.66	4
8/10/2010	65.5669433	-106.546905	9.89	2
8/10/2010	65.568565	-106.5474883	2.79	5
8/10/2010	65.5676017	-106.5457383	4.36	1
8/10/2010	65.5663267	-106.5468767	7.94	1
8/10/2010	65.5661333	-106.5439767	4.33	1
8/10/2010	65.5654833	-106.5462817	4.36	5
8/10/2010	65.5656	-106.543415	3.9	2
8/10/2010	65.5631317	-106.5507	2.07	2
8/10/2010	65.5635417	-106.5487567	1.63	1
8/10/2010	65.5640033	-106.5423333	1.8	2
8/10/2010	65.5621433	-106.5453867	1.59	2
8/10/2010	65.5652983	-106.5478567	5.77	2
8/10/2010	65.5627767	-106.5451433	1.66	4
8/10/2010	65.566955	-106.5469133	9.92	2
8/10/2010	65.568565	-106.5474667	2.81	5
8/10/2010	65.5676	-106.5457583	4.4	1
8/10/2010	65.5663317	-106.546855	7.87	1
8/10/2010	65.566135	-106.544	4.38	1
8/10/2010	65.5654883	-106.5462617	4.31	1
8/10/2010	65.5656	-106.5434383	3.87	2
8/10/2010	65.5635483	-106.5487333	1.61	1
8/10/2010	65.5640017	-106.5423567	1.86	2
8/10/2010	65.5621483	-106.5453583	1.59	2
8/10/2010	65.5652983	-106.5478567	5.68	4
8/10/2010	65.5627917	-106.5451483	1.66	4
8/10/2010	65.566965	-106.5469217	9.99	2
8/10/2010	65.568565	-106.547445	2.79	5
8/10/2010	65.5675983	-106.5457783	4.45	1
8/10/2010	65.5663367	-106.5468333	7.8	1
8/10/2010	65.5661383	-106.54402	4.4	1
8/10/2010	65.5654933	-106.5462417	4.29	1
8/10/2010	65.5655983	-106.54346	3.88	0
8/10/2010	65.563555	-106.5487083	1.57	1
8/10/2010	65.5640017	-106.5423783	1.73	2
8/10/2010	65.5621533	-106.54533	1.61	0
8/10/2010	65.5653083	-106.547855	5.82	0

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5628067	-106.545155	1.66	2
8/10/2010	65.5669767	-106.5469283	10.06	2
8/10/2010	65.568565	-106.5474233	2.77	5
8/10/2010	65.5675967	-106.5457983	4.47	1
8/10/2010	65.56634	-106.5468117	7.73	1
8/10/2010	65.5661417	-106.5440383	4.47	1
8/10/2010	65.5654983	-106.5462217	4.26	1
8/10/2010	65.5655983	-106.5434817	3.92	1
8/10/2010	65.5635617	-106.5486867	1.61	1
8/10/2010	65.564	-106.5424017	1.78	2
8/10/2010	65.5621583	-106.5453033	1.52	2
8/10/2010	65.5653183	-106.547855	5.63	4
8/10/2010	65.5628217	-106.5451617	1.66	4
8/10/2010	65.5669883	-106.5469333	10.11	2
8/10/2010	65.568565	-106.5474017	2.75	5
8/10/2010	65.567595	-106.5458167	4.52	1
8/10/2010	65.5663433	-106.5467883	7.68	1
8/10/2010	65.5661433	-106.5440567	4.47	1
8/10/2010	65.565505	-106.5462017	4.24	1
8/10/2010	65.5655983	-106.5435017	3.9	1
8/10/2010	65.5635683	-106.548665	1.61	1
8/10/2010	65.5639983	-106.5424267	1.76	2
8/10/2010	65.5621617	-106.545275	1.57	0
8/10/2010	65.5653183	-106.547855	5.7	2
8/10/2010	65.5628367	-106.54517	1.71	2
8/10/2010	65.5669983	-106.54694	10.16	2
8/10/2010	65.5685667	-106.54738	2.79	5
8/10/2010	65.5675917	-106.5458367	4.57	1
8/10/2010	65.5663483	-106.5467667	7.61	1
8/10/2010	65.5661467	-106.5440767	4.52	1
8/10/2010	65.56551	-106.5461817	4.23	1
8/10/2010	65.5655983	-106.5435217	3.92	1
8/10/2010	65.563575	-106.5486433	1.63	1
8/10/2010	65.5639967	-106.54245	1.92	4
8/10/2010	65.5621667	-106.5452467	1.59	2
8/10/2010	65.5653183	-106.547855	5.71	2
8/10/2010	65.5628517	-106.5451767	1.68	4
8/10/2010	65.56701	-106.546945	10.08	2
8/10/2010	65.5685667	-106.5473617	2.77	1
8/10/2010	65.56759	-106.545855	4.62	1
8/10/2010	65.5663517	-106.5467467	7.56	5
8/10/2010	65.5661483	-106.544095	4.52	1
8/10/2010	65.565515	-106.5461617	4.19	5
8/10/2010	65.5655967	-106.5435383	3.9	0
8/10/2010	65.56358	-106.5486233	1.59	1
8/10/2010	65.563995	-106.5424733	1.97	4
8/10/2010	65.5621717	-106.5452183	1.54	2
8/10/2010	65.5653183	-106.547855	5.8	4
8/10/2010	65.5628667	-106.5451817	1.64	2
8/10/2010	65.5670217	-106.54695	10.18	2
8/10/2010	65.5685667	-106.5473417	2.79	5
8/10/2010	65.5675867	-106.545875	4.69	1
8/10/2010	65.5663567	-106.546725	7.49	5
8/10/2010	65.56615	-106.544115	4.55	1
8/10/2010	65.56552	-106.5461417	4.17	5

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.565595	-106.5435567	3.92	1
8/10/2010	65.563585	-106.5486017	1.61	0
8/10/2010	65.5639933	-106.5424967	1.73	2
8/10/2010	65.5621767	-106.54519	1.57	4
8/10/2010	65.5653183	-106.547855	5.75	4
8/10/2010	65.5628817	-106.5451883	1.59	2
8/10/2010	65.5670333	-106.5469567	10.28	2
8/10/2010	65.5685667	-106.5473217	2.77	5
8/10/2010	65.567585	-106.545895	4.74	1
8/10/2010	65.56636	-106.546705	7.46	1
8/10/2010	65.56615	-106.544135	4.6	1
8/10/2010	65.565525	-106.54612	4.17	1
8/10/2010	65.5655917	-106.543575	3.92	1
8/10/2010	65.5635917	-106.5485833	1.57	1
8/10/2010	65.5639917	-106.5425217	1.81	2
8/10/2010	65.5621817	-106.5451633	1.61	0
8/10/2010	65.5653183	-106.547855	5.89	2
8/10/2010	65.5628967	-106.5451933	1.57	2
8/10/2010	65.567045	-106.5469633	10.3	2
8/10/2010	65.5685667	-106.5473017	2.77	5
8/10/2010	65.5675817	-106.545915	4.81	1
8/10/2010	65.5663667	-106.5466833	7.43	1
8/10/2010	65.5661517	-106.544155	4.62	1
8/10/2010	65.5655283	-106.5460983	4.16	1
8/10/2010	65.56559	-106.543595	3.93	2
8/10/2010	65.5635983	-106.5485617	1.56	1
8/10/2010	65.5639883	-106.542545	1.86	2
8/10/2010	65.5621867	-106.545135	1.52	2
8/10/2010	65.5653283	-106.547855	6.16	2
8/10/2010	65.5629117	-106.5451983	1.69	4
8/10/2010	65.5670567	-106.5469683	10.33	2
8/10/2010	65.5685667	-106.5472817	2.77	1
8/10/2010	65.56758	-106.5459367	4.84	1
8/10/2010	65.5663717	-106.54666	7.39	1
8/10/2010	65.5661517	-106.544175	4.64	1
8/10/2010	65.565535	-106.5460783	4.16	1
8/10/2010	65.5655867	-106.543615	3.99	1
8/10/2010	65.5636033	-106.5485417	1.52	2
8/10/2010	65.5639867	-106.5425683	2.12	4
8/10/2010	65.5621917	-106.5451067	1.59	2
8/10/2010	65.5653283	-106.547855	6.19	0
8/10/2010	65.5629267	-106.5452033	1.71	2
8/10/2010	65.5670683	-106.546975	10.38	2
8/10/2010	65.568565	-106.54726	2.79	5
8/10/2010	65.5675767	-106.5459583	4.93	1
8/10/2010	65.5663767	-106.5466367	7.34	1
8/10/2010	65.5661517	-106.544195	4.69	1
8/10/2010	65.56554	-106.5460583	4.14	1
8/10/2010	65.565585	-106.5436333	4	1
8/10/2010	65.5636083	-106.54852	1.52	1
8/10/2010	65.5639833	-106.54259	2.12	2
8/10/2010	65.5621967	-106.5450783	1.57	2
8/10/2010	65.5653283	-106.547855	6.11	4
8/10/2010	65.5629417	-106.5452067	1.68	4
8/10/2010	65.56708	-106.54698	10.38	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.568565	-106.54724	2.77	5
8/10/2010	65.567575	-106.5459783	5.03	1
8/10/2010	65.56638	-106.5466117	7.32	1
8/10/2010	65.5661533	-106.5442167	4.72	1
8/10/2010	65.565545	-106.5460367	4.16	1
8/10/2010	65.5655833	-106.5436517	4	1
8/10/2010	65.5636133	-106.5485	1.51	2
8/10/2010	65.5639817	-106.542615	2.57	2
8/10/2010	65.5622033	-106.54505	1.59	0
8/10/2010	65.5653383	-106.5478567	6.31	4
8/10/2010	65.5629567	-106.5452117	1.54	2
8/10/2010	65.56709	-106.5469867	10.42	2
8/10/2010	65.568565	-106.5472183	2.77	1
8/10/2010	65.5675733	-106.546	5.05	1
8/10/2010	65.5663833	-106.5465883	7.31	1
8/10/2010	65.566155	-106.54424	4.72	1
8/10/2010	65.56555	-106.5460167	4.16	1
8/10/2010	65.56558	-106.54367	4	5
8/10/2010	65.5636167	-106.5484783	1.42	2
8/10/2010	65.5639783	-106.5426383	2.75	2
8/10/2010	65.5622083	-106.5450217	1.57	2
8/10/2010	65.5653383	-106.5478567	6.09	2
8/10/2010	65.56297	-106.5452167	1.69	2
8/10/2010	65.5671017	-106.5469917	10.49	2
8/10/2010	65.5685633	-106.5471983	2.81	5
8/10/2010	65.56757	-106.5460217	5.18	1
8/10/2010	65.5663867	-106.5465633	7.22	1
8/10/2010	65.5661583	-106.54426	4.79	1
8/10/2010	65.565555	-106.5459967	4.09	1
8/10/2010	65.5655767	-106.54369	4.09	5
8/10/2010	65.5636217	-106.5484567	1.44	5
8/10/2010	65.563975	-106.54266	2.82	4
8/10/2010	65.5622133	-106.5449933	1.57	4
8/10/2010	65.5653383	-106.5478567	6.35	4
8/10/2010	65.562985	-106.5452217	1.69	2
8/10/2010	65.5671117	-106.547	10.56	2
8/10/2010	65.5685633	-106.5471783	2.81	5
8/10/2010	65.5675683	-106.5460417	5.27	1
8/10/2010	65.5663917	-106.54654	7.2	1
8/10/2010	65.56616	-106.54428	4.79	1
8/10/2010	65.5655617	-106.5459767	4.11	1
8/10/2010	65.565575	-106.54371	4.07	1
8/10/2010	65.5636267	-106.5484367	1.35	2
8/10/2010	65.5639717	-106.542685	2.87	5
8/10/2010	65.56222	-106.544965	1.54	2
8/10/2010	65.5653383	-106.5478567	6.16	0
8/10/2010	65.563	-106.545225	1.69	2
8/10/2010	65.5671233	-106.5470067	10.61	2
8/10/2010	65.5685633	-106.5471583	2.81	5
8/10/2010	65.5675667	-106.5460617	5.32	1
8/10/2010	65.566395	-106.5465183	7.17	1
8/10/2010	65.5661617	-106.5443	4.84	1
8/10/2010	65.5655667	-106.5459567	4.14	1
8/10/2010	65.5655717	-106.54373	4.11	5
8/10/2010	65.5636333	-106.548415	1.4	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5639683	-106.5427083	2.91	1
8/10/2010	65.562225	-106.544935	1.61	2
8/10/2010	65.5653383	-106.5478567	6.14	2
8/10/2010	65.5630167	-106.5452283	1.69	2
8/10/2010	65.5671333	-106.5470133	10.59	2
8/10/2010	65.5685633	-106.5471367	2.82	1
8/10/2010	65.5675667	-106.5460617	5.41	1
8/10/2010	65.5664	-106.5464967	7.12	1
8/10/2010	65.566165	-106.54432	4.84	2
8/10/2010	65.5655717	-106.5459383	4.14	1
8/10/2010	65.56557	-106.5437483	4.14	1
8/10/2010	65.5636383	-106.5483933	1.33	2
8/10/2010	65.563965	-106.54273	2.96	1
8/10/2010	65.5622317	-106.5449067	1.59	2
8/10/2010	65.5653383	-106.5478567	6.43	2
8/10/2010	65.56303	-106.5452333	1.73	4
8/10/2010	65.5671433	-106.54702	10.64	2
8/10/2010	65.5685633	-106.5471167	2.86	1
8/10/2010	65.5675617	-106.546105	5.53	1
8/10/2010	65.566405	-106.546475	7.08	1
8/10/2010	65.5661667	-106.5443383	4.88	1
8/10/2010	65.5655767	-106.5459183	4.14	1
8/10/2010	65.5655683	-106.543765	4.19	1
8/10/2010	65.563645	-106.5483733	1.35	0
8/10/2010	65.5639633	-106.5427533	2.99	1
8/10/2010	65.5622383	-106.5448783	1.57	2
8/10/2010	65.5653383	-106.5478567	6.31	2
8/10/2010	65.563045	-106.545235	1.8	4
8/10/2010	65.567155	-106.5470267	10.69	2
8/10/2010	65.5685633	-106.547095	2.87	1
8/10/2010	65.56756	-106.546125	5.63	1
8/10/2010	65.56641	-106.5464533	7.03	1
8/10/2010	65.56617	-106.5443583	4.88	2
8/10/2010	65.5655817	-106.5458983	4.16	1
8/10/2010	65.565565	-106.5437833	4.21	1
8/10/2010	65.56365	-106.5483517	1.33	2
8/10/2010	65.56396	-106.542775	3.05	1
8/10/2010	65.5622433	-106.5448517	1.59	2
8/10/2010	65.5653383	-106.5478567	6.4	2
8/10/2010	65.56306	-106.5452383	1.76	4
8/10/2010	65.567165	-106.547035	10.71	2
8/10/2010	65.5685633	-106.547075	2.86	1
8/10/2010	65.5675583	-106.5461467	5.73	1
8/10/2010	65.5664133	-106.5464317	7.08	1
8/10/2010	65.566175	-106.5443767	4.89	1
8/10/2010	65.5655867	-106.5458783	4.16	1
8/10/2010	65.5655617	-106.5438017	4.24	1
8/10/2010	65.563655	-106.5483283	1.39	2
8/10/2010	65.5639567	-106.5427983	3.08	1
8/10/2010	65.56225	-106.5448233	1.64	4
8/10/2010	65.5653383	-106.5478567	6.19	4
8/10/2010	65.563075	-106.5452417	1.75	2
8/10/2010	65.5671767	-106.5470417	10.74	4
8/10/2010	65.5685633	-106.5470533	2.87	5
8/10/2010	65.5675583	-106.5461467	5.83	5

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5664167	-106.5464117	7.01	1
8/10/2010	65.5661767	-106.5443967	5.03	1
8/10/2010	65.5655917	-106.5458583	4.14	1
8/10/2010	65.56556	-106.54382	4.26	1
8/10/2010	65.5636617	-106.548305	1.39	4
8/10/2010	65.5639533	-106.5428217	3.1	1
8/10/2010	65.562255	-106.544795	1.59	2
8/10/2010	65.5653483	-106.5478567	6.24	2
8/10/2010	65.5630883	-106.545245	1.76	0
8/10/2010	65.5671883	-106.5470483	10.76	2
8/10/2010	65.5685633	-106.5470333	2.91	5
8/10/2010	65.5675567	-106.5461867	5.95	1
8/10/2010	65.5664217	-106.54639	7	1
8/10/2010	65.5661783	-106.5444167	5.03	1
8/10/2010	65.5655967	-106.54584	4.17	1
8/10/2010	65.5655583	-106.5438383	4.31	1
8/10/2010	65.5636667	-106.5482817	1.37	4
8/10/2010	65.56395	-106.5428467	3.15	1
8/10/2010	65.5622617	-106.5447667	1.54	2
8/10/2010	65.5653483	-106.5478567	6.38	4
8/10/2010	65.5631033	-106.5452483	1.78	4
8/10/2010	65.5671983	-106.547055	10.95	2
8/10/2010	65.5685633	-106.5470117	2.94	5
8/10/2010	65.567555	-106.546205	6.11	1
8/10/2010	65.5664267	-106.54637	6.98	1
8/10/2010	65.56618	-106.5444367	5.08	1
8/10/2010	65.5656017	-106.54582	4.19	1
8/10/2010	65.565555	-106.5438583	4.35	1
8/10/2010	65.5636717	-106.5482583	1.42	2
8/10/2010	65.5639467	-106.54287	3.18	1
8/10/2010	65.5622667	-106.5447383	1.47	2
8/10/2010	65.5653483	-106.5478567	6.42	4
8/10/2010	65.5631167	-106.5452533	1.81	2
8/10/2010	65.56721	-106.54706	10.88	2
8/10/2010	65.5685633	-106.5469933	2.94	1
8/10/2010	65.5675533	-106.546225	6.18	5
8/10/2010	65.56643	-106.54635	6.96	1
8/10/2010	65.5661833	-106.5444567	5.13	1
8/10/2010	65.5656067	-106.5458	4.17	1
8/10/2010	65.5655533	-106.5438783	4.35	1
8/10/2010	65.5636767	-106.5482367	1.16	0
8/10/2010	65.5639433	-106.5428917	3.27	1
8/10/2010	65.5622733	-106.5447083	1.52	2
8/10/2010	65.5653483	-106.5478567	6.14	2
8/10/2010	65.5631317	-106.5452583	1.54	2
8/10/2010	65.5672217	-106.547065	10.88	2
8/10/2010	65.5685633	-106.5469733	2.99	1
8/10/2010	65.5675517	-106.5462433	6.26	5
8/10/2010	65.566435	-106.54633	6.96	1
8/10/2010	65.566185	-106.5444767	5.17	1
8/10/2010	65.5656133	-106.5457817	4.21	1
8/10/2010	65.56555	-106.5438983	4.36	1
8/10/2010	65.5636817	-106.548215	1.33	2
8/10/2010	65.56394	-106.5429133	3.39	1
8/10/2010	65.5622783	-106.54468	1.59	4

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5653483	-106.5478567	6.28	2
8/10/2010	65.5631467	-106.5452633	1.78	4
8/10/2010	65.5672317	-106.5470683	11.07	4
8/10/2010	65.5685617	-106.5469533	2.99	1
8/10/2010	65.5675483	-106.5462617	6.35	5
8/10/2010	65.5664383	-106.5463083	6.95	1
8/10/2010	65.5661867	-106.5444967	5.24	1
8/10/2010	65.5656183	-106.5457617	4.19	1
8/10/2010	65.5655483	-106.5439183	4.38	1
8/10/2010	65.5636883	-106.5481917	1.28	2
8/10/2010	65.5639383	-106.542935	3.46	1
8/10/2010	65.562285	-106.5446517	1.51	0
8/10/2010	65.5653483	-106.5478567	6.14	4
8/10/2010	65.56316	-106.5452683	1.81	2
8/10/2010	65.5672433	-106.5470717	11.19	2
8/10/2010	65.56856	-106.5469317	3.01	1
8/10/2010	65.5675483	-106.5462617	6.6	1
8/10/2010	65.5664433	-106.5462883	6.95	1
8/10/2010	65.5661883	-106.5445167	5.22	1
8/10/2010	65.5656233	-106.5457417	4.23	1
8/10/2010	65.5655467	-106.5439383	4.41	1
8/10/2010	65.5636933	-106.5481683	1.37	2
8/10/2010	65.5639333	-106.5429567	3.54	1
8/10/2010	65.5622917	-106.5446233	1.63	0
8/10/2010	65.5653483	-106.5478567	6.3	4
8/10/2010	65.563175	-106.5452733	1.85	2
8/10/2010	65.5672533	-106.5470767	11.22	4
8/10/2010	65.5685583	-106.5469117	3.17	5
8/10/2010	65.5675467	-106.5462833	6.6	5
8/10/2010	65.5664467	-106.5462667	6.95	1
8/10/2010	65.5661917	-106.5445383	5.29	1
8/10/2010	65.5656267	-106.5457217	4.26	1
8/10/2010	65.565545	-106.5439583	4.45	1
8/10/2010	65.5636983	-106.5481433	1.37	2
8/10/2010	65.56393	-106.542975	3.59	1
8/10/2010	65.5622967	-106.544595	1.57	2
8/10/2010	65.5653483	-106.5478567	6.47	2
8/10/2010	65.56319	-106.5452783	1.85	4
8/10/2010	65.567265	-106.5470817	11.15	2
8/10/2010	65.5685583	-106.54689	3.39	2
8/10/2010	65.5675467	-106.546325	6.72	5
8/10/2010	65.56645	-106.546245	6.95	1
8/10/2010	65.5661933	-106.54456	5.32	1
8/10/2010	65.56563	-106.5457017	4.24	1
8/10/2010	65.5655417	-106.5439783	4.45	1
8/10/2010	65.5637017	-106.54812	1.23	2
8/10/2010	65.563925	-106.5429933	3.61	1
8/10/2010	65.5623017	-106.5445667	1.52	2
8/10/2010	65.5653483	-106.5478567	6.5	4
8/10/2010	65.563205	-106.545285	1.85	2
8/10/2010	65.567275	-106.5470867	11.36	4
8/10/2010	65.5685567	-106.5468683	3.3	0
8/10/2010	65.567545	-106.546345	6.88	5
8/10/2010	65.5664533	-106.5462233	6.89	1
8/10/2010	65.5661967	-106.54458	5.35	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5656333	-106.5456817	4.24	1
8/10/2010	65.5655383	-106.5439967	4.5	1
8/10/2010	65.5637067	-106.5480967	1.39	4
8/10/2010	65.56392	-106.5430117	3.64	1
8/10/2010	65.5623083	-106.5445383	1.57	2
8/10/2010	65.5653483	-106.5478567	6.33	4
8/10/2010	65.56322	-106.54529	1.93	4
8/10/2010	65.567285	-106.5470917	11.05	2
8/10/2010	65.568555	-106.5468467	3.1	5
8/10/2010	65.5675433	-106.5463667	7	1
8/10/2010	65.5664583	-106.5462017	6.88	1
8/10/2010	65.5661983	-106.5446017	5.42	1
8/10/2010	65.5656383	-106.5456617	4.24	1
8/10/2010	65.565535	-106.5440167	4.48	1
8/10/2010	65.5637117	-106.5480717	1.4	2
8/10/2010	65.563915	-106.5430283	3.66	1
8/10/2010	65.5623133	-106.54451	1.52	2
8/10/2010	65.5653483	-106.5478567	6.42	4
8/10/2010	65.563235	-106.545295	2	2
8/10/2010	65.5672967	-106.5470967	11.5	4
8/10/2010	65.5685533	-106.546825	3.1	2
8/10/2010	65.5675417	-106.5463867	7.07	5
8/10/2010	65.5664633	-106.5461817	6.88	1
8/10/2010	65.5662017	-106.5446217	5.47	1
8/10/2010	65.5656433	-106.5456417	4.29	1
8/10/2010	65.5655317	-106.5440367	4.53	1
8/10/2010	65.5637167	-106.5480467	1.39	4
8/10/2010	65.5639083	-106.5430467	3.66	1
8/10/2010	65.5623183	-106.5444817	1.52	2
8/10/2010	65.5653483	-106.5478567	6.45	2
8/10/2010	65.56325	-106.5453017	2.34	4
8/10/2010	65.5673067	-106.5471017	11.58	4
8/10/2010	65.5685533	-106.5468033	3.15	5
8/10/2010	65.5675417	-106.546405	7.17	1
8/10/2010	65.5664667	-106.54616	6.83	1
8/10/2010	65.566205	-106.5446417	5.53	1
8/10/2010	65.5656483	-106.54562	4.26	1
8/10/2010	65.5655283	-106.544055	4.52	1
8/10/2010	65.5637217	-106.5480217	1.35	4
8/10/2010	65.5639017	-106.543065	3.66	1
8/10/2010	65.5623233	-106.5444533	1.59	2
8/10/2010	65.5653483	-106.5478567	6.5	0
8/10/2010	65.563265	-106.5453067	2.29	4
8/10/2010	65.5673183	-106.5471067	11.6	2
8/10/2010	65.5685517	-106.5467833	3.2	1
8/10/2010	65.5675383	-106.546425	7.34	1
8/10/2010	65.5664717	-106.5461383	6.79	1
8/10/2010	65.5662083	-106.5446633	5.51	1
8/10/2010	65.5656533	-106.5456017	4.31	1
8/10/2010	65.565525	-106.5440733	4.52	1
8/10/2010	65.563725	-106.5479983	1.4	2
8/10/2010	65.563895	-106.543085	3.68	1
8/10/2010	65.5623283	-106.5444233	1.57	0
8/10/2010	65.5653483	-106.5478567	6.4	4
8/10/2010	65.56328	-106.54531	2.22	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5673283	-106.5471117	11.75	4
8/10/2010	65.56855	-106.5467617	3.22	5
8/10/2010	65.5675367	-106.546445	7.43	1
8/10/2010	65.5664767	-106.5461183	6.76	1
8/10/2010	65.56621	-106.5446833	5.59	5
8/10/2010	65.5656567	-106.5455817	4.36	1
8/10/2010	65.5655217	-106.5440933	4.53	1
8/10/2010	65.56373	-106.5479733	1.35	2
8/10/2010	65.56389	-106.5431033	3.7	1
8/10/2010	65.5623317	-106.544395	1.61	4
8/10/2010	65.5653483	-106.5478567	6.48	0
8/10/2010	65.563295	-106.5453133	2.16	0
8/10/2010	65.56734	-106.547115	11.91	4
8/10/2010	65.5685483	-106.54674	3.25	5
8/10/2010	65.567535	-106.546465	7.44	1
8/10/2010	65.5664833	-106.5460983	6.72	1
8/10/2010	65.5662133	-106.5447033	5.63	1
8/10/2010	65.5656617	-106.5455617	4.38	1
8/10/2010	65.5655167	-106.5441117	4.53	1
8/10/2010	65.563735	-106.54795	1.37	4
8/10/2010	65.563885	-106.5431233	3.7	1
8/10/2010	65.5623367	-106.5443667	1.59	0
8/10/2010	65.5653483	-106.5478567	6.42	4
8/10/2010	65.5633083	-106.5453167	2.16	4
8/10/2010	65.56735	-106.54712	11.96	4
8/10/2010	65.5685467	-106.5467183	3.3	5
8/10/2010	65.5675333	-106.546485	7.54	1
8/10/2010	65.5664883	-106.5460783	6.67	1
8/10/2010	65.566215	-106.5447233	5.66	1
8/10/2010	65.5656683	-106.5455433	4.36	1
8/10/2010	65.5655133	-106.5441283	4.55	1
8/10/2010	65.56374	-106.547925	1.44	4
8/10/2010	65.56388	-106.543145	3.71	1
8/10/2010	65.56234	-106.5443383	1.64	2
8/10/2010	65.5653483	-106.5478567	6.47	2
8/10/2010	65.5633233	-106.54532	2.04	0
8/10/2010	65.5673617	-106.547125	11.91	0
8/10/2010	65.568545	-106.5466967	3.32	1
8/10/2010	65.56753	-106.5465033	7.63	1
8/10/2010	65.5664917	-106.5460567	6.67	1
8/10/2010	65.5662183	-106.5447433	5.7	1
8/10/2010	65.5656717	-106.5455233	4.4	1
8/10/2010	65.56551	-106.5441467	4.52	1
8/10/2010	65.563745	-106.5479017	1.45	2
8/10/2010	65.563875	-106.543165	3.73	1
8/10/2010	65.5623433	-106.5443117	1.45	2
8/10/2010	65.5653617	-106.5478567	6.52	4
8/10/2010	65.5633383	-106.545325	2.09	4
8/10/2010	65.5673733	-106.54713	12.13	4
8/10/2010	65.5685433	-106.5466767	3.32	5
8/10/2010	65.5675283	-106.5465233	7.7	1
8/10/2010	65.566495	-106.546035	6.62	1
8/10/2010	65.56622	-106.5447633	5.77	1
8/10/2010	65.565675	-106.5455017	4.38	1
8/10/2010	65.5655067	-106.544165	4.53	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.56375	-106.5478783	1.35	2
8/10/2010	65.56387	-106.5431883	3.78	1
8/10/2010	65.5623483	-106.544285	1.57	4
8/10/2010	65.5653617	-106.5478567	6.5	4
8/10/2010	65.5633533	-106.5453283	2.07	2
8/10/2010	65.5673833	-106.547135	12.28	2
8/10/2010	65.5685417	-106.5466567	3.35	5
8/10/2010	65.5675267	-106.5465417	7.78	5
8/10/2010	65.5665	-106.5460117	6.59	1
8/10/2010	65.566225	-106.5447833	5.82	1
8/10/2010	65.56568	-106.5454817	4.43	1
8/10/2010	65.5655033	-106.544185	4.5	5
8/10/2010	65.5637533	-106.547855	1.35	2
8/10/2010	65.563865	-106.5432117	3.78	1
8/10/2010	65.5623517	-106.5442583	1.71	2
8/10/2010	65.5653733	-106.5478533	6.66	4
8/10/2010	65.5633683	-106.545335	2.09	4
8/10/2010	65.567395	-106.5471433	12.34	4
8/10/2010	65.5685417	-106.5466367	3.4	5
8/10/2010	65.5675233	-106.5465617	7.89	5
8/10/2010	65.5665033	-106.54599	6.55	1
8/10/2010	65.5662283	-106.5448033	5.89	1
8/10/2010	65.5656833	-106.5454617	4.43	1
8/10/2010	65.5655	-106.544205	4.53	5
8/10/2010	65.5637583	-106.5478317	1.32	2
8/10/2010	65.56386	-106.5432333	3.8	1
8/10/2010	65.5623583	-106.54423	1.63	0
8/10/2010	65.5653733	-106.5478533	6.67	2
8/10/2010	65.5633833	-106.5453417	2.1	0
8/10/2010	65.567405	-106.5471517	12.27	4
8/10/2010	65.5685383	-106.5466167	3.44	5
8/10/2010	65.5675217	-106.5465817	8.01	5
8/10/2010	65.5665083	-106.54597	6.5	1
8/10/2010	65.56623	-106.5448217	5.92	1
8/10/2010	65.5656883	-106.54544	4.43	1
8/10/2010	65.5654983	-106.544225	4.5	1
8/10/2010	65.5637633	-106.54781	1.42	0
8/10/2010	65.5638567	-106.543255	3.87	1
8/10/2010	65.5623617	-106.5442017	1.51	2
8/10/2010	65.565385	-106.54785	6.67	2
8/10/2010	65.5633983	-106.5453467	2.05	4
8/10/2010	65.5674167	-106.5471583	12.44	4
8/10/2010	65.5685367	-106.546595	3.42	5
8/10/2010	65.56752	-106.5466017	8.13	5
8/10/2010	65.5665133	-106.5459483	6.48	1
8/10/2010	65.5662317	-106.5448417	5.95	1
8/10/2010	65.5656917	-106.5454183	4.47	1
8/10/2010	65.5654967	-106.544245	4.5	1
8/10/2010	65.5637683	-106.5477867	1.51	0
8/10/2010	65.5638533	-106.5432783	3.9	1
8/10/2010	65.5623667	-106.5441733	1.57	2
8/10/2010	65.5653967	-106.5478467	6.66	2
8/10/2010	65.5634133	-106.5453517	1.95	2
8/10/2010	65.5674267	-106.5471683	12.51	2
8/10/2010	65.5685367	-106.5465717	3.4	5

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5675183	-106.5466233	8.25	5
8/10/2010	65.5665167	-106.5459267	6.45	3
8/10/2010	65.5662333	-106.5448617	6.02	1
8/10/2010	65.5656967	-106.5453967	4.5	1
8/10/2010	65.565495	-106.544265	4.48	1
8/10/2010	65.5637733	-106.5477633	1.54	2
8/10/2010	65.5638483	-106.5433017	3.92	1
8/10/2010	65.5623717	-106.5441467	1.63	4
8/10/2010	65.5654067	-106.5478433	6.71	4
8/10/2010	65.5634283	-106.5453567	2.07	4
8/10/2010	65.5674383	-106.5471767	12.51	2
8/10/2010	65.5685367	-106.54655	3.37	5
8/10/2010	65.5675167	-106.546645	8.37	5
8/10/2010	65.5665217	-106.545905	6.42	1
8/10/2010	65.566235	-106.5448833	6.04	1
8/10/2010	65.5657	-106.5453767	4.53	1
8/10/2010	65.5654917	-106.5442817	4.45	1
8/10/2010	65.5637783	-106.54774	1.49	0
8/10/2010	65.563845	-106.5433267	3.92	1
8/10/2010	65.562375	-106.54412	1.61	2
8/10/2010	65.5654167	-106.54784	6.72	0
8/10/2010	65.5634433	-106.5453617	2.04	2
8/10/2010	65.5674483	-106.5471867	12.46	2
8/10/2010	65.5685367	-106.5465283	3.37	5
8/10/2010	65.5675133	-106.5466667	8.52	5
8/10/2010	65.566525	-106.54588	6.36	1
8/10/2010	65.5662367	-106.5449033	6.11	1
8/10/2010	65.5657033	-106.5453533	4.57	5
8/10/2010	65.5654883	-106.5442983	4.43	1
8/10/2010	65.5637833	-106.5477167	1.56	0
8/10/2010	65.5638433	-106.54335	3.95	1
8/10/2010	65.5623817	-106.5440933	1.59	2
8/10/2010	65.5654167	-106.54784	6.72	4
8/10/2010	65.5634583	-106.545365	2.09	0
8/10/2010	65.5674583	-106.547195	12.39	2
8/10/2010	65.568535	-106.5465083	3.39	5
8/10/2010	65.5675117	-106.5466867	8.62	5
8/10/2010	65.5665283	-106.5458567	6.36	1
8/10/2010	65.5662383	-106.544925	6.16	1
8/10/2010	65.5657083	-106.5453317	4.59	5
8/10/2010	65.5654833	-106.5443133	4.4	1
8/10/2010	65.5637883	-106.547695	1.45	2
8/10/2010	65.56384	-106.5433717	3.95	1
8/10/2010	65.5623867	-106.5440683	1.54	2
8/10/2010	65.5654267	-106.54784	6.72	4
8/10/2010	65.5634733	-106.54537	2.09	2
8/10/2010	65.56747	-106.5472033	12.35	2
8/10/2010	65.568535	-106.5464867	3.39	5
8/10/2010	65.5675083	-106.5467083	8.71	5
8/10/2010	65.5665333	-106.5458333	6.31	1
8/10/2010	65.5662383	-106.544945	6.19	1
8/10/2010	65.5657117	-106.5453117	4.67	5
8/10/2010	65.56548	-106.54433	4.4	1
8/10/2010	65.5637917	-106.5476717	1.54	4
8/10/2010	65.5638367	-106.543395	3.99	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5623867	-106.5440683	1.54	2
8/10/2010	65.5654367	-106.5478383	6.74	2
8/10/2010	65.5634867	-106.545375	2.14	0
8/10/2010	65.56748	-106.54721	12.18	2
8/10/2010	65.5685333	-106.5464667	3.37	5
8/10/2010	65.5675067	-106.5467283	8.9	5
8/10/2010	65.5665383	-106.5458117	6.28	1
8/10/2010	65.56624	-106.5449667	6.23	1
8/10/2010	65.565715	-106.5452933	4.72	1
8/10/2010	65.5654767	-106.5443483	4.35	1
8/10/2010	65.5637967	-106.5476467	1.49	2
8/10/2010	65.5638333	-106.54342	3.97	1
8/10/2010	65.5623967	-106.5440133	1.52	2
8/10/2010	65.565445	-106.5478383	6.72	2
8/10/2010	65.5635017	-106.54538	2.12	2
8/10/2010	65.56749	-106.5472183	12.25	4
8/10/2010	65.5685333	-106.5464467	3.35	5
8/10/2010	65.5675033	-106.5467483	9.07	5
8/10/2010	65.5665417	-106.54579	6.24	1
8/10/2010	65.5662417	-106.5449883	6.3	1
8/10/2010	65.56572	-106.545275	4.79	1
8/10/2010	65.5654733	-106.544365	4.33	1
8/10/2010	65.5638017	-106.5476233	1.63	0
8/10/2010	65.56383	-106.5434433	4.02	1
8/10/2010	65.5624017	-106.5439867	1.56	4
8/10/2010	65.565455	-106.5478383	6.72	2
8/10/2010	65.5635167	-106.545385	2.14	2
8/10/2010	65.5675	-106.5472267	12.06	4
8/10/2010	65.5685333	-106.5464267	3.34	5
8/10/2010	65.5675017	-106.5467683	9.17	5
8/10/2010	65.566545	-106.5457667	6.21	1
8/10/2010	65.5662417	-106.5450117	6.35	1
8/10/2010	65.565725	-106.5452583	4.88	1
8/10/2010	65.56547	-106.544385	4.26	1
8/10/2010	65.5638067	-106.5476017	1.52	2
8/10/2010	65.5638267	-106.5434667	4.02	1
8/10/2010	65.5624067	-106.54396	1.56	2
8/10/2010	65.5654633	-106.547835	6.78	2
8/10/2010	65.5635317	-106.54539	2.46	4
8/10/2010	65.5675117	-106.5472367	12.01	4
8/10/2010	65.5685333	-106.5464033	3.34	5
8/10/2010	65.5675	-106.5467883	9.31	5
8/10/2010	65.5665483	-106.545745	6.14	1
8/10/2010	65.5662433	-106.5450333	6.38	1
8/10/2010	65.5657317	-106.5452383	4.93	1
8/10/2010	65.5654667	-106.544405	4.26	1
8/10/2010	65.5638117	-106.5475783	1.57	2
8/10/2010	65.563825	-106.5434917	4.04	1
8/10/2010	65.5624133	-106.543935	1.52	2
8/10/2010	65.5654633	-106.547835	6.76	4
8/10/2010	65.563545	-106.545395	2.65	2
8/10/2010	65.5675217	-106.547245	11.92	2
8/10/2010	65.5685333	-106.5463833	3.3	5
8/10/2010	65.5674983	-106.54681	9.41	5
8/10/2010	65.5665517	-106.54572	6.12	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5662467	-106.545055	6.4	1
8/10/2010	65.5657367	-106.54522	5.05	1
8/10/2010	65.565465	-106.5444267	4.21	5
8/10/2010	65.563815	-106.547555	1.64	4
8/10/2010	65.5638217	-106.543515	4.04	1
8/10/2010	65.5624183	-106.5439083	1.54	0
8/10/2010	65.5654717	-106.5478333	6.74	4
8/10/2010	65.56356	-106.5454	2.87	4
8/10/2010	65.5675333	-106.5472517	11.84	2
8/10/2010	65.56853	-106.5463617	3.32	5
8/10/2010	65.567495	-106.54683	9.67	5
8/10/2010	65.566555	-106.5456983	6.09	1
8/10/2010	65.5662483	-106.545075	6.4	1
8/10/2010	65.5657417	-106.5452033	5.15	1
8/10/2010	65.565465	-106.5444467	4.19	5
8/10/2010	65.5638183	-106.5475333	1.73	4
8/10/2010	65.5638183	-106.5435383	4	1
8/10/2010	65.5624233	-106.5438817	1.56	4
8/10/2010	65.5654717	-106.5478333	6.76	4
8/10/2010	65.563575	-106.5454033	2.89	2
8/10/2010	65.5675433	-106.5472583	11.79	2
8/10/2010	65.5685283	-106.5463417	3.32	5
8/10/2010	65.5674933	-106.5468483	9.77	5
8/10/2010	65.566555	-106.5456767	6.07	1
8/10/2010	65.5662483	-106.5450967	6.47	1
8/10/2010	65.5657467	-106.545185	5.29	1
8/10/2010	65.5654633	-106.5444633	4.16	5
8/10/2010	65.563825	-106.54751	1.54	0
8/10/2010	65.5638167	-106.54356	3.99	1
8/10/2010	65.56243	-106.5438567	1.56	2
8/10/2010	65.5654717	-106.5478333	6.79	4
8/10/2010	65.56359	-106.5454083	2.96	2
8/10/2010	65.5675533	-106.547265	11.75	2
8/10/2010	65.5685267	-106.5463217	3.23	5
8/10/2010	65.5674917	-106.5468667	9.96	5
8/10/2010	65.5665567	-106.545655	6.04	1
8/10/2010	65.5662483	-106.5450967	6.5	1
8/10/2010	65.5657533	-106.5451683	5.32	1
8/10/2010	65.56546	-106.54448	4.17	5
8/10/2010	65.56383	-106.5474883	1.68	0
8/10/2010	65.5638133	-106.5435817	3.93	1
8/10/2010	65.562435	-106.54383	1.56	0
8/10/2010	65.5654717	-106.5478333	6.83	4
8/10/2010	65.5636033	-106.5454133	2.89	0
8/10/2010	65.5675633	-106.5472717	11.57	2
8/10/2010	65.5685267	-106.5463033	3.13	5
8/10/2010	65.5674867	-106.5468833	10.13	5
8/10/2010	65.56656	-106.5456333	5.99	1
8/10/2010	65.56625	-106.5451417	6.54	1
8/10/2010	65.5657583	-106.54515	5.41	1
8/10/2010	65.5654567	-106.5444967	4.12	5
8/10/2010	65.563835	-106.5474667	1.69	4
8/10/2010	65.56381	-106.5436033	3.93	1
8/10/2010	65.5624417	-106.543805	1.56	0
8/10/2010	65.5654717	-106.5478333	6.91	4

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5636183	-106.54542	3.05	2
8/10/2010	65.567575	-106.5472783	11.57	2
8/10/2010	65.568525	-106.546285	3.1	5
8/10/2010	65.5674833	-106.5469017	10.28	5
8/10/2010	65.5665633	-106.5456133	5.95	1
8/10/2010	65.5662517	-106.5451633	6.54	1
8/10/2010	65.565765	-106.5451317	5.54	5
8/10/2010	65.5654517	-106.5445117	4.11	5
8/10/2010	65.56384	-106.5474433	1.32	2
8/10/2010	65.5638067	-106.5436267	3.87	1
8/10/2010	65.5624467	-106.5437783	1.52	2
8/10/2010	65.5654717	-106.5478333	6.89	4
8/10/2010	65.563635	-106.5454233	2.99	2
8/10/2010	65.567585	-106.547285	11.5	2
8/10/2010	65.5685233	-106.5462667	3.05	5
8/10/2010	65.5674817	-106.54692	10.47	5
8/10/2010	65.5665633	-106.5456133	5.89	1
8/10/2010	65.5662533	-106.5451833	6.59	1
8/10/2010	65.56577	-106.5451117	5.58	1
8/10/2010	65.5654483	-106.5445267	4.11	1
8/10/2010	65.563845	-106.54742	1.57	4
8/10/2010	65.5638033	-106.54365	3.85	1
8/10/2010	65.5624517	-106.5437533	1.54	2
8/10/2010	65.56548	-106.5478333	7	4
8/10/2010	65.56365	-106.5454283	3.23	1
8/10/2010	65.5675967	-106.5472917	11.43	2
8/10/2010	65.5685217	-106.5462467	3.01	5
8/10/2010	65.56748	-106.54694	10.57	5
8/10/2010	65.5665683	-106.54557	5.83	1
8/10/2010	65.5662533	-106.5452033	6.59	1
8/10/2010	65.565775	-106.5450933	5.7	1
8/10/2010	65.565445	-106.5445417	4.09	1
8/10/2010	65.56385	-106.5473967	1.64	2
8/10/2010	65.5638	-106.543675	3.78	1
8/10/2010	65.5624583	-106.5437267	1.59	4
8/10/2010	65.56548	-106.5478333	7.03	4
8/10/2010	65.563665	-106.5454317	3.34	1
8/10/2010	65.5676083	-106.5472983	11.36	2
8/10/2010	65.56852	-106.546225	2.99	5
8/10/2010	65.5674783	-106.5469583	10.81	5
8/10/2010	65.5665733	-106.5455483	5.78	1
8/10/2010	65.566255	-106.5452233	6.6	1
8/10/2010	65.56578	-106.5450733	5.85	5
8/10/2010	65.5654417	-106.5445583	4.05	1
8/10/2010	65.563855	-106.5473733	1.51	2
8/10/2010	65.5637967	-106.5436983	3.76	1
8/10/2010	65.5624633	-106.5437	1.54	4
8/10/2010	65.5654883	-106.5478333	7.08	4
8/10/2010	65.56368	-106.5454367	3.4	1
8/10/2010	65.5676183	-106.547305	11.33	2
8/10/2010	65.56852	-106.546205	2.96	5
8/10/2010	65.567475	-106.5469767	10.97	5
8/10/2010	65.5665783	-106.545525	5.71	1
8/10/2010	65.566255	-106.5452433	6.67	1
8/10/2010	65.565785	-106.545055	5.9	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5654383	-106.544575	4.07	1
8/10/2010	65.56386	-106.54735	1.68	4
8/10/2010	65.5637933	-106.5437233	3.73	1
8/10/2010	65.5624683	-106.5436733	1.54	4
8/10/2010	65.5654967	-106.5478317	7.1	4
8/10/2010	65.5636933	-106.5454417	3.59	1
8/10/2010	65.56763	-106.5473117	11.22	2
8/10/2010	65.5685167	-106.5461833	2.91	5
8/10/2010	65.5674733	-106.5469967	11.21	5
8/10/2010	65.5665817	-106.545505	5.65	1
8/10/2010	65.5662567	-106.5452633	6.6	1
8/10/2010	65.56579	-106.5450383	6.02	1
8/10/2010	65.5654333	-106.5445933	4.05	1
8/10/2010	65.563865	-106.5473267	1.75	2
8/10/2010	65.5637917	-106.5437483	3.68	1
8/10/2010	65.562475	-106.5436483	1.57	2
8/10/2010	65.565505	-106.54783	7.2	2
8/10/2010	65.5637083	-106.5454467	3.61	1
8/10/2010	65.56764	-106.5473217	11.19	2
8/10/2010	65.5685167	-106.5461633	2.89	5
8/10/2010	65.56747	-106.5470167	11.33	5
8/10/2010	65.5665867	-106.5454833	5.56	1
8/10/2010	65.5662583	-106.545285	6.66	1
8/10/2010	65.56579	-106.5450383	6.18	1
8/10/2010	65.5654283	-106.5446133	4.04	1
8/10/2010	65.56387	-106.5473033	1.73	4
8/10/2010	65.5637883	-106.5437717	3.66	1
8/10/2010	65.5624817	-106.5436233	1.59	4
8/10/2010	65.5655133	-106.5478283	7.22	0
8/10/2010	65.5637233	-106.5454517	3.66	1
8/10/2010	65.5676517	-106.54733	11.15	2
8/10/2010	65.568515	-106.5461417	2.86	2
8/10/2010	65.5674683	-106.5470383	11.46	5
8/10/2010	65.5665917	-106.5454617	5.51	1
8/10/2010	65.56626	-106.545305	6.62	1
8/10/2010	65.5658017	-106.545	6.21	1
8/10/2010	65.565425	-106.5446317	4.04	1
8/10/2010	65.563875	-106.54728	1.85	4
8/10/2010	65.563785	-106.543795	3.61	5
8/10/2010	65.5624867	-106.5435967	1.57	4
8/10/2010	65.5655133	-106.5478283	7.25	4
8/10/2010	65.5637383	-106.5454567	3.75	1
8/10/2010	65.5676617	-106.5473367	11.12	2
8/10/2010	65.5685133	-106.5461217	2.82	5
8/10/2010	65.5674667	-106.54706	11.69	5
8/10/2010	65.5665967	-106.54544	5.41	1
8/10/2010	65.5662617	-106.545325	6.59	5
8/10/2010	65.5658067	-106.5449817	6.42	1
8/10/2010	65.56542	-106.5446483	4.02	1
8/10/2010	65.56388	-106.5472567	1.83	4
8/10/2010	65.5637817	-106.5438183	3.58	1
8/10/2010	65.562495	-106.5435717	1.54	0
8/10/2010	65.5655217	-106.5478267	7.32	4
8/10/2010	65.5637533	-106.5454617	3.83	1
8/10/2010	65.5676717	-106.547345	11.07	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5685117	-106.5461017	2.79	5
8/10/2010	65.567465	-106.54708	11.86	5
8/10/2010	65.5666	-106.5454183	5.32	1
8/10/2010	65.5662617	-106.5453467	6.6	1
8/10/2010	65.5658117	-106.5449633	6.55	1
8/10/2010	65.565415	-106.5446683	4	1
8/10/2010	65.5638867	-106.5472317	1.83	4
8/10/2010	65.5637783	-106.5438433	3.56	1
8/10/2010	65.5625	-106.543545	1.52	4
8/10/2010	65.5655283	-106.547825	7.34	4
8/10/2010	65.5637683	-106.5454667	3.87	1
8/10/2010	65.5676817	-106.5473533	10.97	2
8/10/2010	65.5685117	-106.5460817	2.74	5
8/10/2010	65.5674633	-106.5471	11.91	5
8/10/2010	65.566605	-106.5453967	5.24	1
8/10/2010	65.5662633	-106.5453683	6.57	1
8/10/2010	65.5658167	-106.544945	6.57	1
8/10/2010	65.565415	-106.5446683	4	1
8/10/2010	65.5638917	-106.5472067	1.81	0
8/10/2010	65.563775	-106.543865	3.56	1
8/10/2010	65.5625067	-106.54352	1.9	2
8/10/2010	65.5655367	-106.5478233	7.43	0
8/10/2010	65.5637833	-106.54547	3.95	1
8/10/2010	65.5676917	-106.5473617	10.76	2
8/10/2010	65.56851	-106.5460617	2.69	0
8/10/2010	65.56746	-106.5471183	12.08	0
8/10/2010	65.5666083	-106.5453767	5.22	1
8/10/2010	65.566265	-106.54539	6.59	1
8/10/2010	65.5658233	-106.5449267	6.66	1
8/10/2010	65.5654083	-106.544705	3.99	1
8/10/2010	65.5638967	-106.5471817	1.8	4
8/10/2010	65.56377	-106.5438883	3.51	1
8/10/2010	65.5625117	-106.543495	1.85	0
8/10/2010	65.5655367	-106.5478233	7.51	4
8/10/2010	65.5637983	-106.545475	3.97	1
8/10/2010	65.5677033	-106.54737	10.83	2
8/10/2010	65.5685083	-106.5460417	2.67	4
8/10/2010	65.5674583	-106.5471383	12.23	4
8/10/2010	65.5666117	-106.545355	5.1	1
8/10/2010	65.5662667	-106.54541	6.55	1
8/10/2010	65.5658283	-106.5449083	6.76	1
8/10/2010	65.565405	-106.5447233	4	1
8/10/2010	65.5639017	-106.5471567	1.85	2
8/10/2010	65.5637667	-106.5439117	3.46	1
8/10/2010	65.5625167	-106.5434717	1.71	4
8/10/2010	65.5655367	-106.5478233	7.6	4
8/10/2010	65.5638133	-106.5454783	4.02	1
8/10/2010	65.5677133	-106.5473783	10.78	2
8/10/2010	65.5685083	-106.5460217	2.57	4
8/10/2010	65.567455	-106.5471567	12.37	4
8/10/2010	65.5666167	-106.545335	5.01	1
8/10/2010	65.5662667	-106.54543	6.55	1
8/10/2010	65.5658333	-106.54489	6.86	1
8/10/2010	65.5654017	-106.54474	3.99	1
8/10/2010	65.5639067	-106.5471333	1.88	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5637633	-106.543935	3.4	2
8/10/2010	65.5625233	-106.5434467	1.66	4
8/10/2010	65.5655367	-106.5478233	7.58	4
8/10/2010	65.5638283	-106.5454817	4.07	1
8/10/2010	65.567725	-106.5473883	10.71	2
8/10/2010	65.5685067	-106.546	2.43	2
8/10/2010	65.5674533	-106.5471767	12.39	2
8/10/2010	65.5666217	-106.5453133	4.94	1
8/10/2010	65.5662683	-106.54545	6.54	1
8/10/2010	65.5658383	-106.5448717	6.86	1
8/10/2010	65.5653983	-106.54476	3.97	1
8/10/2010	65.5639133	-106.54711	1.93	2
8/10/2010	65.56376	-106.5439583	3.44	2
8/10/2010	65.5625283	-106.5434217	1.66	2
8/10/2010	65.5655367	-106.5478233	7.66	4
8/10/2010	65.5638417	-106.545485	4.14	1
8/10/2010	65.567735	-106.5473967	10.59	2
8/10/2010	65.568505	-106.5459783	2.41	2
8/10/2010	65.56745	-106.5471983	12.52	5
8/10/2010	65.566625	-106.5452917	4.86	1
8/10/2010	65.5662683	-106.5454717	6.54	1
8/10/2010	65.565845	-106.5448533	6.95	1
8/10/2010	65.565395	-106.5447783	3.97	1
8/10/2010	65.5639183	-106.547085	1.95	0
8/10/2010	65.5637567	-106.5439817	3.42	2
8/10/2010	65.5625333	-106.5433967	1.59	4
8/10/2010	65.5655367	-106.5478233	7.7	0
8/10/2010	65.5638567	-106.5454867	4.17	1
8/10/2010	65.567745	-106.547405	10.49	2
8/10/2010	65.5685033	-106.5459567	2.33	2
8/10/2010	65.5674467	-106.5472183	12.54	2
8/10/2010	65.5666283	-106.54527	4.84	1
8/10/2010	65.56627	-106.5454917	6.52	1
8/10/2010	65.56585	-106.5448333	6.96	5
8/10/2010	65.5653917	-106.544795	3.95	1
8/10/2010	65.5639233	-106.5470617	2.09	4
8/10/2010	65.5637533	-106.5440067	3.42	0
8/10/2010	65.56254	-106.5433717	1.61	0
8/10/2010	65.5655433	-106.54782	7.73	4
8/10/2010	65.5638717	-106.54549	4.21	1
8/10/2010	65.567755	-106.5474133	10.42	2
8/10/2010	65.5685017	-106.545935	2.24	2
8/10/2010	65.567445	-106.5472383	12.66	5
8/10/2010	65.5666317	-106.5452467	4.74	1
8/10/2010	65.5662717	-106.5455133	6.52	1
8/10/2010	65.565855	-106.544815	7	1
8/10/2010	65.5653883	-106.5448133	3.93	1
8/10/2010	65.5639267	-106.54704	2.04	4
8/10/2010	65.56375	-106.54403	3.4	1
8/10/2010	65.5625467	-106.5433467	1.57	2
8/10/2010	65.5655433	-106.54782	7.78	4
8/10/2010	65.5638867	-106.545495	4.28	1
8/10/2010	65.5677667	-106.5474217	10.35	2
8/10/2010	65.5685	-106.5459133	1.97	4
8/10/2010	65.5674433	-106.54726	12.73	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.566635	-106.545225	4.69	1
8/10/2010	65.5662733	-106.5455317	6.5	1
8/10/2010	65.56586	-106.544795	6.98	1
8/10/2010	65.565385	-106.5448317	3.93	1
8/10/2010	65.5639333	-106.5470183	2.16	4
8/10/2010	65.563745	-106.5440533	3.42	1
8/10/2010	65.5625533	-106.54332	1.57	2
8/10/2010	65.5655433	-106.54782	7.8	4
8/10/2010	65.5639033	-106.5455	4.33	1
8/10/2010	65.5677767	-106.5474283	10.28	2
8/10/2010	65.5685	-106.5458917	1.76	4
8/10/2010	65.5674417	-106.54728	12.73	5
8/10/2010	65.5666383	-106.5452067	4.65	1
8/10/2010	65.5662733	-106.5455517	6.54	1
8/10/2010	65.565865	-106.544775	7.01	1
8/10/2010	65.5653833	-106.5448483	3.9	1
8/10/2010	65.5639383	-106.5469967	2.12	2
8/10/2010	65.5637417	-106.5440767	3.4	1
8/10/2010	65.56256	-106.5432933	1.57	2
8/10/2010	65.5639183	-106.545505	4.4	1
8/10/2010	65.5677867	-106.5474383	10.15	5
8/10/2010	65.5684983	-106.54587	1.61	4
8/10/2010	65.56744	-106.5473	12.8	2
8/10/2010	65.566645	-106.5451867	4.59	1
8/10/2010	65.566275	-106.5455717	6.54	1
8/10/2010	65.5658717	-106.5447567	7.01	1
8/10/2010	65.56538	-106.5448667	3.9	1
8/10/2010	65.563945	-106.5469733	2.26	4
8/10/2010	65.5637383	-106.5441017	3.39	1
8/10/2010	65.562565	-106.5432667	1.57	2
8/10/2010	65.5639333	-106.54551	4.48	1
8/10/2010	65.5677983	-106.547445	10.11	5
8/10/2010	65.5684983	-106.54585	1.49	2
8/10/2010	65.5674383	-106.54732	12.87	2
8/10/2010	65.56665	-106.545165	4.52	1
8/10/2010	65.566275	-106.5455917	6.52	1
8/10/2010	65.5658783	-106.5447383	7	1
8/10/2010	65.5653767	-106.5448833	3.88	1
8/10/2010	65.56395	-106.5469517	2.34	4
8/10/2010	65.563735	-106.5441267	3.37	1
8/10/2010	65.5625717	-106.5432417	1.56	2
8/10/2010	65.5639483	-106.5455167	4.53	1
8/10/2010	65.5678083	-106.547455	9.97	5
8/10/2010	65.5684967	-106.5458317	1.42	2
8/10/2010	65.5674383	-106.5473417	12.83	2
8/10/2010	65.5666533	-106.5451417	4.5	1
8/10/2010	65.5662767	-106.5456117	6.5	1
8/10/2010	65.5658833	-106.54472	6.95	1
8/10/2010	65.5653733	-106.5449017	3.87	1
8/10/2010	65.5639567	-106.5469283	2.17	2
8/10/2010	65.5637317	-106.54415	3.32	1
8/10/2010	65.5625783	-106.543215	1.35	2
8/10/2010	65.563965	-106.5455233	4.6	1
8/10/2010	65.5678183	-106.5474633	9.8	2
8/10/2010	65.568495	-106.5458117	1.35	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5674367	-106.5473617	12.83	2
8/10/2010	65.5666583	-106.5451183	4.45	1
8/10/2010	65.5662767	-106.5456317	6.55	1
8/10/2010	65.5658883	-106.5447017	6.91	1
8/10/2010	65.5653683	-106.5449167	3.87	1
8/10/2010	65.56396	-106.546905	2.21	2
8/10/2010	65.56373	-106.5441733	3.3	2
8/10/2010	65.5625833	-106.5431883	1.49	2
8/10/2010	65.56398	-106.5455283	4.69	1
8/10/2010	65.56783	-106.54747	9.58	2
8/10/2010	65.5684917	-106.5457917	1.03	2
8/10/2010	65.5674367	-106.5473617	12.85	2
8/10/2010	65.5666617	-106.5450967	4.4	1
8/10/2010	65.5662783	-106.5456533	6.57	1
8/10/2010	65.5658933	-106.5446833	6.89	1
8/10/2010	65.5653633	-106.5449333	3.85	1
8/10/2010	65.563965	-106.54688	2.55	4
8/10/2010	65.5637267	-106.5441967	3.27	2
8/10/2010	65.56259	-106.5431633	1.57	4
8/10/2010	65.563995	-106.5455333	4.74	1
8/10/2010	65.56784	-106.54748	9.46	2
8/10/2010	65.56849	-106.5457717	1.21	2
8/10/2010	65.56743	-106.5474017	12.88	2
8/10/2010	65.566665	-106.5450733	4.38	1
8/10/2010	65.56628	-106.545675	6.55	1
8/10/2010	65.5658983	-106.544665	6.84	1
8/10/2010	65.56536	-106.54495	3.85	5
8/10/2010	65.5639683	-106.5468567	2.6	2
8/10/2010	65.5637233	-106.54422	3.23	5
8/10/2010	65.5625967	-106.5431367	1.59	2
8/10/2010	65.56401	-106.5455383	4.79	1
8/10/2010	65.56785	-106.5474883	9.58	2
8/10/2010	65.5684883	-106.5457533	1.25	2
8/10/2010	65.5674283	-106.5474233	12.88	2
8/10/2010	65.5666667	-106.5450517	4.35	1
8/10/2010	65.5662817	-106.5456967	6.55	1
8/10/2010	65.565905	-106.5446467	6.79	1
8/10/2010	65.5653567	-106.544965	3.83	5
8/10/2010	65.5639733	-106.5468333	2.5	4
8/10/2010	65.56372	-106.5442433	3.22	5
8/10/2010	65.5626017	-106.5431117	1.52	0
8/10/2010	65.5640233	-106.5455433	4.79	1
8/10/2010	65.5678617	-106.5474967	9.38	2
8/10/2010	65.5684867	-106.5457333	1.27	2
8/10/2010	65.567425	-106.5474433	12.9	2
8/10/2010	65.56667	-106.54503	4.33	1
8/10/2010	65.5662833	-106.5457183	6.59	1
8/10/2010	65.5659117	-106.5446267	6.76	1
8/10/2010	65.5653517	-106.5449817	3.8	5
8/10/2010	65.5639783	-106.5468117	2.57	4
8/10/2010	65.5637167	-106.5442667	3.18	1
8/10/2010	65.5626083	-106.543085	1.57	4
8/10/2010	65.5640383	-106.5455483	4.86	1
8/10/2010	65.5678717	-106.547505	9.36	2
8/10/2010	65.568485	-106.5457133	1.03	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5674233	-106.547465	12.92	2
8/10/2010	65.5666733	-106.5450067	4.29	1
8/10/2010	65.566285	-106.54574	6.59	1
8/10/2010	65.5659167	-106.5446083	6.69	1
8/10/2010	65.5653483	-106.545	3.8	5
8/10/2010	65.563985	-106.5467883	2.75	2
8/10/2010	65.5637133	-106.5442917	3.15	5
8/10/2010	65.562615	-106.54306	1.59	4
8/10/2010	65.5640533	-106.5455533	4.88	1
8/10/2010	65.5678817	-106.5475133	9.2	2
8/10/2010	65.5684833	-106.5456967	1.01	2
8/10/2010	65.5674217	-106.5474833	12.93	2
8/10/2010	65.5666767	-106.544985	4.24	1
8/10/2010	65.566285	-106.54576	6.67	1
8/10/2010	65.5659217	-106.5445883	6.67	1
8/10/2010	65.5653433	-106.5450183	3.75	1
8/10/2010	65.56399	-106.546765	2.75	2
8/10/2010	65.5637083	-106.544315	3.17	1
8/10/2010	65.5626217	-106.5430333	1.47	2
8/10/2010	65.5640683	-106.5455583	4.91	1
8/10/2010	65.5678917	-106.5475233	9.15	2
8/10/2010	65.56848	-106.5456817	1.11	2
8/10/2010	65.5674183	-106.5475033	12.93	2
8/10/2010	65.5666817	-106.544965	4.19	5
8/10/2010	65.5662867	-106.54578	6.66	1
8/10/2010	65.5659267	-106.5445683	6.6	1
8/10/2010	65.56534	-106.5450383	3.73	1
8/10/2010	65.563995	-106.5467417	2.75	2
8/10/2010	65.563705	-106.54434	3.11	5
8/10/2010	65.5626283	-106.5430083	1.64	2
8/10/2010	65.5640817	-106.5455617	4.91	1
8/10/2010	65.5679017	-106.5475333	9	2
8/10/2010	65.5684767	-106.5456667	1.25	4
8/10/2010	65.567415	-106.5475233	12.93	2
8/10/2010	65.5666867	-106.544945	4.19	2
8/10/2010	65.5662867	-106.5458017	6.62	1
8/10/2010	65.5659317	-106.54455	6.55	1
8/10/2010	65.5653383	-106.5450583	3.76	1
8/10/2010	65.5640017	-106.5467183	2.75	2
8/10/2010	65.5637	-106.544365	3.13	1
8/10/2010	65.562635	-106.5429833	1.63	2
8/10/2010	65.5640967	-106.5455667	4.89	1
8/10/2010	65.5679117	-106.547545	8.95	2
8/10/2010	65.5684717	-106.5456517	1.21	4
8/10/2010	65.5674117	-106.5475433	12.92	2
8/10/2010	65.5666917	-106.5449233	4.12	1
8/10/2010	65.5662883	-106.54582	6.66	1
8/10/2010	65.5659367	-106.5445317	6.54	1
8/10/2010	65.565335	-106.5450767	3.73	1
8/10/2010	65.5640083	-106.5466933	2.77	2
8/10/2010	65.5636967	-106.54439	3.13	1
8/10/2010	65.5626417	-106.5429583	1.47	2
8/10/2010	65.5641117	-106.54557	4.84	1
8/10/2010	65.5679217	-106.5475567	8.88	2
8/10/2010	65.5674083	-106.5475633	12.92	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5666933	-106.5449017	4.09	1
8/10/2010	65.5662917	-106.5458417	6.71	1
8/10/2010	65.5659417	-106.5445133	6.45	1
8/10/2010	65.5653317	-106.5450933	3.73	5
8/10/2010	65.5640133	-106.54667	2.79	2
8/10/2010	65.5636917	-106.5444133	3.13	1
8/10/2010	65.5626483	-106.5429317	1.59	4
8/10/2010	65.5641267	-106.545575	4.81	1
8/10/2010	65.56793	-106.5475683	8.79	2
8/10/2010	65.5684617	-106.5456233	1.06	2
8/10/2010	65.5674067	-106.5475817	12.92	2
8/10/2010	65.5666967	-106.5448817	4.07	1
8/10/2010	65.5662933	-106.5458617	6.78	1
8/10/2010	65.5659483	-106.5444933	6.42	1
8/10/2010	65.5653267	-106.54511	3.71	5
8/10/2010	65.5640183	-106.5466467	2.82	2
8/10/2010	65.5636883	-106.544435	3.11	1
8/10/2010	65.562655	-106.542905	1.4	2
8/10/2010	65.5641417	-106.5455783	4.77	1
8/10/2010	65.56794	-106.54758	8.74	5
8/10/2010	65.5684567	-106.54561	1.09	2
8/10/2010	65.5674033	-106.5476017	12.92	2
8/10/2010	65.5667017	-106.5448617	4.05	5
8/10/2010	65.5662933	-106.5458817	6.74	1
8/10/2010	65.5659533	-106.544475	6.36	1
8/10/2010	65.5653233	-106.5451283	3.68	5
8/10/2010	65.5640233	-106.5466233	2.82	2
8/10/2010	65.563685	-106.54446	3.1	1
8/10/2010	65.56266	-106.5428783	1.49	0
8/10/2010	65.564155	-106.5455817	4.77	2
8/10/2010	65.56795	-106.5475917	8.64	2
8/10/2010	65.5684517	-106.5455967	1.13	2
8/10/2010	65.5674017	-106.54762	12.88	2
8/10/2010	65.566705	-106.54484	4.05	2
8/10/2010	65.566295	-106.5459017	6.79	1
8/10/2010	65.5659567	-106.5444533	6.24	1
8/10/2010	65.5653183	-106.5451433	3.66	5
8/10/2010	65.5640267	-106.5466017	2.81	2
8/10/2010	65.5636817	-106.544485	3.1	3
8/10/2010	65.5626667	-106.5428533	1.51	2
8/10/2010	65.56417	-106.545585	4.74	2
8/10/2010	65.56796	-106.547605	8.45	2
8/10/2010	65.568445	-106.5455867	1.13	2
8/10/2010	65.5673983	-106.5476383	12.9	2
8/10/2010	65.5667083	-106.5448183	4.02	5
8/10/2010	65.5662967	-106.5459217	6.83	1
8/10/2010	65.5659617	-106.544435	6.14	1
8/10/2010	65.565315	-106.5451567	3.64	2
8/10/2010	65.5640317	-106.5465767	2.79	2
8/10/2010	65.5636783	-106.5445083	3.08	5
8/10/2010	65.5626717	-106.5428283	1.56	4
8/10/2010	65.5641867	-106.5455883	4.72	2
8/10/2010	65.56797	-106.5476167	8.47	2
8/10/2010	65.56844	-106.545575	1.18	2
8/10/2010	65.567395	-106.5476583	12.92	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5667133	-106.544795	3.97	2
8/10/2010	65.5663	-106.5459433	6.84	2
8/10/2010	65.5659667	-106.5444167	6.11	1
8/10/2010	65.5653117	-106.5451733	3.63	2
8/10/2010	65.5640367	-106.5465533	2.7	4
8/10/2010	65.563675	-106.5445317	3.06	2
8/10/2010	65.5626783	-106.5428017	1.59	4
8/10/2010	65.5642017	-106.5455917	4.69	2
8/10/2010	65.5679783	-106.5476283	8.28	2
8/10/2010	65.568435	-106.5455633	1.25	4
8/10/2010	65.5673917	-106.5476783	12.83	2
8/10/2010	65.5667167	-106.5447733	3.95	2
8/10/2010	65.5663017	-106.545965	6.88	2
8/10/2010	65.5659717	-106.5443983	6.01	1
8/10/2010	65.5653083	-106.5451933	3.59	0
8/10/2010	65.5640433	-106.54653	2.74	4
8/10/2010	65.5636717	-106.544555	3.06	4
8/10/2010	65.562685	-106.542775	1.52	4
8/10/2010	65.5642167	-106.5455933	4.7	1
8/10/2010	65.5679883	-106.5476417	8.23	2
8/10/2010	65.5684283	-106.5455517	1.13	2
8/10/2010	65.5673883	-106.5476983	12.81	2
8/10/2010	65.56672	-106.5447517	3.88	2
8/10/2010	65.5663033	-106.545985	6.89	2
8/10/2010	65.5659767	-106.5443783	5.89	1
8/10/2010	65.565305	-106.54521	3.56	5
8/10/2010	65.5640483	-106.546505	2.75	2
8/10/2010	65.5636683	-106.5445783	3.05	5
8/10/2010	65.56269	-106.5427483	1.57	0
8/10/2010	65.5642333	-106.5455967	4.67	1
8/10/2010	65.5679967	-106.5476567	8.09	2
8/10/2010	65.5684233	-106.54554	1.28	2
8/10/2010	65.5673867	-106.5477183	12.88	2
8/10/2010	65.5667233	-106.54473	3.88	2
8/10/2010	65.566305	-106.5460067	6.89	2
8/10/2010	65.5659817	-106.5443583	5.83	1
8/10/2010	65.5653017	-106.5452267	3.56	5
8/10/2010	65.5640533	-106.54648	2.69	4
8/10/2010	65.563665	-106.5446017	3.06	2
8/10/2010	65.5626967	-106.5427217	1.49	2
8/10/2010	65.5642483	-106.5456	4.64	3
8/10/2010	65.5680067	-106.5476683	8.11	2
8/10/2010	65.5684183	-106.545525	1.16	2
8/10/2010	65.5673833	-106.5477367	12.85	2
8/10/2010	65.5667267	-106.5447083	3.87	2
8/10/2010	65.566305	-106.5460267	6.95	2
8/10/2010	65.5659867	-106.54434	5.78	1
8/10/2010	65.5652967	-106.545245	3.52	2
8/10/2010	65.56406	-106.546455	2.86	4
8/10/2010	65.5636617	-106.544625	3.03	2
8/10/2010	65.5627017	-106.5426967	1.42	2
8/10/2010	65.5642617	-106.5456033	4.45	4
8/10/2010	65.568015	-106.54768	7.92	2
8/10/2010	65.5684133	-106.5455117	1.18	2
8/10/2010	65.5673817	-106.5477567	12.88	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.56673	-106.5446867	3.83	2
8/10/2010	65.5663067	-106.5460467	6.98	1
8/10/2010	65.5659917	-106.5443217	5.63	1
8/10/2010	65.5652933	-106.5452633	3.51	2
8/10/2010	65.5640667	-106.5464317	3.01	4
8/10/2010	65.5636567	-106.54465	3.05	2
8/10/2010	65.5627083	-106.5426717	1.54	4
8/10/2010	65.5642767	-106.5456067	4.28	4
8/10/2010	65.568025	-106.5476933	7.82	2
8/10/2010	65.5684083	-106.5454967	1.2	2
8/10/2010	65.5673783	-106.547775	12.9	2
8/10/2010	65.5667333	-106.544665	3.8	2
8/10/2010	65.5663083	-106.546065	7.03	1
8/10/2010	65.5659967	-106.5443033	5.58	1
8/10/2010	65.5652883	-106.54528	3.51	2
8/10/2010	65.5640733	-106.5464083	3.2	4
8/10/2010	65.5636533	-106.5446733	3.01	2
8/10/2010	65.562715	-106.5426467	1.56	2
8/10/2010	65.5642917	-106.54561	4	4
8/10/2010	65.568035	-106.547705	7.9	5
8/10/2010	65.5684017	-106.5454833	1.09	0
8/10/2010	65.567375	-106.5477933	12.93	2
8/10/2010	65.5667367	-106.5446417	3.83	1
8/10/2010	65.56631	-106.546085	7.05	1
8/10/2010	65.566	-106.5442867	5.47	1
8/10/2010	65.565285	-106.5452983	3.49	2
8/10/2010	65.5640783	-106.5463833	3.47	2
8/10/2010	65.56365	-106.5446983	3.01	2
8/10/2010	65.56272	-106.54262	1.47	2
8/10/2010	65.5643067	-106.5456133	3.93	2
8/10/2010	65.568045	-106.5477167	7.8	2
8/10/2010	65.5673733	-106.5478133	12.93	2
8/10/2010	65.56674	-106.5446183	3.88	1
8/10/2010	65.5663117	-106.546105	7.07	1
8/10/2010	65.566005	-106.5442667	5.46	1
8/10/2010	65.56528	-106.545315	3.47	5
8/10/2010	65.564085	-106.5463583	3.63	5
8/10/2010	65.5636467	-106.54472	3.01	2
8/10/2010	65.5627267	-106.5425933	1.37	2
8/10/2010	65.5643217	-106.545615	3.87	5
8/10/2010	65.568055	-106.5477283	7.63	4
8/10/2010	65.56737	-106.5478333	12.95	2
8/10/2010	65.5667433	-106.544595	3.87	1
8/10/2010	65.5663117	-106.546125	7.07	1
8/10/2010	65.56601	-106.5442483	5.35	1
8/10/2010	65.5652767	-106.5453317	3.46	5
8/10/2010	65.5640917	-106.5463333	3.78	5
8/10/2010	65.5636433	-106.544745	2.98	2
8/10/2010	65.5627333	-106.5425667	1.51	4
8/10/2010	65.5643367	-106.5456183	3.87	5
8/10/2010	65.5680633	-106.5477417	7.65	0
8/10/2010	65.5673683	-106.5478533	13	2
8/10/2010	65.5667467	-106.5445717	3.93	1
8/10/2010	65.5663133	-106.546145	7.08	1
8/10/2010	65.566015	-106.54423	5.3	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5652717	-106.54535	3.46	5
8/10/2010	65.5640983	-106.5463067	4	1
8/10/2010	65.56364	-106.5447683	2.93	2
8/10/2010	65.5627383	-106.5425383	1.52	2
8/10/2010	65.56435	-106.5456233	3.93	1
8/10/2010	65.5680733	-106.5477533	7.61	2
8/10/2010	65.5673667	-106.5478733	13.05	2
8/10/2010	65.5667483	-106.5445517	4	1
8/10/2010	65.566315	-106.546165	7.12	2
8/10/2010	65.5660183	-106.54421	5.18	1
8/10/2010	65.5652683	-106.5453683	3.42	1
8/10/2010	65.5641033	-106.5462833	4.17	1
8/10/2010	65.5636367	-106.5447917	2.82	4
8/10/2010	65.562745	-106.5425117	1.4	0
8/10/2010	65.564365	-106.5456283	4.02	1
8/10/2010	65.5680817	-106.5477667	7.6	2
8/10/2010	65.567365	-106.5478933	13.07	4
8/10/2010	65.5667517	-106.54453	4.02	0
8/10/2010	65.5663167	-106.546185	7.17	2
8/10/2010	65.5660217	-106.54419	5.13	1
8/10/2010	65.5652633	-106.5453883	3.44	1
8/10/2010	65.56411	-106.54626	4.35	1
8/10/2010	65.5636333	-106.544815	2.79	2
8/10/2010	65.562745	-106.5425117	1.3	2
8/10/2010	65.56438	-106.5456333	4.07	1
8/10/2010	65.5680917	-106.54778	7.48	2
8/10/2010	65.5673617	-106.5479117	13.11	4
8/10/2010	65.566755	-106.5445083	4.04	1
8/10/2010	65.5663167	-106.5462033	7.1	1
8/10/2010	65.5660267	-106.5441717	5	1
8/10/2010	65.56526	-106.5454067	3.46	1
8/10/2010	65.5641167	-106.546235	4.48	1
8/10/2010	65.56363	-106.5448367	2.81	4
8/10/2010	65.562755	-106.5424583	1.54	0
8/10/2010	65.5643967	-106.5456383	4.12	1
8/10/2010	65.5681	-106.547795	7.36	2
8/10/2010	65.56736	-106.5479317	13.17	2
8/10/2010	65.5667567	-106.544485	4.05	1
8/10/2010	65.5663167	-106.5462217	7.17	1
8/10/2010	65.5660317	-106.5441517	4.96	1
8/10/2010	65.565255	-106.545425	3.47	1
8/10/2010	65.5641217	-106.54621	4.62	1
8/10/2010	65.563625	-106.5448583	2.82	4
8/10/2010	65.56276	-106.5424317	1.39	2
8/10/2010	65.5644117	-106.5456417	4.31	1
8/10/2010	65.5681083	-106.54781	7.37	2
8/10/2010	65.5673567	-106.54795	13.24	2
8/10/2010	65.56676	-106.5444617	4	1
8/10/2010	65.5663183	-106.5462433	7.2	1
8/10/2010	65.5660367	-106.5441333	4.93	1
8/10/2010	65.5652517	-106.5454433	3.46	1
8/10/2010	65.5641267	-106.546185	4.82	1
8/10/2010	65.56362	-106.5448817	2.91	2
8/10/2010	65.5627667	-106.5424067	1.23	2
8/10/2010	65.5644267	-106.5456467	4.38	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5681183	-106.5478233	7.2	2
8/10/2010	65.5673533	-106.54797	13.26	2
8/10/2010	65.5667633	-106.5444367	4	0
8/10/2010	65.5663183	-106.546265	7.19	1
8/10/2010	65.5660417	-106.544115	4.82	1
8/10/2010	65.5652467	-106.5454617	3.46	1
8/10/2010	65.5641317	-106.54616	4.86	1
8/10/2010	65.5636167	-106.5449033	2.99	2
8/10/2010	65.5644417	-106.5456517	4.48	1
8/10/2010	65.5681267	-106.5478383	7.24	2
8/10/2010	65.56735	-106.5479883	13.33	2
8/10/2010	65.566765	-106.5444133	3.93	1
8/10/2010	65.56632	-106.5462867	7.2	1
8/10/2010	65.5660467	-106.5440983	4.76	1
8/10/2010	65.5652433	-106.54548	3.47	5
8/10/2010	65.5641383	-106.546135	5.01	1
8/10/2010	65.5636117	-106.5449267	2.96	2
8/10/2010	65.5644567	-106.5456567	4.55	1
8/10/2010	65.5681367	-106.5478517	7.25	2
8/10/2010	65.5673467	-106.5480083	13.38	2
8/10/2010	65.5667683	-106.54439	3.85	2
8/10/2010	65.5663217	-106.5463083	7.2	1
8/10/2010	65.5660517	-106.54408	4.7	1
8/10/2010	65.56524	-106.5454983	3.47	5
8/10/2010	65.564145	-106.5461117	5.12	1
8/10/2010	65.5636083	-106.5449483	2.99	2
8/10/2010	65.5644717	-106.5456617	4.57	1
8/10/2010	65.568145	-106.547865	6.95	2
8/10/2010	65.5673433	-106.5480283	13.46	2
8/10/2010	65.5667717	-106.5443683	3.85	0
8/10/2010	65.5663233	-106.5463283	7.22	5
8/10/2010	65.5660583	-106.5440617	4.62	1
8/10/2010	65.565235	-106.5455167	3.46	1
8/10/2010	65.5641517	-106.5460867	5.27	1
8/10/2010	65.5636033	-106.5449717	3.01	2
8/10/2010	65.5644867	-106.5456683	4.55	1
8/10/2010	65.568155	-106.5478783	6.91	2
8/10/2010	65.5673417	-106.5480483	13.45	2
8/10/2010	65.566775	-106.544345	3.76	2
8/10/2010	65.5663233	-106.5463283	7.24	5
8/10/2010	65.5660617	-106.5440433	4.6	1
8/10/2010	65.5652317	-106.5455333	3.46	1
8/10/2010	65.5641567	-106.54606	5.34	1
8/10/2010	65.5636	-106.5449967	3.03	2
8/10/2010	65.5645	-106.5456767	4.48	1
8/10/2010	65.5681633	-106.54789	6.81	2
8/10/2010	65.5673383	-106.5480683	13.43	2
8/10/2010	65.5667783	-106.5443217	3.7	2
8/10/2010	65.5663233	-106.54637	7.27	1
8/10/2010	65.5660667	-106.544025	4.53	1
8/10/2010	65.5652283	-106.54555	3.47	1
8/10/2010	65.5641617	-106.546035	5.34	2
8/10/2010	65.563595	-106.5450217	3.05	2
8/10/2010	65.564515	-106.5456833	4.41	1
8/10/2010	65.5681717	-106.5479033	6.78	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.567335	-106.5480867	13.46	2
8/10/2010	65.5667817	-106.5443	3.61	2
8/10/2010	65.5663233	-106.54639	7.31	1
8/10/2010	65.5660717	-106.544005	4.5	1
8/10/2010	65.565225	-106.5455683	3.49	1
8/10/2010	65.5641667	-106.54601	5.3	1
8/10/2010	65.56359	-106.545045	3.05	2
8/10/2010	65.56453	-106.5456883	4.41	1
8/10/2010	65.56818	-106.5479167	6.5	2
8/10/2010	65.5673317	-106.548105	13.41	2
8/10/2010	65.5667833	-106.5442783	3.52	2
8/10/2010	65.5663233	-106.54641	7.34	1
8/10/2010	65.566075	-106.5439867	4.41	5
8/10/2010	65.5652217	-106.5455867	3.46	1
8/10/2010	65.56417	-106.5459833	5.27	2
8/10/2010	65.5635867	-106.5450683	3.06	2
8/10/2010	65.564545	-106.5456917	4.35	1
8/10/2010	65.5681883	-106.5479317	6.54	4
8/10/2010	65.5673283	-106.548125	13.45	2
8/10/2010	65.566785	-106.544255	3.35	2
8/10/2010	65.5663233	-106.5464317	7.34	1
8/10/2010	65.5660783	-106.5439683	4.41	2
8/10/2010	65.5652183	-106.5456033	3.49	1
8/10/2010	65.5641733	-106.5459583	5.22	1
8/10/2010	65.5635833	-106.5450917	3.05	2
8/10/2010	65.56456	-106.5456967	4.33	1
8/10/2010	65.5681967	-106.547945	6.62	2
8/10/2010	65.567325	-106.5481433	13.41	2
8/10/2010	65.5667867	-106.5442333	3.34	2
8/10/2010	65.566325	-106.5464533	7.32	5
8/10/2010	65.5660833	-106.54395	4.36	2
8/10/2010	65.5652133	-106.54562	3.49	2
8/10/2010	65.5641783	-106.5459317	5.17	0
8/10/2010	65.56358	-106.545115	3.05	2
8/10/2010	65.564575	-106.5457017	4.31	1
8/10/2010	65.568205	-106.5479617	6.62	2
8/10/2010	65.5673217	-106.5481617	13.4	2
8/10/2010	65.56679	-106.54421	3.17	4
8/10/2010	65.5663267	-106.5464733	7.37	1
8/10/2010	65.5660883	-106.54393	4.36	2
8/10/2010	65.56521	-106.5456367	3.52	2
8/10/2010	65.5641817	-106.5459067	5.13	5
8/10/2010	65.5635767	-106.5451383	3.05	1
8/10/2010	65.5645883	-106.5457067	4.29	1
8/10/2010	65.5682133	-106.5479783	6.45	5
8/10/2010	65.5673183	-106.54818	13.31	2
8/10/2010	65.5667933	-106.5441867	3.22	2
8/10/2010	65.5663267	-106.5464933	7.39	1
8/10/2010	65.5660917	-106.54391	4.29	2
8/10/2010	65.5652067	-106.545655	3.51	2
8/10/2010	65.564185	-106.54588	5.12	5
8/10/2010	65.5635733	-106.54516	3.05	1
8/10/2010	65.5646033	-106.5457117	4.28	1
8/10/2010	65.5682217	-106.5479917	6.4	5
8/10/2010	65.567315	-106.5481983	13.24	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.566795	-106.5441633	3.11	2
8/10/2010	65.5663283	-106.546515	7.41	1
8/10/2010	65.5660917	-106.54391	4.19	2
8/10/2010	65.5652033	-106.5456733	3.51	0
8/10/2010	65.56419	-106.5458517	5.08	5
8/10/2010	65.56357	-106.5451817	3.05	2
8/10/2010	65.5646167	-106.5457183	4.24	1
8/10/2010	65.5682283	-106.5480067	6.3	1
8/10/2010	65.5673117	-106.5482167	13.17	2
8/10/2010	65.5667967	-106.5441417	3.03	2
8/10/2010	65.5663283	-106.546535	7.44	1
8/10/2010	65.5661	-106.54387	4.21	2
8/10/2010	65.5652	-106.54569	3.51	1
8/10/2010	65.564195	-106.545825	5.03	5
8/10/2010	65.563565	-106.545205	3.03	2
8/10/2010	65.5646317	-106.5457233	4.23	1
8/10/2010	65.5682367	-106.5480233	6.18	1
8/10/2010	65.5673083	-106.5482367	13.12	2
8/10/2010	65.5667983	-106.54412	3.05	2
8/10/2010	65.56633	-106.5465567	7.46	5
8/10/2010	65.5661033	-106.54385	4.19	2
8/10/2010	65.5651967	-106.5457083	3.54	5
8/10/2010	65.5641983	-106.5457983	5.01	2
8/10/2010	65.5635617	-106.5452267	3.01	2
8/10/2010	65.5646467	-106.54573	4.23	1
8/10/2010	65.5682433	-106.5480383	6.07	2
8/10/2010	65.5673033	-106.5482533	12.97	2
8/10/2010	65.5668017	-106.5441	3.01	2
8/10/2010	65.56633	-106.5465767	7.48	1
8/10/2010	65.5661067	-106.5438283	4.17	0
8/10/2010	65.5651933	-106.545725	3.54	2
8/10/2010	65.5642017	-106.5457717	5	2
8/10/2010	65.5635567	-106.5452517	2.99	2
8/10/2010	65.5646617	-106.5457333	4.17	1
8/10/2010	65.5682433	-106.5480383	5.95	0
8/10/2010	65.5673033	-106.5482533	12.83	1
8/10/2010	65.5668033	-106.5440783	3.01	4
8/10/2010	65.5663317	-106.5465967	7.53	1
8/10/2010	65.5661117	-106.54381	4.12	2
8/10/2010	65.5651917	-106.545745	3.56	2
8/10/2010	65.564205	-106.545745	4.94	2
8/10/2010	65.5635533	-106.5452733	2.98	2
8/10/2010	65.5646767	-106.5457383	4.16	1
8/10/2010	65.5672967	-106.54829	12.71	1
8/10/2010	65.5668067	-106.544055	2.99	2
8/10/2010	65.5663333	-106.5466183	7.56	1
8/10/2010	65.5661167	-106.54379	4.12	2
8/10/2010	65.5651883	-106.5457617	3.58	2
8/10/2010	65.56421	-106.5457183	4.93	2
8/10/2010	65.56355	-106.5452967	2.96	4
8/10/2010	65.5646917	-106.5457433	4.12	1
8/10/2010	65.5672933	-106.5483083	12.64	1
8/10/2010	65.5668083	-106.5440317	2.96	2
8/10/2010	65.5663333	-106.54664	7.56	1
8/10/2010	65.5661183	-106.5437683	4.09	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.565185	-106.5457783	3.58	5
8/10/2010	65.5642133	-106.5456917	4.86	1
8/10/2010	65.5635467	-106.54532	2.89	4
8/10/2010	65.5647067	-106.54575	4.09	1
8/10/2010	65.56729	-106.548325	12.52	1
8/10/2010	65.5668117	-106.5440083	2.91	2
8/10/2010	65.566335	-106.54666	7.56	1
8/10/2010	65.5661233	-106.54375	4	2
8/10/2010	65.56518	-106.545795	3.63	2
8/10/2010	65.5642167	-106.545665	4.79	2
8/10/2010	65.5635417	-106.5453433	2.65	4
8/10/2010	65.5647217	-106.5457567	4.04	1
8/10/2010	65.567285	-106.5483417	12.37	1
8/10/2010	65.566815	-106.5439867	2.87	2
8/10/2010	65.566335	-106.54668	7.6	1
8/10/2010	65.5661267	-106.5437317	4.07	2
8/10/2010	65.565175	-106.54581	3.68	2
8/10/2010	65.5642167	-106.545665	4.74	2
8/10/2010	65.5635383	-106.5453683	2.53	4
8/10/2010	65.5647367	-106.5457617	4.04	1
8/10/2010	65.56728	-106.5483583	12.2	1
8/10/2010	65.5668167	-106.543965	2.79	2
8/10/2010	65.566335	-106.5467	7.58	1
8/10/2010	65.56613	-106.5437133	4	2
8/10/2010	65.5651717	-106.5458283	3.68	5
8/10/2010	65.5642233	-106.545615	4.7	2
8/10/2010	65.563535	-106.5453933	2.48	2
8/10/2010	65.5647517	-106.5457667	4	1
8/10/2010	65.567275	-106.548375	12.15	1
8/10/2010	65.56682	-106.5439433	2.81	2
8/10/2010	65.5663367	-106.54672	7.63	1
8/10/2010	65.5661333	-106.5436933	4.02	2
8/10/2010	65.5651667	-106.545845	3.7	5
8/10/2010	65.5642267	-106.54559	4.69	2
8/10/2010	65.5635317	-106.5454183	2.16	4
8/10/2010	65.5647667	-106.54577	3.99	1
8/10/2010	65.56727	-106.5483917	11.91	1
8/10/2010	65.5668233	-106.5439217	2.77	2
8/10/2010	65.5663367	-106.54674	7.7	1
8/10/2010	65.5661367	-106.5436733	3.97	2
8/10/2010	65.5651633	-106.5458617	3.71	5
8/10/2010	65.56423	-106.545565	4.65	2
8/10/2010	65.56353	-106.5454433	2.04	4
8/10/2010	65.5647817	-106.545775	4.04	1
8/10/2010	65.5672667	-106.5484083	11.86	1
8/10/2010	65.5668267	-106.5439	2.6	2
8/10/2010	65.5663367	-106.54676	7.77	1
8/10/2010	65.5661417	-106.5436533	3.92	2
8/10/2010	65.5651617	-106.5458767	3.76	5
8/10/2010	65.564235	-106.54554	4.62	2
8/10/2010	65.5635267	-106.5454667	2.02	4
8/10/2010	65.5647967	-106.54578	4.04	1
8/10/2010	65.5672617	-106.5484267	11.7	1
8/10/2010	65.56683	-106.54388	2.69	2
8/10/2010	65.5663367	-106.54678	7.75	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.566145	-106.5436317	3.87	2
8/10/2010	65.5651583	-106.5458917	3.8	1
8/10/2010	65.56424	-106.545515	4.48	1
8/10/2010	65.563525	-106.54549	2.05	4
8/10/2010	65.5648117	-106.545785	4.04	1
8/10/2010	65.5672567	-106.548445	11.51	1
8/10/2010	65.5668333	-106.5438583	2.63	2
8/10/2010	65.5663383	-106.5468017	7.85	1
8/10/2010	65.5661483	-106.5436117	3.83	2
8/10/2010	65.565155	-106.5459067	3.85	1
8/10/2010	65.564245	-106.5454917	4.38	1
8/10/2010	65.5635233	-106.545515	2.09	0
8/10/2010	65.5648267	-106.5457883	4	1
8/10/2010	65.5672517	-106.5484633	11.46	1
8/10/2010	65.5668367	-106.543835	2.58	2
8/10/2010	65.5663383	-106.5468217	7.9	1
8/10/2010	65.5661517	-106.54359	3.78	2
8/10/2010	65.5651517	-106.54592	3.88	1
8/10/2010	65.56425	-106.5454667	4.28	1
8/10/2010	65.5635217	-106.54554	2.07	2
8/10/2010	65.56484	-106.5457917	4.02	1
8/10/2010	65.5672483	-106.5484817	11.33	1
8/10/2010	65.56684	-106.5438133	2.55	2
8/10/2010	65.5663383	-106.5468417	7.92	1
8/10/2010	65.566155	-106.5435717	3.7	0
8/10/2010	65.5651467	-106.5459333	3.93	1
8/10/2010	65.5642567	-106.5454417	4.16	1
8/10/2010	65.5635183	-106.545565	2.02	4
8/10/2010	65.5648533	-106.545795	4.02	1
8/10/2010	65.567245	-106.5484983	11.15	1
8/10/2010	65.5668433	-106.5437917	2.57	2
8/10/2010	65.5663383	-106.5468633	7.9	1
8/10/2010	65.5661583	-106.5435533	3.64	2
8/10/2010	65.5651417	-106.5459467	3.93	1
8/10/2010	65.5642617	-106.5454167	4	5
8/10/2010	65.5635167	-106.54559	1.97	2
8/10/2010	65.5648683	-106.5458	3.97	1
8/10/2010	65.567245	-106.5484983	11.04	1
8/10/2010	65.5668467	-106.54377	2.5	2
8/10/2010	65.5663383	-106.5468833	7.92	1
8/10/2010	65.5661617	-106.543535	3.58	2
8/10/2010	65.565135	-106.54596	3.99	1
8/10/2010	65.5642667	-106.5453933	3.83	1
8/10/2010	65.563515	-106.5456133	1.93	2
8/10/2010	65.5648833	-106.545805	3.95	1
8/10/2010	65.5672367	-106.548535	10.86	1
8/10/2010	65.5668483	-106.5437483	2.45	2
8/10/2010	65.5663383	-106.546905	7.9	1
8/10/2010	65.566165	-106.543515	3.44	2
8/10/2010	65.56513	-106.5459733	4.04	1
8/10/2010	65.5642733	-106.5453683	3.71	1
8/10/2010	65.5635117	-106.5456367	1.97	2
8/10/2010	65.5648983	-106.5458117	3.92	1
8/10/2010	65.5672333	-106.5485517	10.83	1
8/10/2010	65.5668517	-106.5437283	2.46	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5663383	-106.546925	7.9	1
8/10/2010	65.5661683	-106.5434967	3.39	2
8/10/2010	65.5651233	-106.5459867	4.05	1
8/10/2010	65.5642783	-106.5453433	3.59	1
8/10/2010	65.5635083	-106.54566	1.93	4
8/10/2010	65.5649117	-106.5458183	3.92	1
8/10/2010	65.5672317	-106.5485717	10.71	1
8/10/2010	65.5668567	-106.5437067	2.43	2
8/10/2010	65.5663367	-106.5469433	7.85	1
8/10/2010	65.5661717	-106.5434767	3.3	2
8/10/2010	65.5651167	-106.5460017	4.14	1
8/10/2010	65.564285	-106.54532	3.4	1
8/10/2010	65.5635067	-106.545685	1.9	4
8/10/2010	65.5649267	-106.545825	3.87	1
8/10/2010	65.5672283	-106.54859	10.54	1
8/10/2010	65.56686	-106.5436867	2.43	2
8/10/2010	65.5663367	-106.5469633	7.84	1
8/10/2010	65.5661767	-106.5434567	3.18	2
8/10/2010	65.56511	-106.5460167	4.19	1
8/10/2010	65.56429	-106.545295	3.23	5
8/10/2010	65.5635033	-106.5457083	1.93	2
8/10/2010	65.56494	-106.5458333	3.88	1
8/10/2010	65.567225	-106.54861	10.4	1
8/10/2010	65.5668633	-106.5436667	2.43	2
8/10/2010	65.566335	-106.546985	7.77	1
8/10/2010	65.5661817	-106.5434383	3.11	2
8/10/2010	65.5651017	-106.5460317	4.24	1
8/10/2010	65.564295	-106.54527	3.22	1
8/10/2010	65.5635	-106.5457333	2.02	2
8/10/2010	65.564955	-106.5458417	3.88	1
8/10/2010	65.56722	-106.5486283	10.25	1
8/10/2010	65.566865	-106.543645	2.04	2
8/10/2010	65.566335	-106.547005	7.75	1
8/10/2010	65.566185	-106.54342	2.99	2
8/10/2010	65.5650933	-106.546045	4.29	5
8/10/2010	65.5643	-106.5452467	3.08	1
8/10/2010	65.5634983	-106.5457567	1.81	2
8/10/2010	65.5649683	-106.5458517	3.9	1
8/10/2010	65.5672167	-106.5486483	10.18	1
8/10/2010	65.5668683	-106.5436233	1.39	2
8/10/2010	65.5663333	-106.547025	7.72	1
8/10/2010	65.56619	-106.5434	2.91	2
8/10/2010	65.5650833	-106.5460583	4.36	1
8/10/2010	65.564305	-106.5452217	3.05	5
8/10/2010	65.563495	-106.54578	1.76	2
8/10/2010	65.5649817	-106.5458617	3.9	1
8/10/2010	65.5672117	-106.5486667	10.06	1
8/10/2010	65.56687	-106.5436017	1.13	2
8/10/2010	65.5663317	-106.547045	7.72	1
8/10/2010	65.5661933	-106.54338	2.84	0
8/10/2010	65.565075	-106.5460733	4.41	1
8/10/2010	65.56431	-106.5451983	2.98	0
8/10/2010	65.5634917	-106.5458033	1.86	4
8/10/2010	65.564995	-106.5458733	3.87	5
8/10/2010	65.5672083	-106.548685	9.94	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.56633	-106.5470667	7.68	1
8/10/2010	65.5661967	-106.54336	2.74	2
8/10/2010	65.565065	-106.54609	4.5	1
8/10/2010	65.564315	-106.545175	2.94	1
8/10/2010	65.5634883	-106.5458267	1.9	2
8/10/2010	65.56501	-106.5458833	3.9	5
8/10/2010	65.567205	-106.5487033	9.84	1
8/10/2010	65.56633	-106.54709	7.7	1
8/10/2010	65.5662017	-106.5433417	2.74	2
8/10/2010	65.5650567	-106.5461067	4.52	1
8/10/2010	65.56432	-106.54515	2.89	2
8/10/2010	65.5634833	-106.5458517	1.85	4
8/10/2010	65.5650233	-106.5458933	3.93	5
8/10/2010	65.5672	-106.5487233	9.72	1
8/10/2010	65.56633	-106.5471117	7.63	1
8/10/2010	65.5662067	-106.5433233	2.69	2
8/10/2010	65.5650483	-106.5461217	4.62	1
8/10/2010	65.5643233	-106.545125	2.89	2
8/10/2010	65.56348	-106.5458767	1.92	2
8/10/2010	65.5650367	-106.5459033	3.92	5
8/10/2010	65.5671967	-106.5487417	9.51	1
8/10/2010	65.5663283	-106.5471317	7.66	1
8/10/2010	65.5662117	-106.543305	2.69	2
8/10/2010	65.56504	-106.5461367	4.67	1
8/10/2010	65.5643283	-106.5451	2.86	4
8/10/2010	65.5634767	-106.5459	1.86	2
8/10/2010	65.5650367	-106.5459033	3.9	5
8/10/2010	65.5671917	-106.5487617	9.43	4
8/10/2010	65.5663283	-106.5471533	7.66	1
8/10/2010	65.5662167	-106.5432867	2.75	2
8/10/2010	65.5650317	-106.5461533	4.74	1
8/10/2010	65.5643333	-106.5450767	2.93	2
8/10/2010	65.563475	-106.5459233	2	4
8/10/2010	65.565065	-106.545925	3.93	1
8/10/2010	65.5671867	-106.54878	9.12	5
8/10/2010	65.5663283	-106.5471733	7.65	0
8/10/2010	65.5662217	-106.5432683	2.81	2
8/10/2010	65.5650233	-106.5461667	4.81	5
8/10/2010	65.5643383	-106.5450517	3.03	2
8/10/2010	65.5634717	-106.5459467	1.83	4
8/10/2010	65.5650783	-106.5459333	3.95	1
8/10/2010	65.5671817	-106.5488	8.96	5
8/10/2010	65.5663267	-106.547195	7.65	2
8/10/2010	65.566225	-106.54325	2.87	2
8/10/2010	65.565015	-106.5461817	4.88	1
8/10/2010	65.5643433	-106.5450267	2.99	4
8/10/2010	65.5634683	-106.54597	1.85	4
8/10/2010	65.5650917	-106.54594	3.95	1
8/10/2010	65.5671783	-106.5488217	8.85	0
8/10/2010	65.5663267	-106.5472167	7.66	1
8/10/2010	65.5662283	-106.54323	2.96	2
8/10/2010	65.5650067	-106.546195	4.93	5
8/10/2010	65.56435	-106.545005	2.99	0
8/10/2010	65.5634633	-106.5459933	1.88	4
8/10/2010	65.5651067	-106.5459467	3.95	5

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5671733	-106.54884	8.28	4
8/10/2010	65.5663267	-106.5472383	7.68	2
8/10/2010	65.5662333	-106.54321	2.98	4
8/10/2010	65.5649967	-106.5462083	5.03	1
8/10/2010	65.5643583	-106.5449817	3.17	5
8/10/2010	65.56346	-106.5460167	1.88	2
8/10/2010	65.5651217	-106.5459533	3.97	5
8/10/2010	65.56717	-106.5488583	7.99	4
8/10/2010	65.5663267	-106.54726	7.7	1
8/10/2010	65.5662367	-106.54319	3.08	2
8/10/2010	65.5649883	-106.5462217	5.05	1
8/10/2010	65.5643633	-106.5449567	3.27	0
8/10/2010	65.563455	-106.5460383	1.98	0
8/10/2010	65.5651367	-106.54596	3.97	5
8/10/2010	65.567165	-106.5488767	7.53	4
8/10/2010	65.566325	-106.54728	7.68	1
8/10/2010	65.5662383	-106.54317	3.15	2
8/10/2010	65.56498	-106.546235	5.17	1
8/10/2010	65.5643667	-106.5449317	3.35	2
8/10/2010	65.5634517	-106.5460633	1.92	4
8/10/2010	65.5651517	-106.5459683	3.99	5
8/10/2010	65.56716	-106.5488967	6.98	2
8/10/2010	65.566325	-106.5473017	7.68	1
8/10/2010	65.5662417	-106.54315	3.18	2
8/10/2010	65.5649717	-106.54625	5.22	5
8/10/2010	65.5643717	-106.5449067	3.35	1
8/10/2010	65.5634483	-106.5460883	1.88	4
8/10/2010	65.5651683	-106.5459767	3.99	5
8/10/2010	65.567155	-106.548915	6.26	2
8/10/2010	65.5663233	-106.5473217	7.7	5
8/10/2010	65.566245	-106.54313	3.2	2
8/10/2010	65.5649633	-106.5462633	5.27	1
8/10/2010	65.5643767	-106.5448817	3.4	1
8/10/2010	65.563445	-106.5461133	1.92	4
8/10/2010	65.5651833	-106.5459817	4.02	5
8/10/2010	65.5671483	-106.548935	6.21	4
8/10/2010	65.5663217	-106.5473417	7.73	5
8/10/2010	65.56625	-106.5431117	3.2	2
8/10/2010	65.5649533	-106.5462783	5.37	5
8/10/2010	65.5643817	-106.5448567	3.42	1
8/10/2010	65.5634417	-106.5461383	1.93	4
8/10/2010	65.5651983	-106.5459867	4.05	5
8/10/2010	65.5671433	-106.5489533	5.25	2
8/10/2010	65.56632	-106.54736	7.75	5
8/10/2010	65.566255	-106.5430917	3.2	1
8/10/2010	65.564945	-106.5462917	5.46	1
8/10/2010	65.5643867	-106.5448333	3.47	1
8/10/2010	65.5634383	-106.5461633	1.98	0
8/10/2010	65.5652117	-106.5459917	4.05	1
8/10/2010	65.56714	-106.5489733	4.89	2
8/10/2010	65.56632	-106.54738	7.78	5
8/10/2010	65.5662567	-106.5430717	3.22	2
8/10/2010	65.5649367	-106.5463067	5.51	5
8/10/2010	65.56439	-106.54481	3.49	1
8/10/2010	65.563435	-106.5461867	1.88	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5652267	-106.5459983	4.09	1
8/10/2010	65.567135	-106.5489933	4.55	2
8/10/2010	65.56632	-106.5474017	7.84	5
8/10/2010	65.5662583	-106.5430517	3.28	2
8/10/2010	65.56493	-106.5463217	5.59	1
8/10/2010	65.564395	-106.5447867	3.49	1
8/10/2010	65.5634317	-106.5462117	1.95	2
8/10/2010	65.5652417	-106.5460067	4.11	1
8/10/2010	65.5671317	-106.5490133	4.05	0
8/10/2010	65.56632	-106.5474217	7.85	5
8/10/2010	65.56626	-106.5430317	3.28	2
8/10/2010	65.5649217	-106.546335	5.68	5
8/10/2010	65.5644017	-106.5447617	3.46	1
8/10/2010	65.5634283	-106.546235	1.9	2
8/10/2010	65.5652567	-106.5460117	4.14	1
8/10/2010	65.5671267	-106.54903	3.39	2
8/10/2010	65.5663183	-106.5474417	7.9	5
8/10/2010	65.5662633	-106.5430117	3.28	2
8/10/2010	65.564915	-106.5463483	5.75	5
8/10/2010	65.5644067	-106.5447383	3.46	1
8/10/2010	65.5634233	-106.54626	1.85	4
8/10/2010	65.56527	-106.5460183	4.12	1
8/10/2010	65.5671233	-106.5490483	3.13	4
8/10/2010	65.5663183	-106.5474617	7.92	5
8/10/2010	65.566265	-106.5429917	3.25	2
8/10/2010	65.5649083	-106.5463633	5.83	1
8/10/2010	65.5644133	-106.544715	3.42	1
8/10/2010	65.5634183	-106.5462833	1.88	2
8/10/2010	65.565285	-106.5460233	4.11	1
8/10/2010	65.5671183	-106.5490683	2.34	2
8/10/2010	65.5663183	-106.5474833	7.99	0
8/10/2010	65.5662667	-106.5429717	3.25	2
8/10/2010	65.5649017	-106.5463783	5.89	1
8/10/2010	65.5644167	-106.54469	3.46	1
8/10/2010	65.563415	-106.5463083	1.76	2
8/10/2010	65.5653	-106.5460283	4.12	1
8/10/2010	65.5671133	-106.5490883	1.86	2
8/10/2010	65.5663183	-106.5475033	8.04	4
8/10/2010	65.56627	-106.5429517	3.25	2
8/10/2010	65.564895	-106.5463933	5.95	1
8/10/2010	65.5644217	-106.5446633	3.37	1
8/10/2010	65.56341	-106.5463333	1.9	4
8/10/2010	65.565315	-106.546035	4.09	5
8/10/2010	65.56711	-106.5491067	1.3	2
8/10/2010	65.5663183	-106.5475233	8.08	2
8/10/2010	65.5662717	-106.542935	3.27	2
8/10/2010	65.5648883	-106.5464083	6.02	1
8/10/2010	65.5644267	-106.5446383	3.37	1
8/10/2010	65.5634067	-106.5463567	1.92	2
8/10/2010	65.56533	-106.5460383	4.11	1
8/10/2010	65.5663167	-106.5475433	8.18	0
8/10/2010	65.5662733	-106.5429167	3.22	0
8/10/2010	65.5648833	-106.5464233	6.07	0
8/10/2010	65.5644317	-106.5446117	3.4	1
8/10/2010	65.5634033	-106.5463817	2	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5653433	-106.5460433	4.09	1
8/10/2010	65.5663167	-106.5475633	8.26	5
8/10/2010	65.5662767	-106.542895	3.23	2
8/10/2010	65.5648767	-106.5464367	6.12	1
8/10/2010	65.564435	-106.5445867	3.42	1
8/10/2010	65.5634	-106.546405	1.9	2
8/10/2010	65.5653583	-106.54605	4.07	1
8/10/2010	65.5663167	-106.5475633	8.35	5
8/10/2010	65.5662783	-106.542875	3.2	2
8/10/2010	65.56487	-106.5464517	6.18	5
8/10/2010	65.56444	-106.5445633	3.4	1
8/10/2010	65.563395	-106.5464283	1.81	4
8/10/2010	65.5653733	-106.546055	4.07	1
8/10/2010	65.566315	-106.547605	8.47	2
8/10/2010	65.56628	-106.5428533	3.15	2
8/10/2010	65.5648633	-106.546465	6.21	0
8/10/2010	65.5644467	-106.54454	3.44	1
8/10/2010	65.5633917	-106.5464517	1.78	2
8/10/2010	65.5653883	-106.54606	4.07	1
8/10/2010	65.566315	-106.5476267	8.52	2
8/10/2010	65.5662833	-106.5428317	3.1	2
8/10/2010	65.5648567	-106.5464783	6.28	1
8/10/2010	65.5644533	-106.544515	3.4	1
8/10/2010	65.5633867	-106.5464733	1.85	2
8/10/2010	65.5654033	-106.546065	4.09	1
8/10/2010	65.566315	-106.5476467	8.55	5
8/10/2010	65.566285	-106.542815	2.94	4
8/10/2010	65.5648517	-106.5464933	6.33	5
8/10/2010	65.5644583	-106.54449	3.39	1
8/10/2010	65.5633817	-106.5464967	1.81	4
8/10/2010	65.5654183	-106.54607	4.09	1
8/10/2010	65.5663133	-106.5476683	8.73	5
8/10/2010	65.5662867	-106.5427983	2.7	2
8/10/2010	65.564845	-106.5465067	6.36	5
8/10/2010	65.5644633	-106.544465	3.37	1
8/10/2010	65.5633767	-106.5465217	1.64	2
8/10/2010	65.5654317	-106.546075	4.07	5
8/10/2010	65.5663133	-106.5476883	8.81	5
8/10/2010	65.5648383	-106.54652	6.4	1
8/10/2010	65.5644683	-106.54444	3.35	1
8/10/2010	65.5633717	-106.546545	1.78	2
8/10/2010	65.5654467	-106.5460783	4.11	1
8/10/2010	65.5663117	-106.5477083	8.91	5
8/10/2010	65.5648317	-106.5465333	6.45	1
8/10/2010	65.5644733	-106.544415	3.25	1
8/10/2010	65.5633683	-106.5465683	1.83	4
8/10/2010	65.56546	-106.546085	4.12	1
8/10/2010	65.5663117	-106.54773	8.96	5
8/10/2010	65.564825	-106.5465467	6.47	5
8/10/2010	65.5644767	-106.5443917	3.27	1
8/10/2010	65.5633633	-106.5465917	1.66	2
8/10/2010	65.5654733	-106.5460917	4.16	1
8/10/2010	65.56631	-106.54775	9.07	5
8/10/2010	65.5648183	-106.5465617	6.5	1
8/10/2010	65.5644833	-106.5443683	3.17	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.56336	-106.546615	1.78	4
8/10/2010	65.5654883	-106.5460983	4.16	1
8/10/2010	65.56631	-106.5477717	9.1	5
8/10/2010	65.5648117	-106.546575	6.52	5
8/10/2010	65.5644883	-106.5443433	3.13	1
8/10/2010	65.563355	-106.5466383	1.76	4
8/10/2010	65.5655033	-106.546105	4.17	1
8/10/2010	65.56631	-106.547795	9.2	5
8/10/2010	65.564805	-106.5465883	6.54	5
8/10/2010	65.5644917	-106.5443183	3.1	1
8/10/2010	65.56335	-106.54666	1.73	4
8/10/2010	65.5655167	-106.5461133	4.19	5
8/10/2010	65.5663117	-106.5478167	9.29	5
8/10/2010	65.5648	-106.5466033	6.57	1
8/10/2010	65.5644967	-106.5442933	3.08	1
8/10/2010	65.563345	-106.5466833	1.76	4
8/10/2010	65.5655317	-106.54612	4.23	1
8/10/2010	65.5663117	-106.5478367	9.34	5
8/10/2010	65.5648	-106.5466033	6.62	1
8/10/2010	65.5645017	-106.5442683	3.06	1
8/10/2010	65.56334	-106.546705	1.71	4
8/10/2010	65.565545	-106.5461267	4.24	5
8/10/2010	65.5663117	-106.5478567	9.41	5
8/10/2010	65.5647883	-106.5466317	6.66	5
8/10/2010	65.5645067	-106.544245	2.99	1
8/10/2010	65.563335	-106.5467283	1.75	4
8/10/2010	65.56556	-106.546135	4.26	5
8/10/2010	65.5663117	-106.5478783	9.46	1
8/10/2010	65.5647833	-106.5466467	6.72	1
8/10/2010	65.5645117	-106.5442217	3.01	1
8/10/2010	65.5633317	-106.5467517	1.75	0
8/10/2010	65.5655733	-106.5461433	4.29	1
8/10/2010	65.5663133	-106.5478983	9.55	5
8/10/2010	65.5647783	-106.5466617	6.71	1
8/10/2010	65.5645167	-106.5441967	2.99	2
8/10/2010	65.5633267	-106.546775	1.78	4
8/10/2010	65.56559	-106.5461483	4.31	5
8/10/2010	65.5663133	-106.54792	9.6	5
8/10/2010	65.564775	-106.546675	6.76	1
8/10/2010	65.5645167	-106.5441967	2.96	2
8/10/2010	65.5633233	-106.5467983	1.71	2
8/10/2010	65.5656033	-106.5461517	4.33	5
8/10/2010	65.5663133	-106.54794	9.62	5
8/10/2010	65.56477	-106.54669	6.76	1
8/10/2010	65.5645283	-106.54415	2.98	2
8/10/2010	65.5633183	-106.54682	1.8	4
8/10/2010	65.5656167	-106.5461567	4.38	1
8/10/2010	65.5663133	-106.54796	9.68	5
8/10/2010	65.564765	-106.5467033	6.83	1
8/10/2010	65.5645333	-106.544125	2.96	2
8/10/2010	65.563315	-106.5468433	1.83	2
8/10/2010	65.5656317	-106.5461617	4.4	1
8/10/2010	65.5663133	-106.54798	9.75	5
8/10/2010	65.56476	-106.5467167	6.86	1
8/10/2010	65.5645367	-106.5441017	2.94	5

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.56331	-106.5468667	1.8	2
8/10/2010	65.5656467	-106.5461683	4.47	1
8/10/2010	65.5663133	-106.548	9.8	1
8/10/2010	65.5647533	-106.54673	6.91	1
8/10/2010	65.5645417	-106.5440783	2.94	1
8/10/2010	65.5633067	-106.5468883	1.73	4
8/10/2010	65.56566	-106.5461733	4.48	1
8/10/2010	65.5663133	-106.5480217	9.87	1
8/10/2010	65.5647483	-106.5467433	6.93	1
8/10/2010	65.5645467	-106.544055	2.94	1
8/10/2010	65.5633017	-106.5469117	1.69	2
8/10/2010	65.5656733	-106.5461783	4.5	5
8/10/2010	65.5663133	-106.5480417	9.84	1
8/10/2010	65.5647417	-106.5467567	6.95	1
8/10/2010	65.5645517	-106.5440317	2.96	1
8/10/2010	65.5632983	-106.5469333	1.71	0
8/10/2010	65.5656867	-106.5461833	4.53	1
8/10/2010	65.5663133	-106.5480617	9.84	1
8/10/2010	65.5647367	-106.5467683	6.98	1
8/10/2010	65.5645583	-106.5440083	2.93	5
8/10/2010	65.5632933	-106.546955	1.57	4
8/10/2010	65.5657017	-106.5461883	4.59	1
8/10/2010	65.5663133	-106.5480817	9.84	1
8/10/2010	65.56473	-106.54678	7.01	1
8/10/2010	65.5645633	-106.5439833	2.94	5
8/10/2010	65.5632883	-106.5469767	1.61	2
8/10/2010	65.565715	-106.546195	4.64	1
8/10/2010	65.5663117	-106.5481017	9.84	1
8/10/2010	65.564725	-106.5467933	7	1
8/10/2010	65.5645683	-106.54396	2.91	1
8/10/2010	65.5632833	-106.547	1.63	0
8/10/2010	65.56573	-106.5462	4.69	1
8/10/2010	65.5663117	-106.5481217	9.79	1
8/10/2010	65.5647183	-106.5468083	7.01	1
8/10/2010	65.564575	-106.543935	2.91	1
8/10/2010	65.56328	-106.5470233	1.57	2
8/10/2010	65.5657433	-106.546205	4.72	1
8/10/2010	65.56631	-106.5481433	9.75	1
8/10/2010	65.5647133	-106.5468217	7.01	1
8/10/2010	65.5645783	-106.5439117	2.94	1
8/10/2010	65.563275	-106.5470467	1.52	2
8/10/2010	65.5657567	-106.5462133	4.82	1
8/10/2010	65.5663083	-106.5481633	9.7	1
8/10/2010	65.5647067	-106.5468333	7.03	1
8/10/2010	65.5645833	-106.5438867	2.96	1
8/10/2010	65.56327	-106.54707	1.56	2
8/10/2010	65.5657717	-106.54622	4.88	5
8/10/2010	65.5663067	-106.5481833	9.65	1
8/10/2010	65.5647	-106.546845	7.05	1
8/10/2010	65.5645867	-106.5438617	2.94	0
8/10/2010	65.5632667	-106.5470933	1.59	4
8/10/2010	65.565785	-106.5462267	4.89	5
8/10/2010	65.566305	-106.5482033	9.56	1
8/10/2010	65.5646933	-106.546855	7.05	1
8/10/2010	65.56459	-106.5438367	2.96	5

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5632617	-106.5471183	1.57	0
8/10/2010	65.5658	-106.5462333	4.96	5
8/10/2010	65.5663033	-106.5482233	9.5	1
8/10/2010	65.564685	-106.5468633	7.07	1
8/10/2010	65.564595	-106.5438133	2.96	5
8/10/2010	65.5632567	-106.5471433	1.59	0
8/10/2010	65.5658133	-106.54624	5.08	5
8/10/2010	65.5663017	-106.5482433	9.46	1
8/10/2010	65.5646767	-106.5468733	7.05	1
8/10/2010	65.5645983	-106.5437883	2.98	5
8/10/2010	65.5632533	-106.5471683	1.64	2
8/10/2010	65.5658283	-106.5462467	5.1	1
8/10/2010	65.5663	-106.548265	9.38	5
8/10/2010	65.56467	-106.5468833	7.05	1
8/10/2010	65.5646017	-106.5437633	2.99	2
8/10/2010	65.56325	-106.5471917	1.42	2
8/10/2010	65.5658433	-106.5462533	5.2	1
8/10/2010	65.5662983	-106.548285	9.26	1
8/10/2010	65.5646617	-106.5468933	7	1
8/10/2010	65.5646067	-106.5437383	2.99	2
8/10/2010	65.5632467	-106.5472183	1.44	2
8/10/2010	65.5658583	-106.54626	5.29	1
8/10/2010	65.5662967	-106.5483067	9.08	2
8/10/2010	65.5646533	-106.5469067	7	1
8/10/2010	65.5646117	-106.543715	3.03	1
8/10/2010	65.5632433	-106.5472433	1.52	2
8/10/2010	65.5658733	-106.546265	5.32	1
8/10/2010	65.566295	-106.5483267	8.91	2
8/10/2010	65.564645	-106.5469183	6.95	1
8/10/2010	65.5646183	-106.5436917	3.06	1
8/10/2010	65.56324	-106.5472667	1.52	0
8/10/2010	65.5658867	-106.5462683	5.41	1
8/10/2010	65.5662917	-106.5483467	8.49	4
8/10/2010	65.5646383	-106.54693	6.86	1
8/10/2010	65.5646217	-106.5436683	3.06	1
8/10/2010	65.5632367	-106.5472917	1.56	2
8/10/2010	65.5659017	-106.5462733	5.51	1
8/10/2010	65.56629	-106.548365	8.04	2
8/10/2010	65.56463	-106.5469417	6.79	0
8/10/2010	65.5646267	-106.543645	3.1	1
8/10/2010	65.5632333	-106.547315	1.57	2
8/10/2010	65.5659017	-106.5462733	5.56	1
8/10/2010	65.5662883	-106.548385	7.7	2
8/10/2010	65.5646233	-106.5469517	6.74	1
8/10/2010	65.5646317	-106.5436217	3.08	5
8/10/2010	65.5632283	-106.5473383	1.59	4
8/10/2010	65.56593	-106.5462833	5.68	1
8/10/2010	65.5662867	-106.548405	7.2	2
8/10/2010	65.564615	-106.5469617	6.55	1
8/10/2010	65.564635	-106.5435967	3.11	1
8/10/2010	65.563225	-106.5473633	1.61	2
8/10/2010	65.5659433	-106.5462883	5.73	1
8/10/2010	65.5662833	-106.548425	6.47	2
8/10/2010	65.5646067	-106.5469717	6.4	1
8/10/2010	65.56464	-106.54357	3.11	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5632217	-106.5473883	1.61	2
8/10/2010	65.5659583	-106.5462933	5.82	5
8/10/2010	65.5662817	-106.5484467	6.23	2
8/10/2010	65.5645983	-106.5469817	6.31	1
8/10/2010	65.564645	-106.543545	3.11	1
8/10/2010	65.5632183	-106.5474117	1.52	4
8/10/2010	65.5659717	-106.5462967	5.92	1
8/10/2010	65.56628	-106.5484667	5.59	2
8/10/2010	65.56459	-106.5469933	6.18	1
8/10/2010	65.56465	-106.5435217	3.11	1
8/10/2010	65.563215	-106.5474367	1.52	2
8/10/2010	65.565985	-106.5463033	6.01	1
8/10/2010	65.5662767	-106.5484867	5.08	2
8/10/2010	65.5645833	-106.547005	6.01	1
8/10/2010	65.564655	-106.5434983	3.06	2
8/10/2010	65.5632117	-106.54746	1.54	4
8/10/2010	65.566	-106.5463083	6.14	1
8/10/2010	65.5662733	-106.5485067	4.17	2
8/10/2010	65.564575	-106.5470167	5.89	1
8/10/2010	65.56466	-106.543475	3.08	5
8/10/2010	65.5632067	-106.5474833	1.59	0
8/10/2010	65.566015	-106.546315	6.16	1
8/10/2010	65.5662717	-106.5485267	4.02	2
8/10/2010	65.5645667	-106.54703	5.75	1
8/10/2010	65.5646667	-106.5434517	3.06	1
8/10/2010	65.5632033	-106.5475067	1.56	4
8/10/2010	65.5660283	-106.5463217	6.31	1
8/10/2010	65.5662683	-106.548545	3.15	4
8/10/2010	65.56456	-106.5470433	5.54	1
8/10/2010	65.5646733	-106.5434283	3.08	1
8/10/2010	65.5632	-106.54753	1.56	4
8/10/2010	65.5660433	-106.5463267	6.4	1
8/10/2010	65.566265	-106.5485633	2.72	4
8/10/2010	65.5645517	-106.5470583	5.46	1
8/10/2010	65.5646767	-106.543405	3.08	1
8/10/2010	65.563195	-106.5475533	1.52	4
8/10/2010	65.5660567	-106.5463333	6.5	1
8/10/2010	65.5662617	-106.54858	2.16	4
8/10/2010	65.564545	-106.547075	5.29	1
8/10/2010	65.5646833	-106.5433833	3.08	1
8/10/2010	65.5631917	-106.5475767	1.56	0
8/10/2010	65.5660717	-106.54634	6.59	1
8/10/2010	65.5662583	-106.5485967	1.76	2
8/10/2010	65.5645367	-106.54709	5.08	1
8/10/2010	65.5646883	-106.5433617	3.1	1
8/10/2010	65.5631883	-106.5476	1.52	2
8/10/2010	65.5660867	-106.5463467	6.69	5
8/10/2010	65.566255	-106.54861	1.33	2
8/10/2010	65.56453	-106.547105	4.93	1
8/10/2010	65.564695	-106.5433383	3.11	1
8/10/2010	65.5631833	-106.5476233	1.59	4
8/10/2010	65.5661017	-106.5463517	6.81	1
8/10/2010	65.5662517	-106.54862	1.01	2
8/10/2010	65.5645233	-106.5471217	4.84	1
8/10/2010	65.5647	-106.543315	3.08	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5631783	-106.547645	1.57	4
8/10/2010	65.566115	-106.5463583	6.95	5
8/10/2010	65.5645167	-106.5471383	4.53	2
8/10/2010	65.564705	-106.5432917	3.05	5
8/10/2010	65.5631733	-106.5476683	1.49	2
8/10/2010	65.56613	-106.546365	7	1
8/10/2010	65.56451	-106.5471567	4.52	2
8/10/2010	65.5647117	-106.5432667	3.06	5
8/10/2010	65.56317	-106.54769	1.59	0
8/10/2010	65.5661433	-106.5463733	7.17	1
8/10/2010	65.5645033	-106.547175	4.36	2
8/10/2010	65.5647167	-106.5432433	3.06	1
8/10/2010	65.563165	-106.5477133	1.57	2
8/10/2010	65.5661583	-106.54638	7.17	5
8/10/2010	65.5644967	-106.5471933	4.16	2
8/10/2010	65.5647217	-106.5432217	3.1	5
8/10/2010	65.56316	-106.547735	1.59	4
8/10/2010	65.5661733	-106.5463883	7.27	1
8/10/2010	65.5644917	-106.5472133	4.09	4
8/10/2010	65.5647267	-106.5432017	2.98	5
8/10/2010	65.563155	-106.5477583	1.59	0
8/10/2010	65.5661867	-106.5463967	7.34	1
8/10/2010	65.564485	-106.5472317	3.9	4
8/10/2010	65.5647333	-106.54318	2.98	5
8/10/2010	65.5631517	-106.5477817	1.63	4
8/10/2010	65.5662017	-106.5464033	7.39	1
8/10/2010	65.56448	-106.54725	3.71	2
8/10/2010	65.56474	-106.5431567	3.08	1
8/10/2010	65.5631467	-106.547805	1.57	0
8/10/2010	65.5662167	-106.5464117	7.43	1
8/10/2010	65.5644733	-106.54727	3.68	2
8/10/2010	65.5647467	-106.5431333	3.11	1
8/10/2010	65.5631417	-106.5478283	1.59	4
8/10/2010	65.5662317	-106.5464183	7.46	1
8/10/2010	65.5644667	-106.5472883	3.42	2
8/10/2010	65.5647517	-106.5431083	3.15	1
8/10/2010	65.5631367	-106.5478517	1.66	2
8/10/2010	65.5662467	-106.546425	7.46	1
8/10/2010	65.5644617	-106.547305	3.3	2
8/10/2010	65.5647583	-106.5430867	3.17	1
8/10/2010	65.5631333	-106.547875	1.68	4
8/10/2010	65.5662617	-106.5464317	7.46	1
8/10/2010	65.564455	-106.5473233	3.13	2
8/10/2010	65.564765	-106.543065	3.18	1
8/10/2010	65.5631283	-106.5479	1.64	0
8/10/2010	65.5662767	-106.5464367	7.43	1
8/10/2010	65.56445	-106.54734	2.93	2
8/10/2010	65.56477	-106.5430433	3.18	1
8/10/2010	65.563125	-106.5479233	1.75	2
8/10/2010	65.5662917	-106.5464433	7.37	1
8/10/2010	65.5644433	-106.547355	2.87	5
8/10/2010	65.5647733	-106.54302	3.18	1
8/10/2010	65.56312	-106.5479467	1.68	4
8/10/2010	65.5663067	-106.5464483	7.34	1
8/10/2010	65.5644367	-106.5473717	2.81	0

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5647783	-106.542995	3.2	1
8/10/2010	65.563115	-106.5479683	1.71	4
8/10/2010	65.56632	-106.546455	7.29	5
8/10/2010	65.5644317	-106.5473883	2.26	2
8/10/2010	65.5647833	-106.54297	3.15	1
8/10/2010	65.5631117	-106.5479917	1.75	4
8/10/2010	65.566335	-106.54646	7.22	5
8/10/2010	65.5644267	-106.5474083	1.93	2
8/10/2010	65.5647867	-106.542945	3.17	5
8/10/2010	65.5631067	-106.548015	1.69	4
8/10/2010	65.56635	-106.546465	7.19	5
8/10/2010	65.5644217	-106.5474267	1.42	4
8/10/2010	65.5647917	-106.54292	3.11	5
8/10/2010	65.5631017	-106.5480383	1.78	0
8/10/2010	65.566365	-106.5464683	7.17	1
8/10/2010	65.564415	-106.547445	1.13	2
8/10/2010	65.5647967	-106.542895	3.13	2
8/10/2010	65.5630983	-106.54806	1.83	2
8/10/2010	65.56638	-106.5464733	7.12	1
8/10/2010	65.56441	-106.5474633	1.03	2
8/10/2010	65.5648017	-106.5428717	3.11	5
8/10/2010	65.5630933	-106.5480833	1.78	4
8/10/2010	65.5663933	-106.5464783	7.1	1
8/10/2010	65.564805	-106.5428483	3.13	5
8/10/2010	65.5630883	-106.548105	1.75	2
8/10/2010	65.5664083	-106.5464833	7.07	1
8/10/2010	65.5648083	-106.5428233	3.11	5
8/10/2010	65.5630833	-106.5481267	1.85	4
8/10/2010	65.5664233	-106.5464867	7.03	1
8/10/2010	65.5648133	-106.5428	3.13	5
8/10/2010	65.5630783	-106.5481483	1.92	2
8/10/2010	65.5664383	-106.5464917	7.03	1
8/10/2010	65.5648183	-106.5427783	3.11	1
8/10/2010	65.5630733	-106.5481683	1.8	4
8/10/2010	65.5664533	-106.546495	7.01	1
8/10/2010	65.5648183	-106.5427783	3.11	1
8/10/2010	65.5630683	-106.54819	1.92	4
8/10/2010	65.5664667	-106.5465	7.01	1
8/10/2010	65.5648267	-106.5427333	3.11	1
8/10/2010	65.5630633	-106.5482117	2.07	2
8/10/2010	65.5664817	-106.5465033	7.01	1
8/10/2010	65.5648317	-106.54271	3.1	5
8/10/2010	65.5630583	-106.5482333	2.16	5
8/10/2010	65.5664967	-106.5465083	7.01	1
8/10/2010	65.5648383	-106.5426867	3.1	1
8/10/2010	65.5630533	-106.548255	2.24	5
8/10/2010	65.56651	-106.5465133	7.01	1
8/10/2010	65.564845	-106.542665	3.1	1
8/10/2010	65.5630483	-106.5482767	2.34	1
8/10/2010	65.566525	-106.54652	7.05	1
8/10/2010	65.56485	-106.5426417	3.03	1
8/10/2010	65.5630433	-106.5482983	2.38	1
8/10/2010	65.5665383	-106.5465267	7.07	1
8/10/2010	65.564855	-106.5426167	3.05	1
8/10/2010	65.56304	-106.54832	2.41	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5665533	-106.5465333	7.08	1
8/10/2010	65.56486	-106.5425917	3.05	1
8/10/2010	65.563035	-106.54834	2.5	1
8/10/2010	65.5665683	-106.5465383	7.12	1
8/10/2010	65.564865	-106.5425683	3.05	1
8/10/2010	65.56303	-106.5483617	2.53	1
8/10/2010	65.5665833	-106.5465433	7.17	1
8/10/2010	65.56487	-106.5425433	3.05	1
8/10/2010	65.563025	-106.5483833	2.6	1
8/10/2010	65.5665983	-106.54655	7.2	1
8/10/2010	65.564875	-106.5425183	3.1	1
8/10/2010	65.5630183	-106.548405	2.63	1
8/10/2010	65.5666117	-106.5465567	7.24	1
8/10/2010	65.5648817	-106.542495	3.05	1
8/10/2010	65.5630133	-106.5484267	2.65	1
8/10/2010	65.566625	-106.546565	7.29	1
8/10/2010	65.5648883	-106.5424717	3.03	1
8/10/2010	65.5630083	-106.5484483	2.69	1
8/10/2010	65.56664	-106.54657	7.34	1
8/10/2010	65.5648917	-106.5424483	3.01	1
8/10/2010	65.5630017	-106.54847	2.72	1
8/10/2010	65.566655	-106.546575	7.39	5
8/10/2010	65.5648967	-106.5424217	2.98	1
8/10/2010	65.5629967	-106.5484917	2.72	1
8/10/2010	65.5666683	-106.54658	7.44	2
8/10/2010	65.5649	-106.5423967	2.98	1
8/10/2010	65.56299	-106.5485133	2.77	1
8/10/2010	65.5666833	-106.546585	7.49	0
8/10/2010	65.5649033	-106.5423733	2.98	1
8/10/2010	65.562985	-106.5485333	2.79	1
8/10/2010	65.5666967	-106.5465917	7.58	2
8/10/2010	65.5649083	-106.54235	2.94	1
8/10/2010	65.56298	-106.5485567	2.79	1
8/10/2010	65.5667117	-106.5465967	7.65	2
8/10/2010	65.5649133	-106.5423283	2.93	1
8/10/2010	65.562975	-106.54858	2.82	1
8/10/2010	65.566725	-106.5466033	7.7	2
8/10/2010	65.5649183	-106.542305	2.91	1
8/10/2010	65.5629717	-106.5486017	2.84	1
8/10/2010	65.56674	-106.54661	7.77	2
8/10/2010	65.5649233	-106.5422817	2.93	1
8/10/2010	65.5629667	-106.5486233	2.87	1
8/10/2010	65.5667533	-106.5466167	7.84	1
8/10/2010	65.5649283	-106.5422583	2.89	1
8/10/2010	65.5629617	-106.548645	2.89	1
8/10/2010	65.5667683	-106.5466217	8.02	1
8/10/2010	65.5649333	-106.542235	2.87	1
8/10/2010	65.5629567	-106.548665	2.91	1
8/10/2010	65.5667833	-106.5466267	8.08	1
8/10/2010	65.5649383	-106.5422133	2.84	1
8/10/2010	65.56295	-106.548685	2.93	1
8/10/2010	65.5667967	-106.5466317	8.13	1
8/10/2010	65.564945	-106.5421917	2.77	1
8/10/2010	65.562945	-106.548705	2.93	1
8/10/2010	65.56681	-106.5466383	8.23	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5649517	-106.5421683	2.75	1
8/10/2010	65.5629383	-106.548725	2.93	1
8/10/2010	65.5668233	-106.5466433	8.33	5
8/10/2010	65.5649567	-106.542145	2.63	1
8/10/2010	65.5629317	-106.5487433	2.93	1
8/10/2010	65.5668383	-106.54665	8.4	1
8/10/2010	65.5649633	-106.54212	2.62	5
8/10/2010	65.562925	-106.5487633	2.93	1
8/10/2010	65.5668517	-106.5466567	8.45	1
8/10/2010	65.56497	-106.5420983	2.57	5
8/10/2010	65.5629183	-106.5487833	2.93	1
8/10/2010	65.5668667	-106.5466633	8.54	5
8/10/2010	65.5649767	-106.5420767	2.57	1
8/10/2010	65.5629117	-106.5488067	2.93	5
8/10/2010	65.56688	-106.54667	8.62	5
8/10/2010	65.5649833	-106.5420533	2.51	1
8/10/2010	65.5629067	-106.5488283	2.91	1
8/10/2010	65.566895	-106.5466783	8.74	1
8/10/2010	65.56499	-106.5420317	2.46	1
8/10/2010	65.5629017	-106.54885	2.93	1
8/10/2010	65.56691	-106.5466883	8.83	5
8/10/2010	65.564995	-106.5420083	2.48	1
8/10/2010	65.562895	-106.5488733	2.93	1
8/10/2010	65.5669233	-106.5466967	8.9	1
8/10/2010	65.565	-106.541985	2.46	1
8/10/2010	65.56289	-106.5488967	2.93	1
8/10/2010	65.5669383	-106.546705	9.02	5
8/10/2010	65.565005	-106.54196	2.34	4
8/10/2010	65.562885	-106.5489183	2.91	1
8/10/2010	65.5669517	-106.5467133	9.08	1
8/10/2010	65.5650083	-106.5419383	2.17	4
8/10/2010	65.56288	-106.5489417	2.93	1
8/10/2010	65.5669667	-106.5467217	9.14	5
8/10/2010	65.5650133	-106.541915	2.1	4
8/10/2010	65.562875	-106.548965	2.93	1
8/10/2010	65.5669817	-106.5467283	9.27	1
8/10/2010	65.5650167	-106.5418917	2.05	4
8/10/2010	65.5628683	-106.5489867	2.93	1
8/10/2010	65.566995	-106.546735	9.34	5
8/10/2010	65.56502	-106.5418683	2.09	4
8/10/2010	65.5628633	-106.5490083	2.96	1
8/10/2010	65.56701	-106.5467433	9.46	5
8/10/2010	65.565025	-106.541845	2.02	0
8/10/2010	65.5628583	-106.54903	2.93	1
8/10/2010	65.5670233	-106.5467517	9.5	5
8/10/2010	65.56503	-106.5418233	1.92	4
8/10/2010	65.5628533	-106.5490533	2.93	1
8/10/2010	65.5670367	-106.54676	9.56	1
8/10/2010	65.565035	-106.5418017	2.02	4
8/10/2010	65.5628483	-106.549075	2.99	5
8/10/2010	65.5670517	-106.5467683	9.62	1
8/10/2010	65.5650417	-106.5417783	1.93	2
8/10/2010	65.5628433	-106.5490967	3.03	5
8/10/2010	65.5670667	-106.546775	9.65	5
8/10/2010	65.5650467	-106.5417567	1.97	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5628367	-106.5491183	2.96	1
8/10/2010	65.56708	-106.54678	9.73	1
8/10/2010	65.5650533	-106.5417333	1.92	2
8/10/2010	65.5628317	-106.54914	2.96	1
8/10/2010	65.567095	-106.546785	9.77	1
8/10/2010	65.5650583	-106.5417117	1.93	0
8/10/2010	65.562825	-106.54916	2.98	1
8/10/2010	65.56711	-106.5467917	9.79	5
8/10/2010	65.5650617	-106.54169	1.93	4
8/10/2010	65.56282	-106.5491817	2.99	1
8/10/2010	65.567125	-106.5467983	9.89	5
8/10/2010	65.565065	-106.5416683	1.88	0
8/10/2010	65.5628133	-106.5492033	3.03	1
8/10/2010	65.56714	-106.546805	9.91	1
8/10/2010	65.5650683	-106.54165	1.45	2
8/10/2010	65.5628083	-106.5492233	3.03	1
8/10/2010	65.5671533	-106.5468117	9.94	5
8/10/2010	65.5650733	-106.5416317	1.15	2
8/10/2010	65.5628017	-106.5492433	3.06	5
8/10/2010	65.5671667	-106.5468183	9.97	1
8/10/2010	65.562795	-106.5492633	3.08	5
8/10/2010	65.5671817	-106.5468267	10.01	5
8/10/2010	65.5627883	-106.549285	3.1	5
8/10/2010	65.5671967	-106.546835	10.06	1
8/10/2010	65.5627833	-106.549305	3.15	1
8/10/2010	65.56721	-106.5468433	10.08	5
8/10/2010	65.5627767	-106.5493267	3.13	1
8/10/2010	65.567225	-106.54685	10.15	5
8/10/2010	65.5627717	-106.5493483	3.13	1
8/10/2010	65.56724	-106.546855	10.15	1
8/10/2010	65.5627667	-106.5493683	3.11	1
8/10/2010	65.5672533	-106.5468617	10.23	5
8/10/2010	65.56276	-106.54939	3.13	1
8/10/2010	65.5672683	-106.5468683	10.27	5
8/10/2010	65.562755	-106.54941	3.13	1
8/10/2010	65.5672817	-106.546875	10.33	2
8/10/2010	65.5627483	-106.54943	3.1	1
8/10/2010	65.5672967	-106.5468833	10.33	5
8/10/2010	65.5627417	-106.54945	3.1	1
8/10/2010	65.56731	-106.54689	10.42	5
8/10/2010	65.562735	-106.5494683	3.1	1
8/10/2010	65.567325	-106.5468967	10.5	5
8/10/2010	65.5627283	-106.5494867	3.1	1
8/10/2010	65.5673383	-106.546905	10.56	2
8/10/2010	65.56272	-106.5495033	3.08	1
8/10/2010	65.5673517	-106.5469117	10.66	2
8/10/2010	65.5627133	-106.5495217	3.05	1
8/10/2010	65.5673667	-106.54692	10.62	5
8/10/2010	65.562705	-106.54954	3.01	1
8/10/2010	65.56738	-106.5469283	10.73	5
8/10/2010	65.5626983	-106.54956	2.94	1
8/10/2010	65.567395	-106.5469367	10.78	5
8/10/2010	65.56269	-106.5495783	2.82	1
8/10/2010	65.56741	-106.5469433	10.83	5
8/10/2010	65.5626817	-106.5495967	2.74	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5674233	-106.5469517	10.81	5
8/10/2010	65.562675	-106.549615	2.67	1
8/10/2010	65.5674367	-106.5469583	10.81	5
8/10/2010	65.5626683	-106.549635	2.62	2
8/10/2010	65.5674517	-106.5469633	10.78	5
8/10/2010	65.56266	-106.5496533	2.57	2
8/10/2010	65.567465	-106.54697	10.76	5
8/10/2010	65.5626533	-106.5496733	2.5	2
8/10/2010	65.56748	-106.5469783	10.71	5
8/10/2010	65.562645	-106.5496917	2.36	2
8/10/2010	65.5674933	-106.546985	10.66	5
8/10/2010	65.5626383	-106.54971	1.52	4
8/10/2010	65.5675067	-106.5469933	10.59	5
8/10/2010	65.56263	-106.5497283	1.23	2
8/10/2010	65.5675217	-106.5470033	10.54	5
8/10/2010	65.567535	-106.5470133	10.45	5
8/10/2010	65.56755	-106.5470233	10.33	1
8/10/2010	65.5675633	-106.5470333	10.32	1
8/10/2010	65.5675783	-106.5470433	10.23	5
8/10/2010	65.5675917	-106.5470533	10.2	5
8/10/2010	65.5676067	-106.5470633	10.13	5
8/10/2010	65.5676217	-106.547075	10.04	5
8/10/2010	65.567635	-106.5470833	9.99	1
8/10/2010	65.56765	-106.5470917	9.96	1
8/10/2010	65.56256	-106.5497817	1.03	2
8/10/2010	65.5676633	-106.5470983	9.92	1
8/10/2010	65.5676783	-106.5471067	9.87	5
8/10/2010	65.5676917	-106.547115	9.82	5
8/10/2010	65.567705	-106.547125	9.79	1
8/10/2010	65.56772	-106.547135	9.7	1
8/10/2010	65.5677333	-106.5471433	9.65	1
8/10/2010	65.5677467	-106.547155	9.62	1
8/10/2010	65.56776	-106.547165	9.51	1
8/10/2010	65.567775	-106.5471767	9.46	1
8/10/2010	65.5677883	-106.5471883	9.32	1
8/10/2010	65.5678017	-106.5472	9.19	1
8/10/2010	65.5678167	-106.5472117	9.12	1
8/10/2010	65.56783	-106.5472217	8.98	1
8/10/2010	65.567845	-106.5472333	8.88	1
8/10/2010	65.56786	-106.547245	8.78	1
8/10/2010	65.567875	-106.5472583	8.64	1
8/10/2010	65.5678883	-106.54727	8.45	1
8/10/2010	65.5679033	-106.5472783	8.33	1
8/10/2010	65.5679183	-106.5472883	8.25	1
8/10/2010	65.5679317	-106.547295	8.13	1
8/10/2010	65.5679467	-106.5473033	7.99	1
8/10/2010	65.56796	-106.54731	7.82	1
8/10/2010	65.567975	-106.5473167	7.68	1
8/10/2010	65.5679883	-106.5473233	7.49	1
8/10/2010	65.5680033	-106.5473317	7.41	1
8/10/2010	65.5680183	-106.54734	7.22	1
8/10/2010	65.5680317	-106.5473467	7.07	0
8/10/2010	65.5680467	-106.547355	7	1
8/10/2010	65.56806	-106.5473633	6.83	1
8/10/2010	65.568075	-106.547375	6.67	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-1. Substrate Data Collected from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
8/10/2010	65.5680883	-106.5473867	6.59	1
8/10/2010	65.5681033	-106.5473983	6.36	1
8/10/2010	65.5681183	-106.54741	6.16	1
8/10/2010	65.5681333	-106.54742	6.01	1
8/10/2010	65.5681467	-106.54743	5.89	1
8/10/2010	65.56816	-106.54744	5.77	1
8/10/2010	65.568175	-106.5474533	5.59	1
8/10/2010	65.5681883	-106.547465	5.53	1
8/10/2010	65.5682017	-106.5474767	5.27	1
8/10/2010	65.568215	-106.5474867	5.24	1
8/10/2010	65.5682283	-106.5474967	5.03	1
8/10/2010	65.5682433	-106.5475117	4.82	1
8/10/2010	65.56826	-106.5475267	4.74	1
8/10/2010	65.5682783	-106.5475433	4.6	1
8/10/2010	65.568295	-106.5475567	4.45	1
8/10/2010	65.5683083	-106.5475683	4.33	1
8/10/2010	65.5683217	-106.54758	4.26	1
8/10/2010	65.5683317	-106.54759	4.26	1
8/10/2010	65.56834	-106.5475967	4.26	1
8/10/2010	65.5683483	-106.547605	4.09	1
8/10/2010	65.5683567	-106.5476133	3.97	1
8/10/2010	65.5683617	-106.5476217	3.95	1
8/10/2010	65.5683683	-106.5476283	3.9	1
8/10/2010	65.5683733	-106.5476333	3.88	1
8/10/2010	65.5683767	-106.5476383	3.85	1
8/10/2010	65.5683817	-106.5476433	3.85	1
8/10/2010	65.5683817	-106.5476433	3.83	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2

Sustrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

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Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5554767	-106.5455117	1.69	1
11/08/2010	65.5546033	-106.5440333	1.89	2
11/08/2010	65.5539767	-106.5430017	1.89	1
11/08/2010	65.5534383	-106.542115	1.24	2
11/08/2010	65.5519733	-106.537295	1.1	2
11/08/2010	65.55548	-106.5454883	1.69	1
11/08/2010	65.5546017	-106.5439933	1.91	1
11/08/2010	65.5539717	-106.542965	1.91	1
11/08/2010	65.5534317	-106.542085	1.58	2
11/08/2010	65.5519733	-106.5373183	1.29	2
11/08/2010	65.555485	-106.5454683	1.65	1
11/08/2010	65.554605	-106.543955	1.91	1
11/08/2010	65.55397	-106.54293	1.93	1
11/08/2010	65.5534267	-106.5420517	1.79	2
11/08/2010	65.5519767	-106.5373417	1.31	2
11/08/2010	65.5554883	-106.5454517	1.65	1
11/08/2010	65.5546083	-106.5439167	1.89	1
11/08/2010	65.55397	-106.5428967	1.91	1
11/08/2010	65.5534233	-106.5420167	1.89	1
11/08/2010	65.5519817	-106.5373617	1.33	2
11/08/2010	65.55481	-106.5410983	1.05	2
11/08/2010	65.5554933	-106.5454367	1.7	1
11/08/2010	65.5546133	-106.54388	1.89	5
11/08/2010	65.5539717	-106.5428617	1.93	1
11/08/2010	65.5534217	-106.5419817	1.91	1
11/08/2010	65.5519883	-106.53738	1.2	2
11/08/2010	65.5548033	-106.5411217	1.08	2
11/08/2010	65.5554983	-106.5454233	1.65	1
11/08/2010	65.55462	-106.5438417	1.93	1
11/08/2010	65.553975	-106.5428283	2	1
11/08/2010	65.5534217	-106.5419817	1.91	1
11/08/2010	65.5534667	-106.5381183	1	5
11/08/2010	65.5519983	-106.5373983	1.26	2
11/08/2010	65.554795	-106.5411517	1.08	2
11/08/2010	65.5555017	-106.5454133	1.67	1
11/08/2010	65.5546283	-106.5438033	1.88	1
11/08/2010	65.5539783	-106.5427933	1.94	1
11/08/2010	65.5534217	-106.5419117	1.93	3
11/08/2010	65.5520067	-106.537415	1.26	2
11/08/2010	65.55479	-106.541185	1.19	2
11/08/2010	65.554265	-106.5395333	1.05	2
11/08/2010	65.555505	-106.5454033	1.65	1
11/08/2010	65.5546367	-106.543765	1.84	5
11/08/2010	65.553985	-106.5427583	1.98	1
11/08/2010	65.5534217	-106.54188	1.94	1
11/08/2010	65.5534583	-106.5381667	2	2
11/08/2010	65.5520167	-106.53743	1.27	2
11/08/2010	65.5547833	-106.54122	1.08	2
11/08/2010	65.5542567	-106.5395517	1.07	4
11/08/2010	65.5555083	-106.5453933	1.67	1
11/08/2010	65.554645	-106.5437283	1.86	1
11/08/2010	65.55399	-106.5427233	1.98	3
11/08/2010	65.5534233	-106.5418517	1.96	3
11/08/2010	65.5520267	-106.537445	1.29	2
11/08/2010	65.5547767	-106.5412583	1.14	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5542517	-106.5395783	1.05	2
11/08/2010	65.5555117	-106.5453833	1.67	1
11/08/2010	65.554655	-106.54369	1.84	1
11/08/2010	65.5539967	-106.5426883	1.96	1
11/08/2010	65.553425	-106.5418267	1.96	3
11/08/2010	65.55345	-106.5382267	1.05	4
11/08/2010	65.5520367	-106.53746	1.29	2
11/08/2010	65.5556367	-106.5433583	1	2
11/08/2010	65.5547717	-106.5412983	1.2	2
11/08/2010	65.5542467	-106.5396083	1.05	4
11/08/2010	65.5525567	-106.5398117	1.07	2
11/08/2010	65.555515	-106.5453733	1.69	1
11/08/2010	65.5546633	-106.5436517	1.84	1
11/08/2010	65.554005	-106.5426533	1.98	1
11/08/2010	65.553425	-106.5418067	1.96	3
11/08/2010	65.5534467	-106.5382583	1.03	4
11/08/2010	65.55205	-106.537475	1.26	2
11/08/2010	65.5556267	-106.5433867	1.03	2
11/08/2010	65.5547667	-106.54134	1.17	2
11/08/2010	65.5542433	-106.53964	1.05	4
11/08/2010	65.5525617	-106.5397767	1.19	2
11/08/2010	65.5562217	-106.545525	1.02	2
11/08/2010	65.5555217	-106.54536	1.67	1
11/08/2010	65.5546717	-106.5436133	1.79	1
11/08/2010	65.5540117	-106.54262	1.98	1
11/08/2010	65.5534267	-106.5417883	2	1
11/08/2010	65.553445	-106.53829	1.07	2
11/08/2010	65.5520617	-106.53749	1.26	2
11/08/2010	65.5556167	-106.5434133	1.1	2
11/08/2010	65.5547617	-106.5413783	1.17	2
11/08/2010	65.5517833	-106.5383533	1	5
11/08/2010	65.5542417	-106.5396733	1.03	2
11/08/2010	65.5525667	-106.53974	1.29	2
11/08/2010	65.5555283	-106.5453417	1.69	1
11/08/2010	65.55468	-106.5435767	1.79	1
11/08/2010	65.55402	-106.5425867	1.96	1
11/08/2010	65.5534267	-106.5417733	2	1
11/08/2010	65.5534433	-106.538325	1.05	2
11/08/2010	65.552075	-106.5375033	1.22	2
11/08/2010	65.5556067	-106.5434417	1.17	2
11/08/2010	65.554755	-106.5414133	1.24	2
11/08/2010	65.5517833	-106.5383533	1.08	2
11/08/2010	65.5542417	-106.5397083	1.1	2
11/08/2010	65.5525717	-106.5397067	1.27	2
11/08/2010	65.5562117	-106.5455617	1.05	2
11/08/2010	65.5555383	-106.5453167	1.58	2
11/08/2010	65.5546883	-106.5435367	1.81	1
11/08/2010	65.5540283	-106.5425533	1.94	1
11/08/2010	65.5534283	-106.5417583	1.98	0
11/08/2010	65.55344	-106.53836	1.02	2
11/08/2010	65.5520883	-106.5375183	1.22	2
11/08/2010	65.5555967	-106.5434717	1.29	3
11/08/2010	65.55475	-106.5414483	1.29	2
11/08/2010	65.5517867	-106.5383217	1.14	0
11/08/2010	65.5542417	-106.5397433	1.17	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5525783	-106.5396717	1.26	4
11/08/2010	65.5555483	-106.5452917	1.62	1
11/08/2010	65.5546967	-106.5434967	1.77	1
11/08/2010	65.5540367	-106.54252	1.96	3
11/08/2010	65.5534283	-106.541745	2	3
11/08/2010	65.5534383	-106.538395	1.1	4
11/08/2010	65.5521	-106.5375317	1.14	2
11/08/2010	65.5555867	-106.5435	1.41	1
11/08/2010	65.554745	-106.5414817	1.34	2
11/08/2010	65.5517917	-106.5382567	1.15	4
11/08/2010	65.5542433	-106.53978	1.15	2
11/08/2010	65.5525833	-106.5396367	1.22	4
11/08/2010	65.556205	-106.5455933	1.03	2
11/08/2010	65.55556	-106.545265	1.67	1
11/08/2010	65.554705	-106.5434617	1.77	1
11/08/2010	65.554045	-106.5424883	1.94	1
11/08/2010	65.5534283	-106.5417317	2	3
11/08/2010	65.5534367	-106.53843	1.14	2
11/08/2010	65.552115	-106.537545	1.14	2
11/08/2010	65.555575	-106.54353	1.62	3
11/08/2010	65.5547383	-106.5415167	1.36	2
11/08/2010	65.5517917	-106.5382567	1.19	4
11/08/2010	65.5542433	-106.5398167	1.08	4
11/08/2010	65.5525883	-106.5396017	1.82	2
11/08/2010	65.5562033	-106.5456067	1.03	0
11/08/2010	65.55557	-106.5452367	1.69	1
11/08/2010	65.554715	-106.5434283	1.76	1
11/08/2010	65.5540533	-106.5424567	1.94	1
11/08/2010	65.55343	-106.5417167	2	1
11/08/2010	65.5534367	-106.538465	1.15	2
11/08/2010	65.5521283	-106.5375583	1.14	2
11/08/2010	65.5555667	-106.54356	1.65	3
11/08/2010	65.5547333	-106.54155	1.41	2
11/08/2010	65.551795	-106.5382233	1.22	0
11/08/2010	65.554245	-106.5398533	1.12	4
11/08/2010	65.552595	-106.5395667	2.01	4
11/08/2010	65.5562017	-106.54562	1.02	2
11/08/2010	65.55558	-106.5452067	1.65	5
11/08/2010	65.554725	-106.5433967	1.76	1
11/08/2010	65.5540617	-106.5424233	1.94	1
11/08/2010	65.55343	-106.5417033	1.98	3
11/08/2010	65.553435	-106.5384983	1.17	2
11/08/2010	65.5521417	-106.53757	1.17	2
11/08/2010	65.5555567	-106.54359	1.69	3
11/08/2010	65.5547267	-106.5415833	1.46	2
11/08/2010	65.5518033	-106.538155	1.26	4
11/08/2010	65.5542467	-106.53989	1.15	2
11/08/2010	65.5526	-106.5395317	2.48	2
11/08/2010	65.5562	-106.5456317	1.14	2
11/08/2010	65.5555883	-106.5451783	1.64	5
11/08/2010	65.554735	-106.543365	1.77	1
11/08/2010	65.5540683	-106.54239	1.94	1
11/08/2010	65.5534317	-106.5416917	2.01	1
11/08/2010	65.5534333	-106.5385333	1.17	2
11/08/2010	65.5521533	-106.5375833	1.17	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5555483	-106.54362	1.69	1
11/08/2010	65.5547217	-106.541615	1.41	2
11/08/2010	65.5518033	-106.538155	1.1	2
11/08/2010	65.5542483	-106.5399283	1.17	2
11/08/2010	65.5526067	-106.5394967	2.41	2
11/08/2010	65.5562	-106.5456433	1.1	4
11/08/2010	65.5555967	-106.5451533	1.64	5
11/08/2010	65.554745	-106.5433317	1.76	5
11/08/2010	65.5540767	-106.542355	1.98	1
11/08/2010	65.5534317	-106.5416767	2	1
11/08/2010	65.5534317	-106.5385683	1.17	2
11/08/2010	65.5521667	-106.5375967	1.17	2
11/08/2010	65.5555383	-106.5436517	1.7	3
11/08/2010	65.5547167	-106.5416467	1.53	2
11/08/2010	65.5518133	-106.538085	1.17	2
11/08/2010	65.5542483	-106.5399283	1.2	2
11/08/2010	65.5526117	-106.5394617	2.48	2
11/08/2010	65.5561983	-106.5456533	1.14	2
11/08/2010	65.5556067	-106.545125	1.65	5
11/08/2010	65.554755	-106.5433	1.77	1
11/08/2010	65.554085	-106.5423217	1.96	1
11/08/2010	65.5534333	-106.5416567	2.01	1
11/08/2010	65.55343	-106.5386017	1.2	2
11/08/2010	65.55218	-106.5376083	1.17	2
11/08/2010	65.5555283	-106.5436833	1.67	3
11/08/2010	65.5547117	-106.54168	1.45	5
11/08/2010	65.5518133	-106.538085	1.29	2
11/08/2010	65.5542483	-106.54	1.24	2
11/08/2010	65.5526183	-106.5394233	2.41	0
11/08/2010	65.5561983	-106.545665	1.19	2
11/08/2010	65.5556167	-106.545095	1.64	2
11/08/2010	65.554765	-106.5432717	1.76	5
11/08/2010	65.5540917	-106.5422883	1.96	1
11/08/2010	65.553435	-106.5416283	2	1
11/08/2010	65.5534283	-106.5386367	1.26	2
11/08/2010	65.5521933	-106.5376183	1.1	2
11/08/2010	65.55552	-106.543715	1.67	3
11/08/2010	65.554705	-106.541715	1.58	3
11/08/2010	65.55182	-106.5380533	1.64	0
11/08/2010	65.5542467	-106.540035	1.24	2
11/08/2010	65.552625	-106.5393867	2.39	2
11/08/2010	65.5562	-106.5456733	1.08	2
11/08/2010	65.5556283	-106.545065	1.65	2
11/08/2010	65.5547733	-106.543245	1.76	1
11/08/2010	65.5541	-106.542255	2	1
11/08/2010	65.5534367	-106.5416017	1.98	1
11/08/2010	65.5534267	-106.53867	1.24	2
11/08/2010	65.5522083	-106.53763	1.15	0
11/08/2010	65.5555117	-106.5437483	1.69	3
11/08/2010	65.5546983	-106.5417483	1.6	1
11/08/2010	65.55183	-106.5379883	1.76	4
11/08/2010	65.5542467	-106.54007	1.26	2
11/08/2010	65.55263	-106.53935	2.36	3
11/08/2010	65.5562	-106.5456733	1.15	2
11/08/2010	65.55564	-106.5450383	1.62	5

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5547817	-106.5432183	1.76	1
11/08/2010	65.5541083	-106.5422217	1.96	1
11/08/2010	65.55344	-106.541575	1.98	1
11/08/2010	65.5534233	-106.5387067	1.29	2
11/08/2010	65.5522217	-106.5376433	1.14	4
11/08/2010	65.5555017	-106.54378	1.7	3
11/08/2010	65.5546917	-106.54178	1.65	3
11/08/2010	65.55183	-106.5379883	1.88	2
11/08/2010	65.554245	-106.5401083	1.2	2
11/08/2010	65.552585	-106.5378633	1.02	2
11/08/2010	65.5526367	-106.539315	2.39	0
11/08/2010	65.5562	-106.5456817	1.22	2
11/08/2010	65.5556517	-106.5450117	1.62	5
11/08/2010	65.5547917	-106.5431933	1.76	1
11/08/2010	65.5541183	-106.54219	1.96	3
11/08/2010	65.5534433	-106.54155	2	1
11/08/2010	65.5534217	-106.5387417	1.31	2
11/08/2010	65.552235	-106.537655	1.14	4
11/08/2010	65.5554933	-106.5438117	1.67	1
11/08/2010	65.554685	-106.54181	1.65	1
11/08/2010	65.551835	-106.5379567	1.96	0
11/08/2010	65.5542433	-106.5401467	1.19	2
11/08/2010	65.55258	-106.5378967	1.07	2
11/08/2010	65.5526417	-106.5392817	2.38	3
11/08/2010	65.5562017	-106.54569	1.2	2
11/08/2010	65.5556633	-106.5449833	1.65	2
11/08/2010	65.5548	-106.5431683	1.76	1
11/08/2010	65.5541267	-106.5421583	1.96	1
11/08/2010	65.553445	-106.5415283	1.98	1
11/08/2010	65.5534217	-106.5387417	1.33	2
11/08/2010	65.5522467	-106.53767	1.1	4
11/08/2010	65.5554833	-106.543845	1.67	3
11/08/2010	65.55468	-106.54184	1.67	1
11/08/2010	65.551845	-106.5378883	1.94	0
11/08/2010	65.55424	-106.540185	1.27	2
11/08/2010	65.552575	-106.5379283	1.08	0
11/08/2010	65.5526467	-106.5392467	2.41	0
11/08/2010	65.5562033	-106.5456967	1.17	2
11/08/2010	65.5556733	-106.544955	1.65	5
11/08/2010	65.5548083	-106.543145	1.76	0
11/08/2010	65.5541367	-106.5421267	1.96	1
11/08/2010	65.5534483	-106.5415067	1.98	1
11/08/2010	65.553415	-106.53881	1.38	2
11/08/2010	65.5522617	-106.537685	1.12	2
11/08/2010	65.555475	-106.5438767	1.65	3
11/08/2010	65.554675	-106.5418683	1.69	3
11/08/2010	65.551845	-106.5378883	1.96	2
11/08/2010	65.5542367	-106.5402217	1.22	2
11/08/2010	65.55257	-106.5379617	1.03	2
11/08/2010	65.5526517	-106.5392133	2.34	2
11/08/2010	65.5562033	-106.5456967	1.2	2
11/08/2010	65.5556833	-106.5449233	1.64	1
11/08/2010	65.5548167	-106.5431167	1.77	0
11/08/2010	65.5541467	-106.5420967	1.98	1
11/08/2010	65.55345	-106.5414883	1.98	3

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5534117	-106.538845	1.46	2
11/08/2010	65.552275	-106.5377	1.1	4
11/08/2010	65.5554667	-106.5439083	1.67	3
11/08/2010	65.55467	-106.5418933	1.7	1
11/08/2010	65.5518517	-106.537855	1.96	0
11/08/2010	65.5542333	-106.5402583	1.27	2
11/08/2010	65.552565	-106.5379933	1.1	2
11/08/2010	65.5526583	-106.5391783	2.36	2
11/08/2010	65.5562033	-106.5456967	1.2	2
11/08/2010	65.555695	-106.5448933	1.64	2
11/08/2010	65.5548267	-106.5430867	1.74	1
11/08/2010	65.5541567	-106.5420667	1.96	1
11/08/2010	65.5534533	-106.5414717	1.98	1
11/08/2010	65.5534083	-106.5388783	1.51	2
11/08/2010	65.55229	-106.537715	1.07	0
11/08/2010	65.5554567	-106.5439383	1.67	3
11/08/2010	65.554665	-106.541915	1.7	1
11/08/2010	65.5518567	-106.5378233	1.96	3
11/08/2010	65.5542283	-106.5402933	1.29	4
11/08/2010	65.55256	-106.5380233	1.19	2
11/08/2010	65.5526633	-106.539145	2.41	2
11/08/2010	65.556205	-106.545705	1.17	2
11/08/2010	65.555705	-106.5448633	1.64	4
11/08/2010	65.5548383	-106.543055	1.72	1
11/08/2010	65.5541667	-106.542035	1.96	1
11/08/2010	65.553455	-106.5414567	1.98	3
11/08/2010	65.553405	-106.5389117	1.69	2
11/08/2010	65.5523033	-106.5377317	1.15	4
11/08/2010	65.5554483	-106.5439717	1.65	3
11/08/2010	65.5546633	-106.541935	1.72	1
11/08/2010	65.5518617	-106.53779	2.03	2
11/08/2010	65.554225	-106.54033	1.39	2
11/08/2010	65.5525533	-106.5380533	1.17	2
11/08/2010	65.5526683	-106.53911	2.38	2
11/08/2010	65.5562067	-106.5457133	1.26	2
11/08/2010	65.5557167	-106.5448367	1.62	2
11/08/2010	65.55485	-106.543025	1.7	2
11/08/2010	65.5541767	-106.5420033	1.96	1
11/08/2010	65.5534567	-106.5414433	1.98	3
11/08/2010	65.5534017	-106.538945	1.91	2
11/08/2010	65.5523167	-106.5377483	1.1	2
11/08/2010	65.5554383	-106.5440033	1.65	3
11/08/2010	65.55466	-106.5419517	1.74	1
11/08/2010	65.55187	-106.5377217	2.07	2
11/08/2010	65.55422	-106.540365	1.45	2
11/08/2010	65.5525483	-106.5380817	1.2	4
11/08/2010	65.552675	-106.5390767	2.36	2
11/08/2010	65.5562083	-106.54573	1.29	2
11/08/2010	65.55573	-106.54481	1.62	2
11/08/2010	65.5548633	-106.5429933	1.72	1
11/08/2010	65.5541867	-106.5419733	1.96	1
11/08/2010	65.5534583	-106.54143	1.98	3
11/08/2010	65.5533983	-106.5389783	1.91	1
11/08/2010	65.55233	-106.5377667	1.1	2
11/08/2010	65.55543	-106.544035	1.64	3

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.55466	-106.541965	1.74	1
11/08/2010	65.55187	-106.5377217	2.03	0
11/08/2010	65.554215	-106.5404	1.46	2
11/08/2010	65.5525417	-106.5381117	1.22	0
11/08/2010	65.55268	-106.5390417	2.25	2
11/08/2010	65.55621	-106.5457583	1.34	4
11/08/2010	65.5557417	-106.544785	1.62	2
11/08/2010	65.554875	-106.5429633	1.72	5
11/08/2010	65.5541967	-106.5419417	1.96	1
11/08/2010	65.55346	-106.5414167	1.96	1
11/08/2010	65.5533933	-106.5390117	1.91	1
11/08/2010	65.5523417	-106.537785	1.1	2
11/08/2010	65.5554217	-106.5440683	1.64	3
11/08/2010	65.5546583	-106.5419783	1.77	1
11/08/2010	65.55188	-106.5376517	1.79	2
11/08/2010	65.5542083	-106.5404367	1.51	2
11/08/2010	65.552535	-106.5381417	1.15	4
11/08/2010	65.5526867	-106.539005	2.07	2
11/08/2010	65.55621	-106.5457967	1.34	2
11/08/2010	65.555755	-106.54476	1.67	5
11/08/2010	65.5548883	-106.5429333	1.7	2
11/08/2010	65.5542067	-106.54191	1.96	1
11/08/2010	65.5534617	-106.5414033	1.98	3
11/08/2010	65.55339	-106.539045	1.91	1
11/08/2010	65.552355	-106.5378067	1.15	2
11/08/2010	65.5554117	-106.5441	1.62	3
11/08/2010	65.5546567	-106.54199	1.76	1
11/08/2010	65.551885	-106.5376167	1.74	4
11/08/2010	65.5542033	-106.5404717	1.55	2
11/08/2010	65.5525267	-106.5381717	1.24	2
11/08/2010	65.5526933	-106.53897	2.13	2
11/08/2010	65.5562067	-106.5458333	1.31	2
11/08/2010	65.5557683	-106.544735	1.6	5
11/08/2010	65.5549	-106.5429017	1.69	5
11/08/2010	65.554215	-106.5418783	1.96	1
11/08/2010	65.5534633	-106.54139	1.96	1
11/08/2010	65.5533867	-106.539075	1.91	1
11/08/2010	65.55237	-106.5378283	1.14	4
11/08/2010	65.5554033	-106.5441317	1.64	3
11/08/2010	65.5546567	-106.5420017	1.77	1
11/08/2010	65.55189	-106.53758	1.67	2
11/08/2010	65.5541983	-106.5405067	1.57	2
11/08/2010	65.55252	-106.5382033	1.15	4
11/08/2010	65.5527	-106.5389367	2.22	2
11/08/2010	65.5562067	-106.5458333	1.33	2
11/08/2010	65.55578	-106.5447133	1.6	5
11/08/2010	65.5549133	-106.54287	1.69	1
11/08/2010	65.554225	-106.5418467	1.94	1
11/08/2010	65.553465	-106.5413783	1.96	1
11/08/2010	65.5533833	-106.5391033	1.93	1
11/08/2010	65.5523833	-106.5378533	1.24	4
11/08/2010	65.5553933	-106.544165	1.64	3
11/08/2010	65.5546567	-106.5420133	1.77	3
11/08/2010	65.551895	-106.537545	1.57	4
11/08/2010	65.5541917	-106.5405417	1.62	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5525133	-106.538235	1.27	2
11/08/2010	65.5527067	-106.5389017	2.17	2
11/08/2010	65.5561917	-106.5459083	1.38	5
11/08/2010	65.5557933	-106.54469	1.58	2
11/08/2010	65.554925	-106.5428383	1.69	1
11/08/2010	65.5542333	-106.5418133	1.94	3
11/08/2010	65.5534667	-106.5413683	1.96	1
11/08/2010	65.55338	-106.53913	1.93	0
11/08/2010	65.5523833	-106.5378533	1.17	4
11/08/2010	65.555385	-106.5441967	1.62	3
11/08/2010	65.5546583	-106.542025	1.77	1
11/08/2010	65.5519	-106.53751	1.45	2
11/08/2010	65.554185	-106.5405767	1.6	2
11/08/2010	65.5525067	-106.538265	1.29	2
11/08/2010	65.5527133	-106.5388667	2.17	2
11/08/2010	65.5561833	-106.5459417	1.48	2
11/08/2010	65.555805	-106.5446683	1.58	2
11/08/2010	65.5549383	-106.5428067	1.69	1
11/08/2010	65.5542433	-106.5417817	1.93	1
11/08/2010	65.5534667	-106.54136	1.94	1
11/08/2010	65.5533783	-106.5391567	1.93	2
11/08/2010	65.552415	-106.5379	1.19	2
11/08/2010	65.555375	-106.5442283	1.64	3
11/08/2010	65.55466	-106.5420367	1.76	1
11/08/2010	65.551905	-106.537475	1.62	2
11/08/2010	65.5541783	-106.5406117	1.64	1
11/08/2010	65.5524983	-106.538295	1.45	2
11/08/2010	65.55272	-106.53883	2.13	2
11/08/2010	65.5561717	-106.5459733	1.5	4
11/08/2010	65.5558167	-106.5446433	1.6	5
11/08/2010	65.5549517	-106.542775	1.67	1
11/08/2010	65.5542517	-106.54175	1.93	1
11/08/2010	65.5534683	-106.5413517	1.94	3
11/08/2010	65.553375	-106.5391883	1.94	2
11/08/2010	65.55243	-106.5379233	1.17	2
11/08/2010	65.5553633	-106.5442583	1.62	3
11/08/2010	65.55466	-106.5420467	1.77	1
11/08/2010	65.55191	-106.5374417	1.51	2
11/08/2010	65.5541717	-106.5406467	1.65	1
11/08/2010	65.5524917	-106.538325	1.53	4
11/08/2010	65.5527267	-106.5387967	2.08	2
11/08/2010	65.5561617	-106.5460017	1.55	5
11/08/2010	65.5558283	-106.5446167	1.57	5
11/08/2010	65.5549633	-106.5427433	1.65	1
11/08/2010	65.55426	-106.5417183	1.91	1
11/08/2010	65.55347	-106.541335	1.94	1
11/08/2010	65.5533717	-106.5392183	1.96	2
11/08/2010	65.552445	-106.5379467	1.19	2
11/08/2010	65.5553533	-106.5442883	1.62	3
11/08/2010	65.5546617	-106.5420567	1.76	1
11/08/2010	65.551915	-106.53741	1.53	2
11/08/2010	65.554165	-106.54068	1.67	1
11/08/2010	65.552485	-106.5383567	1.58	2
11/08/2010	65.5527333	-106.5387633	2.07	2
11/08/2010	65.5561517	-106.54603	1.57	5

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5558383	-106.54459	1.57	2
11/08/2010	65.5549767	-106.54271	1.65	1
11/08/2010	65.5542683	-106.541685	1.89	1
11/08/2010	65.553475	-106.541305	1.93	1
11/08/2010	65.55337	-106.5392517	2.01	2
11/08/2010	65.55246	-106.53797	1.2	2
11/08/2010	65.5553433	-106.5443183	1.64	3
11/08/2010	65.5546633	-106.5420633	1.76	1
11/08/2010	65.55192	-106.5373767	1.41	2
11/08/2010	65.5541583	-106.5407133	1.7	1
11/08/2010	65.5524783	-106.5383883	1.67	2
11/08/2010	65.55274	-106.5387283	2.01	2
11/08/2010	65.5561417	-106.5460567	1.58	5
11/08/2010	65.5558483	-106.5445583	1.57	5
11/08/2010	65.55499	-106.5426783	1.65	2
11/08/2010	65.5542783	-106.5416533	1.89	1
11/08/2010	65.55348	-106.5412683	1.91	0
11/08/2010	65.5533667	-106.5392833	2.01	1
11/08/2010	65.5524767	-106.5379917	1.17	2
11/08/2010	65.5553317	-106.5443467	1.64	1
11/08/2010	65.554665	-106.54208	1.74	1
11/08/2010	65.551925	-106.5373433	1.34	2
11/08/2010	65.5541517	-106.5407467	1.72	1
11/08/2010	65.5524717	-106.5384183	1.69	2
11/08/2010	65.5527483	-106.538695	1.82	2
11/08/2010	65.5561333	-106.5460833	1.6	5
11/08/2010	65.5558583	-106.5445267	1.57	5
11/08/2010	65.5550017	-106.5426483	1.64	2
11/08/2010	65.5542867	-106.5416217	1.88	1
11/08/2010	65.5534867	-106.5412283	1.91	1
11/08/2010	65.5533633	-106.5393167	2.05	1
11/08/2010	65.5524917	-106.5380133	1.22	2
11/08/2010	65.5553217	-106.544375	1.64	0
11/08/2010	65.5546667	-106.5421067	1.77	1
11/08/2010	65.55193	-106.5373083	1.27	4
11/08/2010	65.554145	-106.5407817	1.74	1
11/08/2010	65.552465	-106.53845	1.77	2
11/08/2010	65.552755	-106.5386633	1.55	4
11/08/2010	65.556125	-106.5461067	1.64	5
11/08/2010	65.5558683	-106.544495	1.57	5
11/08/2010	65.555015	-106.5426167	1.62	0
11/08/2010	65.554295	-106.54159	1.88	1
11/08/2010	65.5534917	-106.541185	1.91	1
11/08/2010	65.55336	-106.53935	2.07	1
11/08/2010	65.5525067	-106.5380333	1.26	4
11/08/2010	65.55531	-106.5444033	1.65	0
11/08/2010	65.5546667	-106.5421367	1.77	1
11/08/2010	65.551935	-106.537275	1.19	2
11/08/2010	65.55414	-106.5408167	1.76	1
11/08/2010	65.5524583	-106.53848	1.86	2
11/08/2010	65.5527617	-106.53863	1.58	2
11/08/2010	65.5561167	-106.5461283	1.64	5
11/08/2010	65.5558767	-106.5444617	1.58	2
11/08/2010	65.5550283	-106.5425867	1.57	1
11/08/2010	65.5543033	-106.5415567	1.86	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5534983	-106.5411383	1.91	1
11/08/2010	65.5533567	-106.539385	2.1	1
11/08/2010	65.5525233	-106.538055	1.22	2
11/08/2010	65.5553017	-106.5444283	1.67	3
11/08/2010	65.5546667	-106.54217	1.77	1
11/08/2010	65.55194	-106.53724	1.26	4
11/08/2010	65.554135	-106.5408533	1.72	1
11/08/2010	65.5524517	-106.53851	1.77	2
11/08/2010	65.55277	-106.5385967	1.46	4
11/08/2010	65.5561083	-106.5461483	1.67	5
11/08/2010	65.5558867	-106.5444283	1.41	2
11/08/2010	65.5550417	-106.5425567	1.57	5
11/08/2010	65.5543117	-106.5415233	1.82	1
11/08/2010	65.5535033	-106.54109	1.91	3
11/08/2010	65.5533533	-106.5394217	2.13	1
11/08/2010	65.5525383	-106.5380767	1.19	2
11/08/2010	65.5552917	-106.5444533	1.69	3
11/08/2010	65.554665	-106.5422067	1.76	1
11/08/2010	65.551945	-106.5372067	1.22	2
11/08/2010	65.55413	-106.5408867	1.76	1
11/08/2010	65.5524467	-106.53854	1.82	0
11/08/2010	65.5527783	-106.5385633	1.39	2
11/08/2010	65.5561	-106.54617	1.69	5
11/08/2010	65.5558967	-106.5443983	1.15	2
11/08/2010	65.555055	-106.5425267	1.5	1
11/08/2010	65.55432	-106.54149	1.81	1
11/08/2010	65.55351	-106.5410433	1.91	1
11/08/2010	65.5533483	-106.5394583	2.15	1
11/08/2010	65.552555	-106.5380967	1.19	2
11/08/2010	65.5552833	-106.544475	1.69	3
11/08/2010	65.5546633	-106.5422433	1.77	3
11/08/2010	65.55195	-106.5371717	1.17	2
11/08/2010	65.5541267	-106.5409183	1.79	1
11/08/2010	65.55244	-106.5385717	1.94	2
11/08/2010	65.5527883	-106.5385317	1.31	2
11/08/2010	65.55609	-106.5461933	1.7	2
11/08/2010	65.5559067	-106.54437	1.14	4
11/08/2010	65.5550683	-106.5424967	1.48	1
11/08/2010	65.5543283	-106.5414567	1.79	1
11/08/2010	65.5535167	-106.5409967	1.94	1
11/08/2010	65.553345	-106.5394933	2.19	1
11/08/2010	65.5525717	-106.5381183	1.19	4
11/08/2010	65.555275	-106.5445	1.69	3
11/08/2010	65.5546617	-106.5422817	1.79	1
11/08/2010	65.551955	-106.5371383	1.14	2
11/08/2010	65.5541217	-106.5409517	1.79	1
11/08/2010	65.5524333	-106.5386033	1.96	4
11/08/2010	65.5527967	-106.5385017	1.27	2
11/08/2010	65.55608	-106.546215	1.7	5
11/08/2010	65.5559067	-106.54437	1.05	2
11/08/2010	65.5550817	-106.542465	1.41	1
11/08/2010	65.5543367	-106.5414233	1.77	1
11/08/2010	65.5535233	-106.5409517	1.98	3
11/08/2010	65.55334	-106.5395283	2.24	1
11/08/2010	65.5525867	-106.5381417	1.17	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5552633	-106.54453	1.7	0
11/08/2010	65.5546583	-106.5423183	1.79	1
11/08/2010	65.5519617	-106.5371033	1.08	2
11/08/2010	65.5541183	-106.540985	1.82	1
11/08/2010	65.5524267	-106.5386333	1.94	2
11/08/2010	65.552805	-106.53847	1.33	4
11/08/2010	65.5560683	-106.5462367	1.7	5
11/08/2010	65.5559167	-106.54434	1	2
11/08/2010	65.555095	-106.542435	1.34	5
11/08/2010	65.5543433	-106.54139	1.77	1
11/08/2010	65.5535317	-106.540905	2	1
11/08/2010	65.553335	-106.5395633	2.25	1
11/08/2010	65.5526033	-106.5381633	1.22	2
11/08/2010	65.5552517	-106.5445583	1.69	3
11/08/2010	65.5546533	-106.542355	1.79	1
11/08/2010	65.5519667	-106.5370683	1.03	0
11/08/2010	65.5541133	-106.54102	1.84	1
11/08/2010	65.55242	-106.5386633	1.96	2
11/08/2010	65.5528133	-106.5384383	1.33	4
11/08/2010	65.5560567	-106.54626	1.76	1
11/08/2010	65.55511	-106.542405	1.27	2
11/08/2010	65.5543517	-106.541355	1.74	1
11/08/2010	65.55354	-106.54086	2.08	1
11/08/2010	65.55333	-106.5395983	2.34	1
11/08/2010	65.5526183	-106.538185	1.26	2
11/08/2010	65.5552417	-106.544585	1.7	3
11/08/2010	65.55465	-106.5423917	1.79	1
11/08/2010	65.5519717	-106.537035	1.1	2
11/08/2010	65.55411	-106.5410567	1.88	1
11/08/2010	65.5524133	-106.538695	2.08	2
11/08/2010	65.5528233	-106.5384083	1.34	4
11/08/2010	65.556045	-106.5462817	1.77	1
11/08/2010	65.5551233	-106.542375	1.26	2
11/08/2010	65.55436	-106.5413217	1.72	1
11/08/2010	65.5535467	-106.5408133	2.1	1
11/08/2010	65.553325	-106.5396317	2.38	2
11/08/2010	65.5526333	-106.538205	1.22	2
11/08/2010	65.55523	-106.5446117	1.7	3
11/08/2010	65.554645	-106.5424283	1.79	1
11/08/2010	65.5519767	-106.5370017	1.05	5
11/08/2010	65.5541067	-106.54109	1.89	1
11/08/2010	65.552405	-106.5387267	2.13	4
11/08/2010	65.5528317	-106.5383767	1.29	2
11/08/2010	65.5560333	-106.5463033	1.81	5
11/08/2010	65.5551367	-106.542345	1.2	2
11/08/2010	65.5543683	-106.5412883	1.72	1
11/08/2010	65.553555	-106.5407667	2.17	1
11/08/2010	65.55332	-106.539665	2.43	1
11/08/2010	65.55265	-106.538225	1.26	4
11/08/2010	65.5552217	-106.5446333	1.72	3
11/08/2010	65.5546383	-106.542465	1.81	1
11/08/2010	65.5519817	-106.5369667	1.15	2
11/08/2010	65.5541017	-106.5411267	1.89	1
11/08/2010	65.5523983	-106.5387583	2.31	2
11/08/2010	65.5528417	-106.5383467	1.26	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5560233	-106.5463267	1.82	2
11/08/2010	65.5551517	-106.5423167	1.17	2
11/08/2010	65.5543767	-106.541255	1.74	0
11/08/2010	65.5535617	-106.54072	2.24	1
11/08/2010	65.553315	-106.5396983	2.43	1
11/08/2010	65.5526667	-106.538245	1.19	2
11/08/2010	65.5552117	-106.5446533	1.72	3
11/08/2010	65.5546333	-106.5425	1.81	1
11/08/2010	65.5540967	-106.5411617	1.94	1
11/08/2010	65.55239	-106.53879	2.29	2
11/08/2010	65.55285	-106.5383167	1.22	4
11/08/2010	65.5560117	-106.54635	1.84	2
11/08/2010	65.555975	-106.5441617	1.33	2
11/08/2010	65.555165	-106.5422883	1.14	2
11/08/2010	65.554385	-106.5412233	1.7	1
11/08/2010	65.5535667	-106.54067	2.25	1
11/08/2010	65.55331	-106.5397333	2.5	2
11/08/2010	65.5526817	-106.538265	1.2	0
11/08/2010	65.555205	-106.5446717	1.74	0
11/08/2010	65.5546283	-106.5425333	1.82	1
11/08/2010	65.5540917	-106.5411983	1.96	1
11/08/2010	65.5523833	-106.53882	2.27	0
11/08/2010	65.55286	-106.5382867	1.2	2
11/08/2010	65.556	-106.5463733	1.82	2
11/08/2010	65.55518	-106.54226	1.08	2
11/08/2010	65.554395	-106.54119	1.69	3
11/08/2010	65.5535717	-106.540625	2.31	1
11/08/2010	65.5533033	-106.5397667	2.55	2
11/08/2010	65.5526983	-106.538285	1.22	2
11/08/2010	65.5551983	-106.5446883	1.74	3
11/08/2010	65.5546217	-106.5425683	1.81	1
11/08/2010	65.5540867	-106.5412333	1.98	1
11/08/2010	65.5523767	-106.5388517	2.15	2
11/08/2010	65.5528683	-106.5382567	1.2	4
11/08/2010	65.55599	-106.5464	1.81	2
11/08/2010	65.5551933	-106.54223	1.03	2
11/08/2010	65.5544033	-106.5411583	1.67	1
11/08/2010	65.5535767	-106.5405783	2.34	1
11/08/2010	65.5532983	-106.5398	2.56	1
11/08/2010	65.5527133	-106.538305	1.2	0
11/08/2010	65.5551933	-106.5447033	1.76	3
11/08/2010	65.554615	-106.5426017	1.81	1
11/08/2010	65.5540817	-106.54127	1.98	1
11/08/2010	65.5523717	-106.5388817	2.22	1
11/08/2010	65.5528783	-106.5382283	1.17	2
11/08/2010	65.5559783	-106.546425	1.82	2
11/08/2010	65.5552067	-106.5422017	1	2
11/08/2010	65.5544133	-106.5411267	1.65	2
11/08/2010	65.5535817	-106.5405333	2.36	1
11/08/2010	65.5532917	-106.5398333	2.6	2
11/08/2010	65.55273	-106.538325	1.24	2
11/08/2010	65.55519	-106.5447133	1.76	3
11/08/2010	65.55461	-106.5426367	1.82	1
11/08/2010	65.5520083	-106.5367967	1.48	2
11/08/2010	65.5540767	-106.5413067	2	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.552365	-106.5389117	2.24	0
11/08/2010	65.5528867	-106.5381983	1.15	4
11/08/2010	65.5559683	-106.5464517	1.84	5
11/08/2010	65.5544217	-106.5410933	1.46	2
11/08/2010	65.5535867	-106.5404867	2.36	1
11/08/2010	65.5532867	-106.5398683	2.67	2
11/08/2010	65.5527467	-106.5383433	1.31	2
11/08/2010	65.5551867	-106.544725	1.74	3
11/08/2010	65.5546033	-106.54267	1.82	1
11/08/2010	65.5520133	-106.5367633	1.29	2
11/08/2010	65.5540733	-106.5413417	2	1
11/08/2010	65.5523583	-106.5389417	2.27	3
11/08/2010	65.552895	-106.53817	1.14	2
11/08/2010	65.5559567	-106.5464783	1.82	5
11/08/2010	65.55443	-106.5410617	1.58	2
11/08/2010	65.55359	-106.5404433	2.34	1
11/08/2010	65.5532817	-106.5399033	2.67	1
11/08/2010	65.5527633	-106.5383617	1.27	0
11/08/2010	65.5551817	-106.5447367	1.76	3
11/08/2010	65.5545967	-106.542705	1.81	1
11/08/2010	65.5540683	-106.54138	2	1
11/08/2010	65.5523517	-106.538975	2.25	0
11/08/2010	65.552905	-106.53814	1.08	4
11/08/2010	65.555945	-106.5465033	1.84	2
11/08/2010	65.5544383	-106.54103	1.5	4
11/08/2010	65.5535967	-106.5404	2.32	1
11/08/2010	65.5532767	-106.53994	2.69	0
11/08/2010	65.5527783	-106.5383817	1.29	2
11/08/2010	65.55518	-106.5447483	1.76	3
11/08/2010	65.5545917	-106.5427383	1.81	1
11/08/2010	65.554065	-106.5414167	2.01	1
11/08/2010	65.552345	-106.5390067	2.24	0
11/08/2010	65.5529133	-106.53811	1.05	4
11/08/2010	65.5559333	-106.54653	1.84	5
11/08/2010	65.5544483	-106.5409967	1.43	2
11/08/2010	65.5536033	-106.5403583	2.31	1
11/08/2010	65.5532717	-106.539975	2.69	0
11/08/2010	65.552795	-106.5384017	1.26	4
11/08/2010	65.5551767	-106.54476	1.77	3
11/08/2010	65.554585	-106.5427717	1.81	1
11/08/2010	65.55406	-106.5414533	2.01	1
11/08/2010	65.5523383	-106.5390383	2.24	2
11/08/2010	65.5529217	-106.5380783	1.05	2
11/08/2010	65.5559217	-106.546555	1.86	1
11/08/2010	65.5544567	-106.5409633	1.39	2
11/08/2010	65.55361	-106.5403217	2.27	1
11/08/2010	65.5532667	-106.54001	2.67	2
11/08/2010	65.5528117	-106.5384217	1.33	2
11/08/2010	65.5551733	-106.544775	1.79	1
11/08/2010	65.5545783	-106.542805	1.82	1
11/08/2010	65.5540567	-106.5414883	2	3
11/08/2010	65.5523317	-106.5390717	2.31	1
11/08/2010	65.55293	-106.5380467	1.03	4
11/08/2010	65.55591	-106.54658	1.84	2
11/08/2010	65.554465	-106.54093	1.36	2

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5536167	-106.5402867	2.25	3
11/08/2010	65.5532617	-106.540045	2.6	0
11/08/2010	65.5528283	-106.53844	1.34	2
11/08/2010	65.55517	-106.544795	1.74	3
11/08/2010	65.5545717	-106.5428383	1.81	1
11/08/2010	65.5540517	-106.5415233	2	1
11/08/2010	65.552325	-106.5391033	2.24	4
11/08/2010	65.55294	-106.538015	1	2
11/08/2010	65.555895	-106.5466017	1.79	1
11/08/2010	65.5544733	-106.5408967	1.34	2
11/08/2010	65.5536233	-106.5402533	2.2	1
11/08/2010	65.5532567	-106.5400783	2.55	1
11/08/2010	65.5528433	-106.5384617	1.31	0
11/08/2010	65.5551633	-106.54482	1.76	3
11/08/2010	65.5545667	-106.54287	1.81	1
11/08/2010	65.5540467	-106.5415583	2.01	3
11/08/2010	65.5523183	-106.5391367	2.17	2
11/08/2010	65.5529483	-106.5379833	1	2
11/08/2010	65.5558817	-106.5466183	1.76	5
11/08/2010	65.5544833	-106.5408633	1.31	2
11/08/2010	65.5536233	-106.5402533	2.17	3
11/08/2010	65.5532517	-106.5401133	2.51	1
11/08/2010	65.55286	-106.5384833	1.34	4
11/08/2010	65.555155	-106.5448467	1.77	3
11/08/2010	65.55456	-106.5429033	1.82	3
11/08/2010	65.5540433	-106.5415933	2	3
11/08/2010	65.5523117	-106.5391683	1.55	2
11/08/2010	65.5558667	-106.5466283	1.72	5
11/08/2010	65.5544917	-106.54083	1.26	4
11/08/2010	65.553635	-106.5401917	2.15	1
11/08/2010	65.5532467	-106.5401467	2.39	0
11/08/2010	65.5528767	-106.538505	1.31	0
11/08/2010	65.5551467	-106.5448717	1.76	0
11/08/2010	65.5545533	-106.5429367	1.81	3
11/08/2010	65.5540383	-106.54163	1.98	1
11/08/2010	65.5523067	-106.5392	1.15	4
11/08/2010	65.5558533	-106.54663	1.6	5
11/08/2010	65.5545017	-106.5407983	1.24	0
11/08/2010	65.5536417	-106.5401667	2.12	1
11/08/2010	65.5532417	-106.5401817	2.27	2
11/08/2010	65.5528917	-106.5385283	1.33	4
11/08/2010	65.5551367	-106.5448983	1.77	1
11/08/2010	65.554545	-106.5429683	1.81	1
11/08/2010	65.554035	-106.541665	2	1
11/08/2010	65.5523017	-106.5392317	1.1	2
11/08/2010	65.55451	-106.5407667	1.22	2
11/08/2010	65.5536467	-106.5401417	2.12	1
11/08/2010	65.5532367	-106.5402167	2.24	1
11/08/2010	65.5529067	-106.5385517	1.33	2
11/08/2010	65.5551267	-106.544925	1.81	1
11/08/2010	65.5545383	-106.5430017	1.82	1
11/08/2010	65.55403	-106.5417	1.98	1
11/08/2010	65.5522967	-106.5392633	1.08	2
11/08/2010	65.55452	-106.540735	1.15	2
11/08/2010	65.5536533	-106.540115	2.07	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5532317	-106.54025	2.22	0
11/08/2010	65.5529233	-106.5385767	1.33	2
11/08/2010	65.5551183	-106.5449533	1.82	3
11/08/2010	65.55453	-106.543035	1.82	1
11/08/2010	65.5540267	-106.5417367	1.98	1
11/08/2010	65.55229	-106.539295	1.17	2
11/08/2010	65.5545283	-106.5407033	1.17	2
11/08/2010	65.55366	-106.5400833	2.03	1
11/08/2010	65.5532267	-106.540285	2.13	1
11/08/2010	65.5529383	-106.5386017	1.43	4
11/08/2010	65.5551083	-106.5449817	1.82	1
11/08/2010	65.5545233	-106.5430667	1.82	1
11/08/2010	65.5540233	-106.5417717	1.98	1
11/08/2010	65.5522833	-106.5393267	1.12	2
11/08/2010	65.5545367	-106.5406717	1.17	2
11/08/2010	65.5536683	-106.5400517	1.98	1
11/08/2010	65.5532217	-106.54032	2.08	1
11/08/2010	65.5529517	-106.5386267	1.45	2
11/08/2010	65.5550983	-106.5450083	1.82	1
11/08/2010	65.5545167	-106.5431	1.82	1
11/08/2010	65.5540183	-106.5418067	1.96	1
11/08/2010	65.554545	-106.54064	1.12	2
11/08/2010	65.5536767	-106.5400217	1.94	1
11/08/2010	65.5532167	-106.5403533	2.1	1
11/08/2010	65.5529667	-106.53865	1.45	2
11/08/2010	65.5550883	-106.5450317	1.86	1
11/08/2010	65.55451	-106.5431283	1.88	1
11/08/2010	65.554015	-106.5418433	1.96	1
11/08/2010	65.5545533	-106.5406083	1.17	2
11/08/2010	65.553685	-106.5399917	1.93	1
11/08/2010	65.5532117	-106.5403883	2.1	1
11/08/2010	65.5529817	-106.538675	1.29	4
11/08/2010	65.5550783	-106.5450517	1.82	3
11/08/2010	65.554505	-106.5431583	1.86	1
11/08/2010	65.55401	-106.5418817	1.96	1
11/08/2010	65.5545617	-106.5405783	1.05	2
11/08/2010	65.5536933	-106.539965	1.93	1
11/08/2010	65.5532067	-106.5404217	2.08	1
11/08/2010	65.5529983	-106.5387	1.36	2
11/08/2010	65.5550683	-106.5450683	1.82	3
11/08/2010	65.5544983	-106.5431883	1.84	1
11/08/2010	65.554005	-106.5419167	1.96	1
11/08/2010	65.55457	-106.540545	1	2
11/08/2010	65.5537	-106.53994	1.89	1
11/08/2010	65.5532017	-106.5404567	2.05	3
11/08/2010	65.5530133	-106.538725	1.69	4
11/08/2010	65.5550617	-106.54508	1.81	3
11/08/2010	65.5544933	-106.54322	1.84	1
11/08/2010	65.554	-106.5419517	1.96	1
11/08/2010	65.55458	-106.5405133	1.07	4
11/08/2010	65.5537067	-106.5399133	1.86	1
11/08/2010	65.553195	-106.5404917	2.05	3
11/08/2010	65.5530283	-106.53875	1.74	4
11/08/2010	65.555055	-106.5450917	1.81	3
11/08/2010	65.5544867	-106.5432533	1.86	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5539967	-106.5419867	1.94	1
11/08/2010	65.553715	-106.539885	1.88	3
11/08/2010	65.5531883	-106.5405267	2.05	1
11/08/2010	65.5530433	-106.538775	1.72	4
11/08/2010	65.5550483	-106.5451017	1.65	2
11/08/2010	65.5544783	-106.5432867	1.86	1
11/08/2010	65.5539917	-106.5420233	1.94	1
11/08/2010	65.5537217	-106.5398583	1.84	1
11/08/2010	65.5531833	-106.5405617	2.07	3
11/08/2010	65.5530583	-106.5388	1.74	2
11/08/2010	65.5550433	-106.5451083	1.36	0
11/08/2010	65.55447	-106.54332	1.86	3
11/08/2010	65.5539883	-106.5420583	1.96	1
11/08/2010	65.5537283	-106.5398317	1.84	1
11/08/2010	65.5531767	-106.540595	2.1	3
11/08/2010	65.5530733	-106.5388267	1.67	2
11/08/2010	65.5550383	-106.5451183	1.1	1
11/08/2010	65.5544633	-106.5433517	1.89	1
11/08/2010	65.5539883	-106.5420583	1.93	1
11/08/2010	65.5537333	-106.5398067	1.86	1
11/08/2010	65.5531717	-106.54063	2.08	3
11/08/2010	65.5530883	-106.5388533	1.72	4
11/08/2010	65.554455	-106.5433833	1.91	1
11/08/2010	65.5539783	-106.5421267	1.96	3
11/08/2010	65.5537383	-106.5397833	1.82	1
11/08/2010	65.553165	-106.5406617	2.1	1
11/08/2010	65.5531017	-106.53888	2.03	2
11/08/2010	65.554445	-106.543415	1.91	1
11/08/2010	65.5539717	-106.5421633	1.94	1
11/08/2010	65.5537433	-106.5397583	1.81	1
11/08/2010	65.5531583	-106.5406933	2.13	3
11/08/2010	65.5531167	-106.5389067	2.17	0
11/08/2010	65.5544367	-106.543445	1.91	1
11/08/2010	65.5539667	-106.5421983	1.94	1
11/08/2010	65.55375	-106.5397267	1.79	1
11/08/2010	65.5531517	-106.5407267	2.17	3
11/08/2010	65.5531317	-106.5389333	2.19	2
11/08/2010	65.5544267	-106.5434733	1.91	1
11/08/2010	65.5539617	-106.5422317	1.94	1
11/08/2010	65.553755	-106.5396917	1.77	1
11/08/2010	65.553145	-106.5407583	2.19	1
11/08/2010	65.5531467	-106.5389617	2.15	1
11/08/2010	65.5544167	-106.5435017	1.91	1
11/08/2010	65.553955	-106.5422667	1.94	1
11/08/2010	65.5537633	-106.5396533	1.77	1
11/08/2010	65.553145	-106.5407583	2.22	1
11/08/2010	65.55316	-106.5389883	2.15	0
11/08/2010	65.5544067	-106.5435283	1.93	1
11/08/2010	65.55395	-106.5423017	1.94	1
11/08/2010	65.55377	-106.5396117	1.76	1
11/08/2010	65.55313	-106.5408217	2.22	3
11/08/2010	65.553175	-106.539015	2.13	1
11/08/2010	65.5543967	-106.543555	1.91	1
11/08/2010	65.553945	-106.542335	1.98	3
11/08/2010	65.5537767	-106.5395717	1.72	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5531233	-106.5408533	2.25	3
11/08/2010	65.5531883	-106.5390417	2.12	1
11/08/2010	65.5543867	-106.54358	1.91	1
11/08/2010	65.55394	-106.54237	1.98	1
11/08/2010	65.5537833	-106.5395317	1.72	1
11/08/2010	65.5531167	-106.5408867	2.24	0
11/08/2010	65.5532033	-106.5390667	2.13	1
11/08/2010	65.5543733	-106.5436033	1.89	1
11/08/2010	65.5539333	-106.5424033	1.98	1
11/08/2010	65.55379	-106.5394917	1.7	0
11/08/2010	65.55311	-106.54092	1.6	4
11/08/2010	65.5532183	-106.5390933	2.1	1
11/08/2010	65.5543617	-106.5436233	1.88	1
11/08/2010	65.5539283	-106.5424383	1.98	1
11/08/2010	65.5537983	-106.5394533	1.65	1
11/08/2010	65.5531017	-106.5409533	1.36	2
11/08/2010	65.5532317	-106.53912	2.1	1
11/08/2010	65.5543483	-106.54364	1.82	1
11/08/2010	65.5539233	-106.5424717	2	1
11/08/2010	65.553805	-106.539415	1.53	2
11/08/2010	65.553095	-106.540985	1.15	2
11/08/2010	65.5532467	-106.539145	2.1	1
11/08/2010	65.5543333	-106.543655	1.81	3
11/08/2010	65.5539183	-106.542505	2.01	1
11/08/2010	65.5538117	-106.5393783	1.55	2
11/08/2010	65.5530883	-106.5410183	1.08	2
11/08/2010	65.5532617	-106.5391717	2.1	1
11/08/2010	65.55432	-106.5436633	1.79	1
11/08/2010	65.5539133	-106.54254	2.01	1
11/08/2010	65.5538167	-106.5393417	1.46	4
11/08/2010	65.5532767	-106.5391967	2.08	1
11/08/2010	65.554305	-106.54367	1.74	5
11/08/2010	65.5539083	-106.5425767	2	1
11/08/2010	65.5538233	-106.53931	1.38	2
11/08/2010	65.5532917	-106.5392217	2.08	1
11/08/2010	65.5539017	-106.5426117	2.01	1
11/08/2010	65.5538267	-106.53928	1.31	2
11/08/2010	65.5533067	-106.5392483	2.07	1
11/08/2010	65.553895	-106.5426483	1.98	1
11/08/2010	65.5538317	-106.5392517	1.29	2
11/08/2010	65.5533067	-106.5392483	2.07	1
11/08/2010	65.5538867	-106.5426817	1.98	3
11/08/2010	65.5538367	-106.539225	1.33	0
11/08/2010	65.553335	-106.5392983	2.05	1
11/08/2010	65.5538767	-106.5427117	1.96	1
11/08/2010	65.55384	-106.5391967	1.34	2
11/08/2010	65.55335	-106.539325	2.05	1
11/08/2010	65.5538667	-106.5427367	1.93	1
11/08/2010	65.553845	-106.53917	1.31	2
11/08/2010	65.553365	-106.53935	2.05	1
11/08/2010	65.55385	-106.5391433	1.22	2
11/08/2010	65.5533783	-106.5393767	2.05	1
11/08/2010	65.553855	-106.5391133	1.22	2
11/08/2010	65.5533933	-106.5394033	2.03	1
11/08/2010	65.55386	-106.5390833	1.17	4

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5534083	-106.53943	2.01	1
11/08/2010	65.553865	-106.539055	1.12	2
11/08/2010	65.5534217	-106.5394567	2.01	1
11/08/2010	65.55387	-106.539025	1.15	2
11/08/2010	65.5534367	-106.539485	2	1
11/08/2010	65.5538767	-106.538995	1.1	2
11/08/2010	65.55345	-106.5395117	2	1
11/08/2010	65.5538817	-106.5389633	1.08	2
11/08/2010	65.553465	-106.53954	2	1
11/08/2010	65.5538883	-106.5389317	1.12	2
11/08/2010	65.5534783	-106.5395667	2	1
11/08/2010	65.553895	-106.5388983	1.1	2
11/08/2010	65.5534933	-106.5395933	2	1
11/08/2010	65.5539017	-106.5388667	1.03	2
11/08/2010	65.5535067	-106.5396183	2	1
11/08/2010	65.5539083	-106.538835	1.03	0
11/08/2010	65.5535217	-106.539645	2	1
11/08/2010	65.553915	-106.5388033	1	5
11/08/2010	65.5535367	-106.53967	2	0
11/08/2010	65.5535533	-106.539695	2	1
11/08/2010	65.5535683	-106.53972	1.96	1
11/08/2010	65.5535833	-106.5397467	1.96	1
11/08/2010	65.5535967	-106.5397717	1.96	1
11/08/2010	65.5536117	-106.5397983	1.96	1
11/08/2010	65.5536283	-106.5398233	1.94	1
11/08/2010	65.5536417	-106.5398483	1.93	1
11/08/2010	65.5536567	-106.539875	1.93	1
11/08/2010	65.5536717	-106.5399017	1.93	1
11/08/2010	65.5536867	-106.5399283	1.91	1
11/08/2010	65.5537017	-106.5399533	1.91	1
11/08/2010	65.553715	-106.53998	1.89	1
11/08/2010	65.55373	-106.5400067	1.91	1
11/08/2010	65.553745	-106.5400317	1.88	1
11/08/2010	65.55376	-106.5400583	1.89	1
11/08/2010	65.553775	-106.5400833	1.88	1
11/08/2010	65.55379	-106.5401083	1.86	1
11/08/2010	65.553805	-106.5401333	1.84	1
11/08/2010	65.55382	-106.54016	1.84	1
11/08/2010	65.553835	-106.540185	1.86	1
11/08/2010	65.55385	-106.54021	1.82	1
11/08/2010	65.553865	-106.5402367	1.82	1
11/08/2010	65.55388	-106.5402617	1.81	1
11/08/2010	65.553895	-106.5402883	1.81	1
11/08/2010	65.5539083	-106.5403133	1.81	1
11/08/2010	65.5539233	-106.5403383	1.81	1
11/08/2010	65.5539383	-106.5403633	1.77	1
11/08/2010	65.5539517	-106.5403883	1.77	1
11/08/2010	65.5539683	-106.5404133	1.77	1
11/08/2010	65.5539833	-106.5404367	1.76	1
11/08/2010	65.5539983	-106.5404583	1.79	2
11/08/2010	65.5540133	-106.5404817	1.76	1
11/08/2010	65.55403	-106.540505	1.74	1
11/08/2010	65.554045	-106.5405283	1.74	1
11/08/2010	65.55406	-106.5405517	1.76	0
11/08/2010	65.554075	-106.5405767	1.74	1

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5540917	-106.5406	1.72	1
11/08/2010	65.5541067	-106.540625	1.7	2
11/08/2010	65.5541217	-106.54065	1.72	1
11/08/2010	65.5541367	-106.5406733	1.7	0
11/08/2010	65.5541517	-106.5406983	1.67	1
11/08/2010	65.5541667	-106.5407233	1.67	1
11/08/2010	65.5541817	-106.5407467	1.67	1
11/08/2010	65.5541967	-106.54077	1.65	1
11/08/2010	65.5541967	-106.54077	1.65	0
11/08/2010	65.5542267	-106.5408167	1.67	1
11/08/2010	65.5542417	-106.5408383	1.65	3
11/08/2010	65.5542567	-106.54086	1.67	1
11/08/2010	65.5542733	-106.5408817	1.65	1
11/08/2010	65.5542883	-106.5409017	1.65	1
11/08/2010	65.554305	-106.5409233	1.64	0
11/08/2010	65.55432	-106.5409467	1.64	0
11/08/2010	65.5543367	-106.54097	1.62	2
11/08/2010	65.55435	-106.5409967	1.53	2
11/08/2010	65.554365	-106.5410217	1.64	0
11/08/2010	65.5543783	-106.54105	1.64	0
11/08/2010	65.5543933	-106.5410783	1.65	3
11/08/2010	65.5544067	-106.5411067	1.64	2
11/08/2010	65.5544217	-106.541135	1.64	1
11/08/2010	65.554435	-106.5411633	1.64	2
11/08/2010	65.55445	-106.54119	1.58	2
11/08/2010	65.5544633	-106.5412183	1.62	0
11/08/2010	65.5544783	-106.541245	1.64	0
11/08/2010	65.5544917	-106.5412733	1.62	0
11/08/2010	65.554505	-106.5413	1.64	1
11/08/2010	65.55452	-106.5413267	1.6	0
11/08/2010	65.5545333	-106.5413567	1.62	1
11/08/2010	65.5545483	-106.5413833	1.62	1
11/08/2010	65.5545633	-106.5414133	1.64	3
11/08/2010	65.5545767	-106.5414417	1.62	0
11/08/2010	65.5545917	-106.5414717	1.62	1
11/08/2010	65.554605	-106.5415	1.62	3
11/08/2010	65.5546183	-106.5415283	1.62	0
11/08/2010	65.5546333	-106.5415567	1.64	3
11/08/2010	65.5546467	-106.541585	1.62	1
11/08/2010	65.5546617	-106.5416117	1.6	0
11/08/2010	65.554675	-106.54164	1.6	0
11/08/2010	65.55469	-106.54167	1.58	1
11/08/2010	65.5547033	-106.5416983	1.6	0
11/08/2010	65.5547167	-106.541725	1.62	1
11/08/2010	65.5547317	-106.541755	1.6	0
11/08/2010	65.554745	-106.5417833	1.6	1
11/08/2010	65.55476	-106.5418117	1.6	0
11/08/2010	65.5547733	-106.54184	1.58	1
11/08/2010	65.5547883	-106.5418683	1.6	1
11/08/2010	65.5548017	-106.5418967	1.6	1
11/08/2010	65.554815	-106.541925	1.6	3
11/08/2010	65.55483	-106.5419533	1.57	3
11/08/2010	65.5548433	-106.5419817	1.57	3
11/08/2010	65.5548567	-106.54201	1.57	0
11/08/2010	65.5548717	-106.5420383	1.57	3

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.554885	-106.5420667	1.55	1
11/08/2010	65.5548983	-106.542095	1.55	1
11/08/2010	65.5549133	-106.5421233	1.53	1
11/08/2010	65.5549267	-106.5421517	1.55	3
11/08/2010	65.5549417	-106.54218	1.51	5
11/08/2010	65.554955	-106.5422083	1.51	3
11/08/2010	65.55497	-106.5422367	1.51	3
11/08/2010	65.5549833	-106.542265	1.5	3
11/08/2010	65.5549967	-106.5422917	1.48	3
11/08/2010	65.5550117	-106.54232	1.48	3
11/08/2010	65.555025	-106.5423483	1.46	3
11/08/2010	65.55504	-106.5423767	1.45	0
11/08/2010	65.5550533	-106.542405	1.45	0
11/08/2010	65.5550667	-106.5424333	1.45	1
11/08/2010	65.5550817	-106.54246	1.45	3
11/08/2010	65.555095	-106.5424883	1.41	1
11/08/2010	65.55511	-106.542515	1.41	0
11/08/2010	65.5551233	-106.5425433	1.39	1
11/08/2010	65.5551383	-106.5425717	1.41	3
11/08/2010	65.5551517	-106.5426	1.41	3
11/08/2010	65.5551667	-106.5426283	1.38	1
11/08/2010	65.55518	-106.542655	1.39	3
11/08/2010	65.555195	-106.5426817	1.31	2
11/08/2010	65.5552083	-106.5427083	1.36	1
11/08/2010	65.5552233	-106.5427367	1.36	3
11/08/2010	65.5552383	-106.542765	1.39	3
11/08/2010	65.5552517	-106.5427917	1.38	3
11/08/2010	65.5552667	-106.54282	1.36	3
11/08/2010	65.5552817	-106.5428467	1.34	3
11/08/2010	65.555295	-106.542875	1.33	3
11/08/2010	65.55531	-106.5429017	1.26	2
11/08/2010	65.5553233	-106.54293	1.29	2
11/08/2010	65.5553383	-106.5429567	1.33	3
11/08/2010	65.5553533	-106.5429833	1.29	0
11/08/2010	65.5553683	-106.5430117	1.24	0
11/08/2010	65.5553817	-106.5430383	1.26	2
11/08/2010	65.5553967	-106.5430667	1.26	1
11/08/2010	65.55541	-106.543095	1.27	1
11/08/2010	65.555425	-106.5431217	1.27	1
11/08/2010	65.5554383	-106.54315	1.26	2
11/08/2010	65.5554533	-106.5431783	1.27	5
11/08/2010	65.5554667	-106.5432067	1.24	2
11/08/2010	65.55548	-106.5432333	1.19	2
11/08/2010	65.5554933	-106.5432567	1.36	0
11/08/2010	65.5555083	-106.5432767	1.31	2
11/08/2010	65.555525	-106.5432967	1.26	2
11/08/2010	65.5555417	-106.5433183	1.24	2
11/08/2010	65.5555567	-106.5433417	1.2	2
11/08/2010	65.55557	-106.5433667	1.2	2
11/08/2010	65.5555833	-106.5433933	1.19	2
11/08/2010	65.5555983	-106.5434183	1.2	2
11/08/2010	65.5556133	-106.543445	1.1	2
11/08/2010	65.5556267	-106.54347	1.14	0
11/08/2010	65.5556417	-106.543495	1.12	4
11/08/2010	65.5556567	-106.54352	1.07	0

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.1-2. Substrate Data Collected from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Date	Latitude	Longitude	Depth (m)	Type
11/08/2010	65.5556717	-106.543545	1.05	2
11/08/2010	65.555685	-106.5435733	1.07	2
11/08/2010	65.5556983	-106.5436017	1.03	2
11/08/2010	65.5557117	-106.5436317	2.01	2
11/08/2010	65.5557233	-106.5436617	1.1	4
11/08/2010	65.5557367	-106.5436917	1	2
11/08/2010	65.55575	-106.5437183	1.02	2
11/08/2010	65.555765	-106.5437467	1.05	4
11/08/2010	65.55578	-106.5437767	1.15	4

Hydroacoustic substrate categories: 1 = sand with periphton, 2 = mixed rock, 3 = mud, 4 = cobble/boulder, 5 = sand without periphyton, 0 = no type

Appendix 3.2-1

Fish Biological Data, Back River Project, 2010

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Appendix 3.2-1. Fish Biological Data, Back River Project, 2010

Lake	Date	Sample Number	Species Code	Net Number	Fork Length (mm)	Weight (g)	Condition (g/mm^3)	Age (years)	Sex	Maturity	Aging Structure			Stomach Sample	Comments
											Otolith	Scales	Fin Ray		
Reference B	10-Aug-10	1	LKTR	1	450	905	0.99	15	-	-	-	Y	Y	-	live sample
Reference B	10-Aug-10	2	LKTR	1	378	522	0.97	8	-	-	-	Y	Y	-	live sample
Reference B	10-Aug-10	3	LKTR	2	450	704	0.77	22	F	M	Y	Y	Y	small bivalves	mortality
Reference B	10-Aug-10	4	RDWH	2	397	706	1.13	13	F	M	-	Y	Y	no contents	mortality, ID as RDWH, photos: 0001,0002,0003,0004
Reference B	10-Aug-10	5	LKTR	2	495	1,145	0.94	19	M	M	Y	Y	Y	chironomids	mortality
Reference B	10-Aug-10	6	LKTR	3	473	949	0.90	16	-	-	-	Y	Y	-	live sample, photo 0005
Reference B	10-Aug-10	7	LKTR	5	523	1,134	0.79	16	F	M	Y	Y	Y	no contents	mortality
Reference B	10-Aug-10	8	RDWH	5	381	654	1.18	13	M	M	-	Y	Y	no contents	mortality
Reference B	10-Aug-10	9	RDWH	5	404	785	1.19	14	M	M	-	Y	Y	no contents	mortality
Reference B	10-Aug-10	10	RDWH	5	402	763	1.17	13	M	M	-	Y	Y	no contents	mortality
Reference B	10-Aug-10	11	RDWH	5	373	597	1.15	12	M	IM	-	Y	Y	no contents	mortality
Reference B	10-Aug-10	12	LKTR	4	454	840	0.90	14	-	-	-	Y	Y	-	live sample
Reference B	10-Aug-10	13	LKTR	6	780	-	-	-	-	-	-	-	-	-	live sample, photo 0006, fish too large for scale, unable to age
Reference B	10-Aug-10	14	LKTR	6	445	1,068	1.21	16	M	M	Y	Y	Y	no contents	mortality
Reference B	10-Aug-10	15	LKTR	7	580	2,044	1.05	-	-	-	-	Y	Y	-	live sample, unable to age
Llama	11-Aug-10	1	LKTR	3	396	567	0.91	14	F	IM	Y	Y	Y	no contents	mortality
Llama	12-Aug-10	2	LKTR	5	435	1,588	1.93	-	-	-	-	Y	Y	-	live sample, unable to age
Llama	12-Aug-10	3	LKTR	5	295	303	1.18	7	F	IM	Y	Y	Y	daphnia, copepods	mortality
Llama	12-Aug-10	4	LKTR	5	97	11	1.21	-	U	IM	-	-	-	-	juvenile, not sampled for age structures
Llama	12-Aug-10	5	LKTR	5	724	3,625	0.96	25	-	-	-	Y	Y	-	live sample
Llama	12-Aug-10	6	LKTR	4	544	1,585	0.98	26	-	-	-	Y	Y	-	live sample
Llama	12-Aug-10	7	LKTR	4	401	696	1.08	14	-	-	-	Y	Y	-	live sample
Llama	12-Aug-10	8	LKTR	4	340	368	0.94	8	F	IM	Y	Y	Y	zooplankton	mortality
Llama	12-Aug-10	9	LKTR	4	405	702	1.06	12	F	M	Y	Y	Y	zooplankton	mortality
Llama	12-Aug-10	10	LKTR	4	314	333	1.08	7	F	IM	Y	Y	Y	zooplankton	mortality
Llama	12-Aug-10	11	LKTR	4	256	182	1.08	6	F	IM	Y	Y	Y	zooplankton	mortality
Llama	12-Aug-10	12	LKTR	4	324	401	1.18	8	F	IM	Y	Y	Y	zooplankton	mortality
Llama	12-Aug-10	13	LKTR	4	271	198	0.99	6	F	IM	Y	Y	Y	zooplankton	mortality
Llama	12-Aug-10	14	RDWH	4	290	292	1.20	4	M	IM	-	Y	Y	zooplankton	mortality
Llama	12-Aug-10	15	RDWH	4	400	809	1.26	12	F	M	-	Y	Y	zooplankton	mortality
Llama	12-Aug-10	16	RDWH	4	404	780	1.18	11	F	M	-	Y	Y	zooplankton	mortality, photo 0011
Llama	12-Aug-10	17	RDWH	4	390	711	1.20	11	F	M	-	Y	Y	zooplankton	mortality
Llama	12-Aug-10	18	LKTR	4	284	253	1.10	7	M	IM	Y	Y	Y	zooplankton	mortality
Umwelt	13-Aug-10	1	ARGR	3	245	186	1.26	4	F	M	-	Y	Y	periphyton	photo 0012
Umwelt	13-Aug-10	2	ARGR	3	354	478	1.08	9	M	M	-	Y	Y	periphyton, bloodworms	mortality
Umwelt	13-Aug-10	3	ARGR	3	166	46	1.01	2	-	-	-	Y	Y	-	live sample
Umwelt	13-Aug-10	4	ARGR	3	288	268	1.12	5	F	M	-	Y	Y	periphyton	mortality
Umwelt	13-Aug-10	5	ARGR	3	338	433	1.12	8	-	-	-	Y	Y	-	live sample
Umwelt	13-Aug-10	6	ARGR	3	294	318	1.25	6	-	-	-	Y	Y	-	live sample
Umwelt	13-Aug-10	7	ARGR	3	250	188	1.20	4	-	-	-	Y	Y	-	live sample
Umwelt	13-Aug-10	8	ARGR	3	298	312	1.18	7	-	-	-	Y	Y	-	live sample
Umwelt	13-Aug-10	9	ARGR	3	257	224	1.32	4	-	-	-	Y	Y	-	live sample
Umwelt	13-Aug-10	10	ARGR	3	239	154	1.13	4	-	-	-	Y	Y	-	live sample
Umwelt	13-Aug-10	11	ARGR	3	305	336	1.18	5	-	-	-	Y	Y	-	live sample

Species codes: ARGR = Arctic grayling, LKTR = lake trout, RDWH = round whitefish

Sex: F = female, M = male, U = unknown; Maturity: M = mature, IM = immature

Dashes (-) indicate data not collected

Y indicates data was collected

Appendix 3.2-1. Fish Biological Data, Back River Project, 2010

Lake	Date	Sample Number	Species Code	Net Number	Fork Length (mm)	Weight (g)	Condition (g/mm^3)	Age (years)	Sex	Maturity	Aging Structure			Stomach Sample	Comments
											Otolith	Scales	Fin Ray		
Umwelt	13-Aug-10	12	ARGR	3	134	25	1.04	2	-	-	-	Y	Y	-	live sample
Umwelt	13-Aug-10	13	ARGR	3	170	53	1.08	2	-	-	-	Y	Y	-	live sample
Umwelt	13-Aug-10	14	ARGR	3	296	289	1.11	-	-	-	-	-	-	-	live sample, not sampled for aging structures
Umwelt	13-Aug-10	15	ARGR	3	230	155	1.27	-	-	-	-	-	-	-	live sample, not sampled for aging structures
Umwelt	13-Aug-10	16	ARGR	3	226	134	1.16	-	-	-	-	-	-	-	live sample, not sampled for aging structures
Umwelt	13-Aug-10	17	RDWH	3	287	246	1.04	-	-	-	-	-	-	-	live sample, not sampled for aging structures
Umwelt	13-Aug-10	18	RDWH	3	220	93	0.87	2	F	IM	-	Y	Y	no contents	mortality
Umwelt	13-Aug-10	19	RDWH	3	235	135	1.04	3	F	IM	-	Y	Y	no contents	mortality
Umwelt	13-Aug-10	20	RDWH	3	240	144	1.04	2	M	IM	-	Y	Y	no contents	mortality
Umwelt	13-Aug-10	21	RDWH	2	270	238	1.21	4	F	M	-	Y	Y	no contents	mortality
Umwelt	13-Aug-10	22	RDWH	2	295	315	1.23	4	F	M	-	Y	Y	no contents	mortality
Umwelt	13-Aug-10	23	ARGR	2	296	309	1.19	-	-	-	-	-	-	-	live sample, not sampled for aging structures
Umwelt	13-Aug-10	24	ARGR	2	284	307	1.34	7	-	-	-	Y	Y	-	live sample
Umwelt	13-Aug-10	25	ARGR	2	270	255	1.30	-	-	-	-	-	-	-	live sample, not sampled for aging structures
Umwelt	13-Aug-10	26	ARGR	2	284	290	1.27	-	-	-	-	-	-	-	live sample, not sampled for aging structures

Species codes: ARGR = Arctic grayling, LKTR = lake trout, RDWH = round whitefish

Sex: F = female, M = male, U = unknown; Maturity: M = mature, IM = immature

Dashes (-) indicate data not collected

Y indicates data was collected

Appendix 3.2-2

Fish Track Data Derived from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

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Appendix 3.2-2. Fish Track Data Derived from Hydroacoustic Surveys of Llama Lake, Back River Project, 2010

Lake	Date	Time	Longitude	Latitude	Region ID	Transducer Type	Ping	Mean Target Strength	Wedge Volume Sampled
Llama	10-Aug-10	11:36:41.39	-106.5466082	65.56623444	74	DL	147	-68.378092	0.063
Llama	10-Aug-10	11:37:07.29	-106.5466962	65.56651747	75	DL	406	-67.984895	0.066
Llama	10-Aug-10	11:38:19.59	-106.547105	65.56731444	76	DL	1129	-66.547118	0.053
Llama	10-Aug-10	11:38:51.59	-106.547334	65.5676576	78	DL	1449	-66.853607	0.093
Llama	10-Aug-10	11:39:31.39	-106.5477341	65.56805861	80	DL	1847	-64.075167	0.035
Llama	10-Aug-10	11:39:49.29	-106.5479828	65.56821611	81	DL	2026	-68.354567	0.072
Llama	10-Aug-10	11:45:23.50	-106.5444787	65.567651	83	DL	4174	-65.775054	0.041
Llama	10-Aug-10	11:47:20.60	-106.5468783	65.56748817	85	DL	5345	-67.944138	0.057
Llama	10-Aug-10	11:47:34.10	-106.547142	65.56745767	86	DL	5480	-66.134807	0.069
Llama	10-Aug-10	11:48:04.70	-106.5477527	65.567382	90	DL	5786	-66.471527	0.032
Llama	10-Aug-10	11:48:06.00	-106.5477768	65.567378	91	DL	5799	-66.952704	0.035
Llama	10-Aug-10	11:48:11.80	-106.5478913	65.56736517	92	DL	5857	-66.554155	0.078
Llama	10-Aug-10	11:48:41.01	-106.5484285	65.56726117	93	DL	6149	-67.286745	0.037
Llama	10-Aug-10	11:52:05.51	-106.547793	65.56615867	94	DL	6918	-66.932958	0.086
Llama	10-Aug-10	11:52:11.11	-106.5476776	65.5661854	95	DL	6974	-68.17829	0.085
Llama	10-Aug-10	12:01:44.24	-106.5475493	65.56631667	96	DL	11415	-66.019299	0.039
Llama	10-Aug-10	12:05:53.35	-106.5473001	65.56521753	98	DL	12270	-69.340607	0.051
Llama	10-Aug-10	12:08:14.66	-106.5444811	65.56595166	100	DL	13683	-66.58589	0.058
Llama	10-Aug-10	12:08:34.76	-106.5441018	65.56604562	101	DL	13884	-68.68677	0.062
Llama	10-Aug-10	12:31:10.32	-106.541128	65.56409219	103	DL	22884	-35.557714	0.024
Llama	10-Aug-10	13:46:00.31	-106.5472252	65.5678345	123	DL	34680	-66.681808	0.069
Llama	10-Aug-10	13:46:32.51	-106.5475632	65.56830241	124	DL	35002	-46.479874	0.090
Llama	10-Aug-10	12:05:44.25	-106.5474857	65.5651665	125	DL	12179	-69.599698	0.116

Transducer type: DL = down-looking, SL = side-looking

Appendix 3.2-3

Fish Track Data Derived from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

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Appendix 3.2-3. Fish Track Data Derived from Hydroacoustic Surveys of Umwelt Lake, Back River Project, 2010

Lake	Date	Time	Longitude	Latitude	Region ID	Transducer Type	Ping	Mean Target Strength	Wedge Volume Sampled
Umwelt	11-Aug-10	10:06:24.71	-106.5456063	65.55556733	2	DL	13262	-60.581233	0.093
Umwelt	11-Aug-10	10:08:41.11	-106.544025	65.55532433	3	DL	14359	-58.805129	0.118
Umwelt	11-Aug-10	11:08:05.57	-106.5394083	65.55270333	5	DL	24981	-57.419818	0.000
Umwelt	11-Aug-10	10:07:03.11	-106.544255	65.55571633	7	DL	13646	-51.530556	0.048
Umwelt	11-Aug-10	10:06:24.71	-106.5456063	65.55556733	2	SL	13262	-60.581233	0.093
Umwelt	11-Aug-10	10:08:41.11	-106.544025	65.55532433	3	SL	14359	-58.805129	0.118
Umwelt	11-Aug-10	10:07:03.11	-106.544255	65.55571633	7	SL	13646	-51.530556	0.048
Umwelt	11-Aug-10	10:22:47.85	-106.5389077	65.553026	9	SL	20649	-57.171892	0.255
Umwelt	11-Aug-10	10:22:54.25	-106.5391073	65.55301367	10	SL	20713	-52.041332	0.243

Transducer type: DL = down-looking, SL = side-looking

Appendix V6-6B

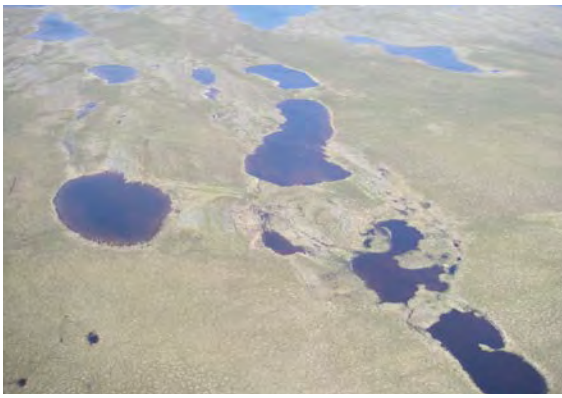
Back River Project: 2011 Fish and Fish Habitat Baseline Report

Rescan™
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Sabina Gold & Silver Corp.

BACK RIVER PROJECT
2011 Fish and Fish Habitat Baseline Report







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April 2012

BACK RIVER PROJECT

2011 FISH AND FISH HABITAT BASELINE REPORT

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Prepared by:

Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

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Executive Summary

Environmental baseline studies were conducted by Rescan Environmental Services Ltd. (Rescan) on behalf of Sabina Gold and Silver Corp. (Sabina) at the Back River Project in 2011. The Back River property is located in the West Kitikmeot region of Nunavut, south of Bathurst Inlet.

This report presents the results from the 2011 fish and fish habitat baseline program. The objectives of the program were to assess the fish-bearing status of ponds in the Goose property area, to collect baseline information on lake trout and round whitefish from four lakes in the Goose property area, and to collect baseline tissue metal concentrations from lake trout and round whitefish in four lakes within the Goose property area.

Fish habitat in ponds and lakes was assessed through visual surveys of the shoreline and mapping of littoral areas and shoals. A total of 18 ponds and 4 lakes were assessed for fish habitat and community. Fine substrates were found to dominate the pond shorelines, while cobble and boulder substrates were more common in the larger lakes.

Only three of the 18 ponds surveyed were found to contain fish. Arctic grayling were captured in two ponds, while slimy sculpins were captured in the third. Two of the three fish-bearing ponds had very low catch-per-unit-effort, which suggests that fish densities may be very low. This could mean that more of the ponds were fish-bearing than the data suggest.

Lake trout and round whitefish were captured in the four lakes sampled for fish community and tissue metal analysis (Goose, Llama, Umwelt and Reference B). Between five and seven lake trout were sacrificed from Goose, Llama and Reference B lakes. Lake trout were not captured in Umwelt Lake, but round whitefish were. The low sample numbers limited the power of the analyses conducted; however, there did not appear to be significant differences among lakes in fish health, age, energy storage, energy use or tissue metal concentrations. Diet analyses suggest that fish from Reference B Lake have fewer prey fish available to them than fish from Goose and Llama Lakes.

Acknowledgements

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Acknowledgements

This report was prepared for Sabina Gold and Silver Corp. (Sabina) by Rescan Environmental Services Ltd. The 2011 fish and fish habitat fieldwork was conducted by Kirsten Seymour (M.Sc., R.P.Bio.) and Kyla Warren (M.Sc.). Rescan staff were assisted in the field by Julia Plukasz, Mike Murenbeeld, and Andy (geotechnicians provided by Sabina). The report was prepared by Kirsten Seymour with support from Kyla Warren, and was reviewed by Chris Burns (B.Sc., R.P.Bio.) and Deborah Muggli (Ph.D., M.Sc., R.P.Bio.). The Back River project was managed by Deborah Muggli, with project coordination assistance from Fiona Hodge (M.Sc.).

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BACK RIVER PROJECT
2011 FISH AND FISH HABITAT BASELINE REPORT

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ANOVA	Analysis of variance
ANCOVA	Analysis of covariance
CPUE	Catch-per-unit-effort
DEIS	Draft Environmental Impact Statement
GLM	General linear model
ICPMS	Inductively Coupled Plasma – Mass Spectrometry
MMER	Metal Mining Effluent Regulations
QA/QC	Quality assurance/Quality control

1. Introduction

1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold & Silver Corporation (Sabina) located in the West Kitikmeot region on Nunavut. The Project consists of several properties, one of which is the Goose property (Figure 1-1). An exploration camp is located beside Goose Lake (Goose Camp), and Sabina conducted a drilling program out of this camp during 2011.

Several exploration targets exist in the Goose property area, including the Llama, Umwelt, Echo and Goose deposits. For 2011, select baseline studies were conducted in the areas that could be influenced by the future development of these deposits. Rescan Environmental Services (Rescan) was contracted by Sabina, to conduct the following baseline studies in 2011:

- Dustfall and Air Quality;
- Surface Hydrology;
- ML/ARD;
- Lake and Pond Bathymetry;
- Freshwater Water Quality, Sediment Quality and Aquatic Biology;
- Freshwater Fish and Fish Habitat;
- Wildlife; and
- Archaeology.

In addition, Sabina continued the on-site meteorology and hydrogeology monitoring programs. Data from these programs will also be included in 2011 baseline reports to be prepared by Rescan.

This report presents the results from the Fish and Fish Habitat Baseline Program that was carried out in 2011. Fish and fish habitat baseline data collection has occurred at the Goose property since 2010. Past investigations have focused on assessing the fish community and habitat quality in area lakes (Goose, Umwelt, Llama and Reference B), and collecting detailed habitat information through the use of hydroacoustics. Fish and fish habitat data collection in 2011 focused on establishing the fish-bearing status of several ponds in the area, as well as collecting fish health and tissue quality data from four lakes in the area. This report presents the results of the 2011 baseline program.

The specific objectives of the 2011 Fish and Fish Habitat program were as follows:

- Pond Assessments: to define the fish-bearing status of ponds, and describe the type of fish habitat (substrate composition and cover in the littoral areas). Ponds were also evaluated for their ability to support perennial fish habitat. Ponds included in the 2011 program were as follows:
  - five ponds in the Giraffe Watershed;
  - seven ponds in the Wolf Watershed;
  - three ponds in the Echo and Goose Watersheds; and
  - two ponds in the Llama Watershed.



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Back River Project Location

Figure 1-1

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- Lake Fish Communities:
  - to characterize the fish communities of four lakes (Goose, Llama, Umwelt and Reference B) in terms of species composition, relative fish species abundance, and other biological variables; and
  - to collect detailed baseline biological data, including tissue metal samples, on lake trout and/or round whitefish from Goose, Llama, Umwelt and Reference B lakes.

2. Materials and Methods

2. Materials and Methods

2.1 STUDY DESIGN AND SAMPLING LOCATIONS

A total of 18 ponds in the Goose property area were surveyed for fish habitat and community composition in 2011. The objective of sampling was to confirm the fish-bearing status and habitat quality of each pond in order to inform the future project design and locations of infrastructure. The selection of ponds for sampling was based on their proximity to deposits and potential future infrastructure. Figure 2.1-1 shows the locations of ponds sampled in the Goose property area in 2011.

2.2 POND ASSESSMENT

2.2.1 Fish Habitat

Fish habitat was assessed in each pond through a visual survey of the shoreline and littoral zone. The substrate of each zone was recorded as a percent of surface area covered by a type of substrate (e.g., 50% boulder and 50% fines). Substrate types were defined by their average particle diameter: fines (< 2 mm diameter), gravel (2 to 64 mm), cobble (64 to 256 mm), boulder (256 to 4,000 mm), and bedrock (> 4,000 mm). The extent of the littoral zone (shallow shoreline area) and any shoals or shallow zone in the lake was mapped. Any emergent or submergent vegetation that may provide cover for fish was also recorded. Inflows and outflows were identified and photographs were taken of representative habitat types. Maximum depth was estimated using a hand-held depth sounder. Some ponds were too shallow for boating. An aerial reconnaissance of all the ponds was conducted at the beginning of the sampling trip to determine which ponds could be sampled with a boat. Ponds estimated to be less than 2 m deep at their deepest point, or which had very small areas of deep water were surveyed from the shore.

2.2.2 Fish Community

The fish community in each pond was sampled using a combination of minnow traps (in all ponds) and gillnets (in ponds where boating was possible). Minnow traps were baited with commercial dry prawn bait and set along the shoreline, generally in less than 2 m of water. Traps were left to fish overnight and retrieved the following day.

Each gillnet consisted of a standard gang of six panels of different mesh sizes (25 mm, 76 mm, 51 mm, 89 mm, 38 mm and 64 mm) (RIC 2001). Each panel was 15.2 m long, and the panels were sewn together to make a net that is 91.2 m long and 2.4 m deep. Gillnets were deployed by boat in the deepest part of each pond and left to fish for up to two hours. Sampling at each pond began with short sets of one hour to minimize fish mortality. If no fish were captured, the set time was increased to maximize the probability of capturing fish. No overnight gillnet sets were used due to the shallow depth of the ponds and the possibility that birds could become entangled in the nets if left unattended. Figures 2.2-1 to 2.2-17 show the locations of sampling equipment in each pond.

Catch-per-unit-effort (CPUE) was calculated as the number of fish captured per trap per day for minnow traps. CPUE for gillnetting was calculated as the number of fish captured per 100 m^2 of net per hour.

Captured fish were identified to species, measured for fork length (mm) and weighed (g). Scale samples were taken from Arctic grayling for age determination. All captured fish were released alive back into the pond. Age samples were sent to North South Consultants in Winnipeg, MB for analysis.

2.3 LAKE ASSESSMENTS

2.3.1 Sampling Locations and Methods

The *Metal Mining Effluent Regulations* (MMER) recommend a number of survey measurements that will be used to determine the effects of the proposed mine on fish growth, reproduction, condition and survival in the mine receiving environment. These measurements include length, weight, age, gonad weight, egg size, fecundity (total number of eggs per female), liver weight, external condition and sex. These measurements would be used to determine survival, energy use and storage, gonadosomatic index, liversomatic index and condition factor among fish of both sexes. For 2011, baseline data collection was based on methods and metrics outlined in the MMER Guidance Document (Environment Canada 2011). These baseline data will provide useful information during the environmental assessment process and can be used if and when the proposed Project is developed.

Three lakes were selected for MMER baseline sampling based on their proximity to deposits (Goose, Llama, and Umwelt), and one lake was sampled as a reference lake (Reference B). In Llama, Goose and Reference B Lakes, lake trout were the targeted species because they are large-bodied fish and top predators that are most likely to be affected by changes in water quality. In Umwelt Lake, round whitefish were targeted because no lake trout were present (based on sampling in 2010).

All fish were sampled using gillnets. All gillnets conformed to RIC Standard guidelines (RIC 2001) and were set for 0.5 to 3 hours at a time to minimize unnecessary mortality. Sampling was conducted at various locations within each lake (Figure 2.3-1 to 2.3-4). CPUE for gillnetting was calculated as the number of fish captured per 100 m^2 of net per hour.

2.3.2 Energy Storage

Energy storage is assessed through the analysis of fish condition and relative liver size. Fish condition may be assessed by two methods. The first method involves comparing length-weight regressions among waterbodies and is generally considered to be more robust than comparisons of indices such as condition factor (Environment Canada 2011). The length-weight relationship was first tested using a regression analysis for captured fish from each lake with weight as the dependent variable and length as the independent variable. If the regressions were significant, a general linear model (GLM) was used to test for equality of regression slopes among lakes. A significant interaction between lake and fork length indicates that the slopes of the regressions are not equal and cannot be compared; however, if the interaction term is not significant, then weight-at-length can be compared using an analysis of covariance (ANCOVA).

Condition factor was used to compare fish condition among lakes if the slopes of the length-weight regressions were not equal. Condition (K) is calculated using the following equation:

$$Condition\ (K) = \frac{weight\ (g) x\ 10^5}{length\ (mm)^3}$$

Condition factor was ln-transformed to meet assumptions of normality and compared among lakes using analysis of variance (ANOVA).

Relative liver size was compared among lakes using a regression analysis, similar to the weight-length regression. The analysis used liver weight as the dependent variable and fish somatic weight (i.e., body weight minus weight of internal organs) as the independent variable. GLM was used to test for differences in the regressions slopes, and ANCOVA was used to test for differences in liver weight among sites.

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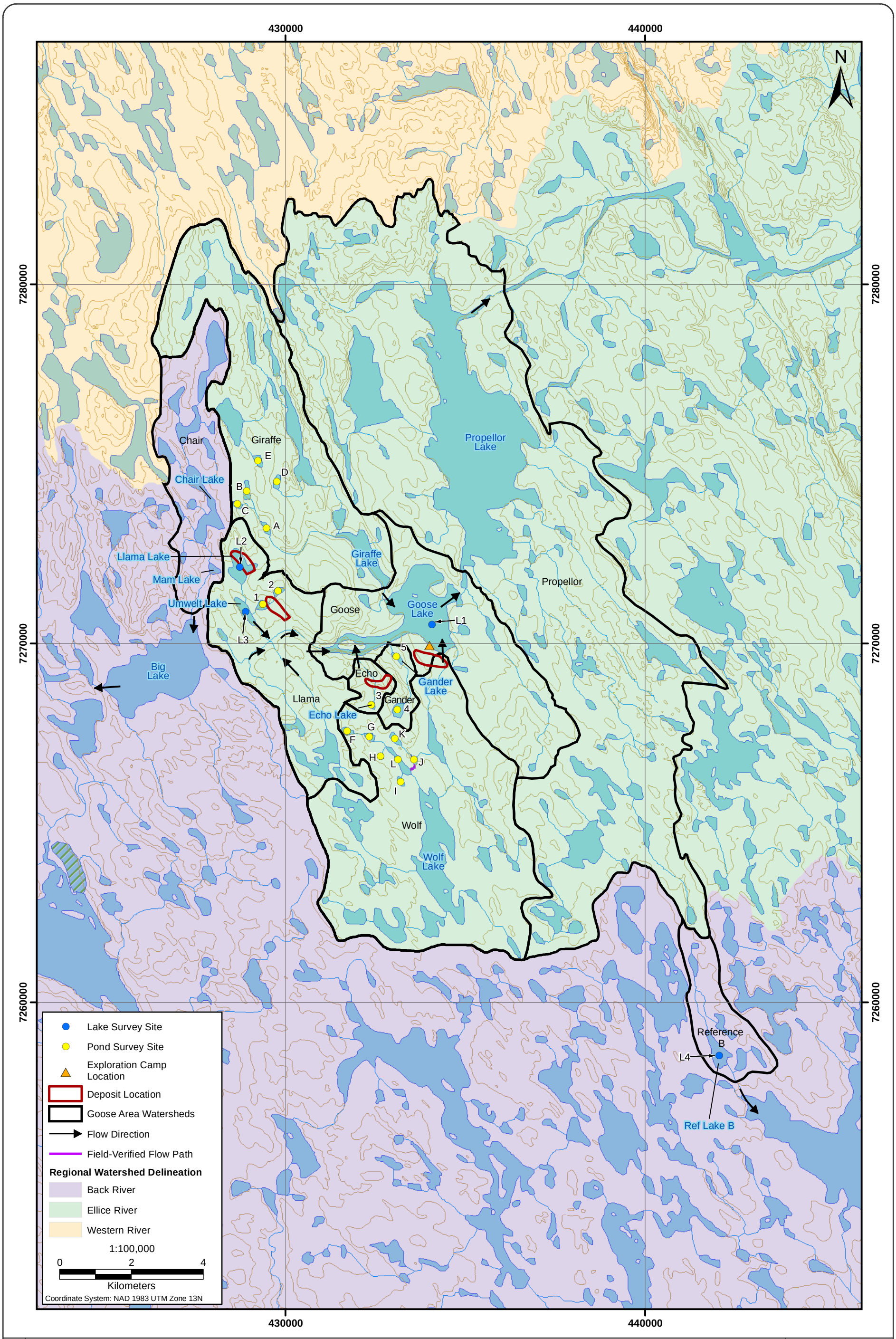


Figure 2.1-1

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2011 Fish and Fish Habitat Sampling Locations, Back River Project

Figure 2.1-1

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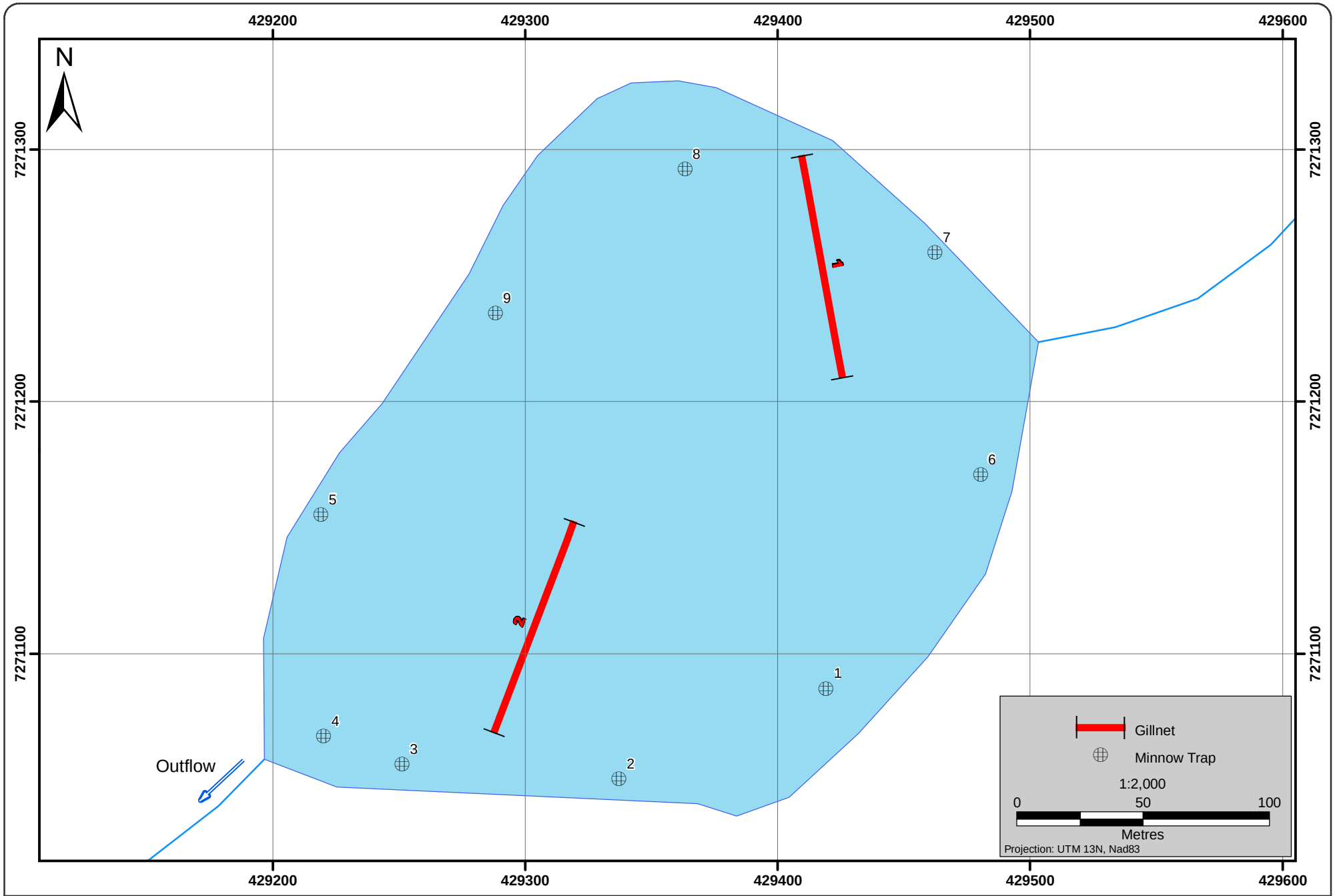


Figure 2.2-1

Sabina GOLD & SILVER CORP.

Gillnet and Minnow Trap Set Locations on Pond 1, Back River Project, 2011

Figure 2.2-1

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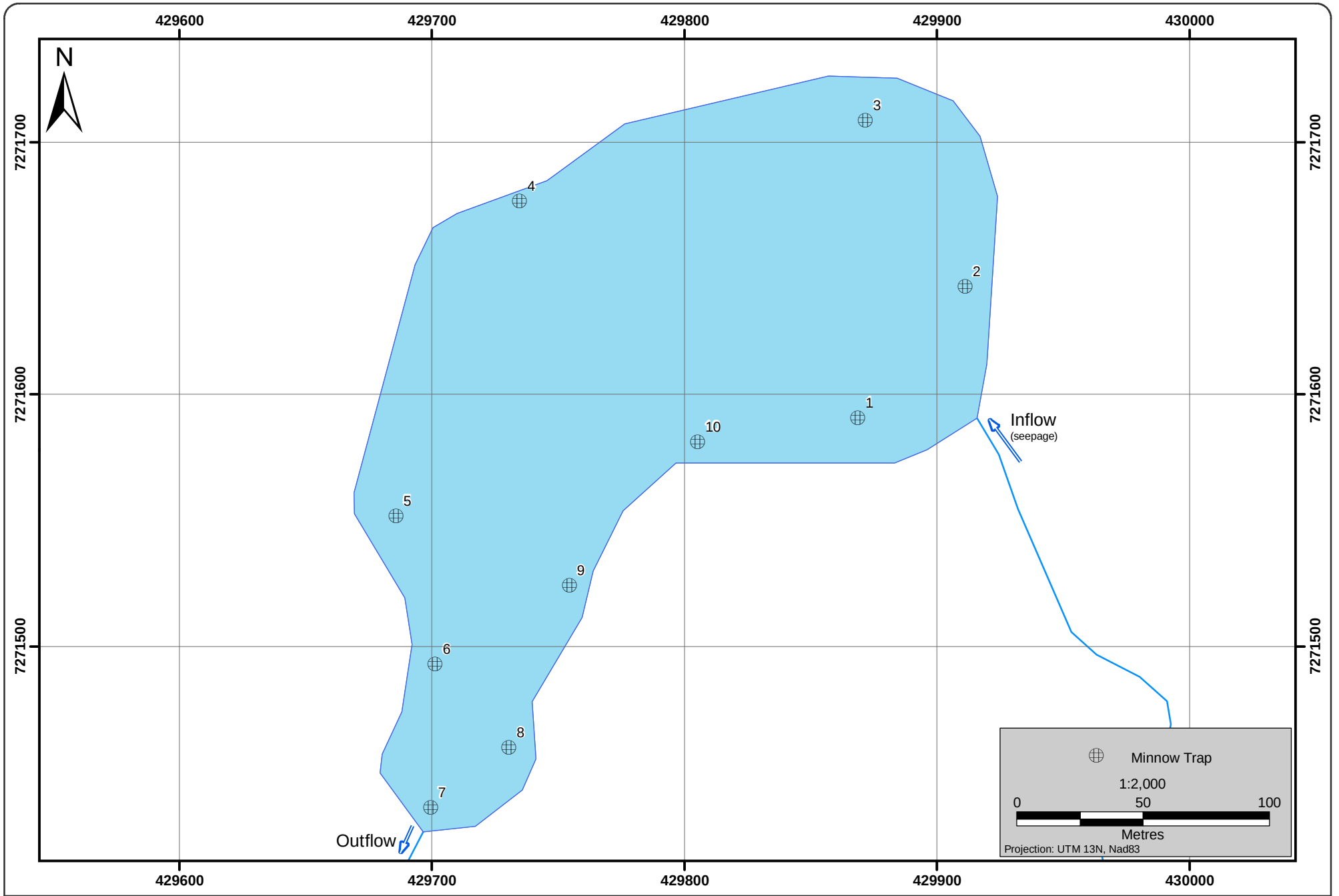


Figure 2.2-2

Sabina GOLD & SILVER CORP.

Gillnet and Minnow Trap Set Locations on Pond 2, Back River Project, 2011

Figure 2.2-2

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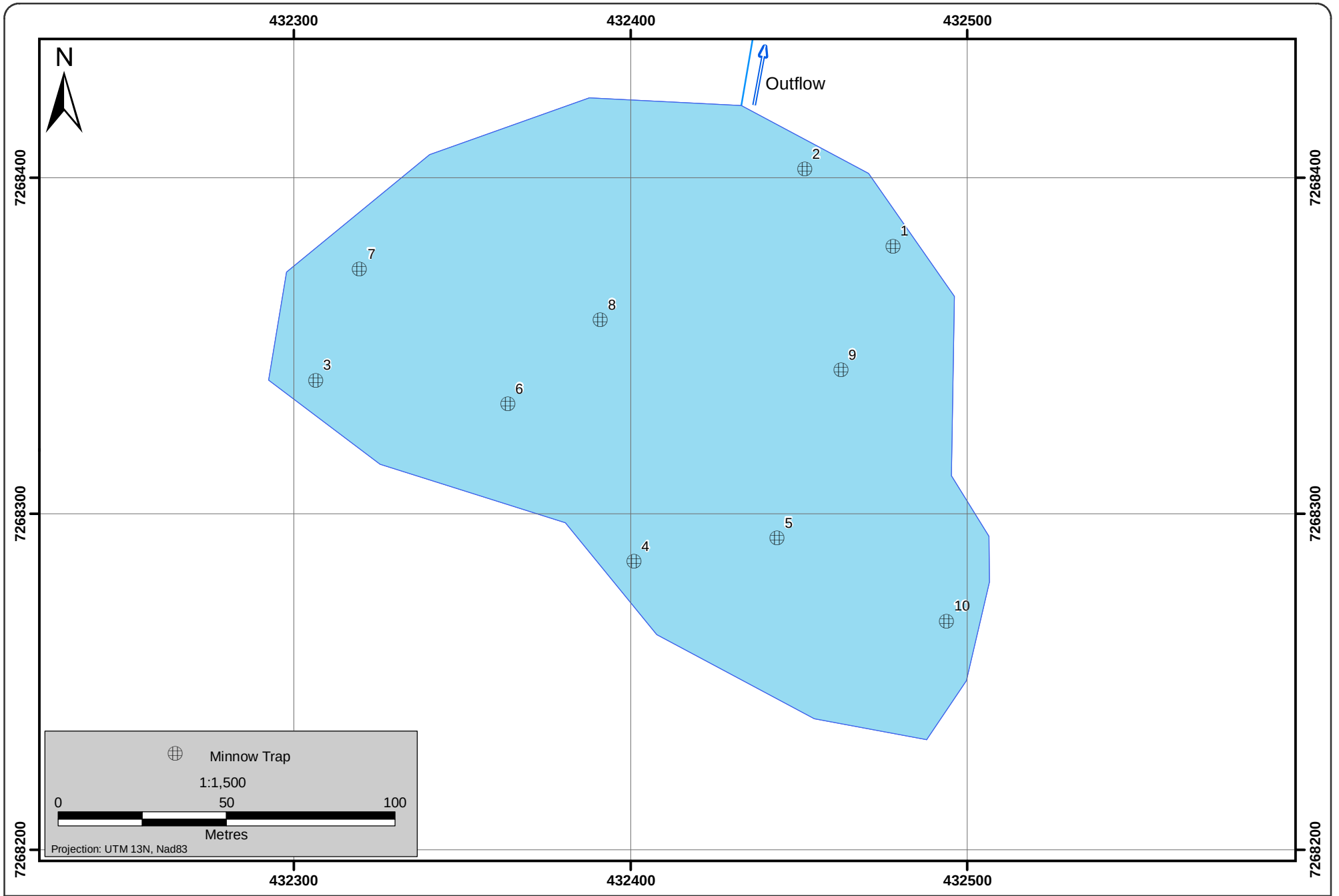


Figure 2.2-3

Sabina GOLD & SILVER CORP.

Gillnet and Minnow Trap Set Locations on Pond 3, Back River Project, 2011

Figure 2.2-3

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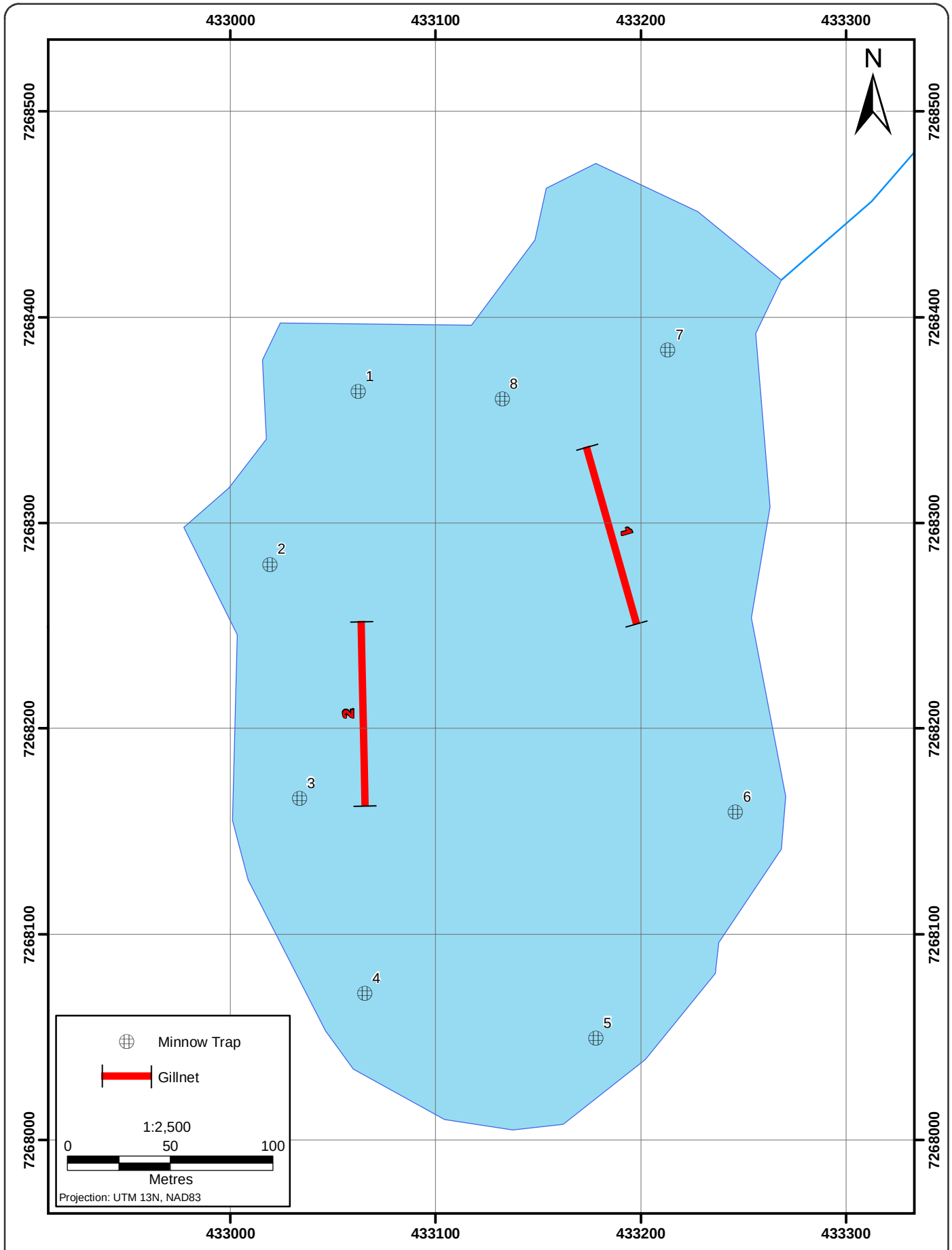


Figure 2.2-4

Gillnet and Minnow Trap Set Locations on Pond 4, Back River Project, 2011

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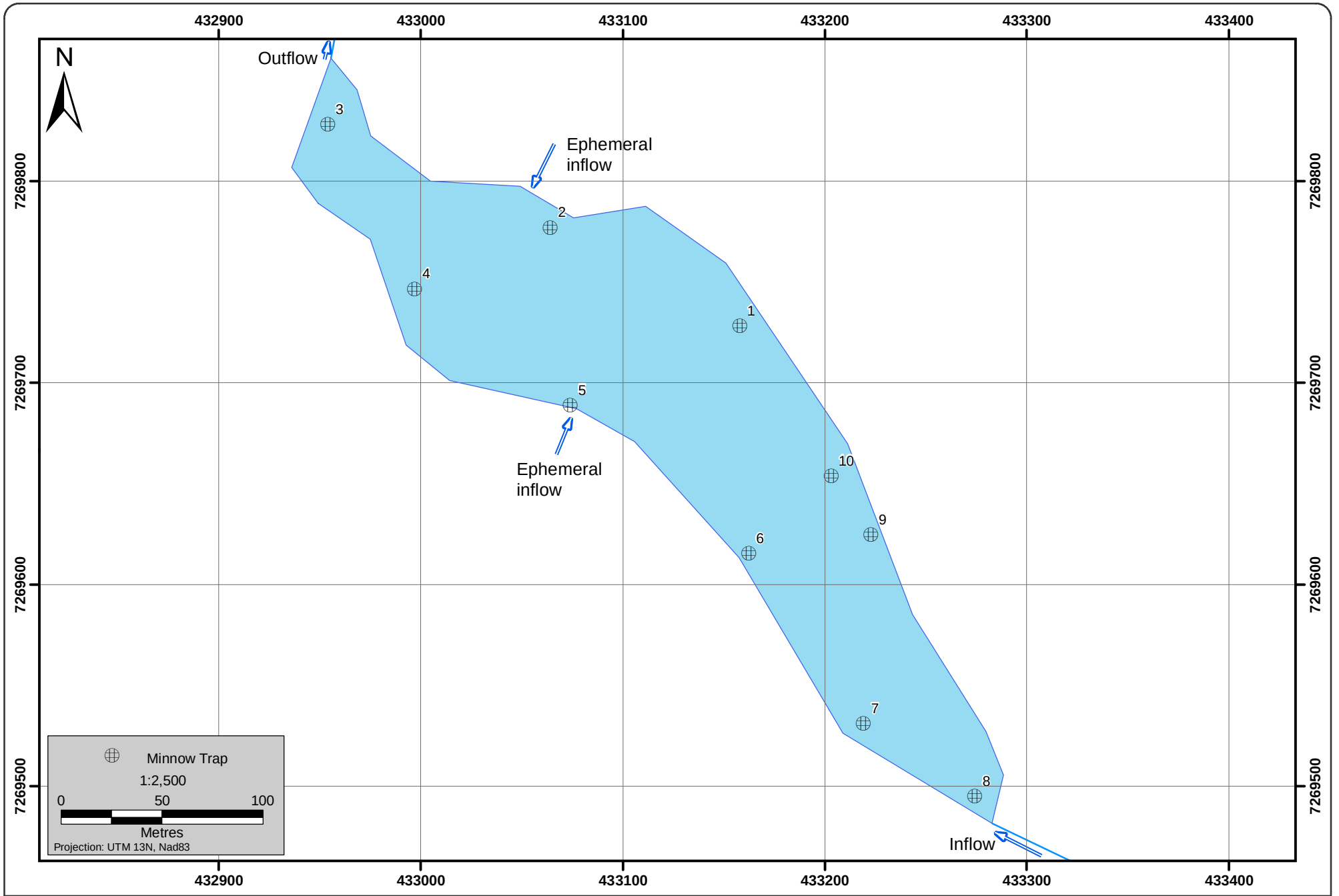


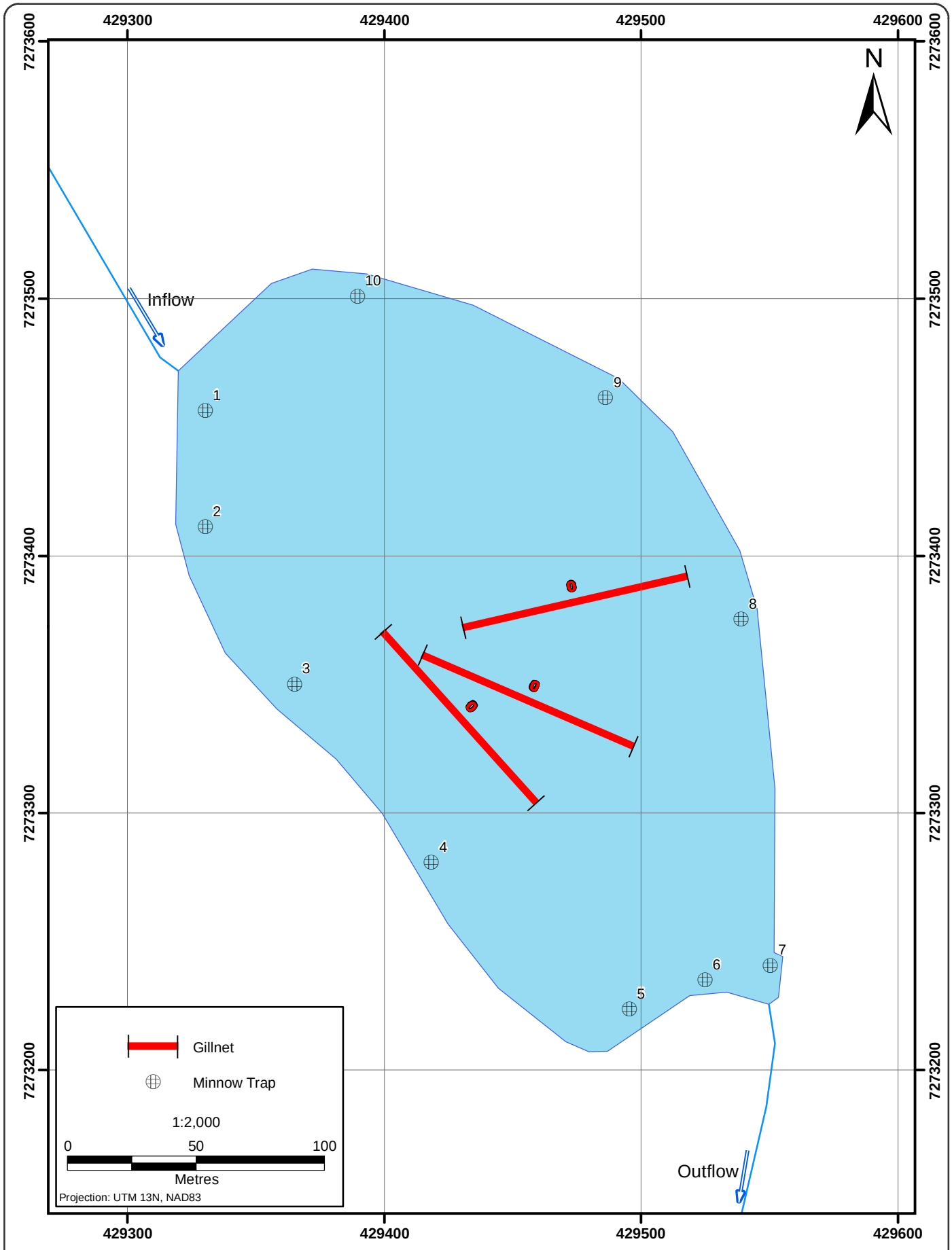
Figure 2.2-5

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Gillnet and Minnow Trap Set Locations on Pond 5, Back River Project, 2011

Figure 2.2-5

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Figure 2.2-6

Gillnet and Minnow Trap Set Locations on Pond A, Back River Project, 2011

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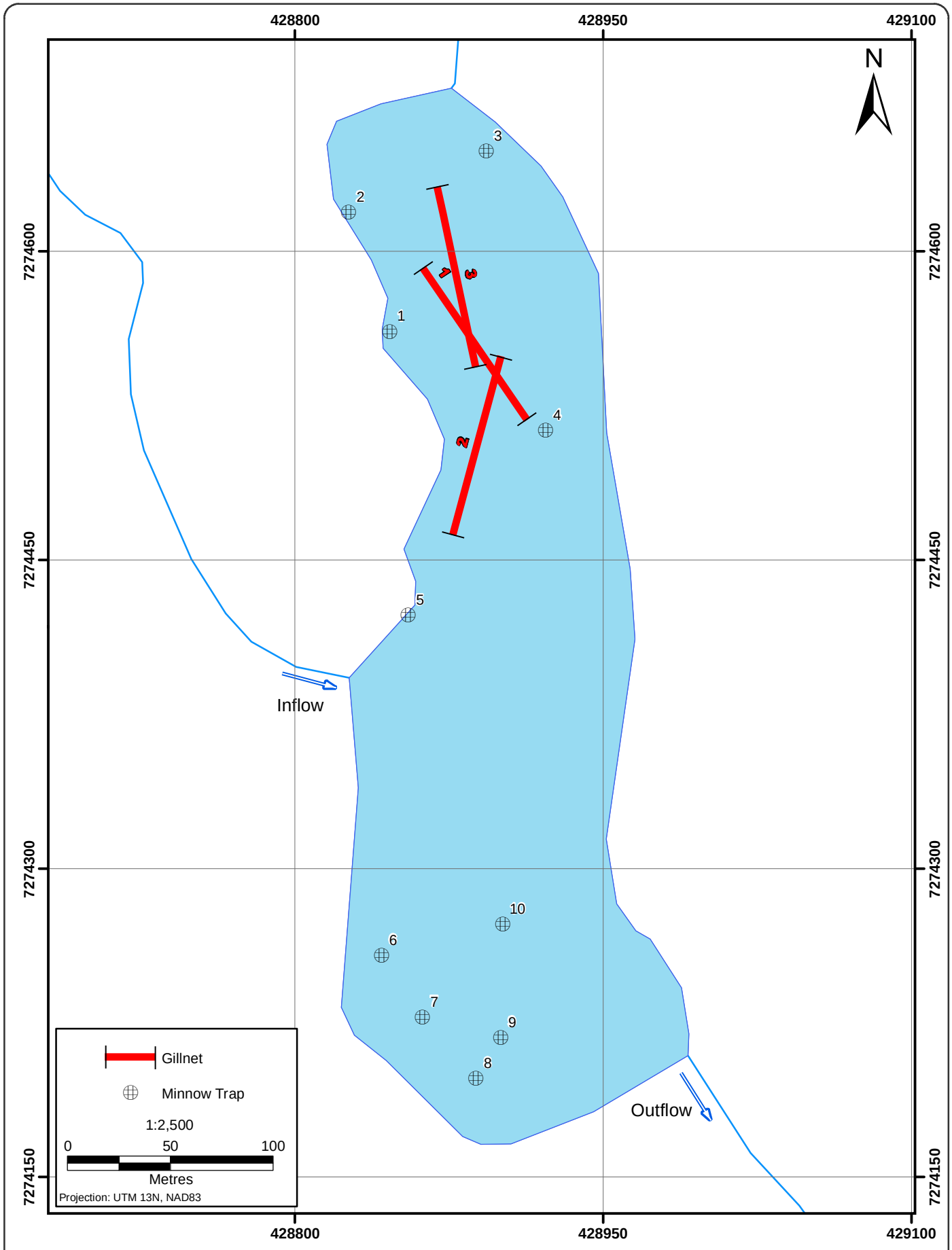


Figure 2.2-7

Gillnet and Minnow Trap Set Locations on Pond B, Back River Project, 2011

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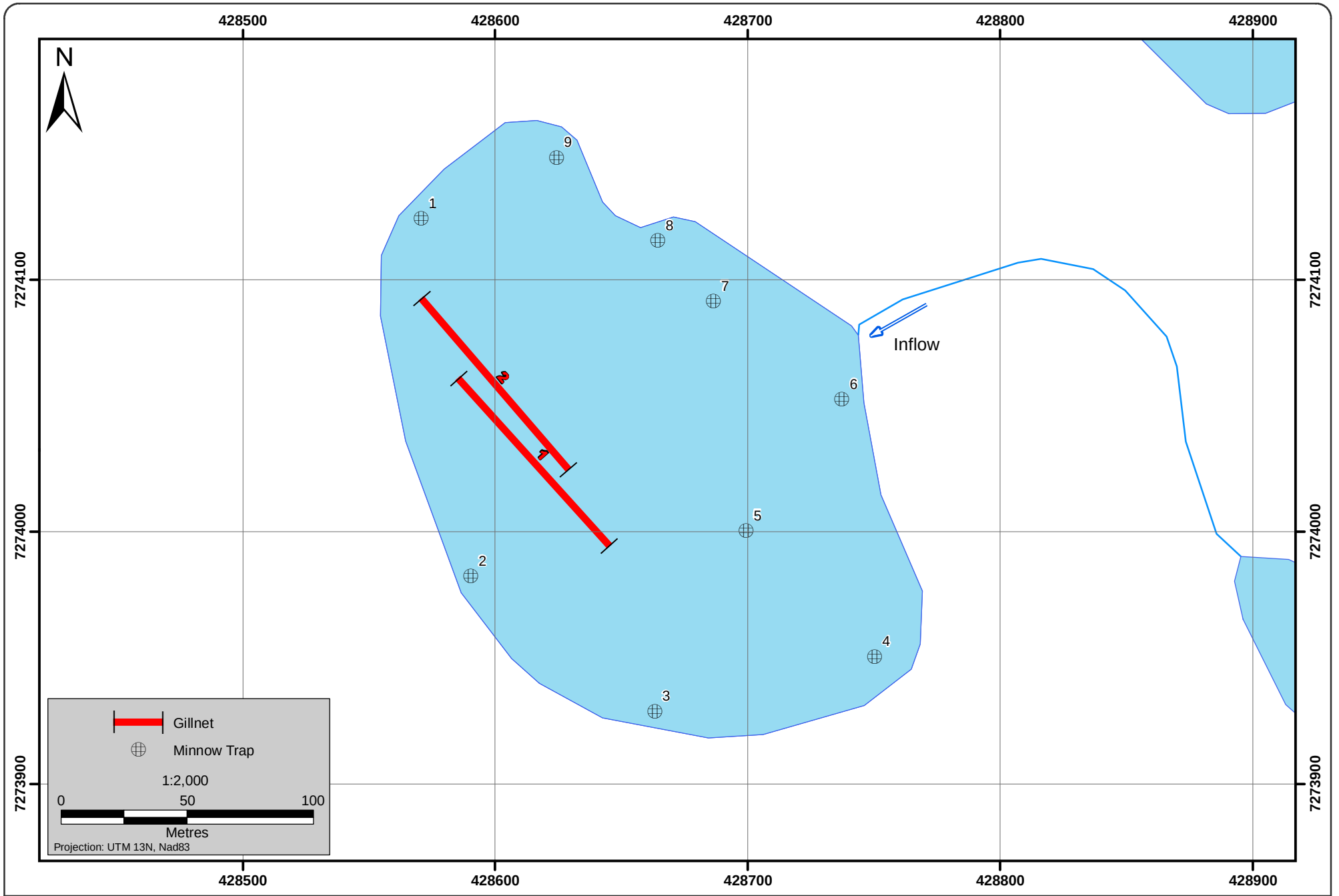


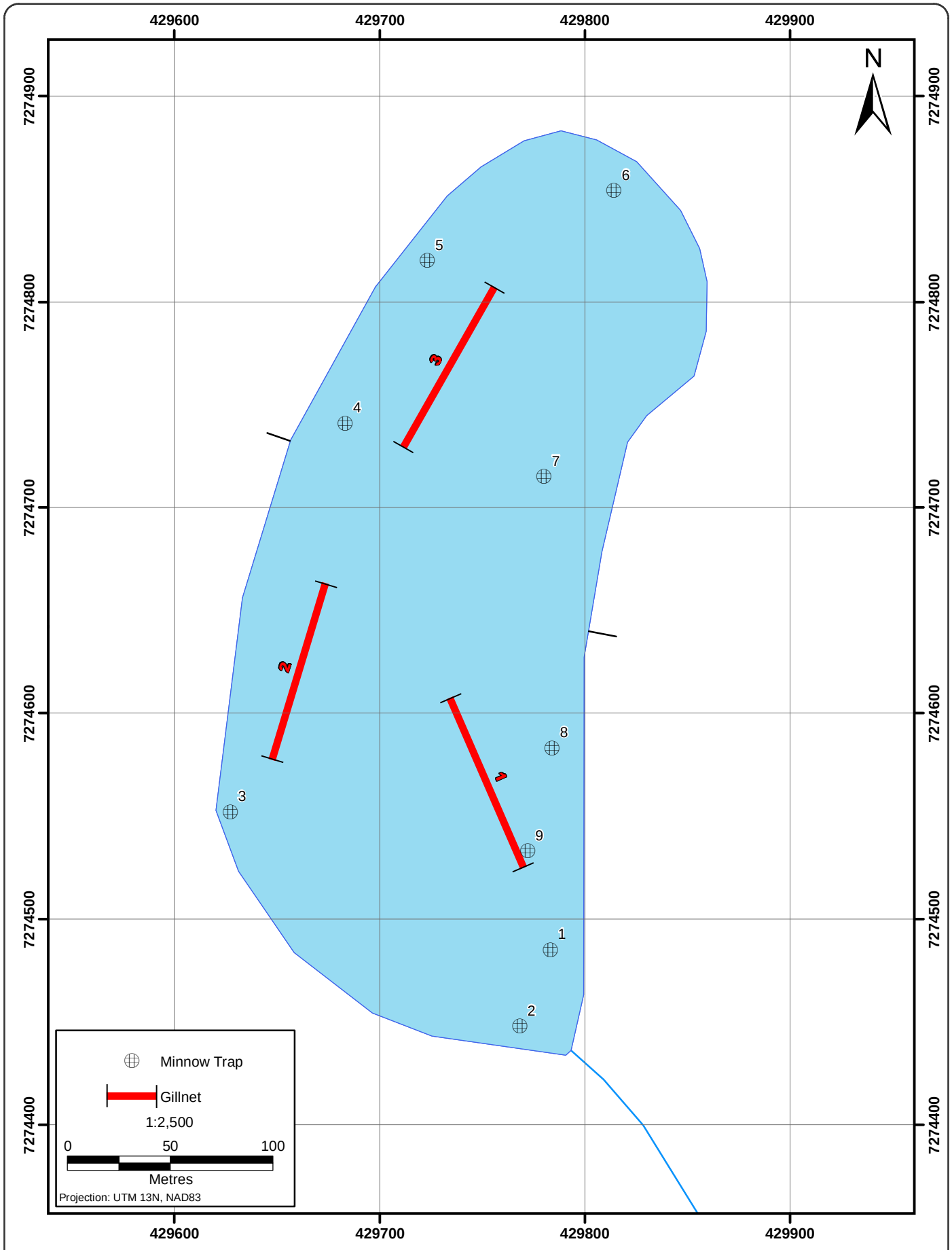
Figure 2.2-8

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Gillnet and Minnow Trap Set Locations on Pond C, Back River Project, 2011

Figure 2.2-8

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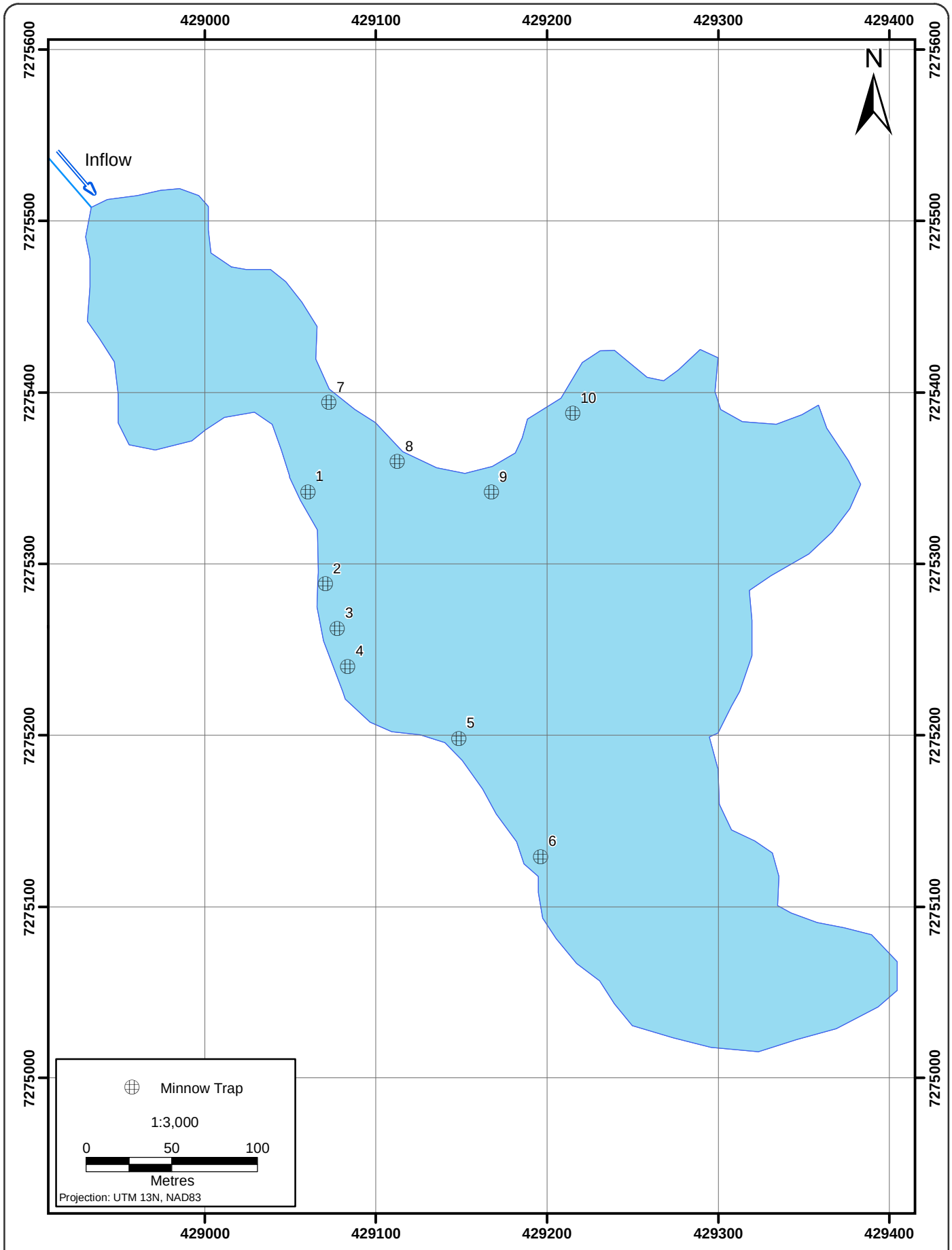


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Gillnet and Minnow Trap Set Locations on Pond D, Back River Project, 2011

Figure 2.2-9

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Gillnet and Minnow Trap Set Locations on Pond E, Back River Project, 2011

Figure 2.2-10

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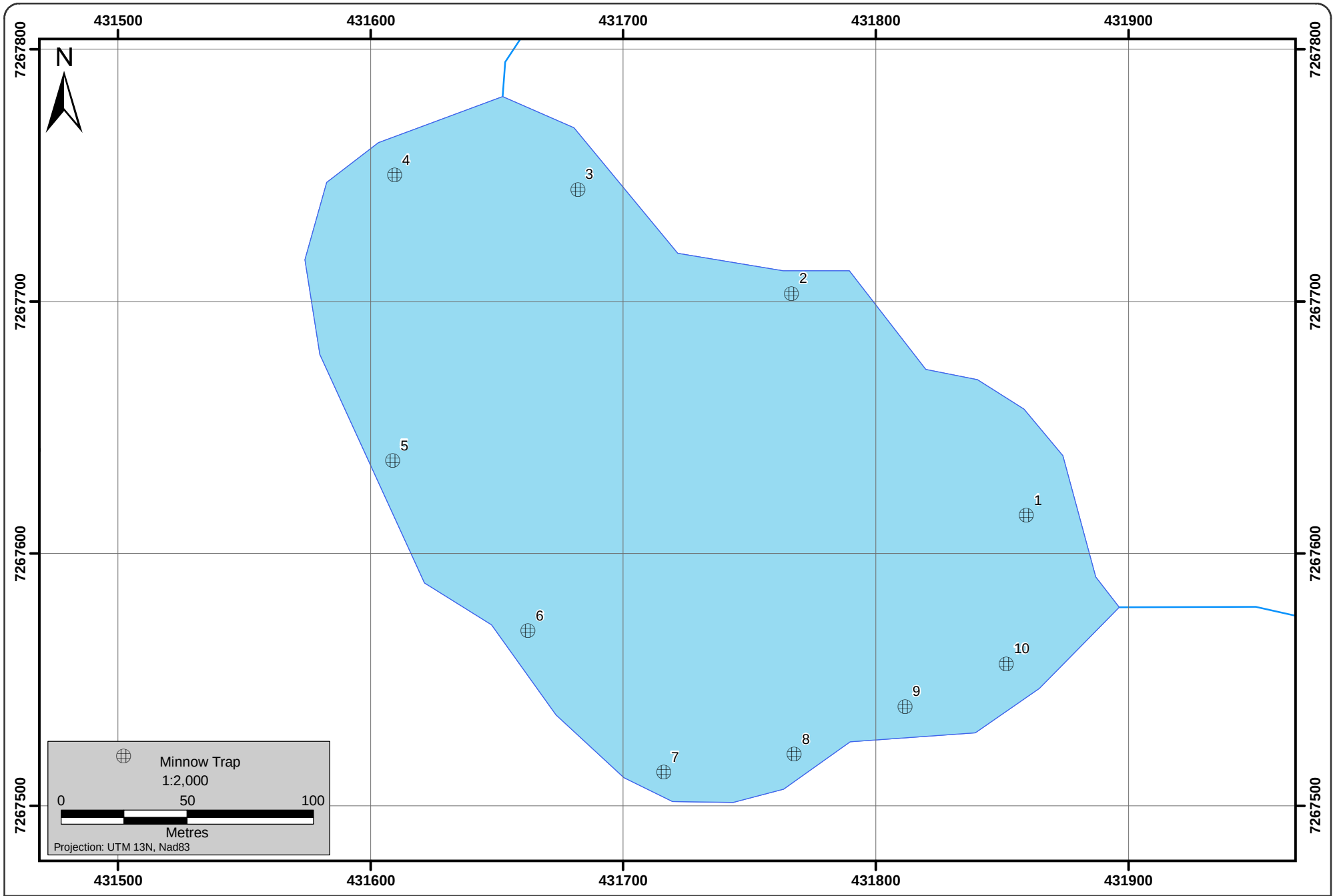


Figure 2.2-12

Figure 2.2-11

Gillnet and Minnow Trap Set Locations on Pond F, Back River Project, 2011

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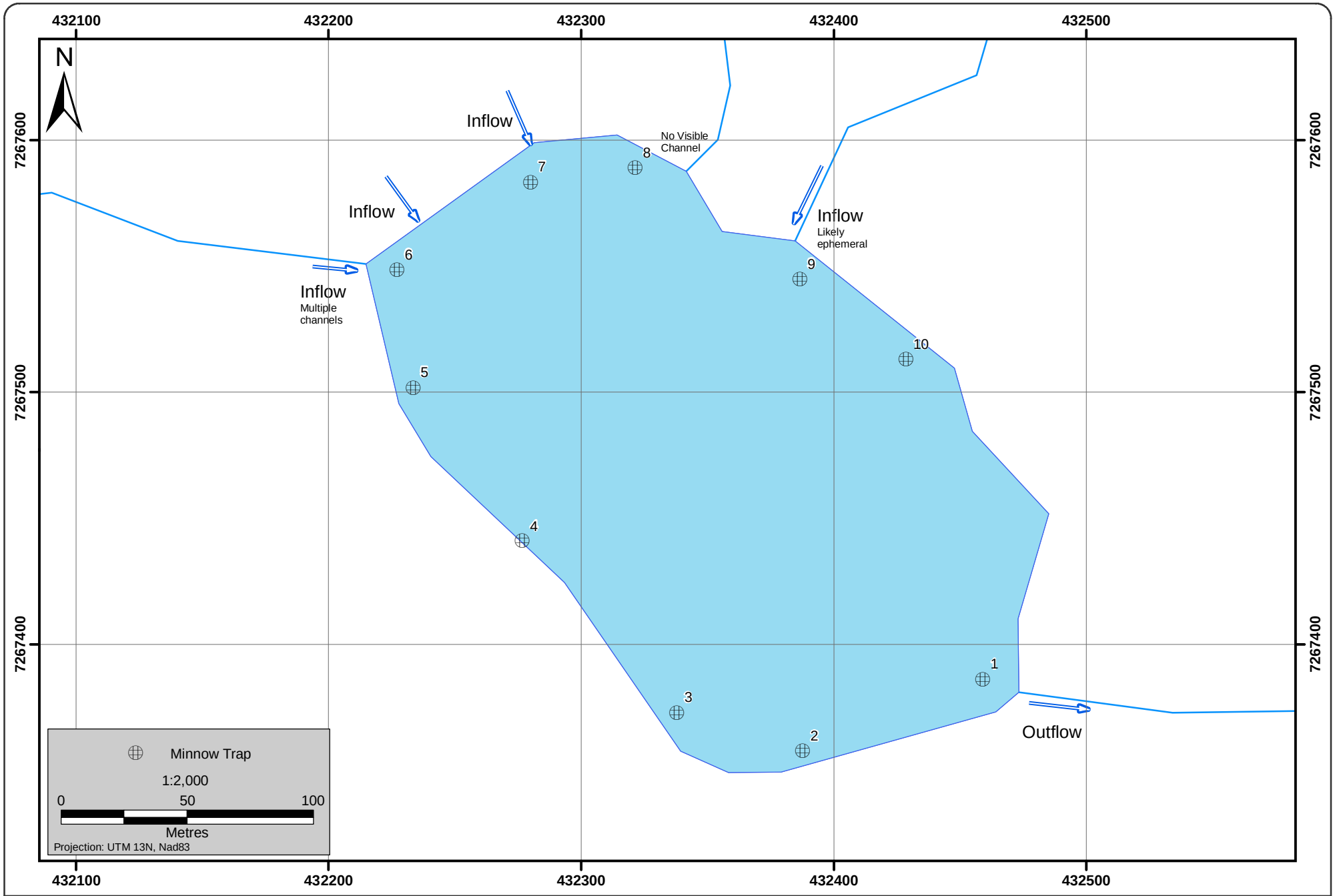


Figure 2.2-11

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Gillnet and Minnow Trap Set Locations on Pond G, Back River Project, 2011

Figure 2.2-12

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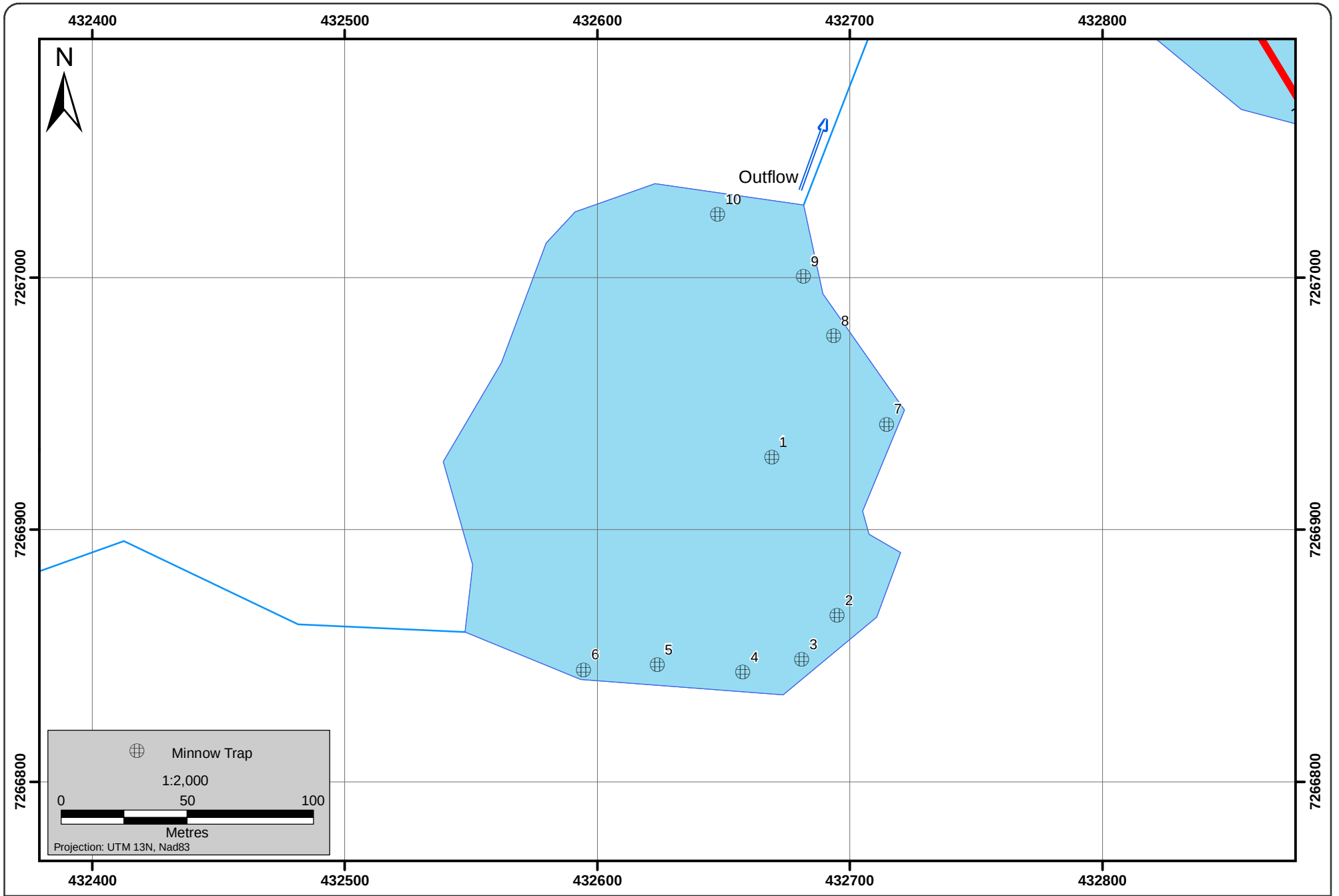


Figure 2.2-13

Sabina GOLD & SILVER CORP.

Gillnet and Minnow Trap Set Locations on Pond H, Back River Project, 2011

Figure 2.2-13

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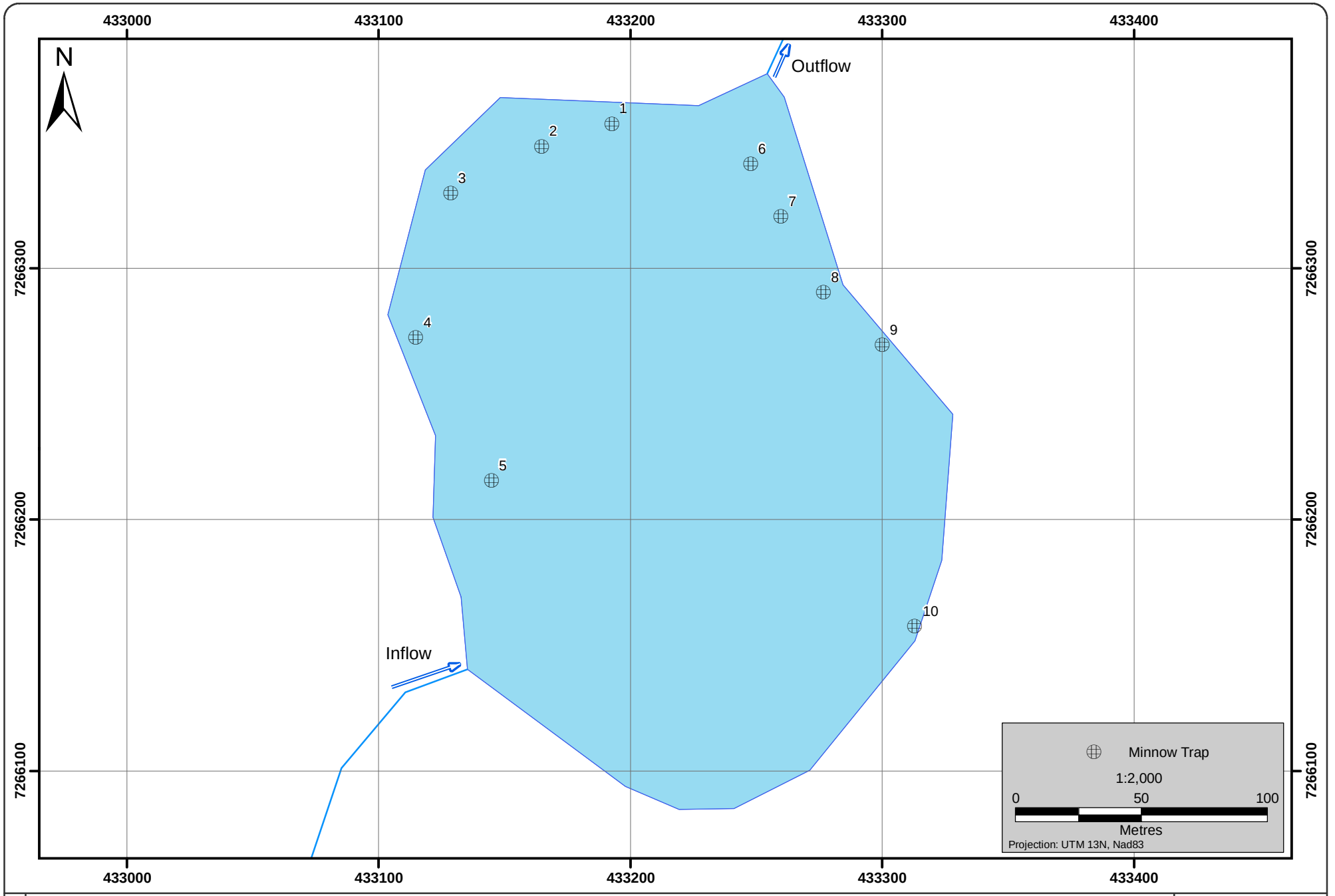


Figure 2.2-14

Sabina GOLD & SILVER CORP.

Gillnet and Minnow Trap Set Locations on Pond I, Back River Project, 2011

Figure 2.2-14

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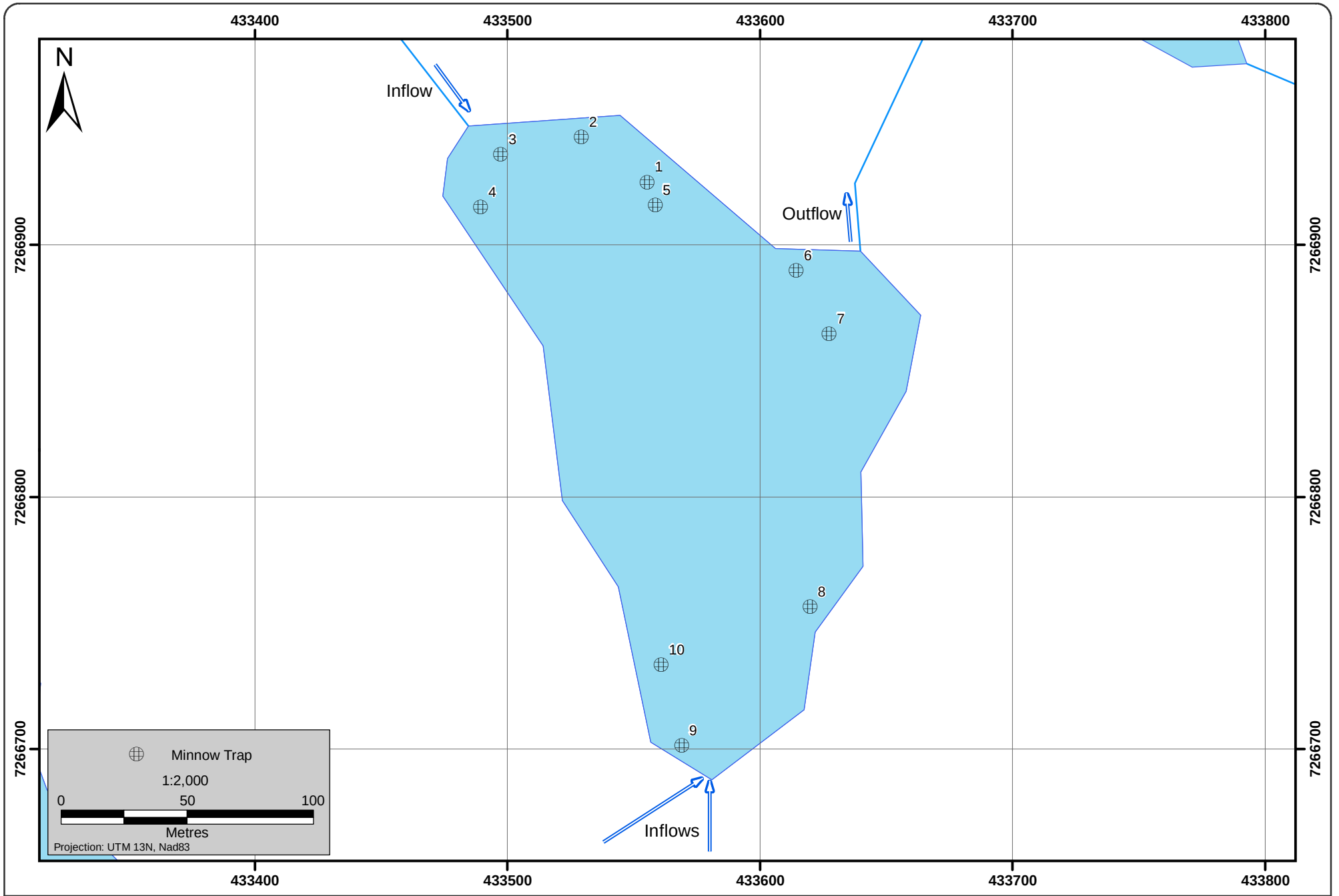


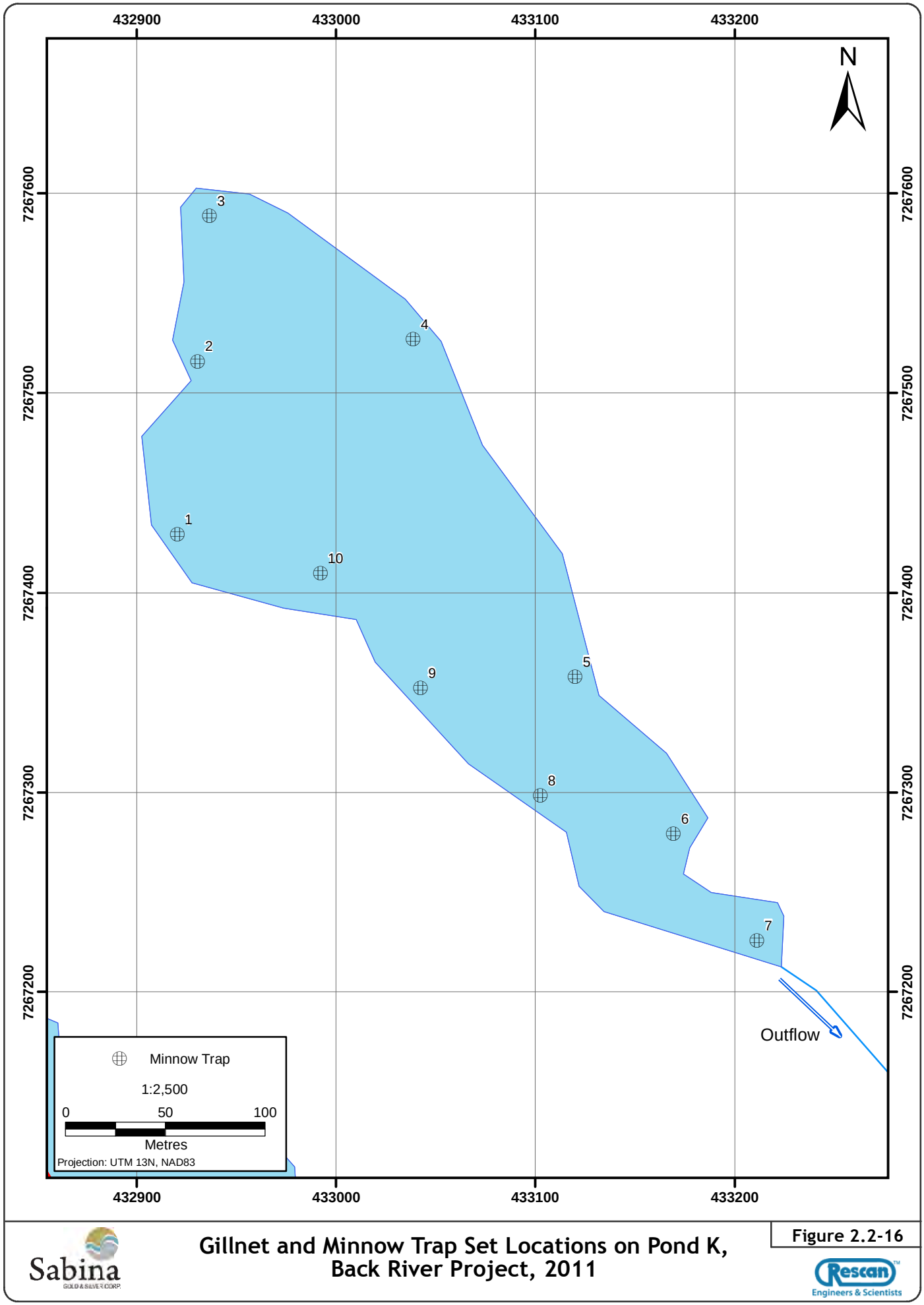
Figure 2.2-15

Sabina GOLD & SILVER CORP.

Gillnet and Minnow Trap Set Locations on Pond J, Back River Project, 2011

Figure 2.2-15

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Gillnet and Minnow Trap Set Locations on Pond K, Back River Project, 2011

Figure 2.2-16

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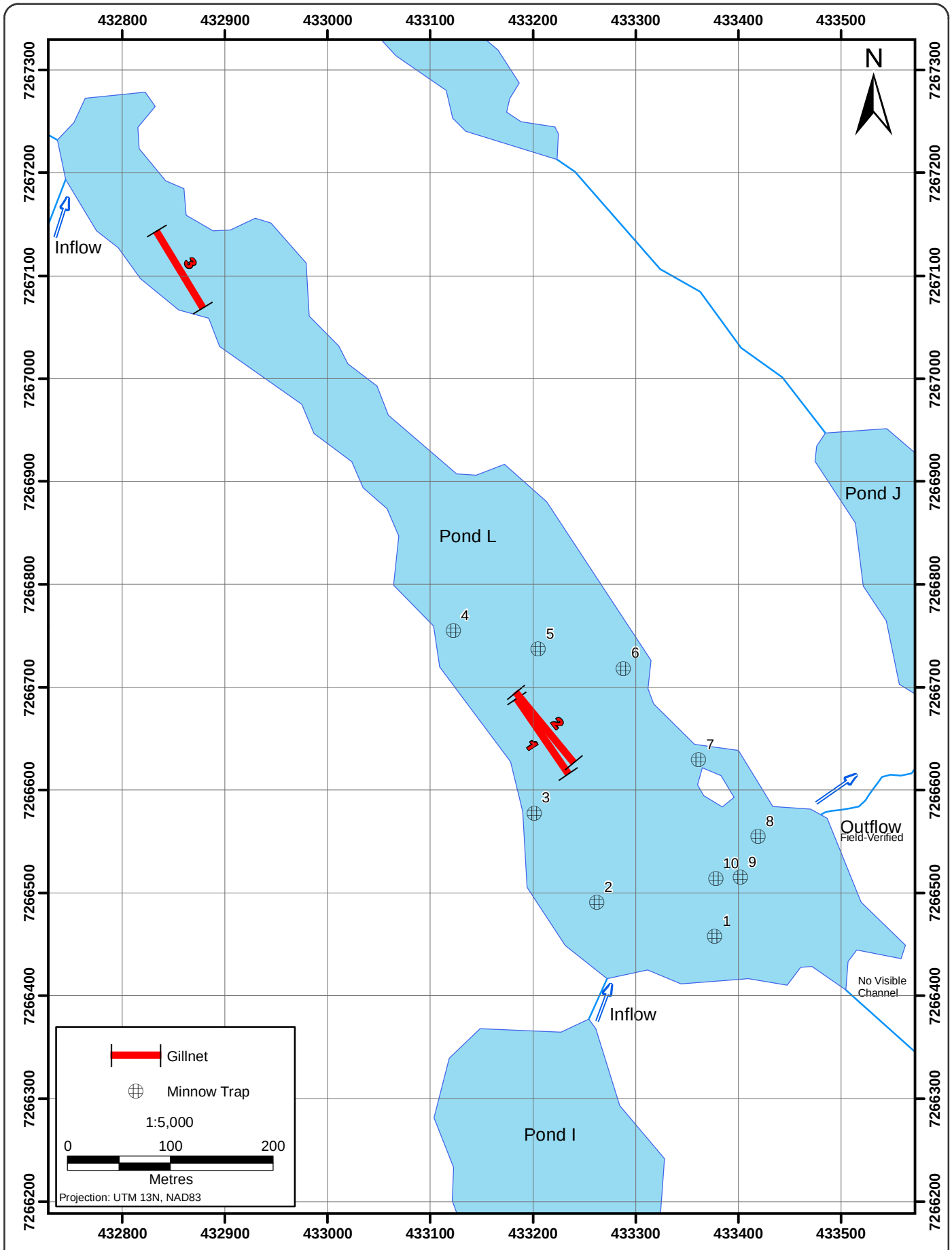


Figure 2.2-17

Gillnet and Minnow Trap Set Locations on Pond L, Back River Project, 2011

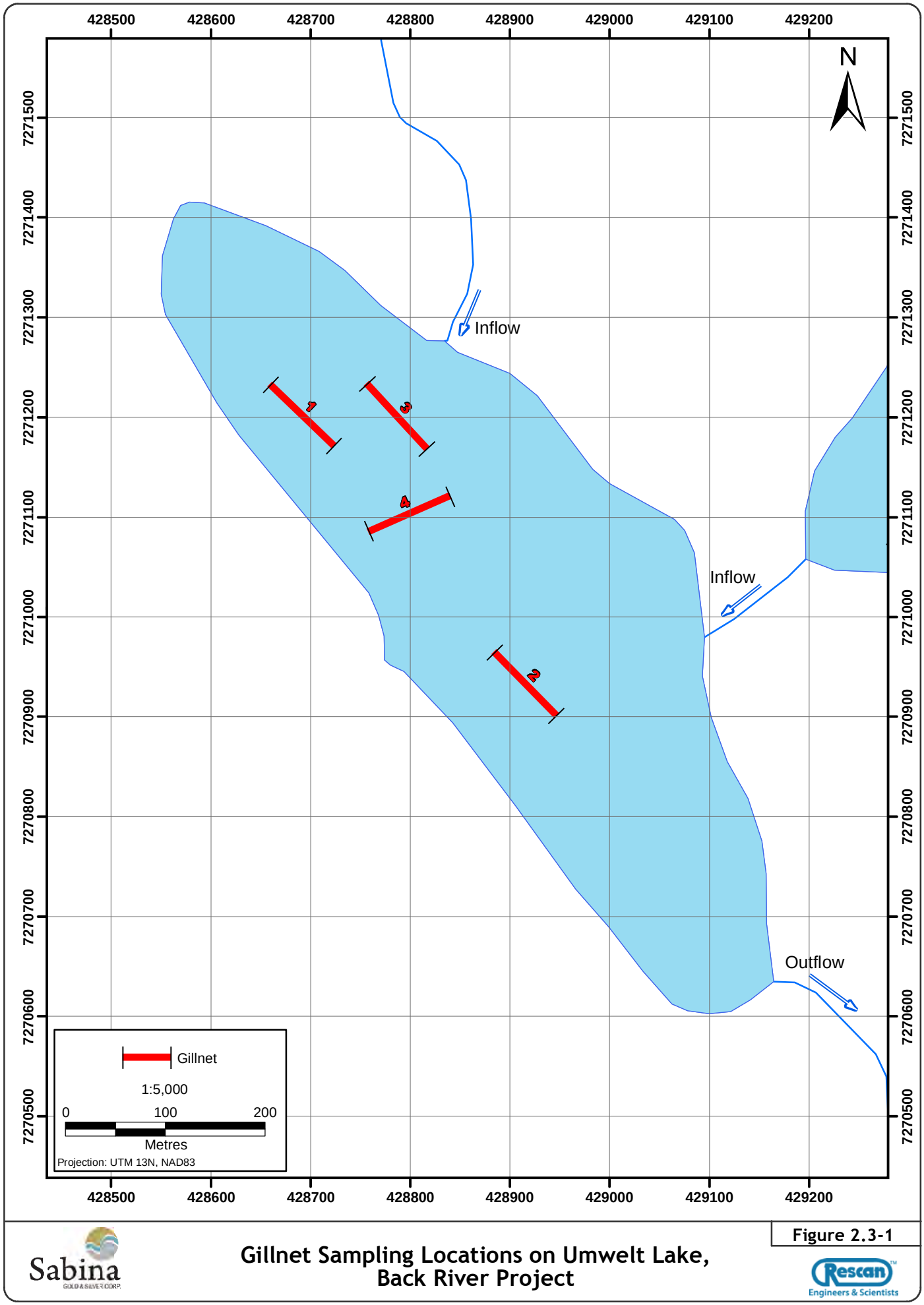


Figure 2.3-1

Gillnet Sampling Locations on Umwelt Lake, Back River Project

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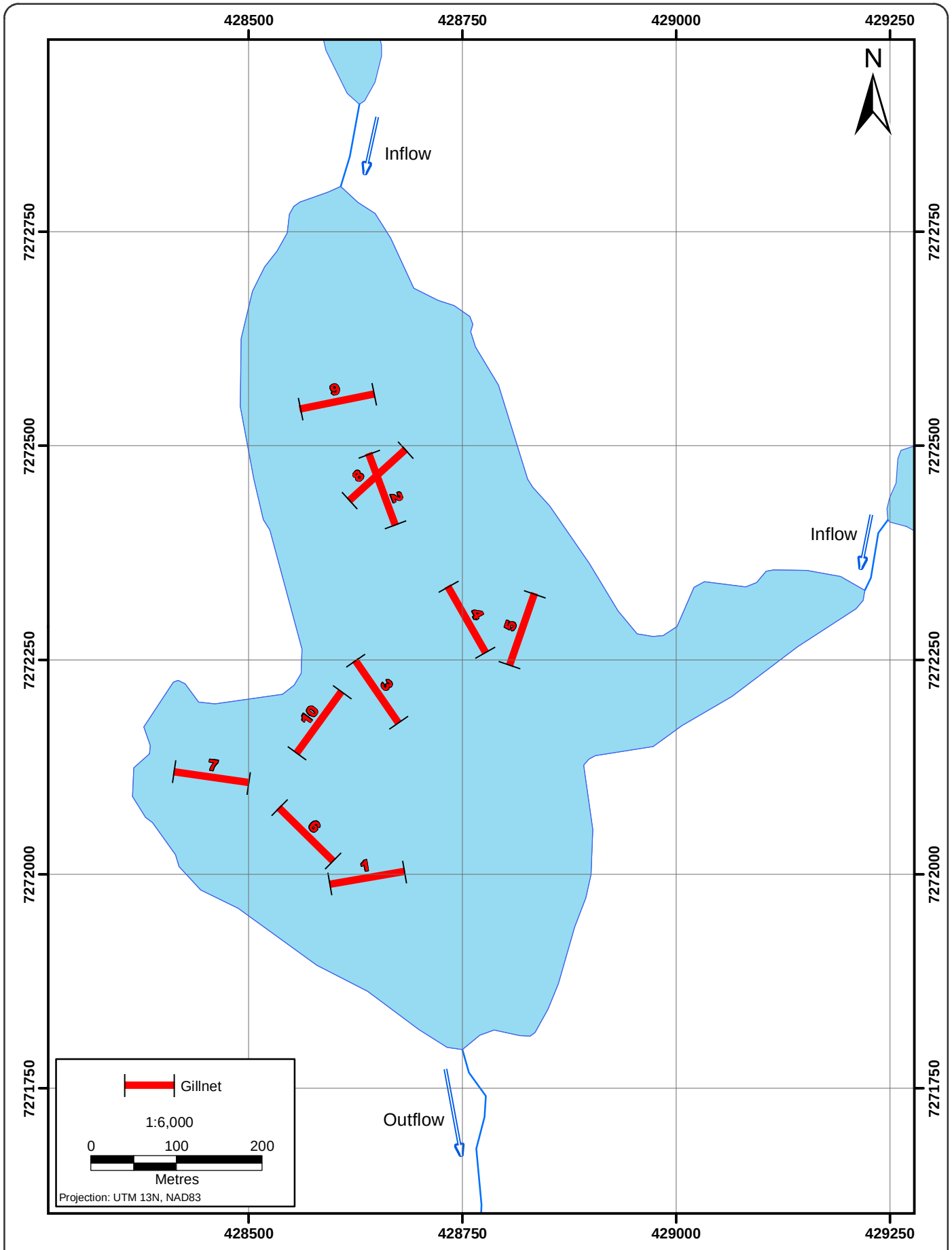


Figure 2.3-2

Gillnet Sampling Locations on Llama Lake, Back River Project

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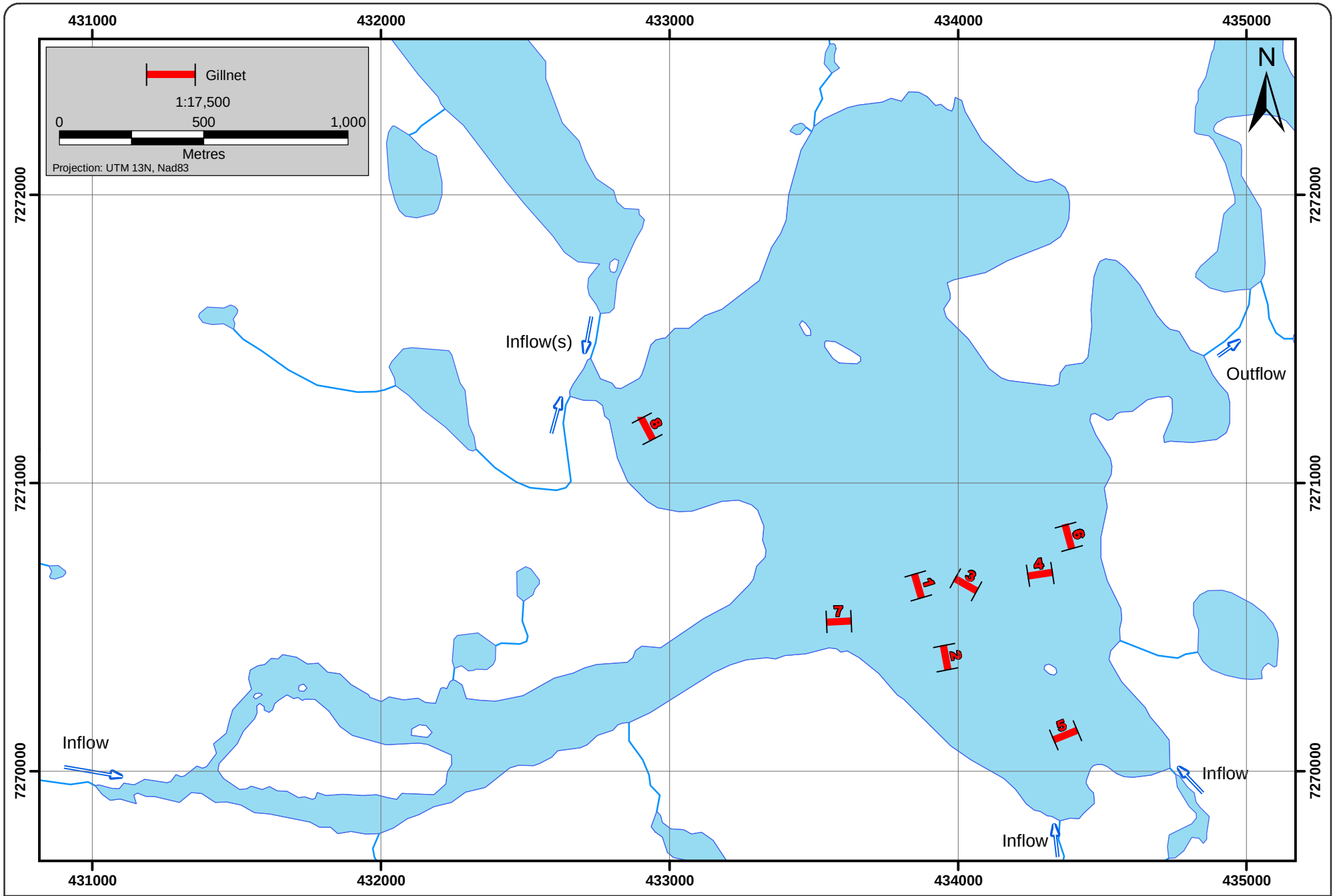


Figure 2.3-3

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Gillnet Sampling Locations on Goose Lake, Back River Project

Figure 2.3-3

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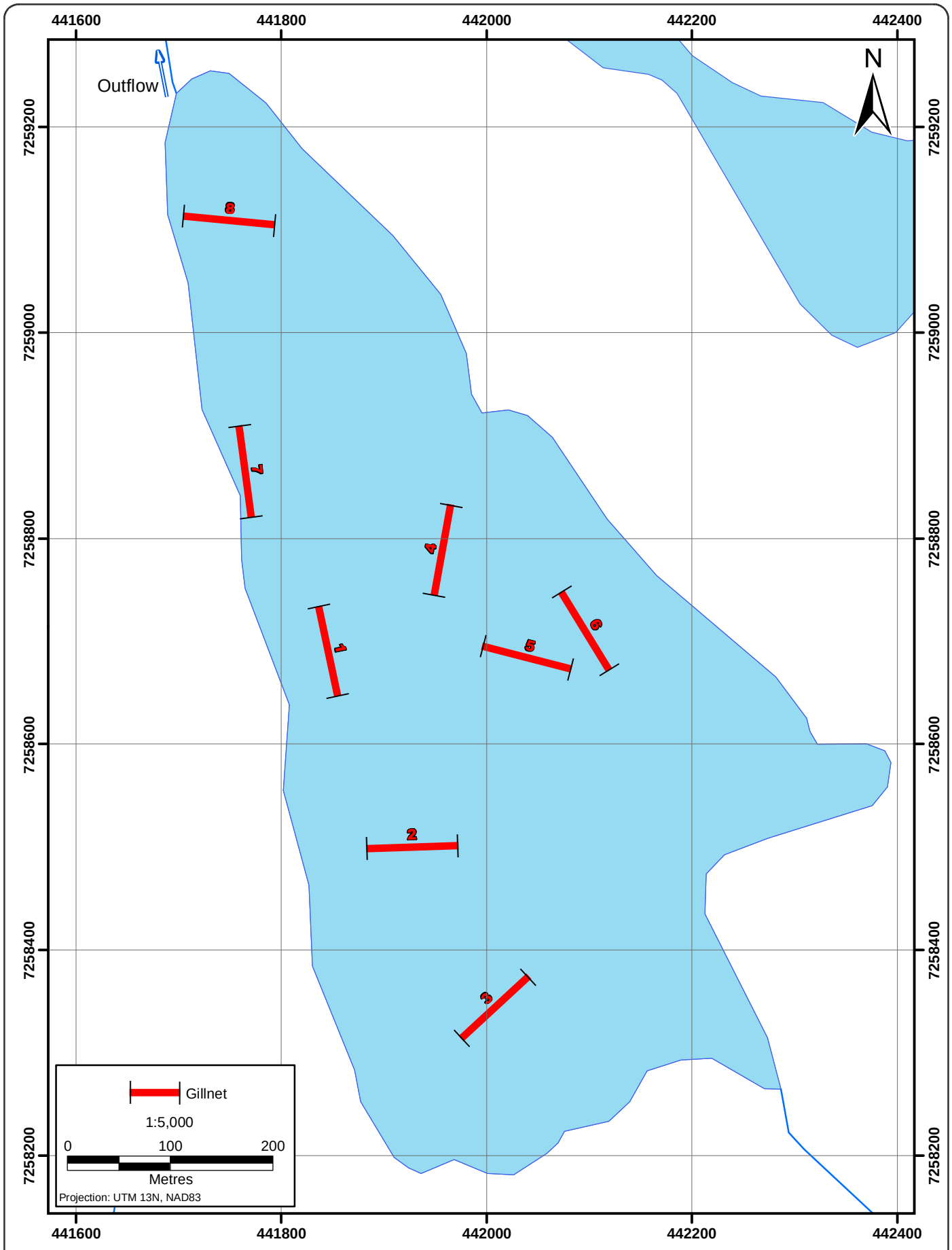


Figure 2.3-4

Gillnet Sampling Locations on Reference B Lake, Back River Project

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2.3.3 Energy Use

Energy use by fish is assessed through the use of growth models and reproduction. Growth was evaluated through the use of length-frequency distributions and size-at-age regressions. Fish size-at-age was analyzed using a regression analysis with fork length as the dependent variable and age as the independent variable. Linear regression analysis was used because all fish captured were adults, thus making the length-age relationship appear linear. A GLM was used to test the equality of regression slopes among lakes, and ANCOVA was used to test for differences in fish size-at-age among lakes.

Reproduction can be assessed through analyses of fecundity and relative gonad size. Fecundity (the number of eggs per female) was not assessed because all female fish captured were not yet mature. Relative gonad size must be compared among fish from each sex due to the difference in gonad size between sexes. Due to the low sample number, gonad size could not be assessed using robust statistical analyses. A Pearson product moment correlation analysis was used to test for relationships between fish somatic weight (i.e., weight of body without organs) and gonad weight. Gonad weight was not compared among sites due to the low sample number for each sex.

2.3.4 Tissue Quality

All lake trout collected for tissue sampling were filleted and the bones and skin were removed. Fillets were placed in sterile Whirl-Pak bags and frozen. Dissecting tools were cleaned between each sample. Tissue samples were sent to ALS Environmental in Burnaby, BC for analysis.

In the lab, tissue samples were homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis was by Inductively Coupled Plasma – Mass Spectrometry (ICPMS). Mercury concentrations were analyzed by atomic fluorescence spectrophotometry.

2.3.5 Diet

The stomachs of each sacrificed lake trout were removed from oesophagus to intestine and placed in sterile Whirl-Pak bags. Samples were preserved with 10% buffered formalin and sent to Applied Technical Services for analysis. Diet contents were weighed and enumerated, and contents were identified to the lowest possible taxonomic level.

2.4 QUALITY ASSURANCE/QUALITY CONTROL

Data forms were checked daily for completion and stored at camp to avoid data loss. Once in the office, data were scanned and entered in spreadsheets. Data entry was checked against the original datasheets and outliers were corrected or removed from the dataset. All test results reported with the tissue quality analyses were conducted within ALS recommended hold times. Laboratory QA/QC results are presented in Appendix 2.4-1.

3. Results and Discussion

3. Results and Discussion

3.1 POND ASSESSMENT

3.1.1 Fish Habitat

Eighteen ponds in the Goose property area were assessed for fish presence and habitat potential in 2011. The ponds ranged in size from 0.9 to 15.2 ha, and in depth from approximately 1 m to 4.5 m (detailed bathymetric surveys were not conducted, but gillnets were generally set in the deepest parts of each pond, except where ponds were too shallow for boating). Appendix 3.1-1 presents the habitat assessment data from each pond sampled. Figure 2.1-1 indicates the locations of all of the ponds that were sampled. All ponds were assigned numbers or letters depending on the watershed in which they were located. The following text presents the ponds results by watershed.

Llama Watershed

Pond 1 flows into Umwelt Lake from the east. It has one outflow and one inflow (from Pond 2). The shoreline habitat is homogenous, and is dominated by fine sediment (Plate 3.1-1). Boulders make up approximately 20% of the shoreline substrate. The pond is uniformly shallow, with a maximum depth of about 3 m. Figure 3.1-1 shows a map of the shoreline substrate and the extent of the littoral zone.



Plate 3.1-1. Shoreline of Pond 1 in the Llama watershed, looking west on July 4, 2011.

Pond 2 flows into Pond 1 from the east and has one outflow and one seepage inflow. Approximately two-thirds of the shoreline is dominated by fine sediments, while one third is dominated by cobble (Plate 3.1-2). Boulder and bedrock are also present in small amounts. Pond 2 was too shallow for boating, and the maximum depth was estimated to be less than 2 m from aerial reconnaissance surveys. Figure 3.1-2 shows a map of the shoreline substrate and extent of the littoral zone.

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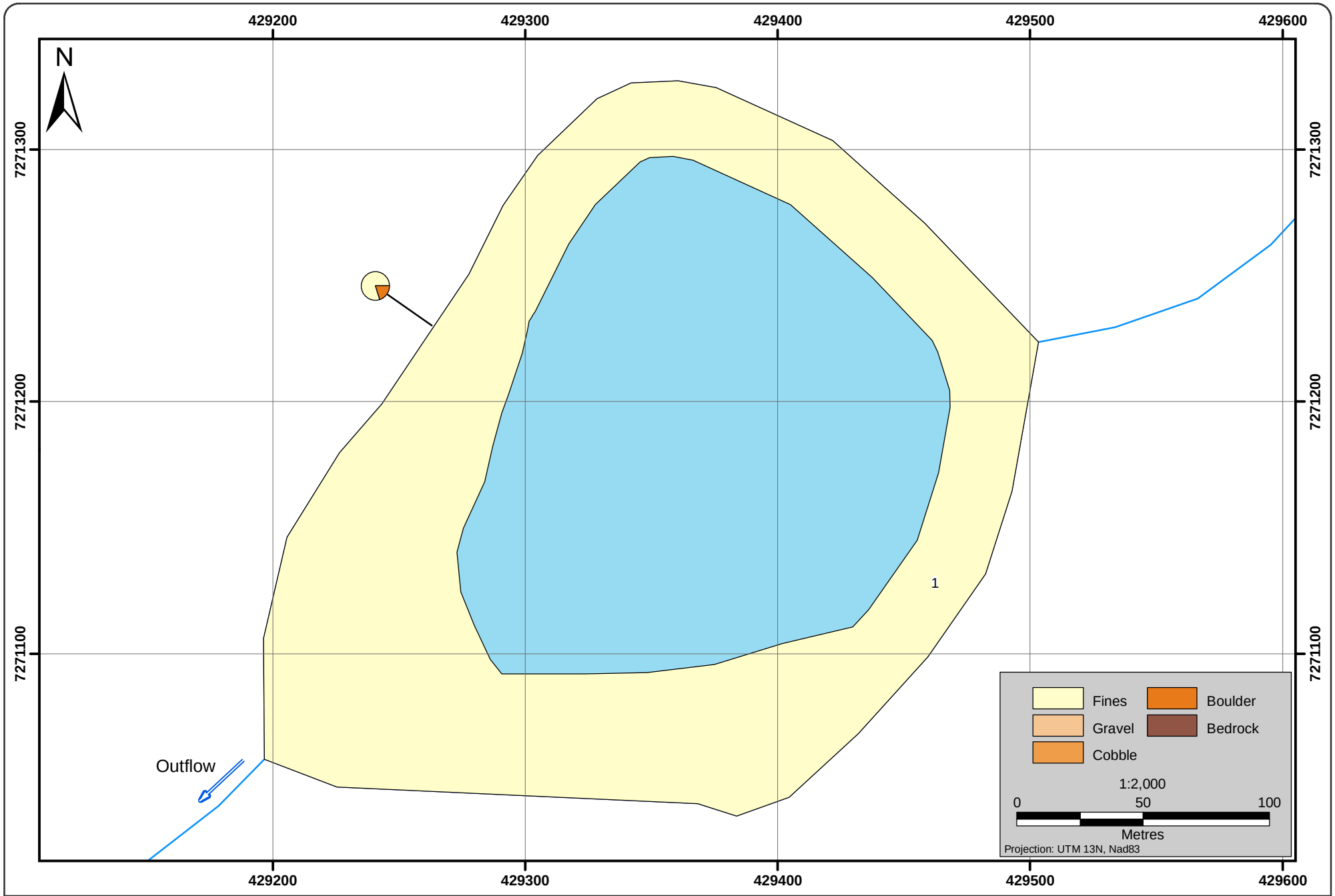


Figure 3.1-1

Sabina GOLD & SILVER CORP.

Shoreline Substrate of Pond 1, Llama Watershed, Back River Project

Figure 3.1-1

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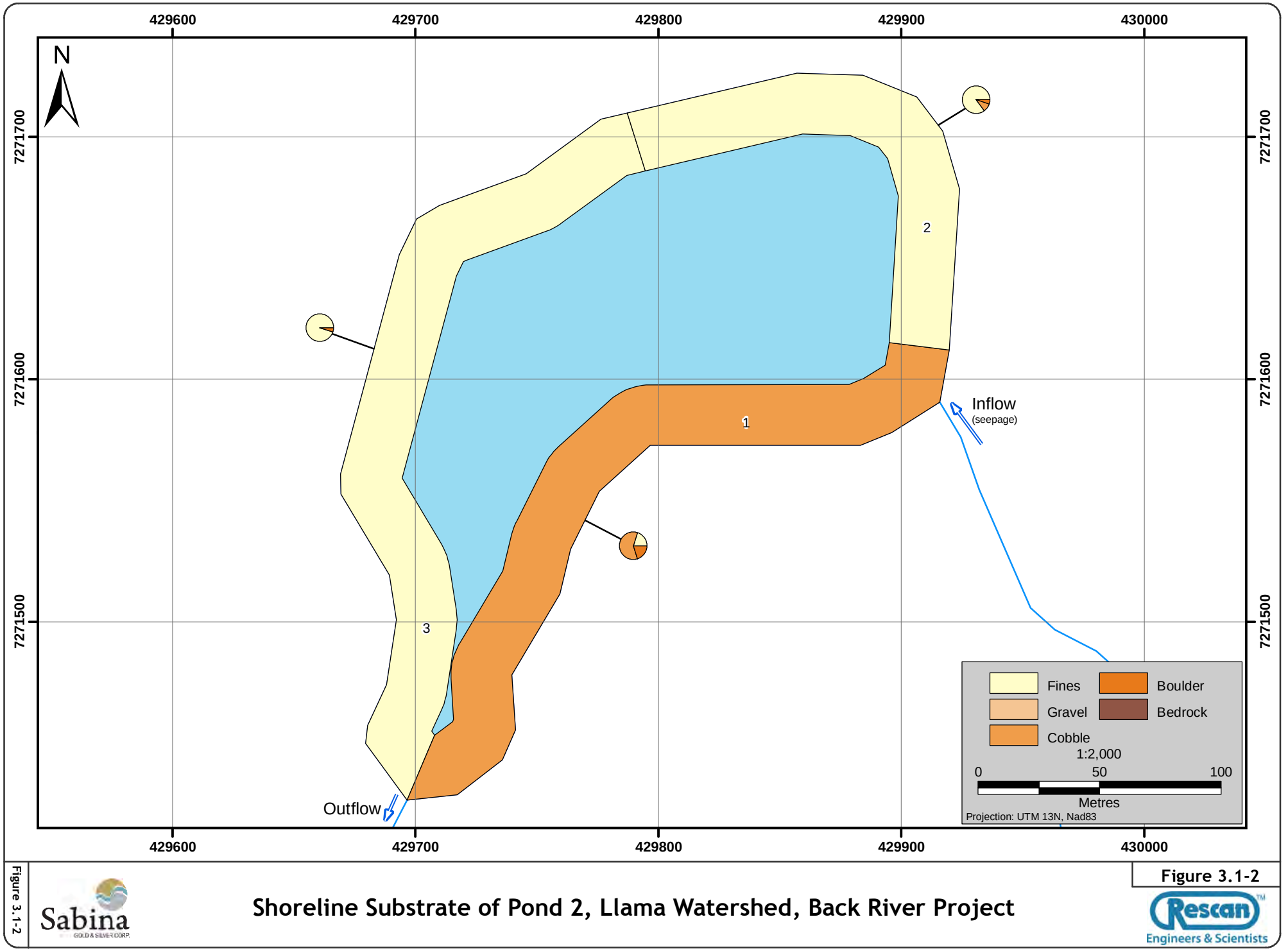


Figure 3.1-2

Sabina GOLD & SILVER CORP.

Shoreline Substrate of Pond 2, Llama Watershed, Back River Project

Figure 3.1-2

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Plate 3.1-2. Shoreline substrate and minnow trap at Pond 2, Llama watershed, looking north on July 5, 2011.

Echo Watershed

Pond 3 is also called "Echo Lake" and is located at the headwaters of the small Echo watershed that flows into Goose Lake. The shoreline of Pond 3 is dominated by fine sediments around most of the perimeter. Cobble and boulder dominate the shoreline around the northwest side. The pond has one outflow and no permanent inflows. Pond 3 was too shallow for boating, with a maximum depth of approximately 2 m estimated from the air. Figure 3.1-3 shows a map of the shoreline and littoral zone.

Gander Watershed

Pond 4 is located south of Goose Lake at the headwaters of a small watershed that drains into Goose Lake. The shoreline of the pond is dominated by boulder substrate with occasional cobble and bedrock. The pond has a single outflow and no permanent inflow. The maximum depth of the pond was estimated to be approximately 4 m. Figure 3.1-4 shows a map of the shoreline and littoral zone.

Pond 5 (also known as Gander Pond) is located downstream and west of Goose camp near the proposed airstrip. It drains north into Goose Lake. The shoreline of Pond 5 is composed almost entirely of fine sediment, with a small area of cobble and boulder habitat near the inflow at the south end (Plate 3.1-3). One permanent inflow and two ephemeral inflows were present, and the pond has one outflow to Goose Lake. Pond 5 was too shallow for boating, with a maximum depth of approximately 1.5 m. Figure 3.1-5 shows a map of the shoreline and littoral zone.

Giraffe Watershed

Pond A is located along a chain of ponds that flows into Giraffe Lake. It features one outflow and one inflow, and the shoreline is dominated by fines (Plate 3.1-4). A deeper section of cobble and boulder habitat is present off the shoreline on the west side of the pond. Pond A has a maximum depth of approximately 3 m. A small, unmapped pond, dubbed Pond A1, lies between Pond A and Pond B to the north (Plate 3.1-5). It is dominated by fine sediment substrates and shoreline, and has a maximum depth of less than 2 m. Figure 3.1-6 shows a map of the shoreline habitat and littoral zone of Pond A.

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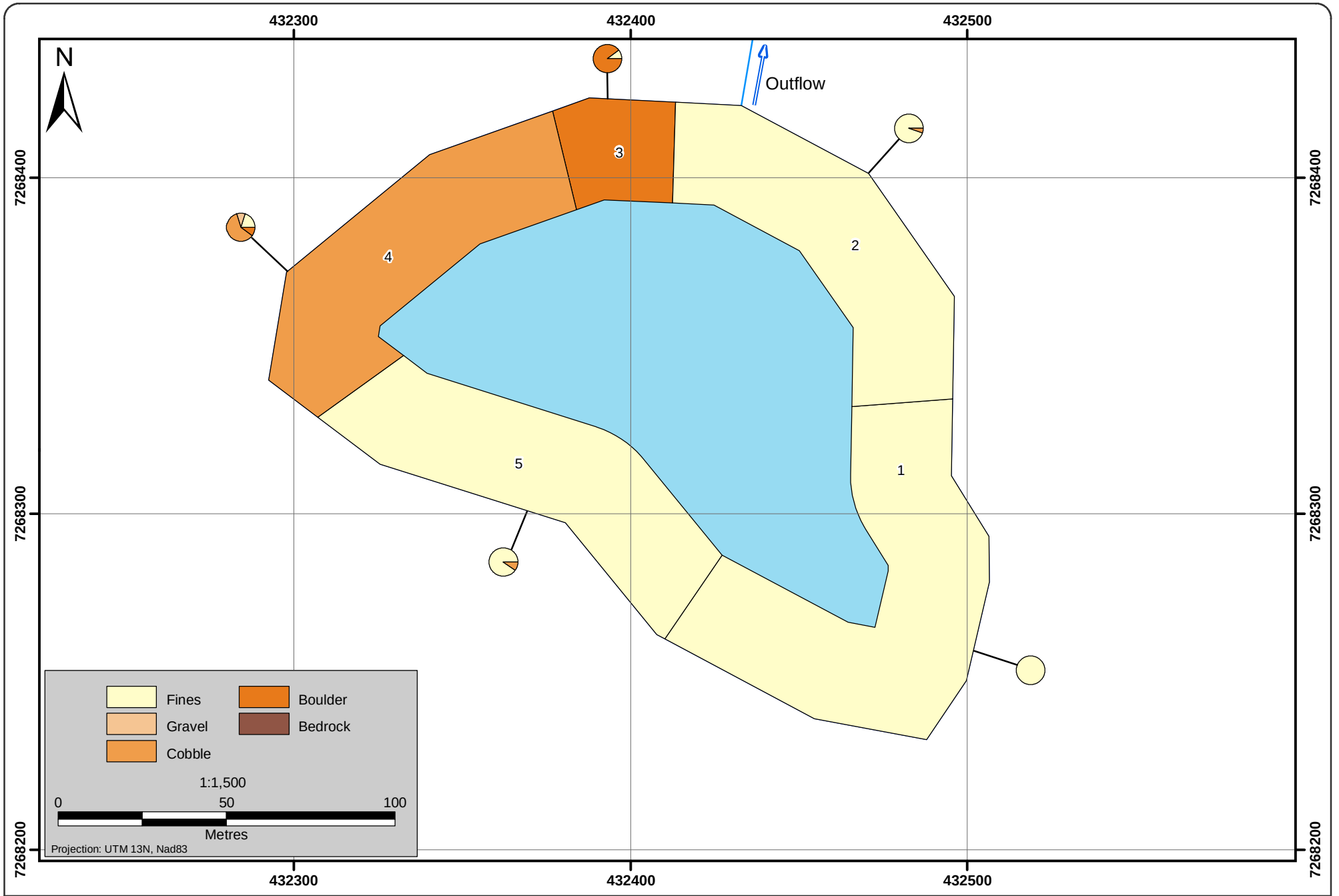


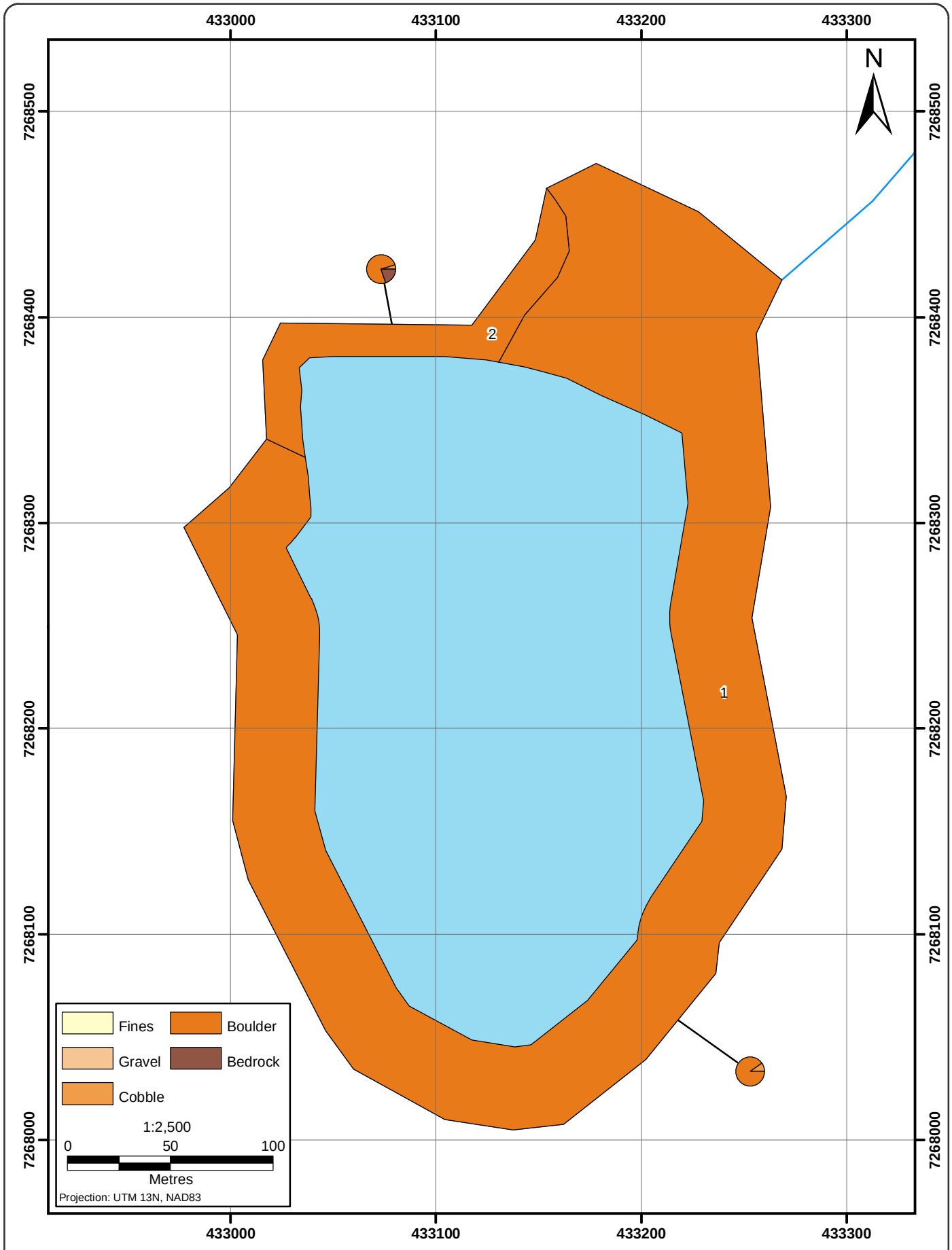
Figure 3.1-3

Sabina GOLD & SILVER CORP.

Shoreline Substrate of Pond 3, Echo Watershed, Back River Project

Figure 3.1-3

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Shoreline Substrate of Pond 4, Gander Watershed, Back River Project

Figure 3.1-4

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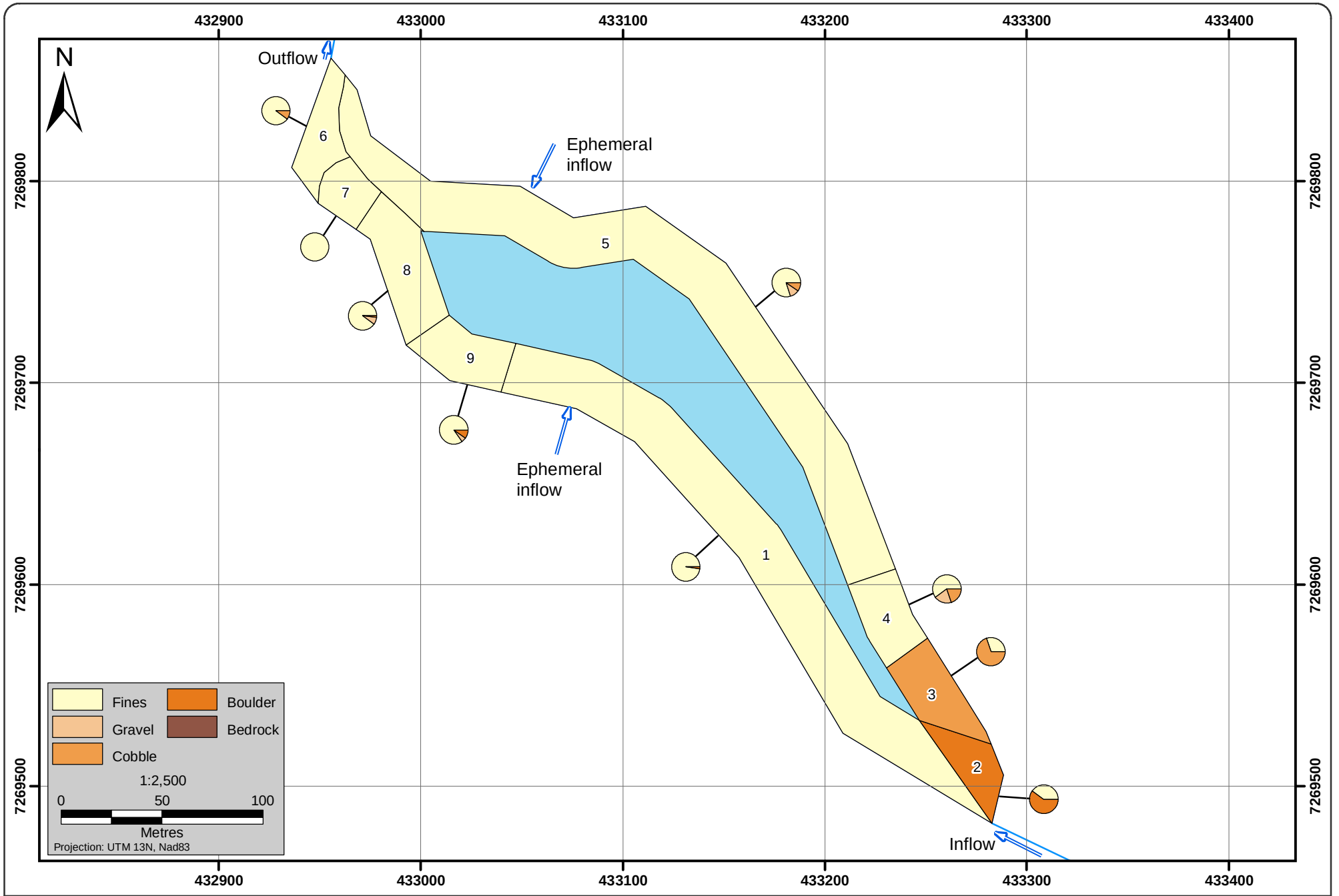


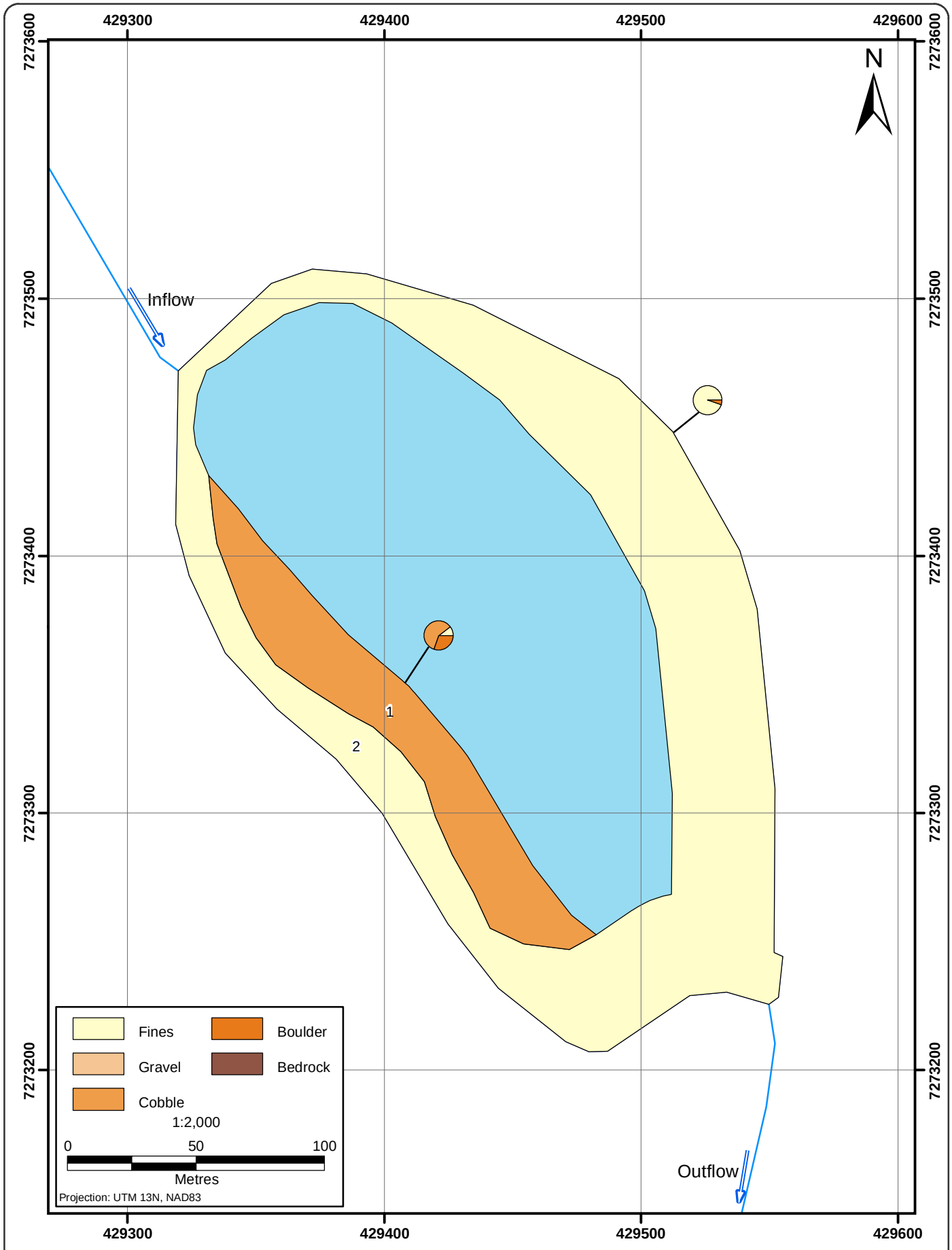
Figure 3.1-5

Sabina GOLD & SILVER CORP.

Shoreline Substrate of Pond 5 (Gander Pond), Gander Watershed, Back River Project

Figure 3.1-5

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Shoreline Substrate of Pond A, Giraffe Watershed, Back River Project

Figure 3.1-6

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Plate 3.1-3. Pond 5 (Gander Pond) looking south on July 2, 2011.

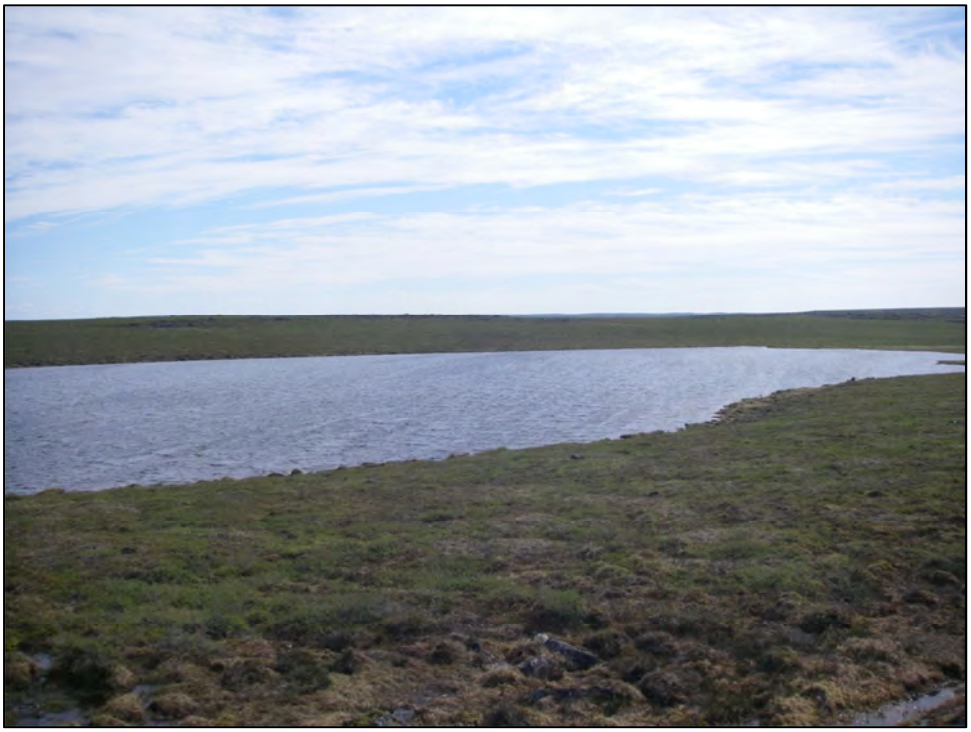


Plate 3.1-4. Pond A in the Giraffe watershed, looking to the southeast on July 5, 2011.

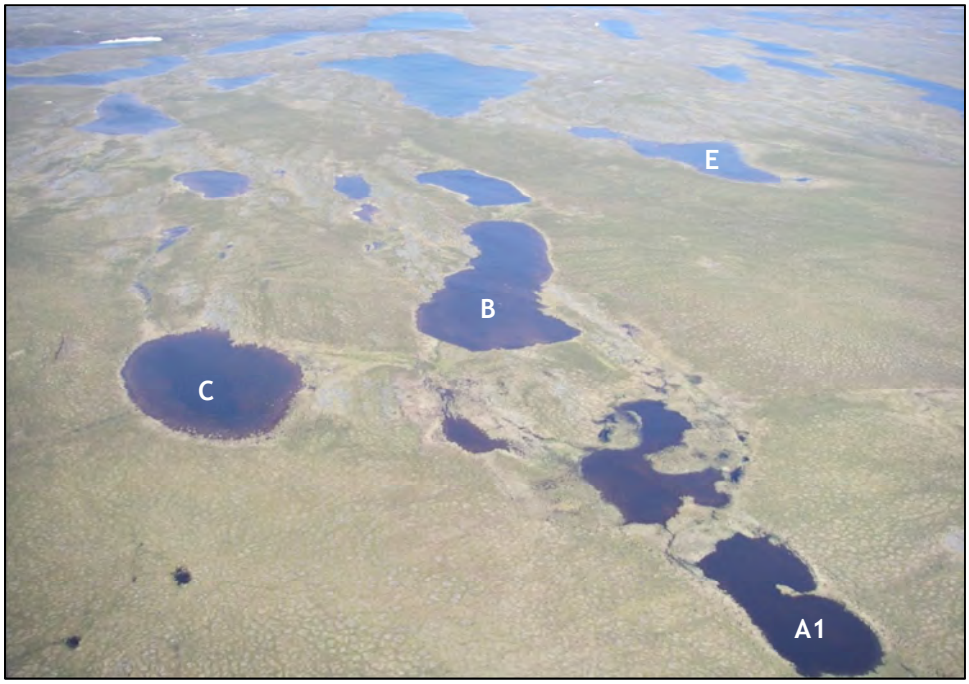


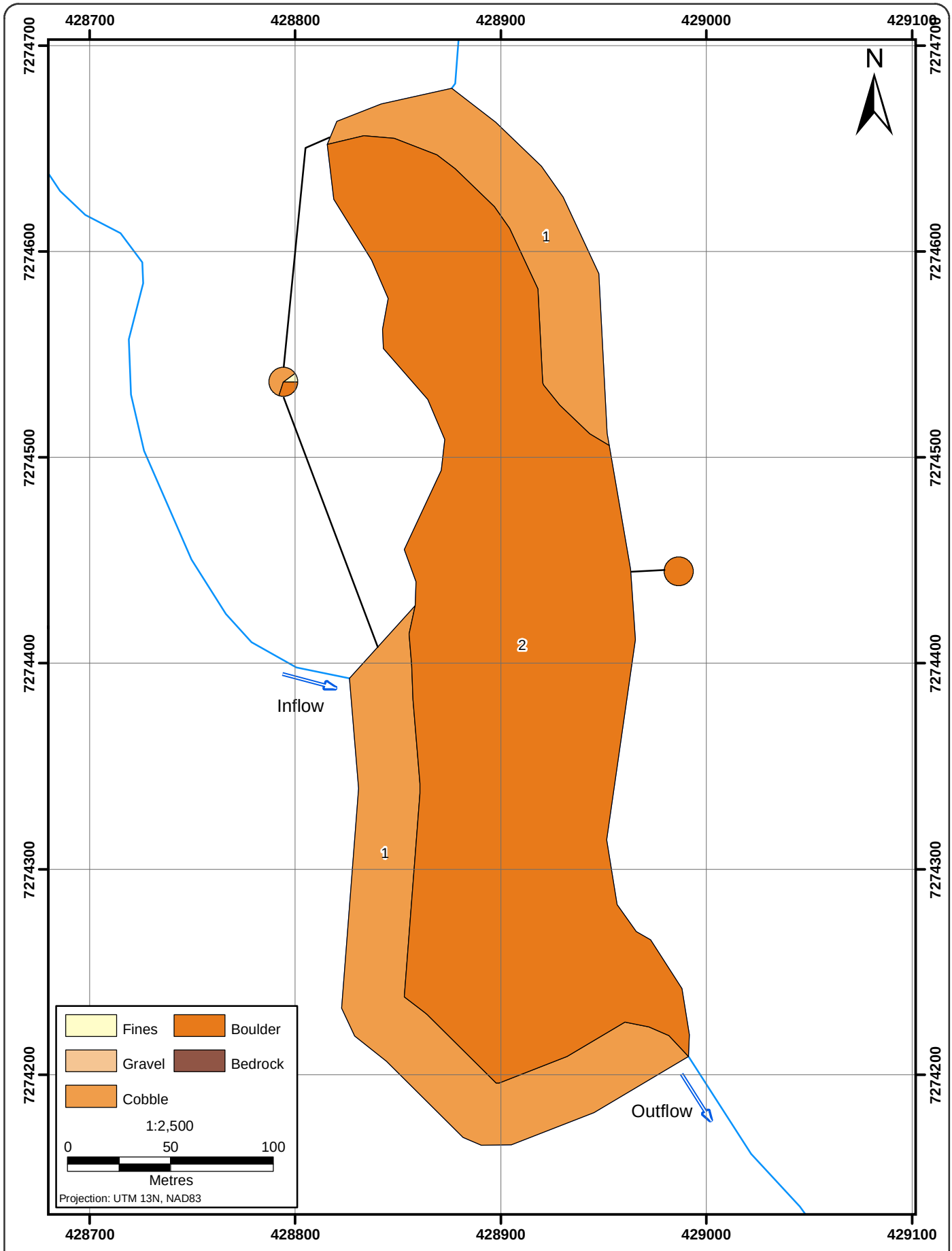
Plate 3.1-5. Aerial view of Ponds A1 – C in the Giraffe watershed. Pond A1 is in the lower right. Pond C lies to the left, and Pond B is the elongate waterbody at center. Taken on July 5, 2011.

Pond B is located upstream of Pond A, in the Giraffe watershed. The shoreline and pond substrate are dominated by boulder and cobble and the bottom is visible throughout the lake (Plate 3.1-6). The maximum depth of the pond was estimated to be approximately 1.5 m. The pond has two inflows and one outflow. Figure 3.1-7 shows a map of the substrate.



Plate 3.1-6. Pond B in the Giraffe watershed, looking east on July 5, 2011.

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Shoreline Substrate of Pond B, Giraffe Watershed, Back River Project

Figure 3.1-7

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Pond C is located west of Pond B within the Giraffe watershed. It flows into the stream connecting Ponds A and B. The pond has one outflow and no permanent inflows. The shoreline is dominated by fines around 60% of the perimeter and boulder around the remaining perimeter. The maximum depth of the pond is approximately 4 m. Figure 3.1-8 shows a map of the shoreline habitat and littoral zone.

Pond D is located east of Pond B in the Giraffe watershed. It has a single outflow and no permanent inflows. The shoreline is dominated by fines and boulders (Plate 3.1-7). The maximum depth was estimated to be approximately 4 m. Figure 3.1-9 shows a map of the shoreline habitat and littoral zone.

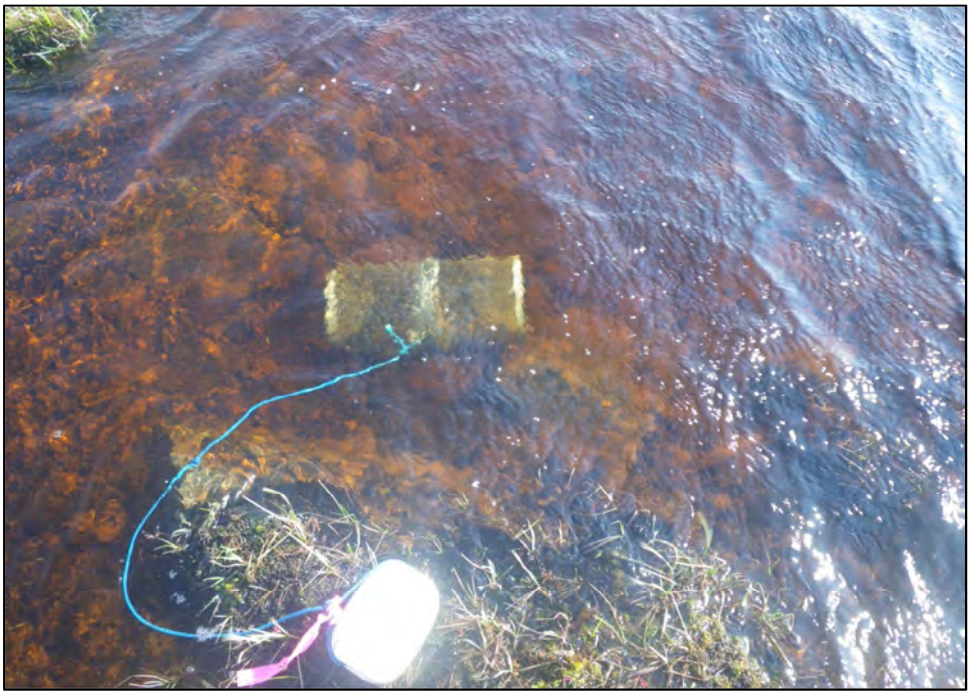


Plate 3.1-7. Shoreline substrate and minnow trap at Pond D in the Giraffe watershed, July 6, 2011.

Pond E is a large, shallow pond located north of Pond D in the Giraffe watershed. It has a single inflow and is presumed to have a single outflow (the outflow was not observed in the field). The shoreline and substrate of the lake are dominated by boulders, with some areas of bedrock and fines (Plate 3.1-8). The pond was too shallow to launch a boat, but the maximum depth was estimated from the air to be less than 2 m. Figure 3.1-10 shows a map of the substrate zones.

Wolf Watershed

Pond F is located south of Goose Lake in the upper reaches of the Wolf watershed. It has one inflow and one outflow. The shoreline is dominated by fine sediment with occasional patches of boulder (Plate 3.1-9). The pond was too shallow for boating, with a maximum depth estimated to be less than 2 m. Figure 3.1-11 shows a map of the shoreline habitat and littoral zone.

Pond G is located downstream of Pond F in the Wolf watershed. It has one main inflow with multiple channels and several ephemeral inflows. One outflow flows towards the southeast. The shoreline is dominated by boulder habitat, followed by fines and small proportions of cobble and bedrock (Plate 3.1-10). The pond was too shallow to launch a boat, and the maximum depth was estimated from the air to be less than 2 m. Figure 3.1-12 shows a map of the shoreline habitat and littoral zone.

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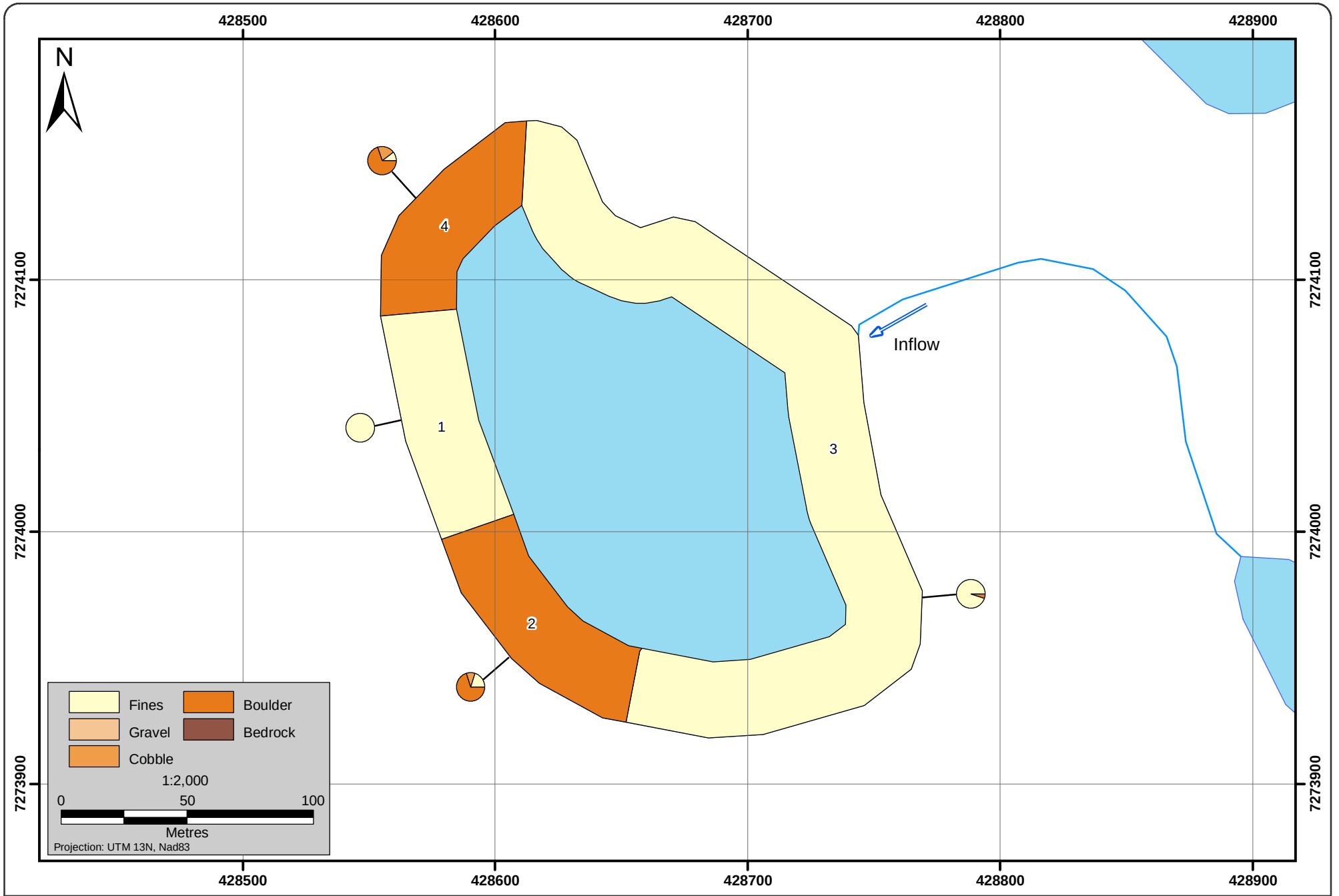


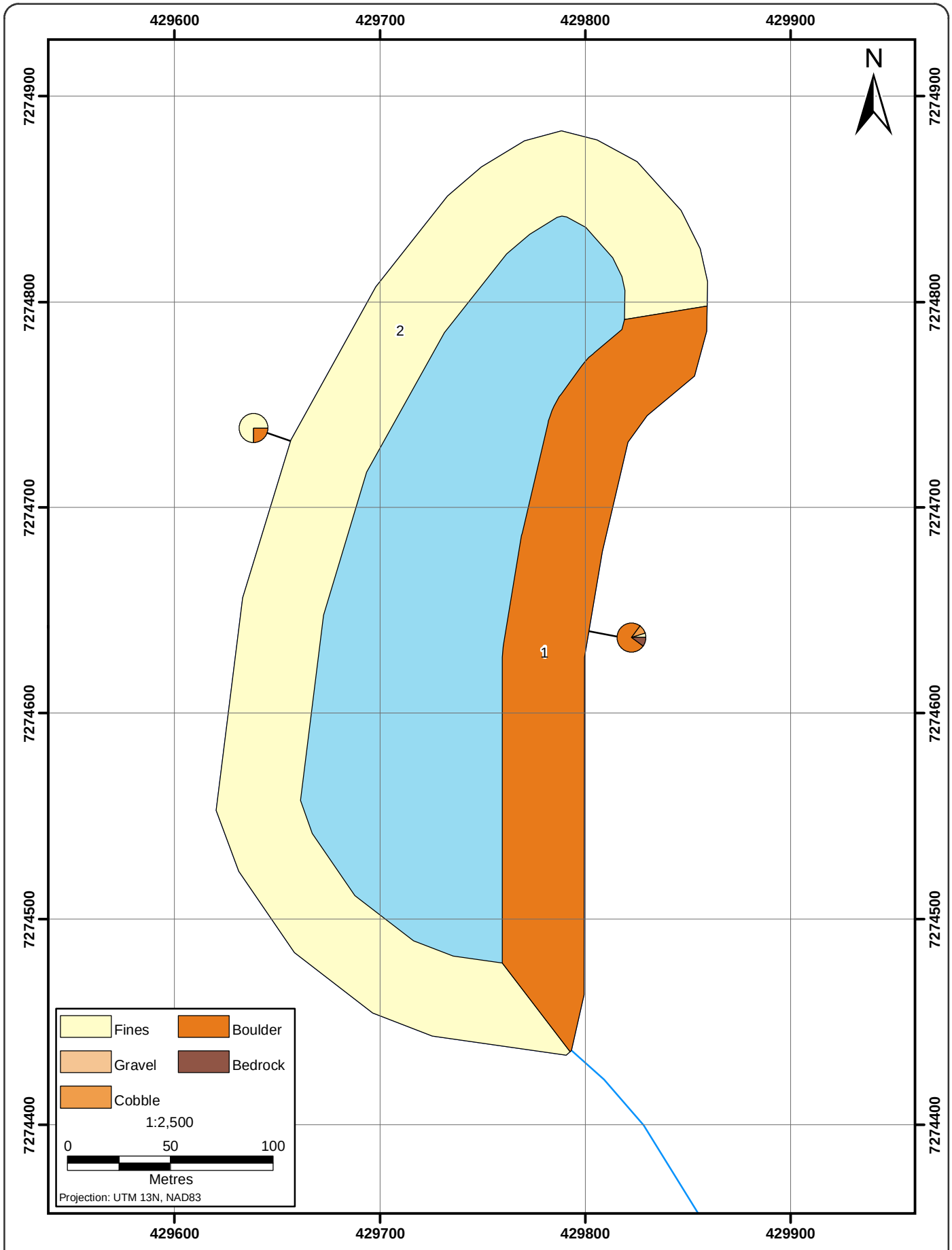
Figure 3.1-8

Sabina GOLD & SILVER CORP.

Shoreline Substrate of Pond C, Giraffe Watershed, Back River Project

Figure 3.1-8

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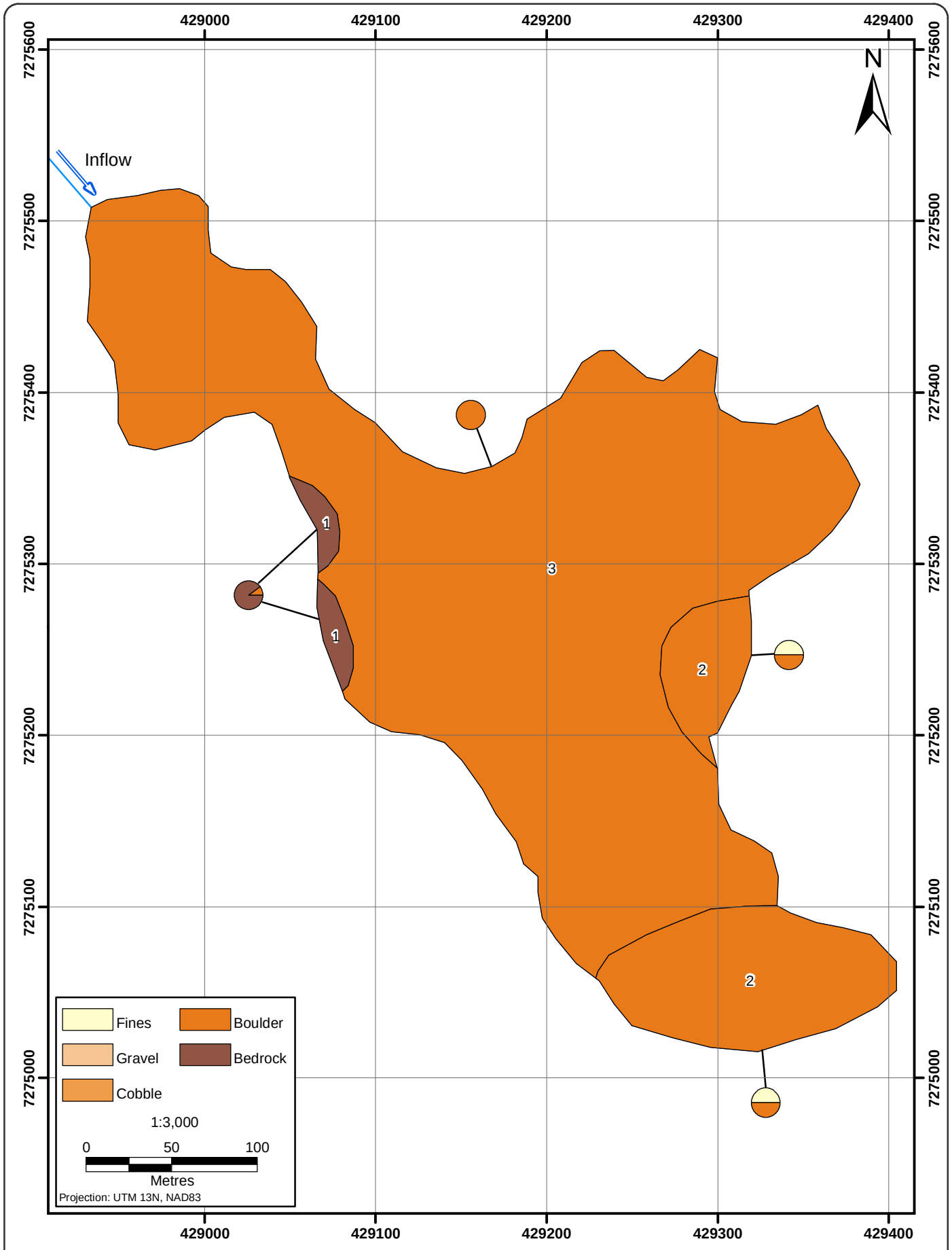


Sabina GOLD & SILVER CORP.

Shoreline Substrate of Pond D, Giraffe Watershed, Back River Project

Figure 3.1-9

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Figure 3.1-10

Shoreline Substrate of Pond E, Giraffe Watershed, Back River Project

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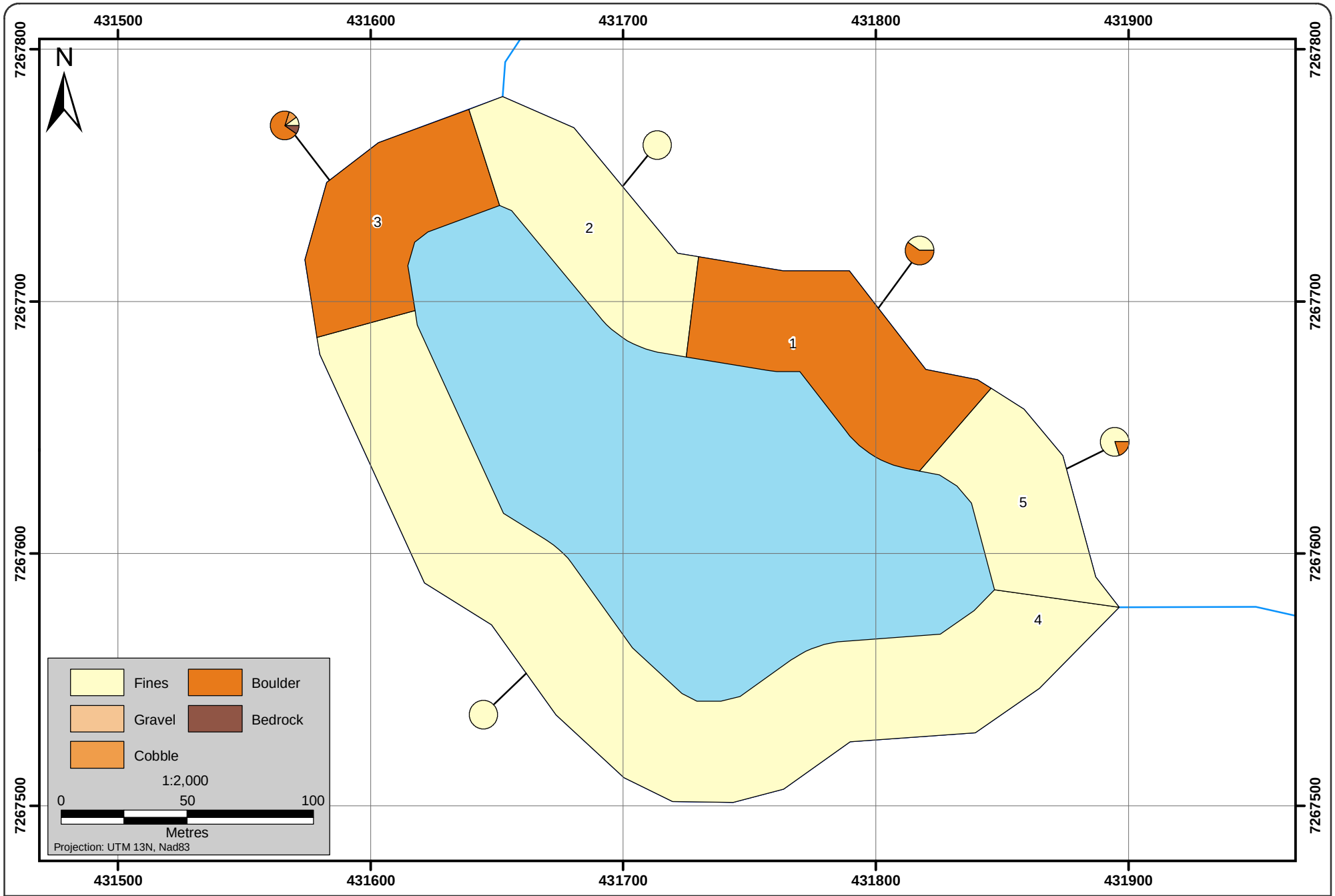


Figure 3.1-11

Sabina GOLD & SILVER CORP.

Shoreline Substrate of Pond F, Wolf Watershed, Back River Project

Figure 3.1-11

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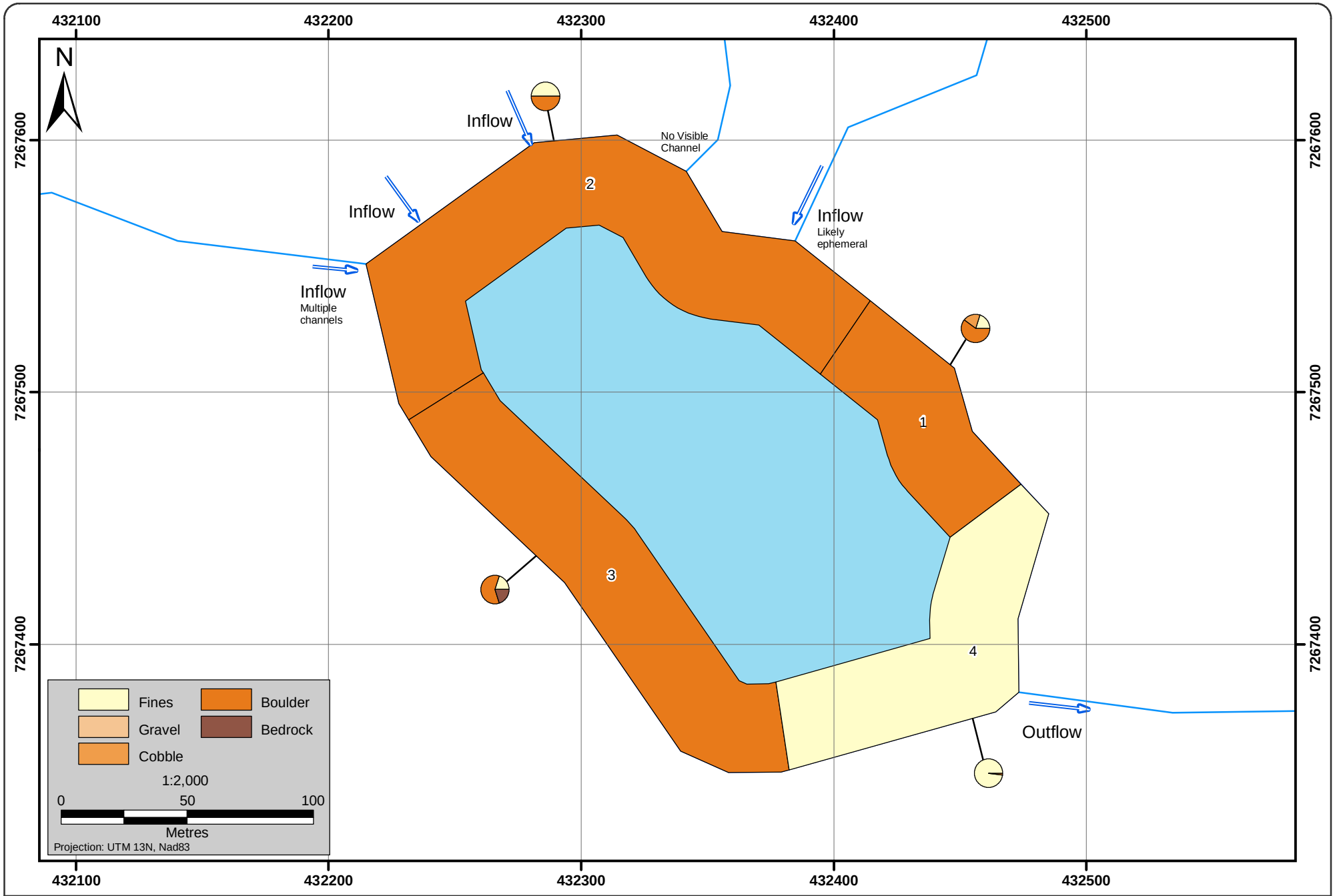


Figure 3.1-12

Sabina GOLD & SILVER CORP.

Shoreline Substrate of Pond G, Wolf Watershed, Back River Project

Figure 3.1-12

Rescan™ Engineers & Scientists

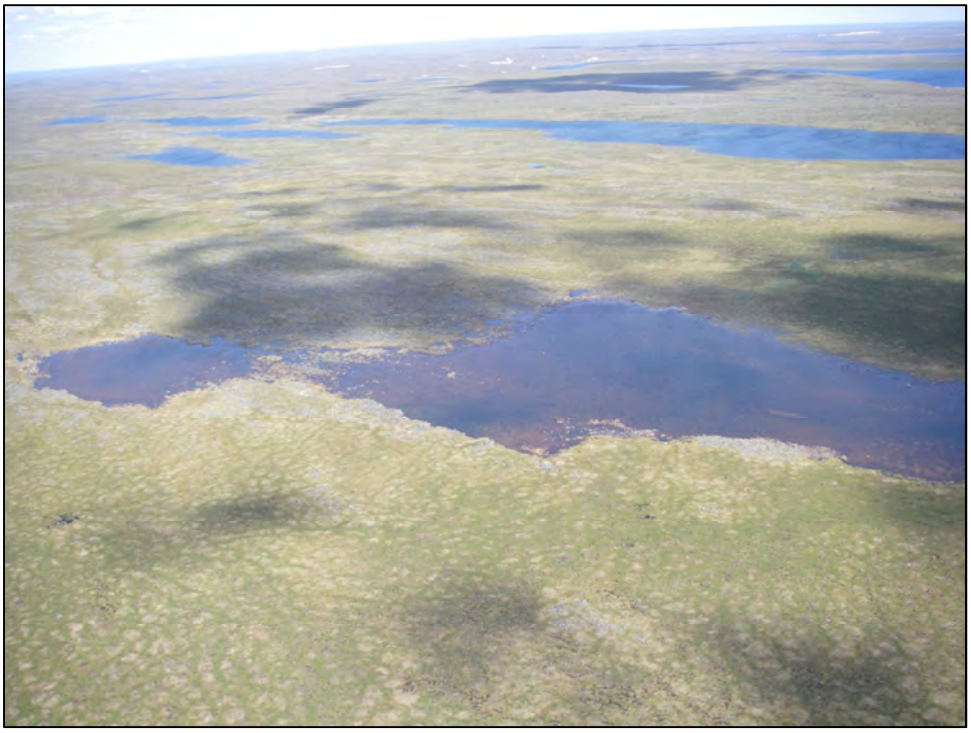


Plate 3.1-8. Aerial view of Pond E, Giraffe watershed, looking east on July 5, 2011.



Plate 3.1-9. Shoreline of Pond F, Wolf watershed, looking northwest on July 4, 2011.



Plate 3.1-10. Pond G in the Wolf watershed, looking northeast on July 3, 2011.

Pond H is located west of Pond L in the Wolf watershed. It is a shallow pond with one outflow and one inflow. The maximum depth was estimated from the air to be less than 2 m. The shoreline and pond substrate were dominated by fines with a small proportion of boulders (Plate 3.1-11). Figure 3.1-13 shows a map of the substrate zones.



Plate 3.1-11. Pond H in the Wolf watershed, looking west from the outflow on July 5, 2011.

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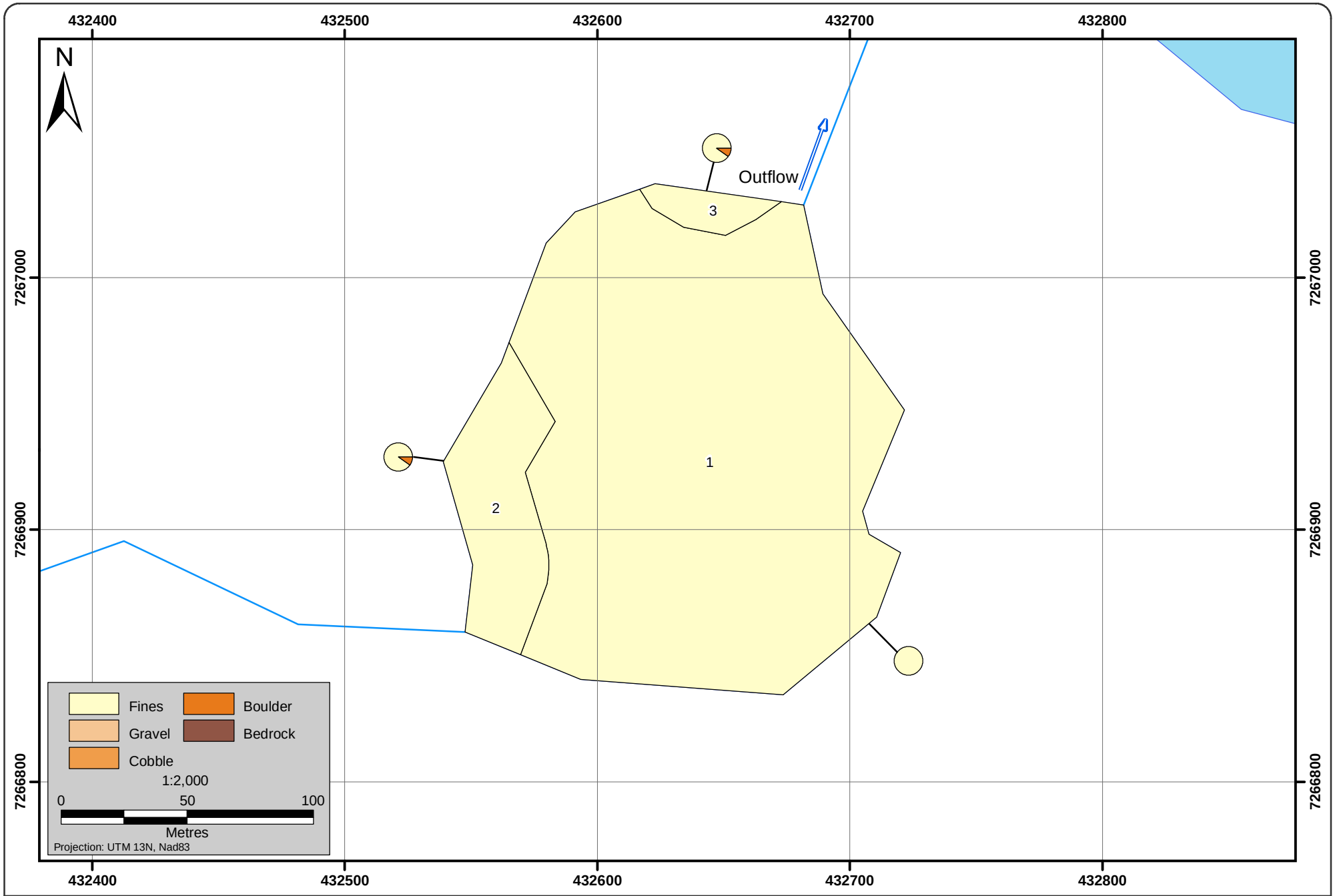


Figure 3.1-13

Sabina GOLD & SILVER CORP.

Shoreline Substrate of Pond H, Wolf Watershed, Back River Project

Figure 3.1-13

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Pond I is located southwest of Pond L in the Wolf Lake watershed, and is joined to Pond L by a wide boulder field. The maximum depth was estimated from the air to be less than 2 m. The pond has one inflow and one outflow. The shoreline of Pond I is dominated by boulder and fines (Plate 3.1-12). Figure 3.1-14 shows a map of the shoreline habitat and littoral zone.



Plate 3.1-12. Northern shoreline of Pond I in the Wolf watershed, looking east, with Pond L in the background on July 3, 2011.

Pond J is located east of Pond L in the Wolf watershed. It is a shallow pond with a maximum depth estimated to be less than 2 m. The substrate throughout most of the pond is dominated by fine sediments, with boulder habitat along the shoreline on the west and north sides (Plate 3.1-13). The pond has 3 inflows and one outflow. Figure 3.1-15 shows a map of the substrate zones.

Pond K is located north of Pond J in the Wolf watershed. It has one outflow and no permanent inflows. The pond was too shallow to launch a boat, and the maximum depth was estimated from the air to be less than 2 m. The shoreline is dominated by fine sediment with a few areas of boulder and bedrock. Figure 3.1-16 shows a map of the shoreline and littoral zone.

Pond L is an elongate pond located north of Wolf Lake. It is mostly shallow, with a shoreline and substrate dominated by boulders, except for a fine sediment beach at the north end (Plate 3.1-14). The maximum depth is approximately 2.5 m. The pond has three inflows and one outflow. The outflow is shown on maps flowing towards Wolf Lake in the south, but field surveys indicated that it actually flows east towards Pond J. Figure 3.1-17 shows a map of the shoreline and substrate zones.

3.1.2 Fish Community

Community Composition and CPUE

Only three of the 18 ponds sampled during 2011 were found to contain fish. Two species were captured: Arctic grayling (*Thymallus arcticus*) and slimy sculpin (*Cottus cognatus*) (Plate 3.1-15). Grayling were mainly captured in gillnets, although the one grayling in Pond I (Wolf watershed) was observed along the shoreline and not captured. The slimy sculpin was captured in a minnow trap. Appendix 3.1-2 presents a summary of gear locations and catch composition. Appendix 3.1-3 presents the individual fish measurements for all captured fish.

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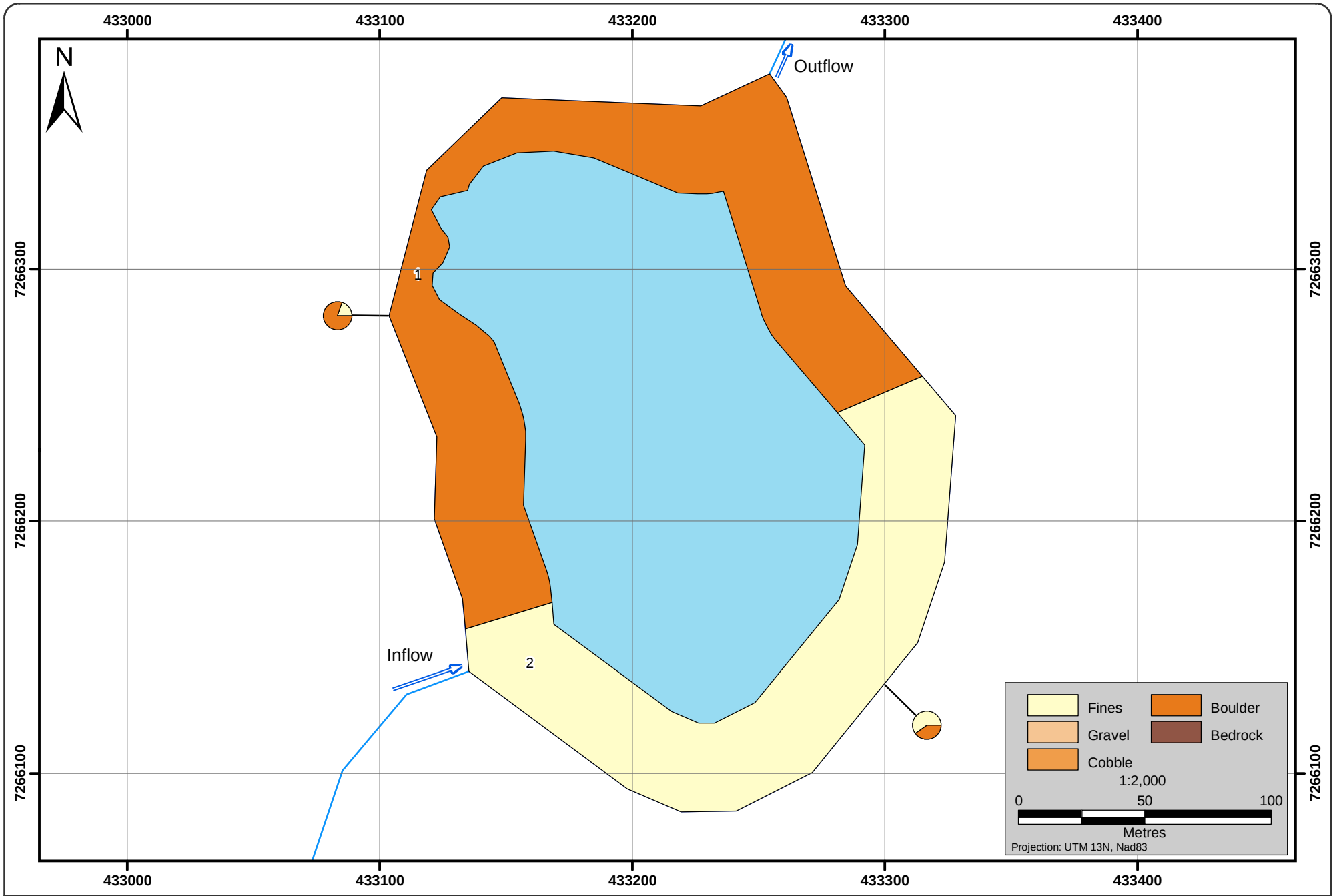


Figure 3.1-14

Sabina GOLD & SILVER CORP.

Shoreline Substrate of Pond I, Wolf Watershed, Back River Project

Figure 3.1-14

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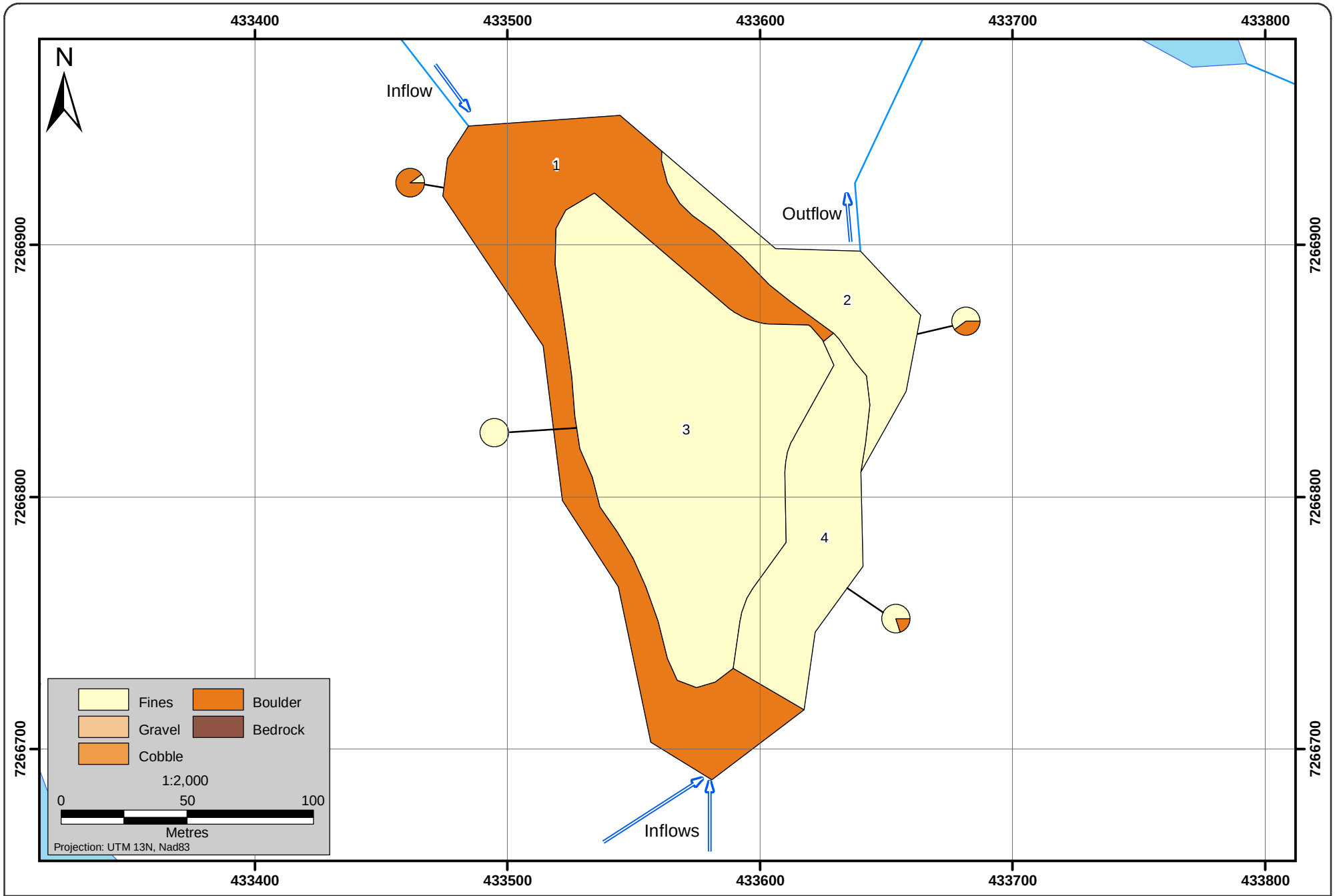


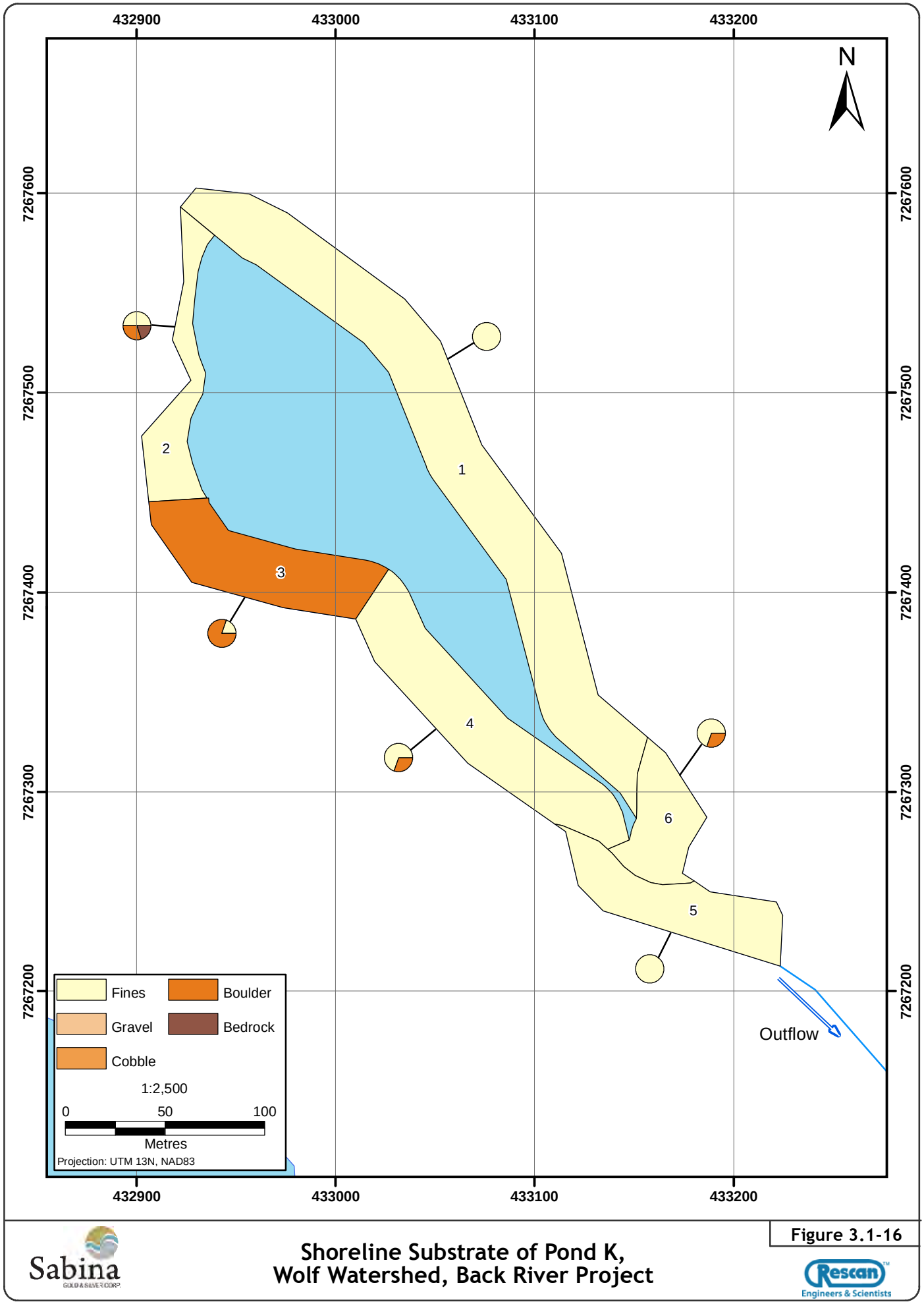
Figure 3.1-15

Sabina GOLD & SILVER CORP.

Shoreline Substrate of Pond J, Wolf Watershed, Back River Project

Figure 3.1-15

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Shoreline Substrate of Pond K, Wolf Watershed, Back River Project

Figure 3.1-16

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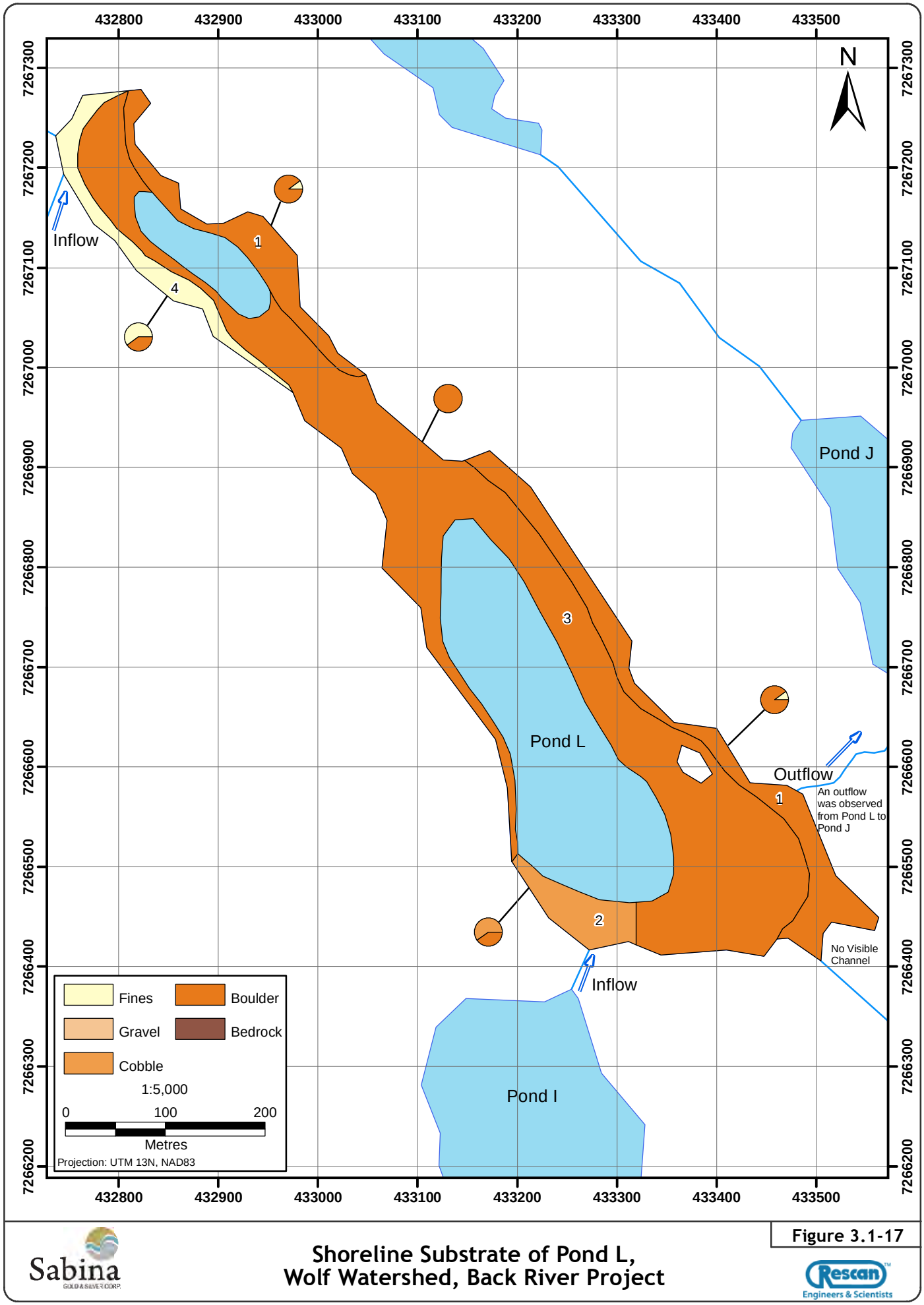


Figure 3.1-17

Shoreline Substrate of Pond L,
Wolf Watershed, Back River Project

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Plate 3.1-13. Eastern shoreline of Pond J in the Wolf watershed, looking north, with a minnow trap in the foreground. July 2, 2011.



Plate 3.1-14. Southeast shoreline of Pond L in the Wolf watershed, looking south, with Pond I on the right. July 3, 2011.



Plate 3.1-15. Arctic grayling captured in Pond L in the Wolf watershed on July 3, 2011.

Gillnets were deployed in seven of the 18 ponds, and gillnetting effort in each pond ranged from 2.1 hours to 3.7 hours. Gillnet CPUE in Pond L averaged 1.16 fish/100 m^2/h. All fish captured in gillnets were Arctic grayling. No fish were captured in gillnets in any other pond. One additional Arctic grayling was observed in Pond I, which is connected to Pond L in the Wolf watershed; however, Pond I was too shallow to deploy gillnets and no fish were captured in minnow traps. Minnow trapping was conducted in all ponds, and effort in each pond ranged from 134.8 trap hours to 286.0 trap hours. Only one slimy sculpin was captured in a minnow trap in Pond D in the Giraffe watershed. This low capture rate may mean that some ponds could be fish-bearing, even though no fish were captured. Table 3.1-1 shows the catch summary for each of the ponds where fish were captured.

Table 3.1-1. Catch Summary for Ponds in the Back River Project Area, 2011

	Species Captured	
Pond	**Arctic Grayling**	**Slimy Sculpin**
Giraffe watershed		
Pond D	0	1
Wolf watershed		
Pond I	1	0
Pond L	11	0

Biological Characteristics

Arctic grayling captured in Pond L (Wolf watershed) ranged in size from 213 mm to 330 mm with a mean of 281 mm. No weights were obtained due to a scale malfunction. The fish ranged in age from four to seven years with a mean of six years of age. Two of the grayling captured died during sampling. Both fish contained numerous parasites and worms. The one sculpin captured measured 62 mm and weighed 2 g. No other fish were captured during pond sampling.

3.2 LAKE ASSESSMENTS

3.2.1 Fish Habitat

Four lakes in the Goose property area were surveyed for shoreline habitat type and quality. Appendix 3.2-1 presents the habitat substrate data for each of the lakes.

Umwelt Lake is located between Goose Lake and Llama Lake in the Llama Watershed. It has two inflows (from Llama Lake and Pond 1), and one outflow (to Goose Lake). It is relatively shallow with a maximum depth of 3 m (Rescan 2010). The shoreline is dominated by cobble substrate and a shallow slope (Figure 3.2-1).

Llama Lake is located north of Umwelt Lake in the Llama Watershed. It has two inflows and one outflow. The maximum depth is approximately 13 m (Rescan 2010). The shoreline is dominated by cobble and boulder substrate with small patches of fines at the north and west sides (Figure 3.2-2). The water in Llama Lake was clear compared to other lakes, and patches of sandy substrate were observed in the deeper parts of the lake.

Goose Lake is a large waterbody with diverse shoreline habitat. Approximately half of the shoreline area is dominated by boulder habitat. Fines and cobble were also present in the main basin of the lake. One section of shoreline near the west end of the lake is dominated by bedrock (Figure 3.2-3). There are multiple inflows to Goose Lake, including flows from the Llama Watershed, Echo Watershed, Wolf Watershed, Giraffe Watershed and smaller unnamed lakes. One main outflow drains Goose Lake towards Propeller Lake to the east. Shallow shoals are present in the south and north parts of the lake, as well as around islands.

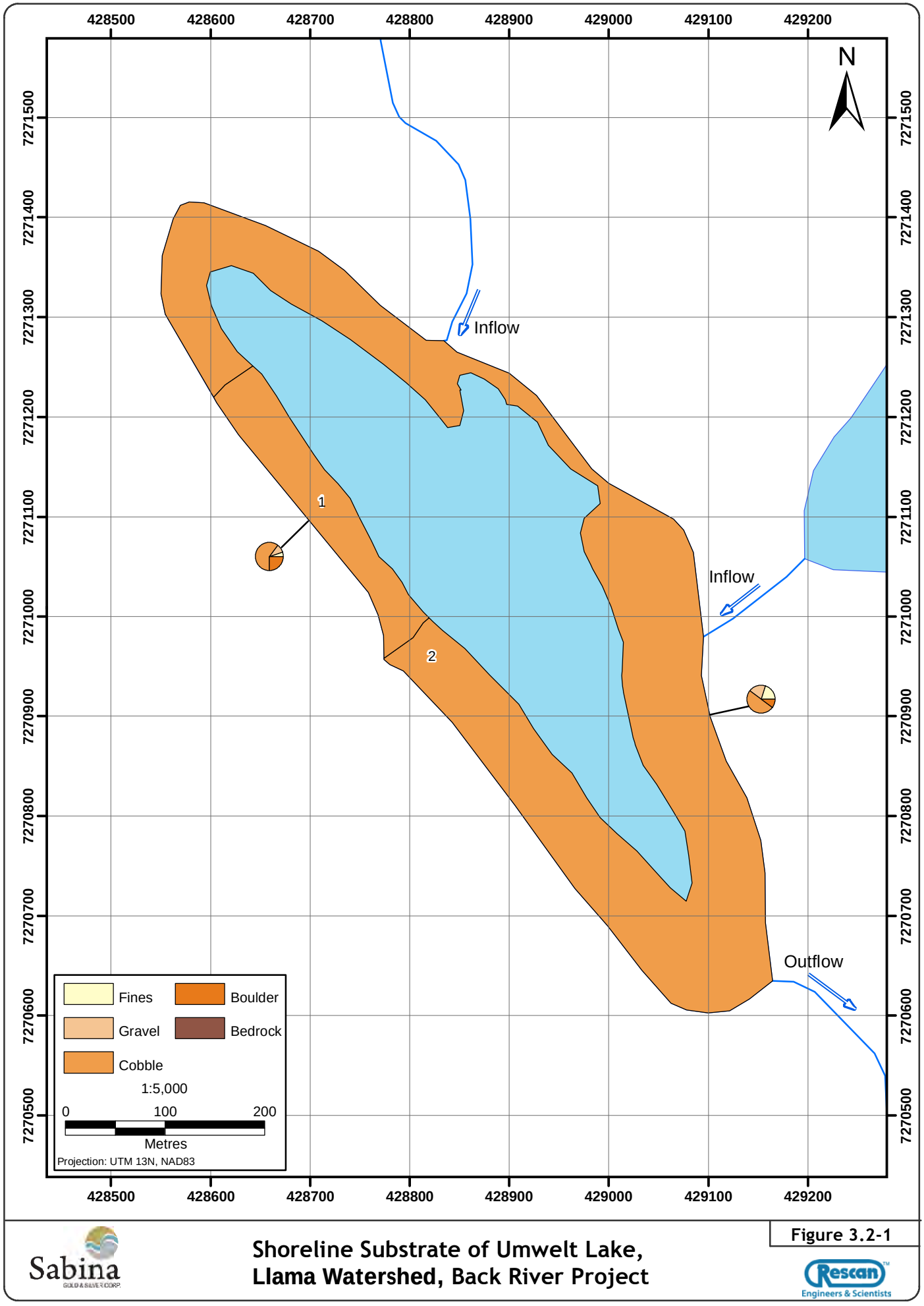
Reference B Lake is located south of the Project area in the Back River regional watershed (Reference B local watershed). The shoreline substrate is dominated by cobble and boulder habitat with very few fines (Figure 3.2-4). There is a single inflow and outflow. The maximum depth is approximately 5 m (Rescan 2010).

3.2.2 Community Composition and CPUE

Lake trout (*Salvelinus namaycush*) and round whitefish (*Prosopium cylindraceum*) were targeted for detailed sampling because they are generally the most abundant large fish in the Project area. Lake trout were captured in Goose Lake, Llama Lake and Reference B Lake, while round whitefish were captured in Reference B Lake and Umwelt Lake. All fish were captured by gillnetting. Gillnet effort in each lake ranged from 4.2 hours to 14.1 hours. CPUE ranged from 0.34 to 2.89 fish/100 m^2/h, and was highest in Reference B Lake and lowest in Umwelt Lake. Table 3.2-1 shows the catch summary for lakes sampled for MMER.

Table 3.2-1. Catch Summary for Lakes Sampled for MMER, 2011

Lake	Species Captured		Mean Total CPUE (fish/100 m^2/h)
	Lake trout	Round whitefish	
Llama Watershed			
Umwelt	0	2	0.34
Llama	6	1	0.52
Goose Watershed			
Goose	6	0	0.78
Reference B Watershed			
Reference B	7	13	2.89

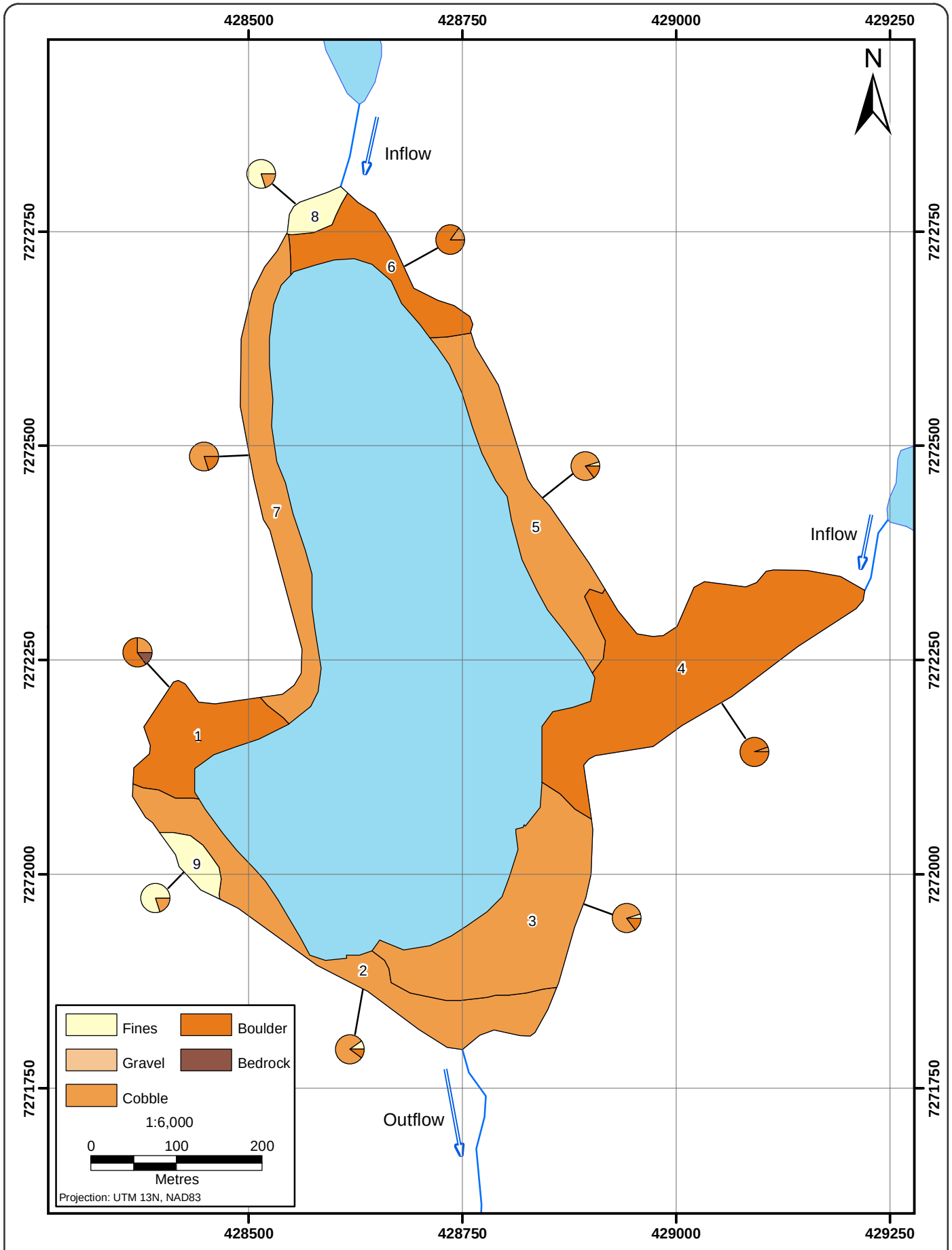


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Shoreline Substrate of Umwelt Lake, Llama Watershed, Back River Project

Figure 3.2-1

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Shoreline Substrate of Llama Lake, Goose Watershed, Back River Project

Figure 3.2-2

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PROJECT #0833-002-04 GIS # BAC-06-012t February-07-12

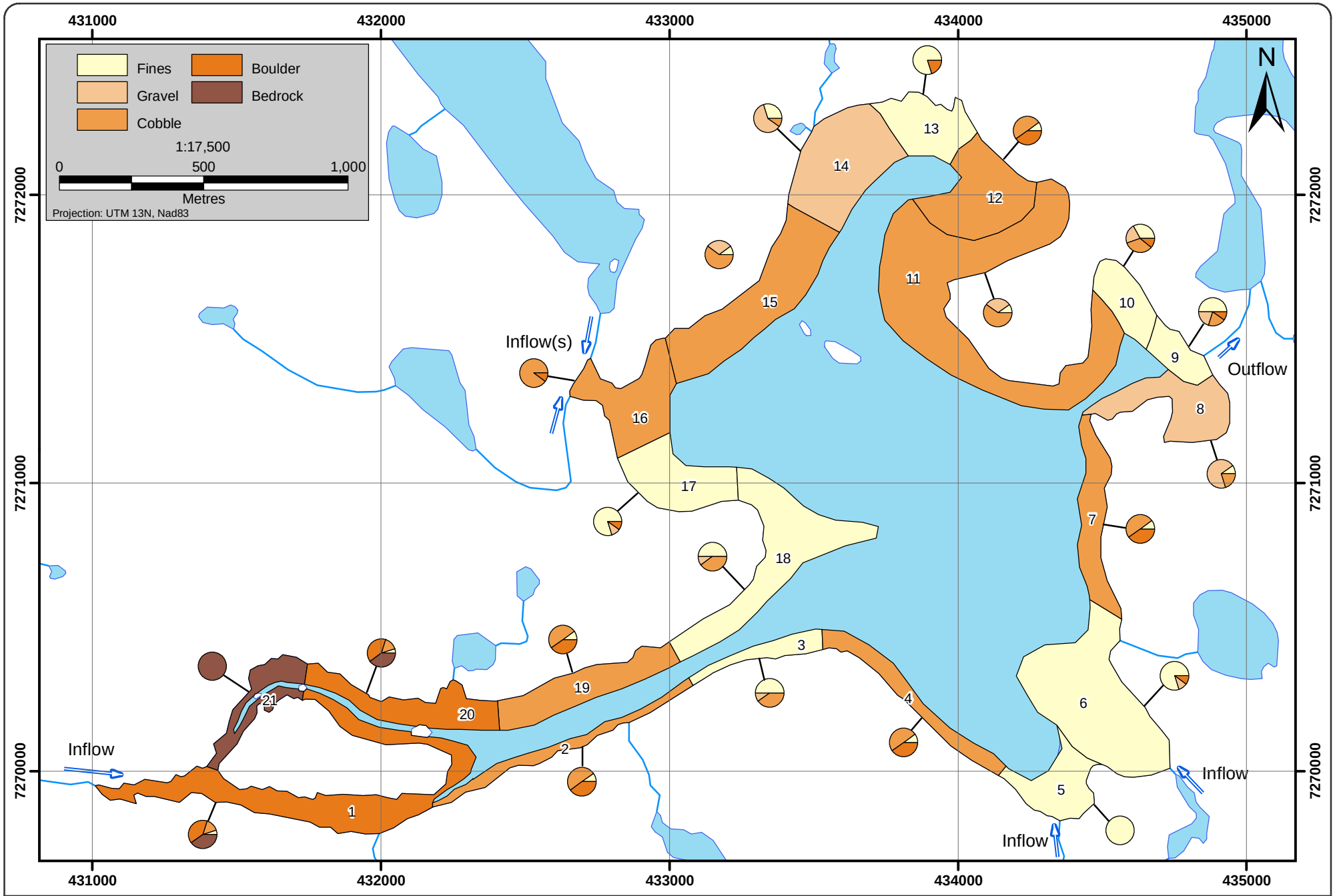


Figure 3.2-3

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Shoreline Substrate of Goose Lake, Goose Watershed, Back River Project

Figure 3.2-3

Rescan™ Engineers & Scientists

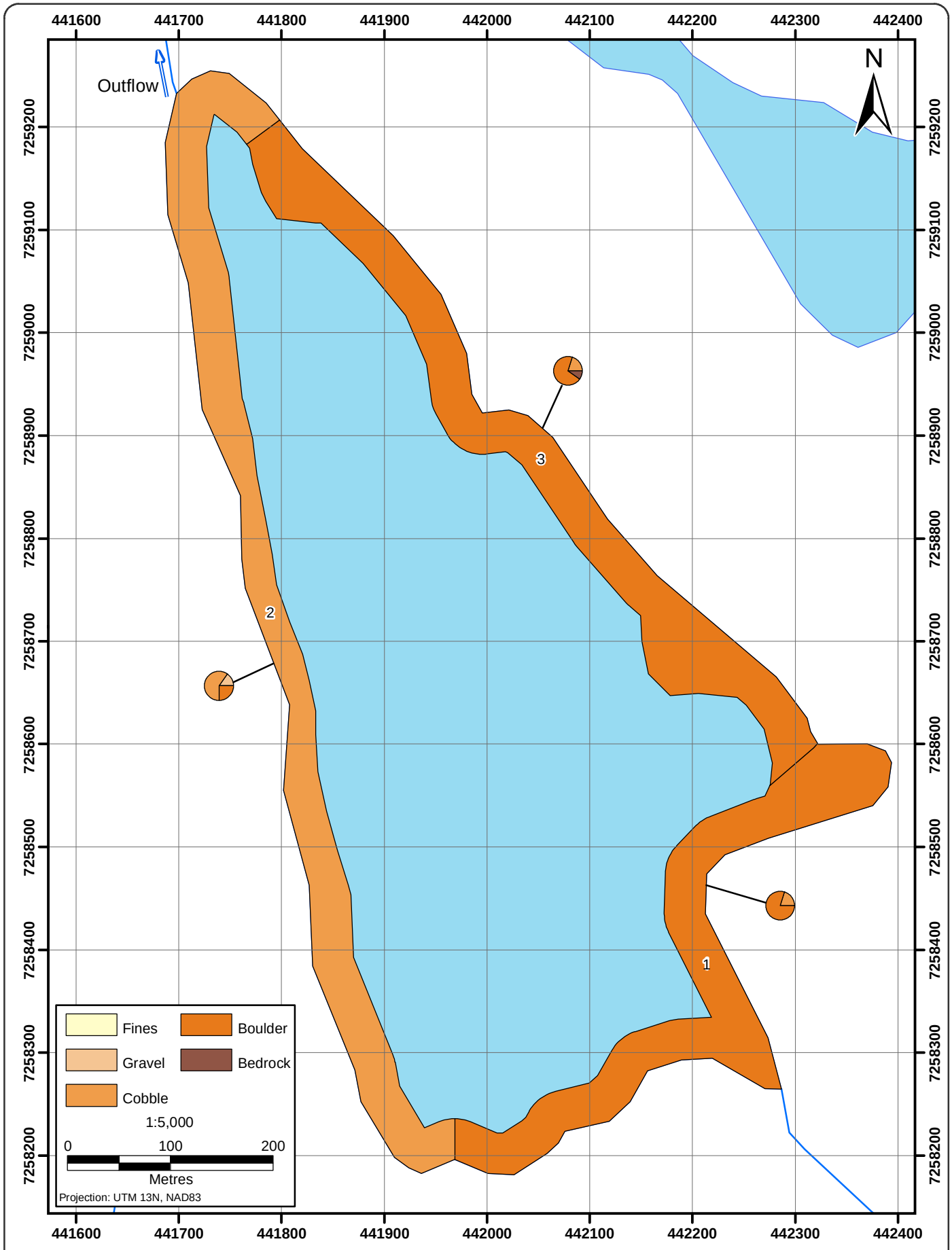


Figure 3.2-4

Shoreline Substrate of Reference B Lake, Reference B Watershed, Back River Project

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Plates 3.2-1 and 3.2-2 show a lake trout captured from Llama Lake and a round whitefish captured from Umwelt Lake. Appendix 3.2-2 presents the gear location and catch summary data for each lake. Appendix 3.2-3 presents the individual fish data from each lake.



Plate 3.2-1. Lake trout captured from Llama Lake in August 2011.



Plate 3.2-2. Round whitefish captured from Umwelt Lake in August 2011.

3.2.3 Biological Characteristics

Energy Storage

In Goose Lake and Llama Lake, only lake trout were captured. In Goose Lake, lake trout ranged in length from 315 to 496 mm, with a mean of 403 mm fork length. Total weight ranged from 349 g to 1,424 g, with a mean of 750 g. In Llama Lake, lake trout ranged in length from 331 to 592 mm, with a mean of 489 mm. Total weight ranged from 340 to 1,950 g, with a mean of 1,235 g.

In Reference B Lake, both lake trout and round whitefish were captured. Lake trout ranged in size from 422 to 529 mm, with a mean of 482 mm fork length. Total weight ranged from 678 to 1,512 g with a mean of 1,106 g. Round whitefish ranged in length from 379 to 395 mm with a mean of 390 mm fork length. Total weight ranged from 651 to 811 g with a mean of 697 g.

Only round whitefish were captured in Umwelt Lake. Two fish were captured, with a minimum size of 255 mm and 136 g and a maximum size of 263 mm and 138 g. Table 3.2-2 presents a summary of fish measurements from each of the lakes. Due to the low sample size, fish from Umwelt Lake were not sacrificed for tissue analysis.

Table 3.2-2. Summary of Fish Measurements from Lakes, 2011

	Goose Lake	Llama Lake	Reference B Lake		Umwelt Lake
	Lake trout	Lake trout	Lake trout	Round whitefish	Round whitefish
	6	5	7	4	2
Fork length (mm)					
Minimum	315	331	422	379	255
Maximum	496	592	529	395	263
Mean	403	489	482	390	259
Standard error	29	46	15	4	4
Total weight (g)					
Minimum	349	340	678	651	136
Maximum	1,424	1,950	1,512	811	138
Mean	750	1,235	1,106	697	137
Standard error	164	284	100	38	1
Condition					
Minimum	0.97	0.94	0.84	1.06	0.76
Maximum	1.17	1.01	1.11	1.32	0.82
Mean	1.06	0.96	0.98	1.17	0.79
Standard error	0.03	0.01	0.04	0.06	0.03
Gonad weight (g)					
Minimum	0.64	6.59	4.53	-	-
Maximum	43.79	40.30	37.40	-	-
Mean	10.10	16.96	18.11	-	-
Standard error	7.70	7.04	4.49	-	-
Liver weight (g)					
Minimum	2.44	2.02	4.21	-	-
Maximum	11.98	12.87	13.68	-	-
Mean	5.01	7.29	9.01	-	-
Standard error	1.46	1.93	1.06	-	-

The mean fork length and total weight of lake trout were compared among lakes located near deposits (Goose and Llama) and the reference (Reference B) lake. There was no significant difference in fork length (ANOVA; $F_{2,15}$=2.53, *P*=0.11) or total weight (ANOVA; $F_{2,15}$=1.80, *P*=0.20) among the lakes. Mean condition factor was also compared among lakes. No significant differences in lake trout condition were observed (ANOVA; $F_{2,15}$=1.95, *P*=0.18). Figure 3.2-5 shows the mean fork length, total weight and condition of lake trout in Goose, Llama and Reference B lakes.

A length-frequency distribution of all lake trout captured shows that the majority of fish fell into a size class between 420 and 540 mm; however, modes also appear at 320 to 340 mm, 380 to 400 mm and over 560 mm (Figure 3.2-6). Possible explanations include the deceleration of growth as fish age (as fish age, growth tends to slow so that age classes become indiscernible from one another), gear selectivity, or lack of recruitment into smaller size classes; however, the small sample size is insufficient for making generalizations about the population as a whole.

The relationship between total weight and fork length of lake trout was tested using a regression analysis. Weight-length regressions for lake trout were significant in all lakes (adjusted r^2 from 0.80 to 0.99; *P*<0.05). A general linear model (GLM) was used to compare the slopes of the regressions and weight-at-length (a measure of condition). The interaction between fork length and lake did not have a significant effect on total weight (GLM; $F_{2,16}$=0.13, *P*=0.88), indicating that the slopes of the regressions were equal. Weight-at-length was not significantly different among lakes (GLM; $F_{2,16}$=1.34, *P*=0.29). Figure 3.2-7 shows the weight-length regressions for lake trout in Goose, Llama and Reference B lakes.

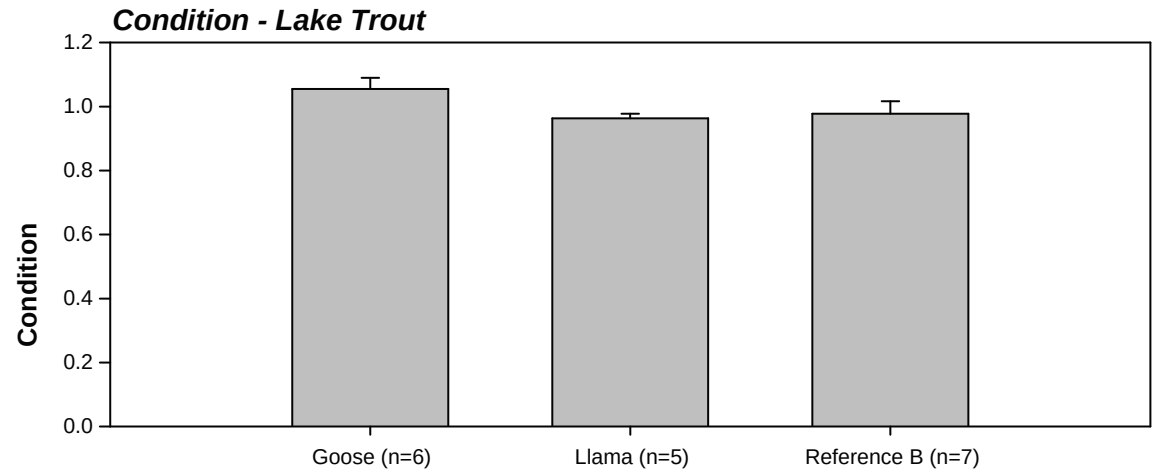
There was a significant linear relationship between liver weight and somatic body weight for lake trout captured in Goose Lake and Llama Lake (*P*<0.05 for both), but not for trout from Reference B Lake (*P*=0.40) (Figure 3.2-8). Fish from Reference B Lake fell into a smaller size range which, together with the small sample size, may have reduced the power of the analysis. No comparison of liver weight-at-body weight could be made among lakes due to this result.

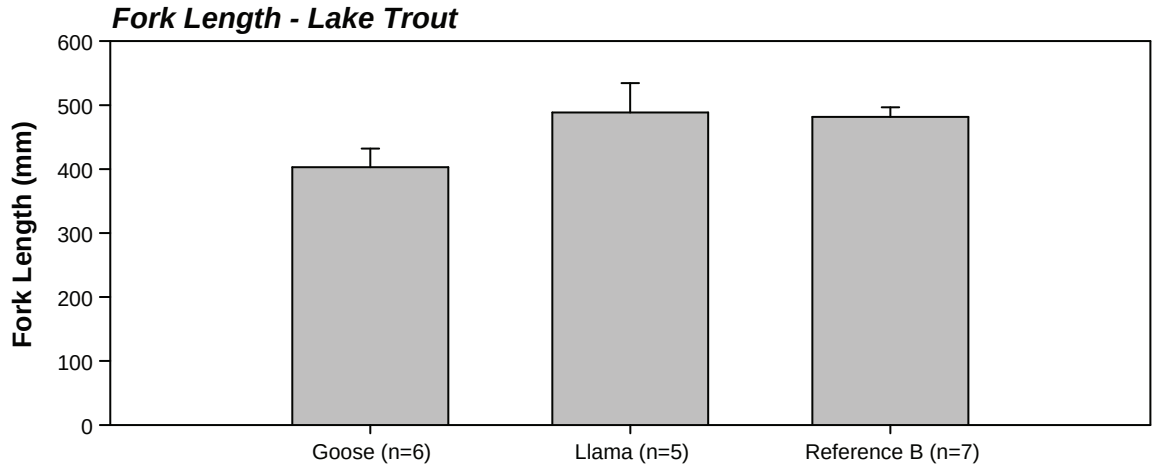
Energy Use

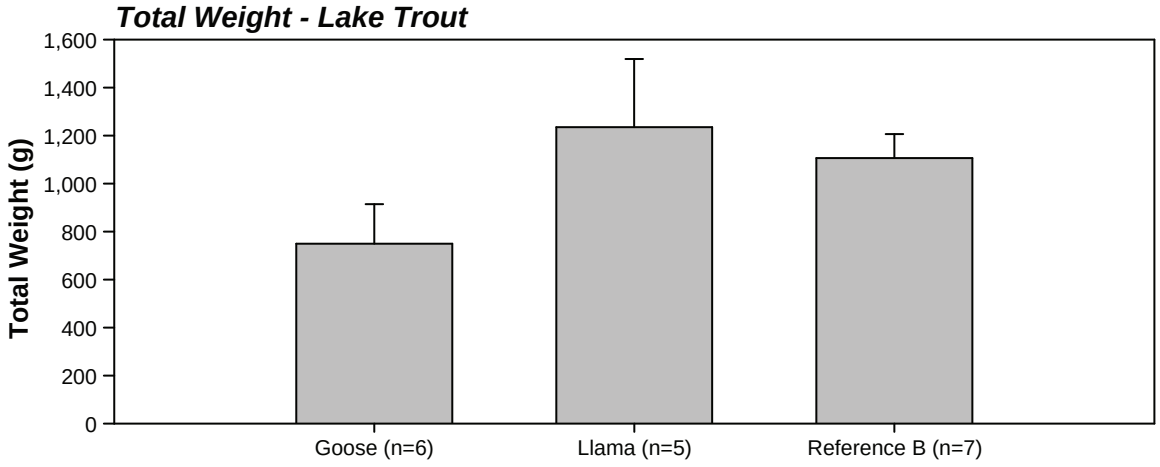
An age-frequency distribution of all lake trout captured seems to show that older fish were captured more than younger fish (Figure 3.2-9). This result is likely due to the selectivity of the sampling gear used. Gillnets tend to target larger (hence, older) fish, potentially skewing age- and size-related distributions. There were no significant differences in the age of lake trout among lakes (ANOVA; $F_{2,14}$=1.70, *P*=0.22) (Figure 3.2-10). The mean age of lake trout captured ranged from 13.7 years in Goose Lake to 19 years in Llama Lake.

The length-age relationship (an indicator of growth rate) was tested using a regression analysis. Age had a significant effect on lake trout fork length in all waterbodies (Regression; $F_{1,15}$ = 112.55, *P*<0.01); and the slopes of the regression lines were not significantly different (GLM; $F_{2,13}$=1.29, *P*=0.31). There was no significant difference in length-at-age among lakes (ANCOVA; $F_{2,13}$=1.00, *P*=0.39). Figure 3.2-11 shows the length-age relationship for all lake trout captured.

The fecundity of females (i.e., number of eggs) was not recorded because the eggs of females captured were not fully developed. Table 3.2-3 shows the number of fish of each sex and maturity level captured from each lake. Reproduction was analyzed through the use of gonad-body weight relationships. Due to the low sample size, regression analysis could not be used to assess relative gonad size. Instead, lake trout from each sex were pooled from all lakes and a Pearson product moment correlation test was used to look for relationships between gonad size and body size. Gonad weight was significantly correlated with somatic body weight for females (*P*<0.01), but not for males (*P*=0.55). Figure 3.2-12 shows the gonad weight-somatic weight relationship for lake trout from each sampled lake.





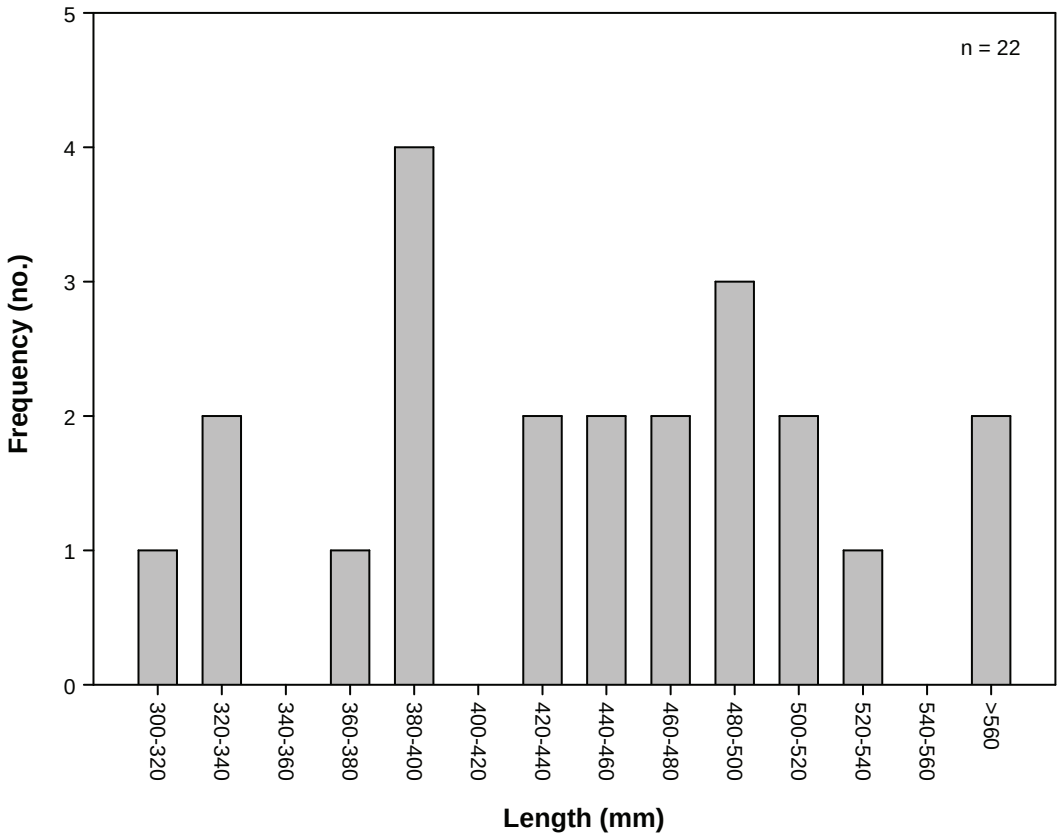


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Mean Fork Length, Total Weight and Condition of Lake Trout from Goose, Llama and Reference B Lakes, 2011

Figure 3.2-5

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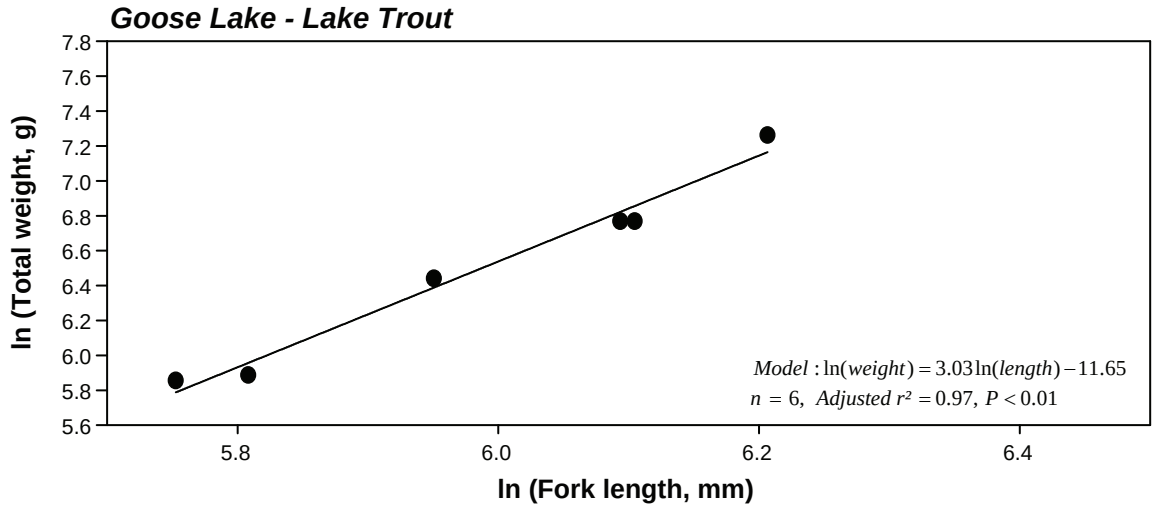


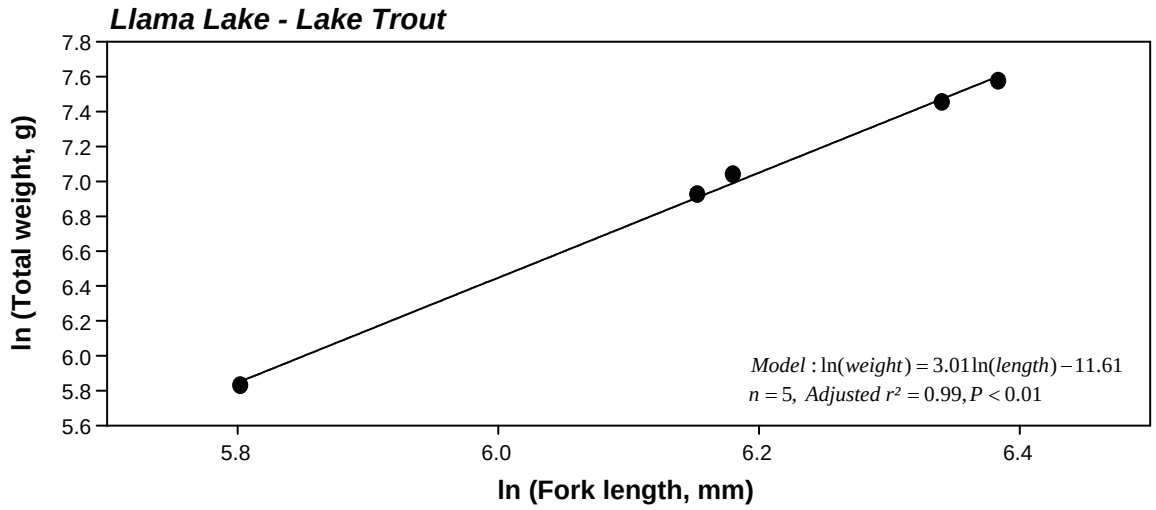
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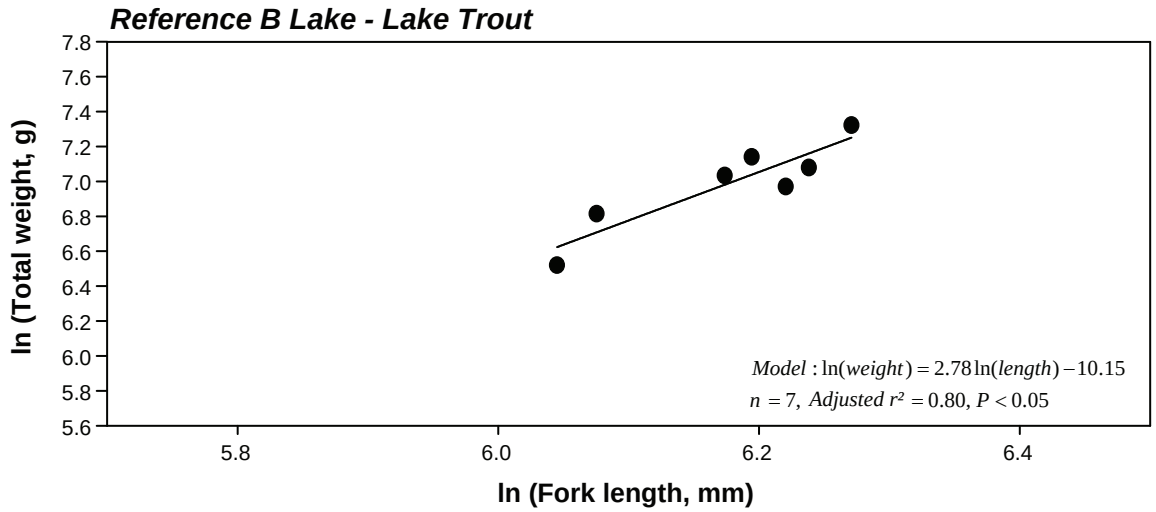
Length-Frequency Distribution of Lake Trout Captured in Goose, Llama and Reference B Lakes, 2011

Figure 3.2-6

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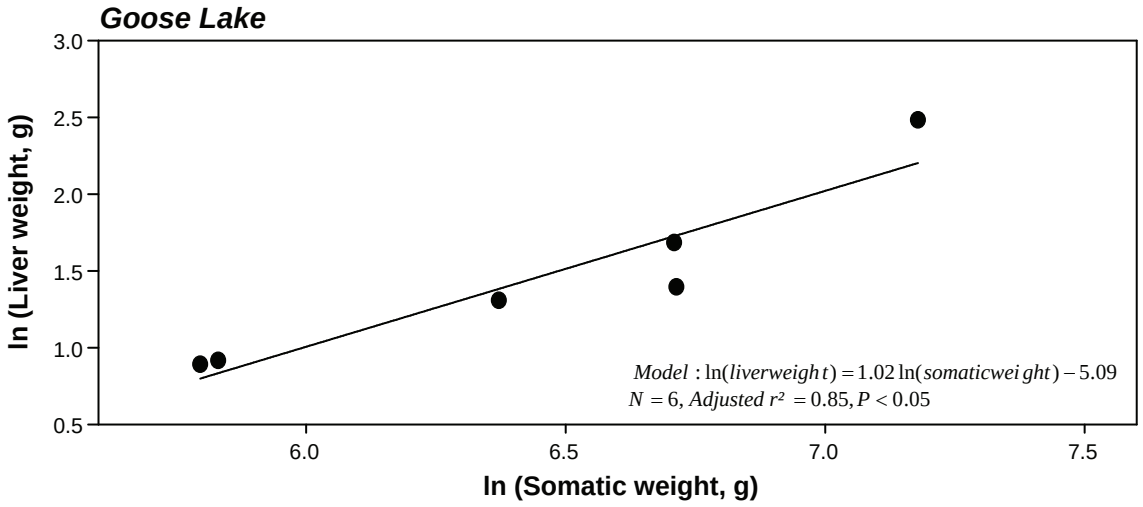


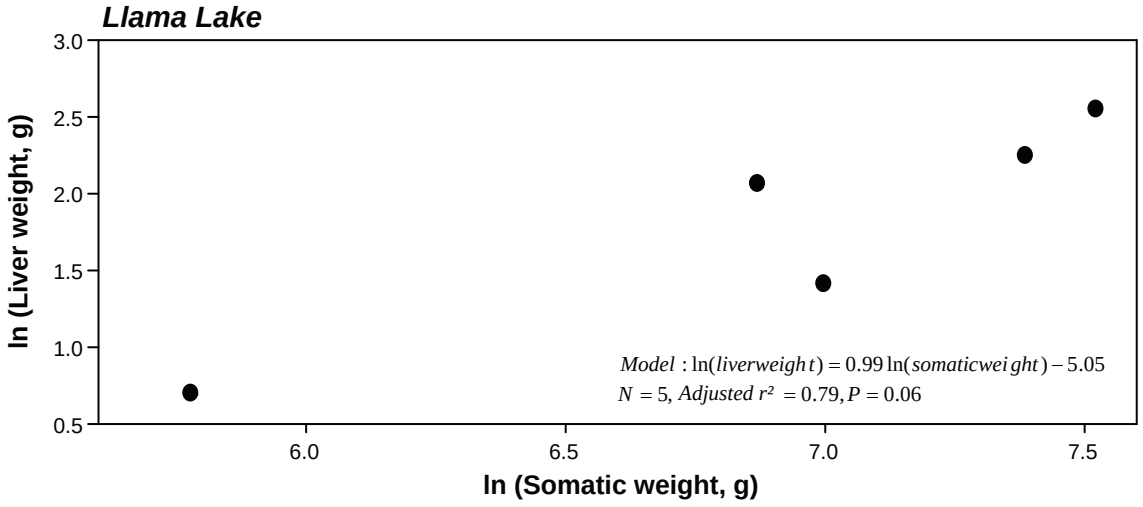
Sabina GOLD & SILVER CORP.

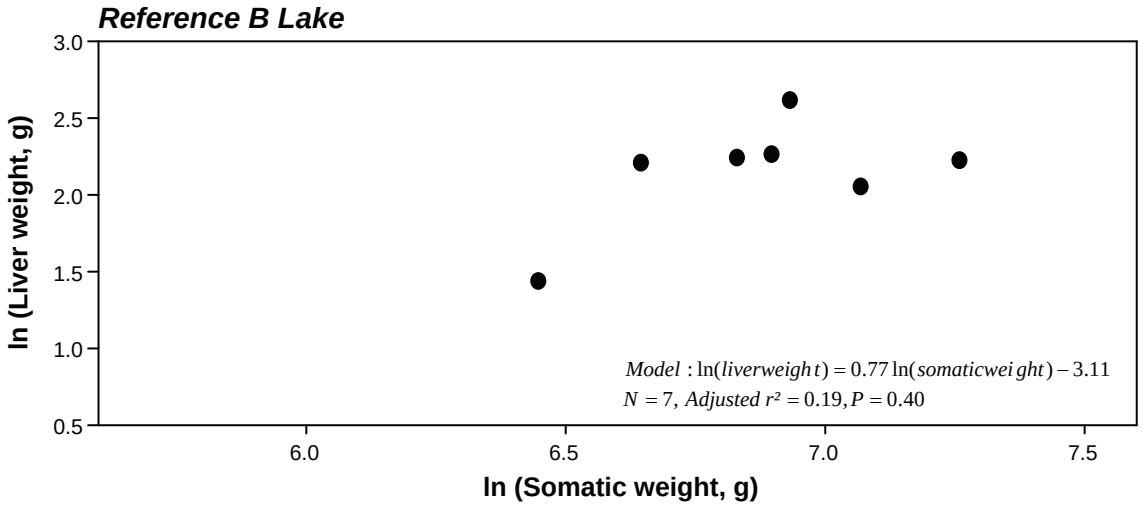
Weight-Length Regressions for Lake Trout from Goose, Llama and Reference B Lakes, 2011

Figure 3.2-7

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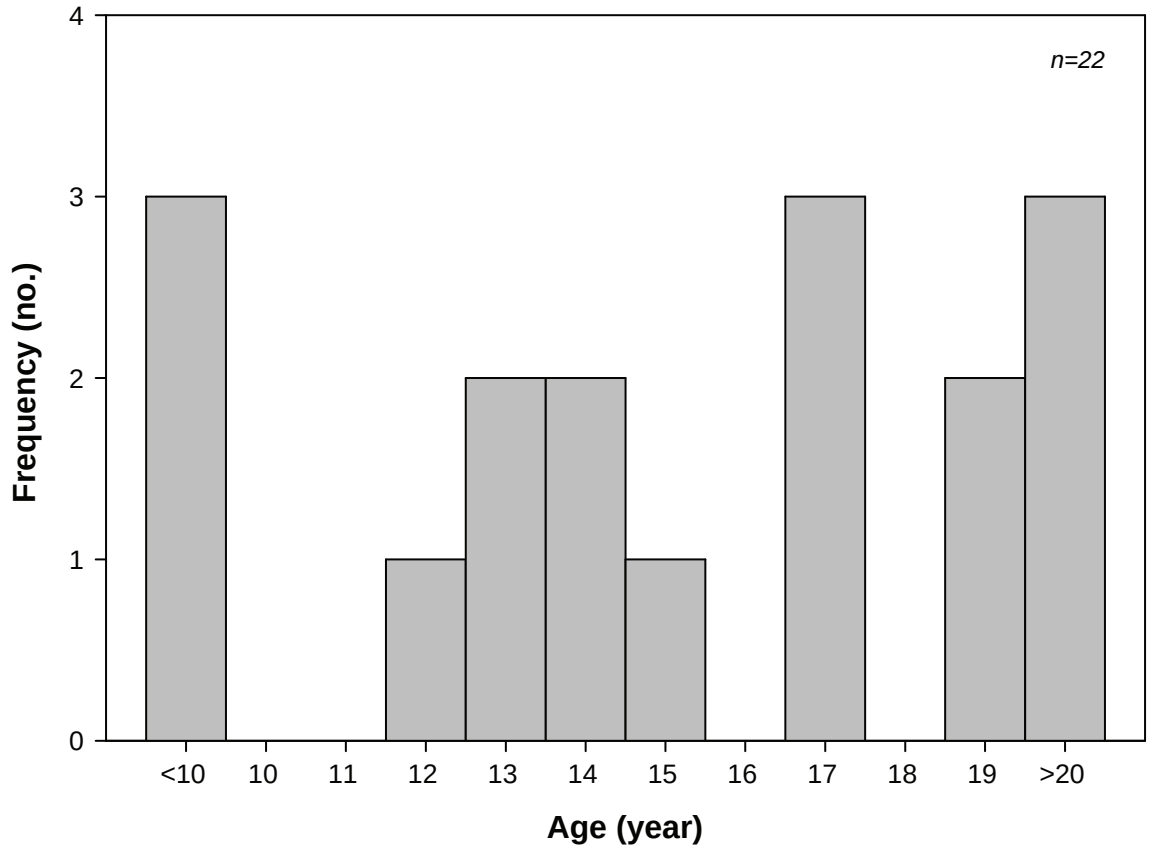






Liver Weight-Somatic Weight Regressions for Lake Trout from Goose, Llama and Reference B Lakes, 2011

Figure 3.2-8

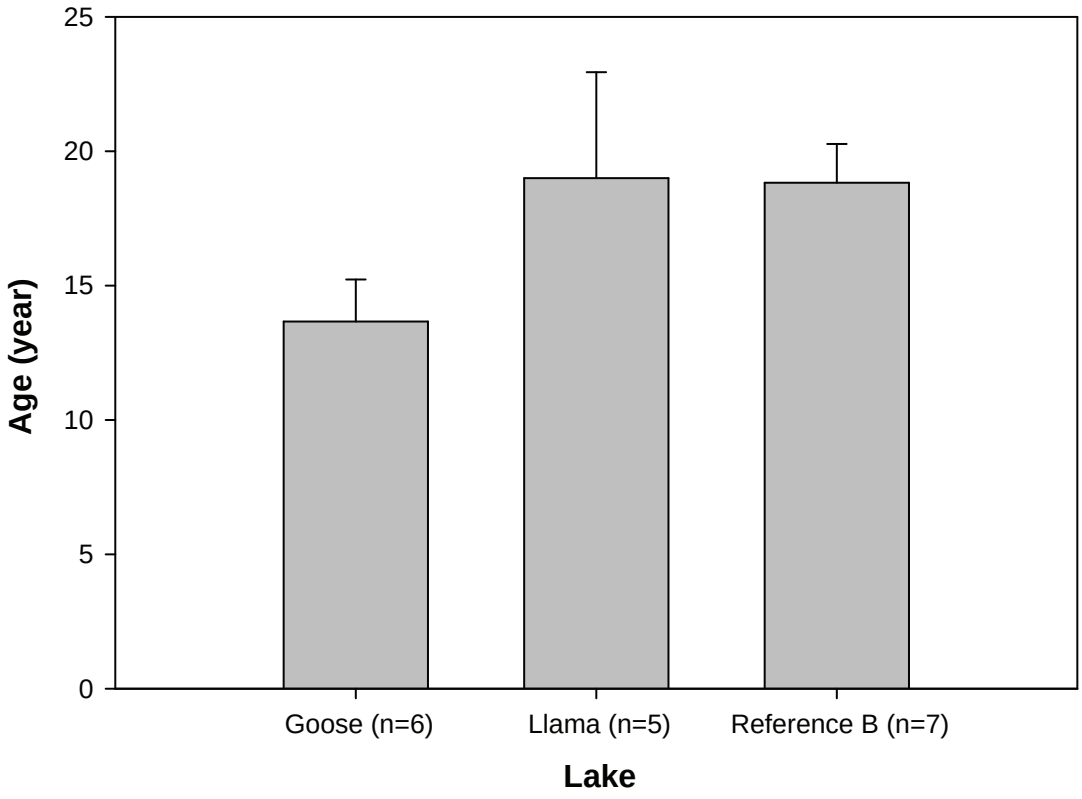


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Age-Frequency Distribution of Lake Trout Captured in Goose, Llama and Reference B Lakes, 2011

Figure 3.2-9

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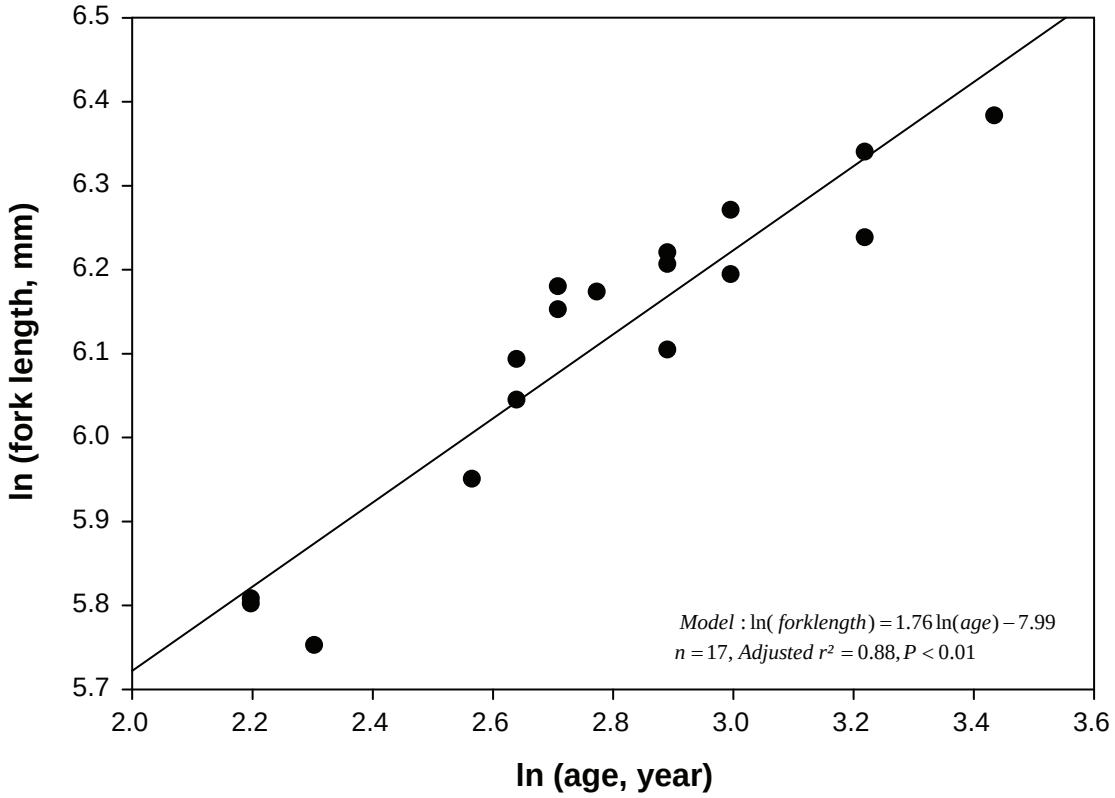
Note: Error bars represent standard error of the mean.

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Mean Age of Lake Trout Captured in Goose, Llama and Reference B Lakes, 2011

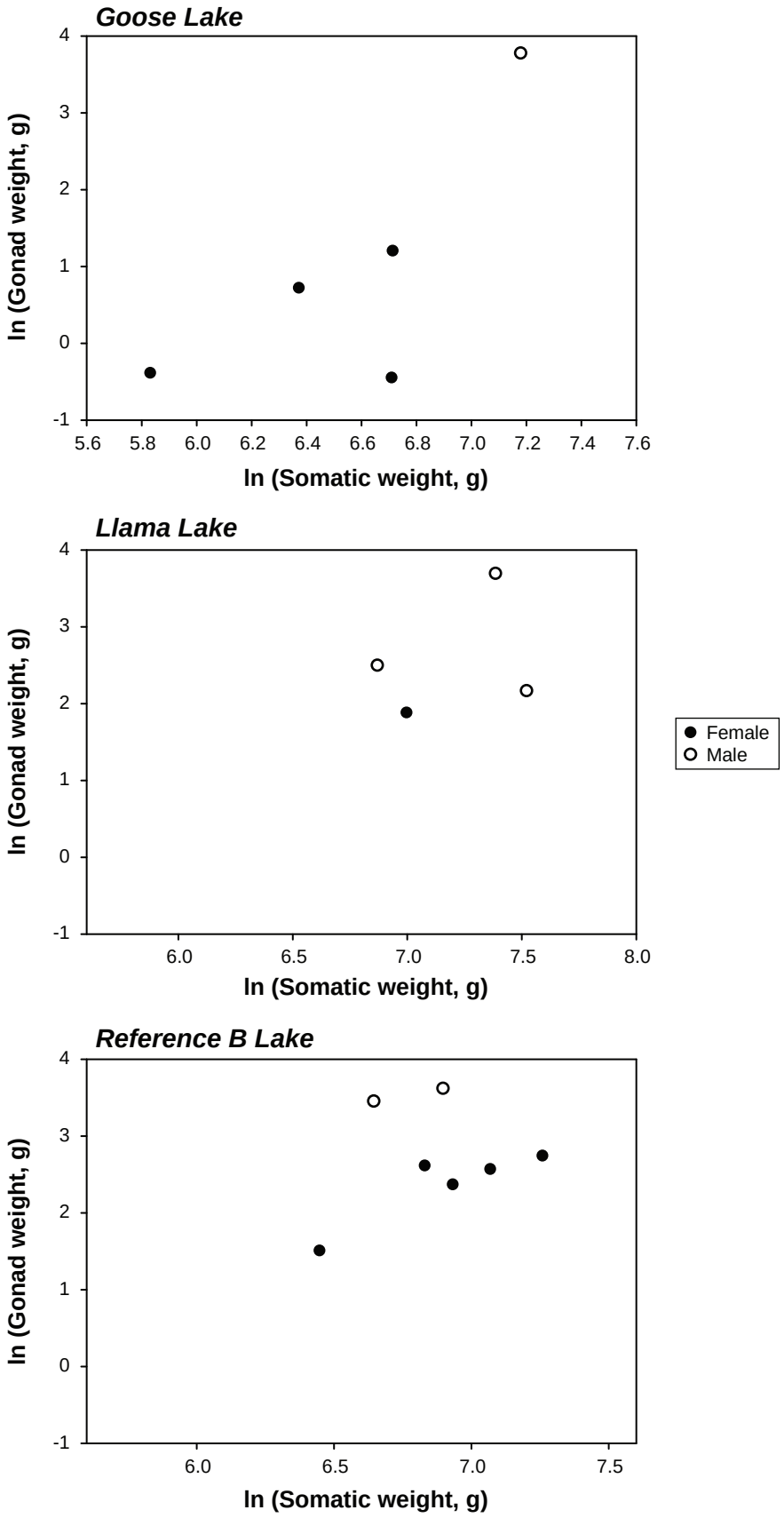
Figure 3.2-10

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Age-Length Regression for Lake Trout Captured in Goose, Llama and Reference B Lakes, 2011

Figure 3.2-11



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Gonad Weight-Somatic Weight Relationships for Lake Trout in Goose, Llama and Reference B Lakes, 2011

Figure 3.2-12

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Table 3.2-3. Maturity of Lake Trout Collected from in August 2011

	Goose			Llama			Reference B	
Maturity	Female	Male	Unknown	Female	Male	Unknown	Female	Male
Immature	2	0	1	1	1	1	0	0
Maturing	2	0	0	0	0	0	5	0
Mature	0	1	0	0	2	0	0	1
Spawning	0	0	0	0	0	0	0	1

Tissue Quality

Of the 25 metals included in the tissue quality analysis, 15 occurred at levels below the detection limit in more than 25% of the fish captured; therefore, these metals were excluded from further examination. Figure 3.2-13 shows the mean concentrations of tissue metals in lake trout from each of the sampled lakes. Appendix 3.2-4 presents the results of the tissue metal analysis.

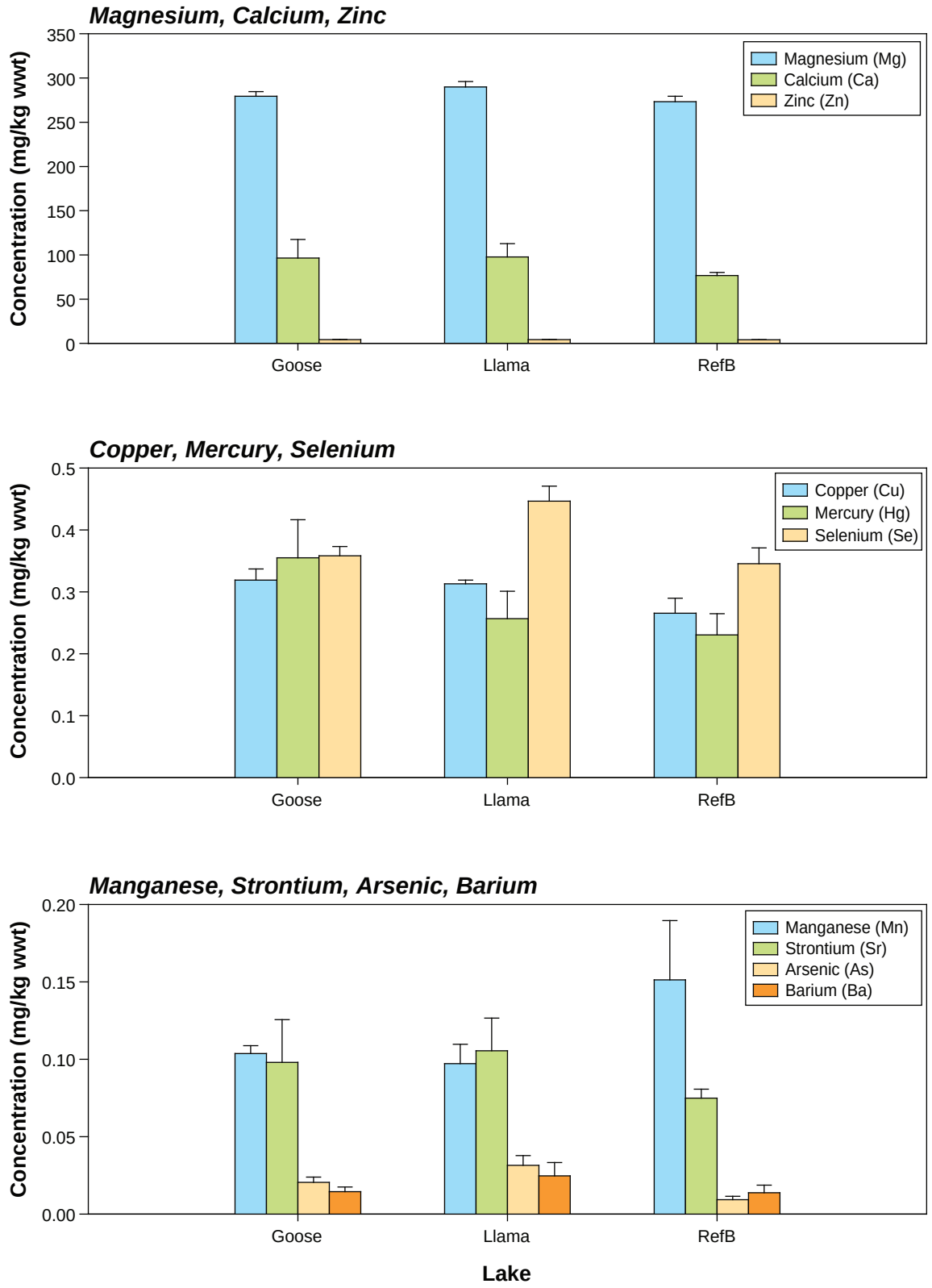
A Pearson product moment correlation analysis indicated that fish somatic weight (i.e., total weight minus the weight of internal organs) was significantly correlated with the concentrations of four metals: barium (P<0.05), calcium (P<0.01), mercury (P<0.05), and strontium (P<0.01). Further analysis indicated that there were no significant differences in the concentration of barium across all given weights among fish from different lakes (ANCOVA; $F_{2,13}$=1.05, P=0.38); however, the low sample number from each waterbody may limit the power of the analysis. For the remaining three metals, the interaction between lake and somatic weight had a significant effect on the concentration of metals in fish tissues, indicating that the relationship between fish weight and tissue metal concentration differed among lakes and could not be compared. Again, low sample numbers from each waterbody may limit the power of these analyses.

Two metals, arsenic and selenium, did not show a significant relationship with fish weight, yet concentrations of these metals in lake trout tissues differed among lakes. Concentrations of arsenic in fish tissues were significantly higher in Goose and Llama Lakes than in Reference B Lake (ANOVA; $F_{2,15}$=11.16, P<0.01). Concentrations of selenium in lake trout tissues were significantly higher in Llama Lake than in Reference B Lake (ANOVA; $F_{2,15}$=5.01, P<0.05); however, Goose Lake fish did not differ significantly from the reference waterbody (P=0.08).

No other differences in lake trout tissue metal concentrations were observed among lakes. Table 3.2-4 shows the results of the analysis of tissue metal quality among lakes in the sampled area.

Table 3.2-4. Analysis Summary for Fish Tissue Analysis in Back River Lakes, 2011

Metal	Somatic Weight	Lake	Lake * Somatic Weight	Comment
Arsenic	P=0.35	P<0.01	N/A	Significant difference among lakes
Barium	P<0.05	P=0.60	P=0.34	Significant regression; No difference among lakes
Calcium	P<0.01	P<0.05	P<0.05	Significant interaction - no further analysis possible
Copper	P=0.73	P=0.09	N/A	No difference among lakes
Magnesium	P=0.09	P=0.33	N/A	No difference among lakes
Manganese	P=0.15	P=0.08	N/A	No difference among lakes
Mercury	P<0.05	P<0.05	P<0.01	Significant interaction - no further analysis possible
Selenium	P=0.45	P<0.05	N/A	Significant difference among lakes
Strontium	P<0.01	P<0.05	P<0.05	Significant interaction - no further analysis possible
Zinc	P=0.64	P=0.85	N/A	No difference among lakes



Note: Error bars indicate +/- 1 standard error of the mean

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Mean Lake Trout Tissue Metal Concentrations in Goose, Llama and Reference B Lakes, 2011

Figure 3.2-13

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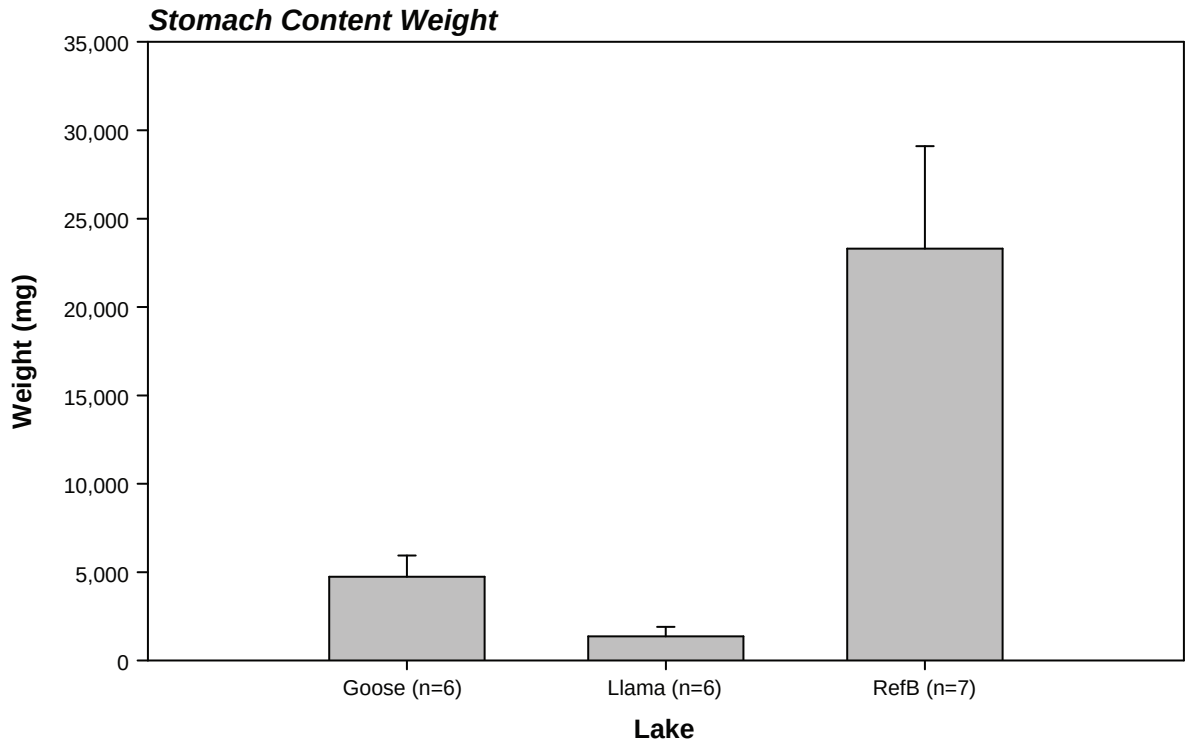
Diet

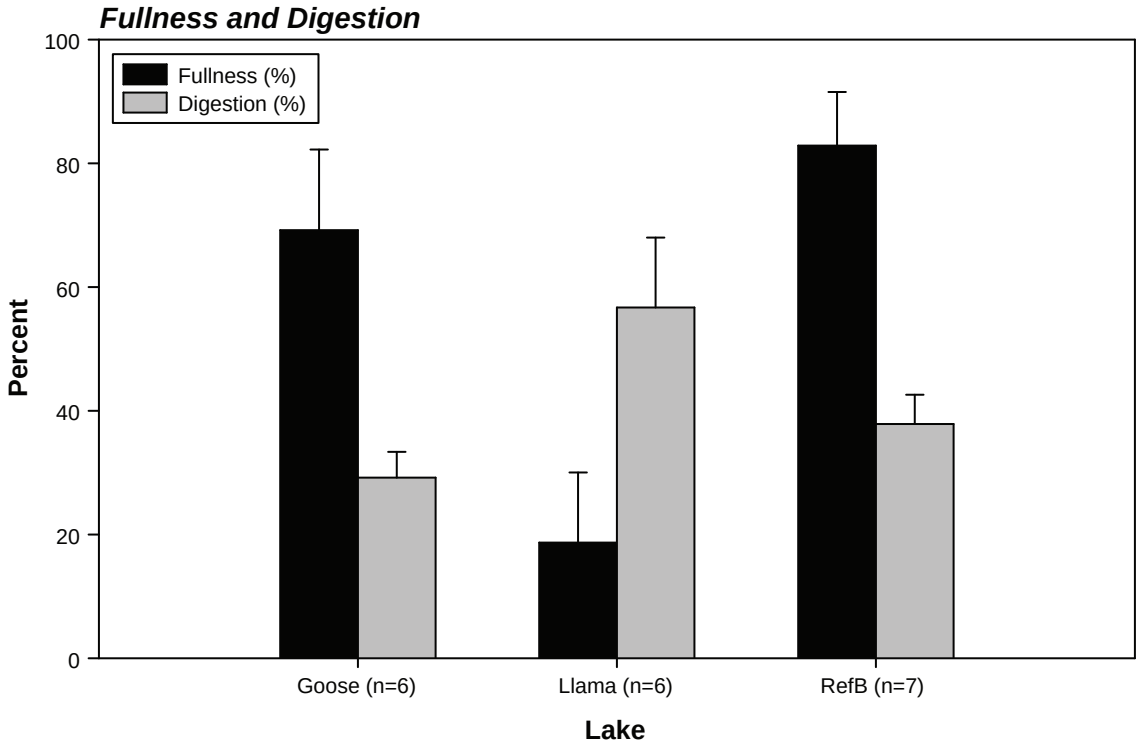
Stomach content weight was higher among lake trout from Reference B Lake than those from Goose or Llama lake (Figure 3.2-14). Gut fullness was highest among lake trout from Reference B Lake and lowest among lake trout from Llama Lake, while the proportion of food digested was highest among fish from Llama Lake and lowest among fish from Goose Lake. Appendix 3.2-5 presents the diet analysis results from all samples.

Lake trout diet was compared among lake trout from the difference lakes sampled. By number, the diets of lake trout in each of the lakes were dominated by different organisms (Figure 3.2-15). In Goose Lake, trichoptera (caddis flies) were the most numerous items in the diet, making up an average of 54% of the prey items in the stomachs. This was followed by bivalves (21%) and fish (20%). The majority of prey items (68%) eaten by Goose Lake fish were benthic in origin (Figure 3.2-16). In Llama Lake, the diet of lake trout was dominated by diptera (fly) larvae (40% of prey items) and cladocera (39% of prey items). The majority of prey items (68%) were benthic in origin. The diet of lake trout from Reference B Lake was dominated by bivalves (55% of prey items), followed by trichoptera (34% of prey items) and cladocerans (11% of prey items). The origin of prey items in Reference B lake trout stomachs was predominantly benthic (89% of prey items).

The biomass of prey items in lake trout stomachs tells a different story from the number of prey items (Figure 3.2-17). In Goose Lake, 44% of the prey biomass came from fish, followed by trichoptera and bivalves. Prey biomass was split between benthic (46% of biomass) and water column (46% of biomass) (Figure 3.2-18). In Llama Lake, the majority of the prey biomass also came from fish (49%), followed by cladocera (20%). The majority of the prey biomass in Llama Lake originated from the water column (60%). In Reference B Lake, the majority of the prey biomass came from bivalves (53%) and trichoptera (39%). The origins were primarily benthic (92%).

Most fish feed preferentially on the largest prey items available, and this is reflected in the results of the diet analysis. Fish (relatively large organisms) make up a higher percentage of the biomass of lake trout stomachs in Goose and Llama lakes than their abundance in the diet would suggest. In contrast, numerically dominant prey items such as diptera larvae, trichoptera and cladocerans make up a relatively small proportion of the biomass. The low biomass of fish in the diet of lake trout from Reference B Lake suggest that prey fish may not be as abundant as they are in the other lakes.





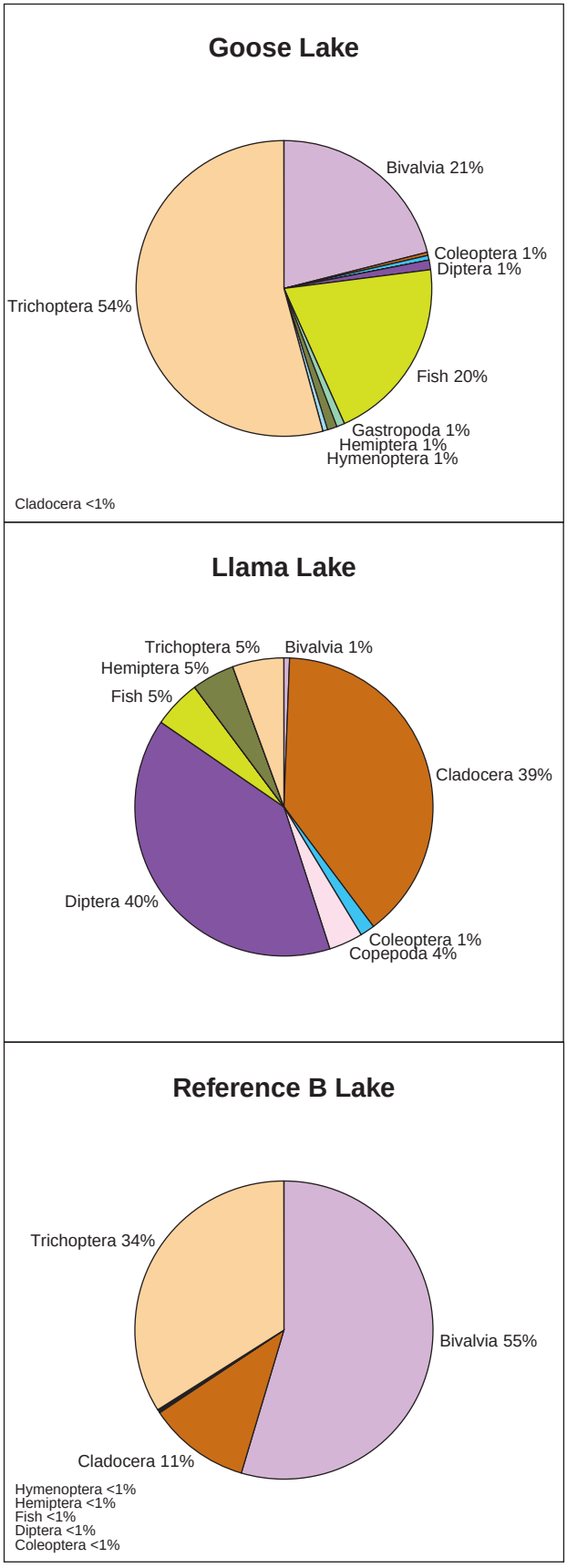
Note: Error bars indicate +/- 1 standard error of the mean

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Mean Weight, Fullness and Digestion of Stomach Content from Lake Trout in Goose, Llama and Reference B Lakes, 2011

Figure 3.2-14

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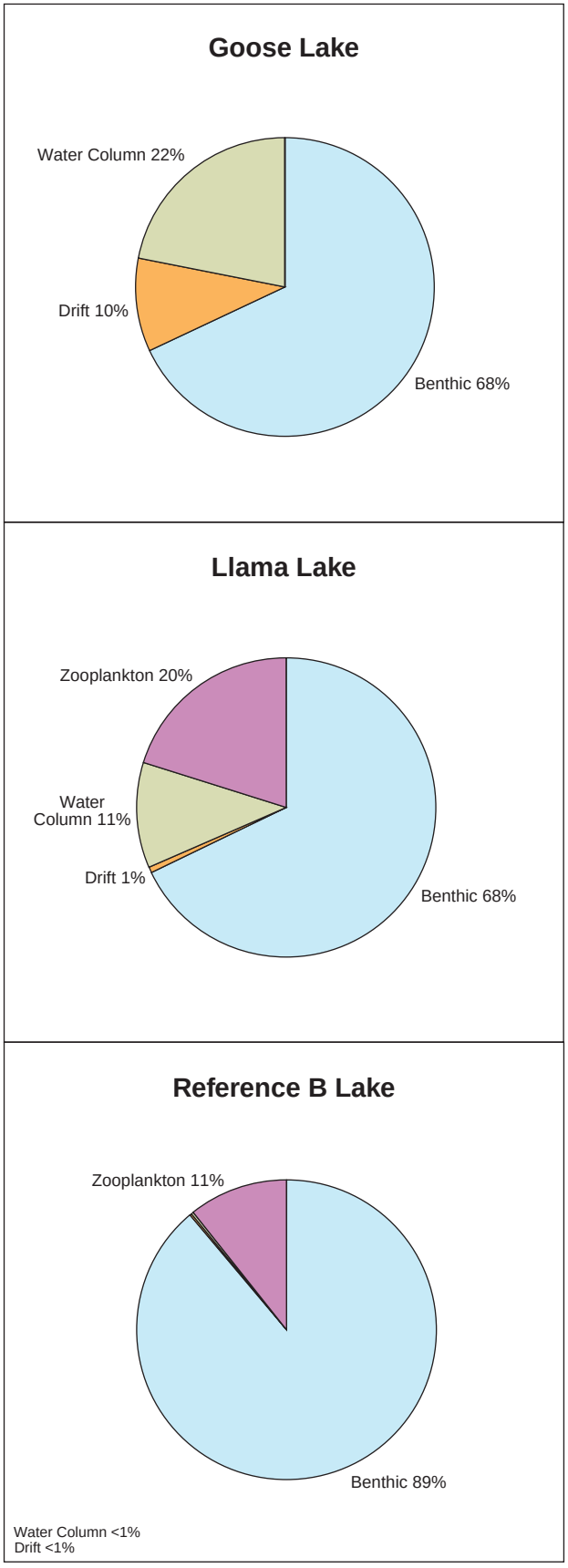


Sabina GOLD & SILVER CORP.

Mean Percent Composition (by Number) of Prey Items in the Diet of Lake Trout from Goose, Llama and Reference B Lakes, 2011

Figure 3.2-15

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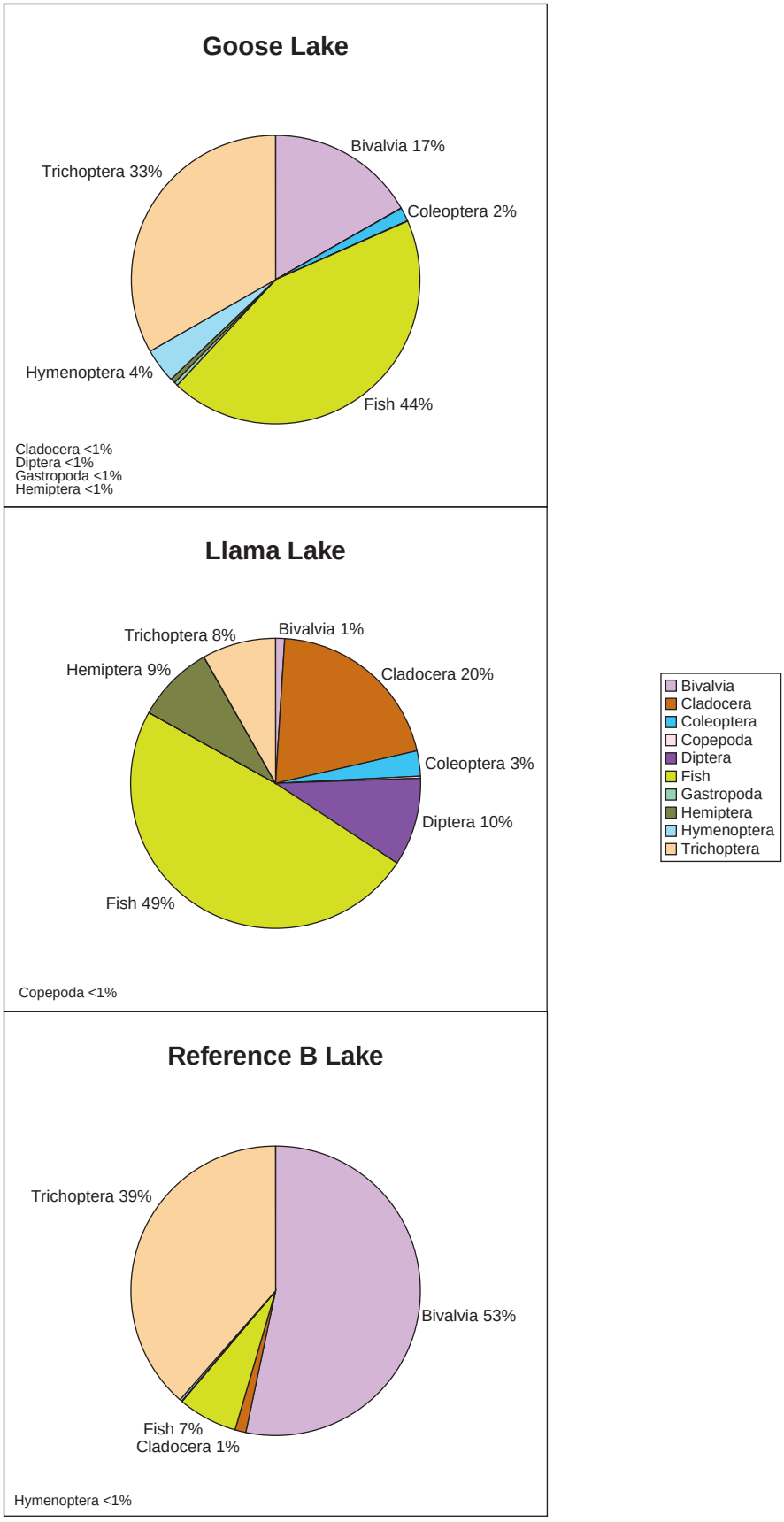


Sabina GOLD & SILVER CORP.

Mean Percent Composition (by Number) of Prey Items by Origin in Goose, Llama and Reference B Lakes, 2011

Figure 3.2-16

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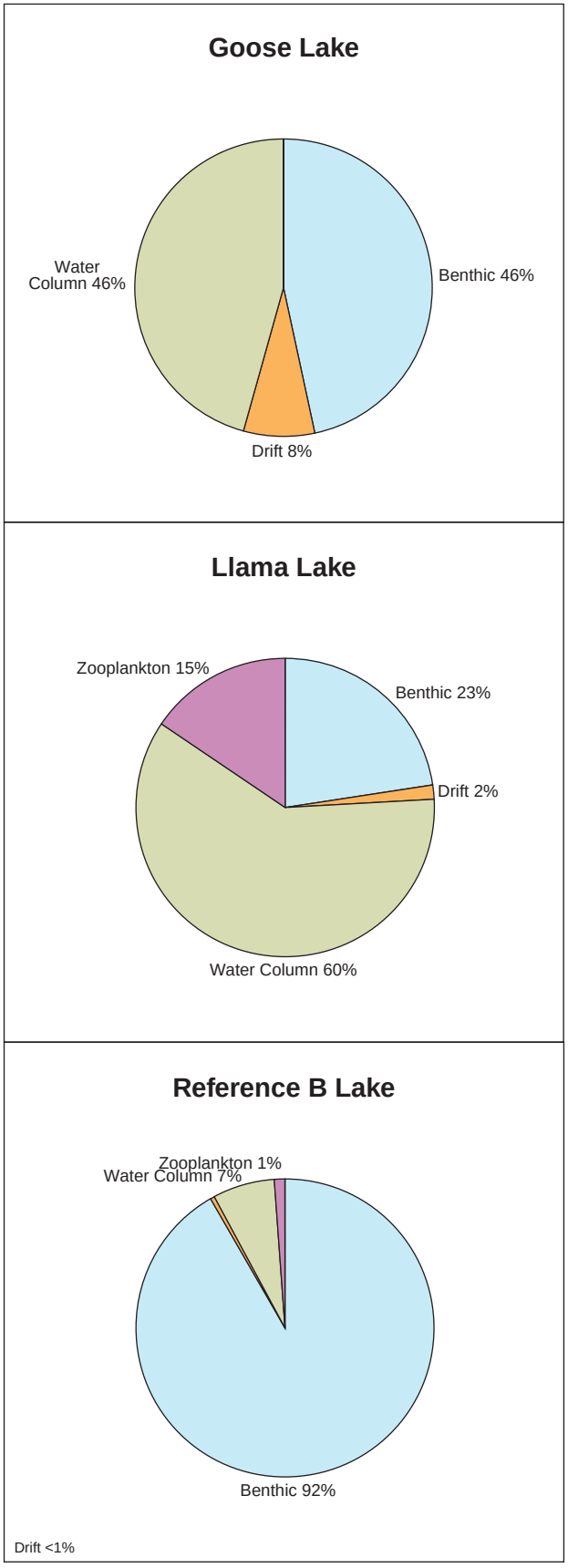


Sabina GOLD & SILVER CORP.

Mean Percent Composition (by Weight) of Prey Items in the Stomachs of Lake Trout from Goose, Llama and Reference B Lakes, 2011

Figure 3.2-17

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Sabina GOLD & SILVER CORP.

Mean Percent Composition (by Weight) of Prey Items by Origin in Goose, Llama and Reference B Lakes, 2011

Figure 3.2-18

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4. Summary

4. Summary

4.1 FISH HABITAT

Most of the ponds in the Goose property area contain low quality fish habitat. Pond habitat was generally shallow and many of the ponds featured ephemeral inflows or outflow that would limit fish migration into and out of the waterbodies. The shallow depth of the ponds causes them to be susceptible to freezing to the bottom in winter, making them unsuitable for overwintering habitat. Pond L (Wolf Watershed), one of the few fish-bearing ponds, featured a larger surface area (15 ha) and moderate depth (3 m), therefore it may contain some overwintering habitat potential. Pond I (Wolf Watershed), which also contained fish, was located adjacent to Pond L with good access.

Fish habitat in the larger lakes sampled was fair to good. The larger lakes featured more boulder and cobble shoreline substrate than the smaller ponds, which were mostly dominated by fine sediment and boulders. Clean cobble and boulder habitat is considered to provide good spawning habitat for lake trout, while round whitefish prefer clean gravel substrates along the shorelines of lakes (Scott and Crossman 1973). Lakes in the Project area were also deeper than the ponds, providing extra habitat under the winter ice and allowing for overwintering.

4.2 FISH COMMUNITY

No fish were captured in most of the ponds where sampling was conducted in 2011. Three ponds were confirmed to be fish-bearing: Pond L (Wolf Watershed), Pond I (Wolf Watershed) and Pond D (Giraffe Watershed). Ponds L and I contained Arctic grayling, while Pond D contained slimy sculpin. With the exception of Pond L, catch-per-unit-effort was very low with only one fish captured or seen in each of the other fish-bearing ponds. This introduces a level of uncertainty into the results because it is possible that other ponds may also contain very low densities of fish.

Fish captured in lakes in 2011 consisted of lake trout and round whitefish; however, Arctic grayling and ninespine stickleback (*Pungitius pungitius*) have also been captured in the past (Rescan 2010). Round whitefish in Umwelt Lake were targeted for tissue metal sampling in 2011; however, only two fish were captured in that waterbody so no lethal sampling was conducted.

Lake trout were sacrificed from Llama, Goose and Reference B Lakes for tissue metal sampling. CPUE was highest in Reference B Lake and lowest in Llama Lake; however, only 6 or 7 fish were captured from each lake. There were no significant differences in lake trout size or condition among the waterbodies sampled. Energy storage and use indicators were similar among lakes.

Tissue metal concentrations among lake trout were similar among the lakes sampled. Concentrations of arsenic and selenium tended to be lower in Reference B Lake than in fish from Goose and Llama lakes.

Lake trout diet differed among the lakes sampled. The majority of prey items in the stomachs of lake trout from all of the lakes were benthic in origin, but the dominant prey group in each lake differed. When the biomass of prey items was analyzed, the majority of the prey biomass in Goose and Llama lakes came from fish; whereas fish from Reference B Lake fed primarily on benthic organisms. This may indicate that prey fish are not as abundant in the reference lake as they are in the other lakes.

References

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Appendix 2.4-1

Quality Assurance and Quality Control Results for Tissue Metal Sampling at Back River, 2011

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Appendix 2.4-1a. Replicate Results for Tissue Metal Sampling at Back River, 2011

Sample ID	Matrix	ALS ID	Analyte	Replicate 1	Replicate 2	Units	RPD	RPD Limit	Diff	Diff Limit	Qualifier
Physical Tests											
L1053002-7	Tissue	WG1353262-1	% Moisture	78.3	77.7	%	0.77	20	-	-	-
Metals											
L1053002-7	Tissue	WG1353265-3	Aluminum (Al)-Total	<2.0	<2.0	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Antimony (Sb)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Arsenic (As)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Barium (Ba)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Beryllium (Be)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Bismuth (Bi)-Total	<0.030	<0.030	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Cadmium (Cd)-Total	<0.0050	<0.0050	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Calcium (Ca)-Total	68.1	68.0	mg/kg wwt	0.17	50	-	-	-
L1053002-7	Tissue	WG1353265-3	Chromium (Cr)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Cobalt (Co)-Total	0.021	0.020	mg/kg wwt	4.8	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Copper (Cu)-Total	0.275	0.249	mg/kg wwt	9.9	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Lead (Pb)-Total	<0.020	<0.020	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Lithium (Li)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Magnesium (Mg)-Total	264	262	mg/kg wwt	0.65	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Manganese (Mn)-Total	0.139	0.135	mg/kg wwt	2.7	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Mercury (Hg)-Total	0.178	0.189	mg/kg wwt	6.0	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Molybdenum (Mo)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Nickel (Ni)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Selenium (Se)-Total	0.37	0.36	mg/kg wwt	1.6	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Strontium (Sr)-Total	0.066	0.063	mg/kg wwt	5.0	50	-	-	-
L1053002-7	Tissue	WG1353265-3	Thallium (Tl)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Tin (Sn)-Total	<0.050	<0.050	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Uranium (U)-Total	<0.0020	<0.0020	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Vanadium (V)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Zinc (Zn)-Total	4.05	4.14	mg/kg wwt	2.2	30	-	-	-

RPD-NA - Relative Percent Difference Not Available due to result(s) being less than detection limit.

Appendix 2.4-1b. Quality Control Results for Tissue Metal Sampling at Back River, 2011

Matrix	QC Type	Analyte	QC Spl. No.	Reference	Result	Target	Units	%	Limits	Qualifier
Metals										
Tissue	CRM	Arsenic (As)-Total	WG1353265-4	VA-NRC-TORT2	24.5	21.6	mg/kg wwt	113	70-130	
Tissue	CRM	Cadmium (Cd)-Total	WG1353265-4	VA-NRC-TORT2	29.8	26.7	mg/kg wwt	112	70-130	
Tissue	CRM	Chromium (Cr)-Total	WG1353265-4	VA-NRC-TORT2	0.86	0.77	mg/kg wwt	0.86	0-1.77	
Tissue	CRM	Cobalt (Co)-Total	WG1353265-4	VA-NRC-TORT2	0.553	0.510	mg/kg wwt	108	70-130	
Tissue	CRM	Copper (Cu)-Total	WG1353265-4	VA-NRC-TORT2	105	106	mg/kg wwt	105	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1353265-4	VA-NRC-TORT2	0.318	0.350	mg/kg wwt	0.318	.15-.55	
Tissue	CRM	Manganese (Mn)-Total	WG1353265-4	VA-NRC-TORT2	13.5	13.6	mg/kg wwt	99	70-130	
Tissue	CRM	Mercury (Hg)-Total	WG1353265-4	VA-NRC-TORT2	0.234	0.270	mg/kg wwt	87	70-130	
Tissue	CRM	Molybdenum (Mo)-Total	WG1353265-4	VA-NRC-TORT2	1.06	0.950	mg/kg wwt	112	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1353265-4	VA-NRC-TORT2	2.28	2.50	mg/kg wwt	91	70-130	
Tissue	CRM	Selenium (Se)-Total	WG1353265-4	VA-NRC-TORT2	6.97	5.63	mg/kg wwt	124	70-130	
Tissue	CRM	Strontium (Sr)-Total	WG1353265-4	VA-NRC-TORT2	46.2	45.2	mg/kg wwt	102	70-130	
Tissue	CRM	Vanadium (V)-Total	WG1353265-4	VA-NRC-TORT2	1.93	1.64	mg/kg wwt	1.93	.64-2.64	
Tissue	CRM	Zinc (Zn)-Total	WG1353265-4	VA-NRC-TORT2	198	180	mg/kg wwt	110	70-130	
Tissue	CRM	Arsenic (As)-Total	WG1353265-5	VA-NRC-DOLT4	9.51	9.66	mg/kg wwt	98	70-130	
Tissue	CRM	Cadmium (Cd)-Total	WG1353265-5	VA-NRC-DOLT4	24.2	24.3	mg/kg wwt	99	70-130	
Tissue	CRM	Copper (Cu)-Total	WG1353265-5	VA-NRC-DOLT4	32.5	31.2	mg/kg wwt	104	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1353265-5	VA-NRC-DOLT4	0.153	0.160	mg/kg wwt	0.153	.06-.26	
Tissue	CRM	Mercury (Hg)-Total	WG1353265-5	VA-NRC-DOLT4	2.41	2.58	mg/kg wwt	93	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1353265-5	VA-NRC-DOLT4	0.76	0.97	mg/kg wwt	0.76	.47-1.47	
Tissue	CRM	Selenium (Se)-Total	WG1353265-5	VA-NRC-DOLT4	9.60	8.30	mg/kg wwt	116	70-130	
Tissue	CRM	Zinc (Zn)-Total	WG1353265-5	VA-NRC-DOLT4	124	116	mg/kg wwt	107	70-130	
Tissue	MB	Aluminum (Al)-Total	WG1353265-1		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Antimony (Sb)-Total	WG1353265-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1353265-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1353265-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1353265-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1353265-1		<0.030	<0.03	mg/kg wwt	-	0.03	
Tissue	MB	Cadmium (Cd)-Total	WG1353265-1		<0.0050	<0.005	mg/kg wwt	-	0.005	
Tissue	MB	Calcium (Ca)-Total	WG1353265-1		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1353265-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1353265-1		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1353265-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Lead (Pb)-Total	WG1353265-1		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1353265-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1353265-1		<1.0	<1	mg/kg wwt	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1353265-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Mercury (Hg)-Total	WG1353265-1		<0.0010	<0.001	mg/kg wwt	-	0.005	
Tissue	MB	Molybdenum (Mo)-Total	WG1353265-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Nickel (Ni)-Total	WG1353265-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Selenium (Se)-Total	WG1353265-1		<0.20	<0.2	mg/kg wwt	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1353265-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1353265-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1353265-1		<0.050	<0.05	mg/kg wwt	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1353265-1		<0.0020	<0.002	mg/kg wwt	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1353265-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1353265-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Aluminum (Al)-Total	WG1353265-2		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Antimony (Sb)-Total	WG1353265-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1353265-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1353265-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1353265-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1353265-2		<0.030	<0.03	mg/kg wwt	-	0.03	
Tissue	MB	Cadmium (Cd)-Total	WG1353265-2		<0.0050	<0.005	mg/kg wwt	-	0.005	

Appendix 2.4-1b. Quality Control Results for Tissue Metal Sampling at Back River, 2011

Matrix	QC Type	Analyte	QC Spl. No.	Reference	Result	Target	Units	%	Limits	Qualifier
Metals										
Tissue	MB	Calcium (Ca)-Total	WG1353265-2		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1353265-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1353265-2		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1353265-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Lead (Pb)-Total	WG1353265-2		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1353265-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1353265-2		<1.0	<1	mg/kg wwt	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1353265-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Mercury (Hg)-Total	WG1353265-2		<0.0010	<0.001	mg/kg wwt	-	0.005	
Tissue	MB	Molybdenum (Mo)-Total	WG1353265-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Nickel (Ni)-Total	WG1353265-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Selenium (Se)-Total	WG1353265-2		<0.20	<0.2	mg/kg wwt	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1353265-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1353265-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1353265-2		<0.050	<0.05	mg/kg wwt	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1353265-2		<0.0020	<0.002	mg/kg wwt	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1353265-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1353265-2		<0.10	<0.1	mg/kg wwt	-	0.1	

Appendix 3.1-1

Shoreline Substrate and Habitat Unit Data for Back River Ponds

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Appendix 3.1-1. Shoreline Substrate and Habitat Unit Data for Back River Ponds

Waterbody ID	Habitat Unit ID	Pond area (ha)	Dominant Substrate	Substrate				
				Bedrock	Boulder	Cobble	Gravel	Fines
Pond 1	1	6.2507	Fines	0	20	0	0	80
Pond 2	1	4.0856	Cobble	0	20	60	0	20
Pond 2	2	4.0856	Fines	0	5	10	0	85
Pond 2	3	4.0856	Fines	0	5	0	0	95
Pond 3	1	2.6031	Fines	0	0	0	0	100
Pond 3	2	2.6031	Fines	0	0	5	0	95
Pond 3	3	2.6031	Boulder	0	90	0	0	10
Pond 3	4	2.6031	Cobble	0	10	60	10	20
Pond 3	5	2.6031	Fines	0	0	10	0	90
Pond 4	1	9.7942	Boulder	0	90	10	0	0
Pond 4	2	9.7942	Boulder	20	75	5	0	0
Pond 5	1	3.5148	Fines	0	2	0	0	98
Pond 5	2	3.5148	Boulder	0	60	0	0	40
Pond 5	3	3.5148	Cobble	0	0	70	0	30
Pond 5	4	3.5148	Fines	0	0	20	20	60
Pond 5	5	3.5148	Fines	0	0	10	10	80
Pond 5	6	3.5148	Fines	0	0	10	0	90
Pond 5	7	3.5148	Boulder	0	60	0	0	40
Pond 5	8	3.5148	Fines	0	0	0	0	100
Pond 5	9	3.5148	Fines	0	2	0	8	90
Pond 5	10	3.5148	Fines	0	10	0	5	85
Pond A	1	4.7815	Cobble	0	30	60	0	10
Pond A	2	4.7815	Fines	0	5	0	0	95
Pond A1	1	0.9297	Fines	0	0	0	0	100
Pond A1	2	0.9297	Fines	0	5	0	0	95
Pond A1	3	0.9297	Fines	0	20	0	0	80
Pond B	1	5.7538	Cobble	0	30	60	0	10
Pond B	2	5.7538	Boulder	0	100	0	0	0
Pond C	1	3.6006	Fines	0	0	0	0	100
Pond C	2	3.6006	Boulder	0	70	10	0	20
Pond C	3	3.6006	Fines	0	5	0	0	95
Pond C	4	3.6006	Boulder	0	70	20	0	10
Pond D	1	6.7796	Boulder	10	75	10	0	5
Pond D	2	6.7796	Fines	0	25	0	0	75
Pond E	1	9.3243	Bedrock	100	0	0	0	0
Pond E	2	9.3243	Boulder	0	50	0	0	50
Pond E	3	9.3243	Boulder	0	100	0	0	0
Pond F	1	5.4081	Boulder	0	60	0	0	40
Pond F	2	5.4081	Fines	0	0	0	0	100
Pond F	3	5.4081	Boulder	10	70	10	0	10
Pond F	4	5.4081	Fines	0	0	0	0	100
Pond F	5	5.4081	Fines	0	20	0	0	80
Pond G	1	4.2177	Boulder	0	60	20	0	20
Pond G	2	4.2177	Boulder	0	50	0	0	50
Pond G	3	4.2177	Boulder	20	60	0	0	20
Pond G	4	4.2177	Fines	0	2	0	0	98

Appendix 3.1-1. Shoreline Substrate and Habitat Unit Data for Back River Ponds

Waterbody ID	Habitat Unit ID	Pond area (ha)	Dominant Substrate	Substrate				
				Bedrock	Boulder	Cobble	Gravel	Fines
Pond H	1	2.7832	Fines	0	0	0	0	100
Pond H	2	2.7832	Fines	0	10	0	0	90
Pond H	3	2.7832	Fines	0	10	0	0	90
Pond I	1	4.7007	Boulder	0	80	0	0	20
Pond I	2	4.7007	Fines	0	40	0	0	60
Pond I	3	4.7007	Boulder	0	100	0	0	0
Pond J	1	2.7233	Boulder	0	90	0	0	10
Pond J	2	2.7233	Fines	0	40	0	0	60
Pond J	3	2.7233	Fines	0	0	0	0	100
Pond J	4	2.7233	Fines	0	20	0	0	80
Pond K	1	4.4346	Fines	0	0	0	0	100
Pond K	2	4.4346	Fines	20	30	0	0	50
Pond K	3	4.4346	Boulder	0	80	0	0	20
Pond K	4	4.4346	Fines	0	30	0	0	70
Pond K	5	4.4346	Fines	0	0	0	0	100
Pond K	6	4.4346	Fines	0	30	0	0	70
Pond L	1	15.2134	Boulder	0	90	0	0	10
Pond L	2	15.2134	Cobble	0	40	60	0	0
Pond L	3	15.2134	Boulder	0	100	0	0	0
Pond L	4	15.2134	Fines	0	40	0	0	60

Appendix 3.1-2

Fish Sampling Locations and Catch Summary in Back River Ponds, 2011

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Appendix 3.1-2. Fish Sampling Locations and Catch Summary in Back River Ponds

Date	Lake	Crew	Method	Net/Trap No.	Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1	Zone	Easting 1	Northing 1
04-Jul-11	Pond 1	KW/MM	GN	1	13:45	14:30	0:45	0.75	3	13N	429470	7271065
04-Jul-11	Pond 1	KW/MM	GN	2	14:45	15:55	1:10	1.17	3	13N	429337	7270920
04-Jul-11	Pond 1	KW/MM	MT	1	13:50	8:21	18:31	18.52	-	13N	429458	7270893
04-Jul-11	Pond 1	KW/MM	MT	2	13:52	8:23	18:31	18.52	-	13N	429376	7270857
04-Jul-11	Pond 1	KW/MM	MT	3	13:55	8:26	18:31	18.52	-	13N	429290	7270863
04-Jul-11	Pond 1	KW/MM	MT	4	13:56	8:27	18:31	18.52	-	13N	429259	7270874
04-Jul-11	Pond 1	KW/MM	MT	5	13:58	8:30	18:32	18.53	-	13N	429258	7270962
04-Jul-11	Pond 1	KW/MM	MT	6	14:05	8:32	18:27	18.45	-	13N	429519	7270978
04-Jul-11	Pond 1	KW/MM	MT	7	14:07	8:35	18:28	18.47	-	13N	429501	7271066
04-Jul-11	Pond 1	KW/MM	MT	8	14:10	8:36	18:26	18.43	-	13N	429402	7271099
04-Jul-11	Pond 1	KW/MM	MT	9	14:11	8:38	18:27	18.45	-	13N	429327	7271042
05-Jul-11	Pond 2	KW/MM	MT	1	14:31	11:27	20:56	20.93	0.3	13N	429887	7271374
05-Jul-11	Pond 2	KW/MM	MT	2	14:37	11:30	20:53	20.88	0.3	13N	429960	7271427
05-Jul-11	Pond 2	KW/MM	MT	3	14:40	11:32	20:52	20.87	0.3	13N	429890	7271492
05-Jul-11	Pond 2	KW/MM	MT	4	14:49	11:34	20:45	20.75	0.4	13N	429753	7271460
05-Jul-11	Pond 2	KW/MM	MT	5	14:52	11:37	20:45	20.75	0.5	13N	429704	7271335
05-Jul-11	Pond 2	KW/MM	MT	6	14:55	11:40	20:45	20.75	0.5	13N	429748	7271269
05-Jul-11	Pond 2	KW/MM	MT	7	14:58	11:42	20:44	20.73	0.6	13N	429732	7271206
05-Jul-11	Pond 2	KW/MM	MT	8	15:00	11:46	20:46	20.77	0.2	13N	729778	7271248
05-Jul-11	Pond 2	KW/MM	MT	9	15:03	11:50	20:47	20.78	0.3	13N	729802	7271302
05-Jul-11	Pond 2	KW/MM	MT	10	15:05	11:52	20:47	20.78	0.3	13N	729818	7271343
02-Jul-11	Pond 3	KW/MM	MT	1	10:20	9:22	23:02	23.03	0.5	13N	432524	7268185
02-Jul-11	Pond 3	KW/MM	MT	2	10:35	9:19	22:44	22.73	0.3	13N	432506	7268215
02-Jul-11	Pond 3	KW/MM	MT	3	10:42	9:15	22:33	22.55	0.5	13N	432349	7268138
02-Jul-11	Pond 3	KW/MM	MT	4	10:50	9:08	22:18	22.30	1	13N	-	7268064
02-Jul-11	Pond 3	KW/MM	MT	5	11:06	9:06	22:00	22.00	1	13N	432486	7268091
02-Jul-11	Pond 3	KW/MM	MT	6	11:08	9:03	21:55	21.92	0.5	13N	432406	-
02-Jul-11	Pond 3	KW/MM	MT	7	11:11	9:00	21:49	21.82	0.5	13N	432362	7268171
02-Jul-11	Pond 3	KW/MM	MT	8	11:15	9:58	22:43	22.72	0.5	13N	-	-
02-Jul-11	Pond 3	KW/MM	MT	9	11:20	9:55	22:35	22.58	0.3	13N	432505	7268141
02-Jul-11	Pond 3	KW/MM	MT	10	10:25	9:26	23:01	23.02	0.3	13N	-	-
04-Jul-11	Pond 4	KW/MM	GN	1	16:50	18:00	1:10	1.17	3.4	13N	433239	7268025
05-Jul-11	Pond 4	KW/MM	GN	2	10:00	11:15	1:15	1.25	4	13N	433101	7268020
04-Jul-11	Pond 4	KW/MM	MT	1	17:10	10:05	16:55	16.92	-	13N	433099	7268153
04-Jul-11	Pond 4	KW/MM	MT	2	17:14	10:07	16:53	16.88	-	13N	433056	7268069
04-Jul-11	Pond 4	KW/MM	MT	3	17:15	10:08	16:53	16.88	-	13N	433084	7267965
04-Jul-11	Pond 4	KW/MM	MT	4	17:17	10:10	16:53	16.88	-	13N	433137	7267880
04-Jul-11	Pond 4	KW/MM	MT	5	17:20	10:13	16:53	16.88	-	13N	433200	7287847
04-Jul-11	Pond 4	KW/MM	MT	6	17:29	10:16	16:47	16.78	-	13N	433268	7287957
04-Jul-11	Pond 4	KW/MM	MT	7	17:31	10:18	16:47	16.78	-	13N	433250	7268150
04-Jul-11	Pond 4	KW/MM	MT	8	17:35	10:22	16:47	16.78	-	13N	433177	7268136
01-Jul-11	Pond 5	KW/MM	MT	1	13:00	9:26	20:26	20.43	0.3	13N	-	-
01-Jul-11	Pond 5	KW/MM	MT	2	13:05	9:23	20:18	20.30	0.5	13N	-	-
01-Jul-11	Pond 5	KW/MM	MT	3	13:12	9:18	20:06	20.10	0.5	13N	-	-
01-Jul-11	Pond 5	KW/MM	MT	4	13:18	9:14	19:56	19.93	0.5	13N	-	-
01-Jul-11	Pond 5	KW/MM	MT	5	13:25	9:10	19:45	19.75	0.3	13N	433125	7269457
01-Jul-11	Pond 5	KW/MM	MT	6	13:35	9:07	19:32	19.53	0.2	13N	433203	7269377
01-Jul-11	Pond 5	KW/MM	MT	7	13:42	9:04	19:22	19.37	0.5	13N	433270	7269299
01-Jul-11	Pond 5	KW/MM	MT	8	13:45	9:00	19:15	19.25	1	13N	433325	7269263
01-Jul-11	Pond 5	KW/MM	MT	9	13:50	9:30	19:40	19.67	0.3	13N	433282	7269409
01-Jul-11	Pond 5	KW/MM	MT	10	14:00	9:33	19:33	19.55	0.3	13N	433254	7269422
05-Jul-11	Pond A	KM/JP	GN	1	9:15	10:30	1:15	1.25	2	13N	GPS Dead	-
05-Jul-11	Pond A	KM/JP	GN	2	10:30	12:00	1:30	1.50	1.5	13N	GPS Dead	-

GN = gillnet *- = data not collected* *CPUE = Catch-per-unit-effort*

MT = minnow trap *NA = not applicable*

Appendix 3.1-2. Fish Sampling Locations and Catch Summary in Back River Ponds

Date	Lake	Crew	Method	Net/Trap No.	Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1	Zone	Easting 1	Northing 1
05-Jul-11	Pond A	KM/JP	GN	3	12:05	1:05	13:00	13.00	1.5	13N	GPS Dead	-
05-Jul-11	Pond A	KM/JP	MT	1	8:30	13:10	4:40	28.67	-	13N	GPS Dead	-
05-Jul-11	Pond A	KM/JP	MT	2	8:33	13:13	4:40	28.67	-	13N	GPS Dead	-
05-Jul-11	Pond A	KM/JP	MT	3	8:36	13:15	4:39	28.65	-	13N	GPS Dead	-
05-Jul-11	Pond A	KM/JP	MT	4	8:40	13:18	4:38	28.63	-	13N	GPS Dead	-
05-Jul-11	Pond A	KM/JP	MT	5	8:43	13:20	4:37	28.62	-	13N	GPS Dead	-
05-Jul-11	Pond A	KM/JP	MT	6	8:46	13:23	4:37	28.62	-	13N	GPS Dead	-
05-Jul-11	Pond A	KM/JP	MT	7	8:50	13:25	4:35	28.58	-	13N	GPS Dead	-
05-Jul-11	Pond A	KM/JP	MT	8	8:53	13:26	4:33	28.55	-	13N	GPS Dead	-
05-Jul-11	Pond A	KM/JP	MT	9	8:56	13:28	4:32	28.53	-	13N	GPS Dead	-
05-Jul-11	Pond A	KM/JP	MT	10	9:00	13:30	4:30	28.50	-	13N	GPS Dead	-
05-Jul-11	Pond A1	KM/JP	MT	1	10:55	7:40	20:45	20.75	0.4	13N	429189	7273648
05-Jul-11	Pond A1	KM/JP	MT	2	10:58	7:41	20:43	20.72	1	13N	429162	7273663
05-Jul-11	Pond A1	KM/JP	MT	3	11:00	7:43	20:43	20.72	0.4	13N	429144	7273707
05-Jul-11	Pond A1	KM/JP	MT	4	11:01	7:45	20:44	20.73	0.4	13N	429126	7273735
05-Jul-11	Pond A1	KM/JP	MT	5	11:03	7:47	20:44	20.73	0.4	13N	429106	7273766
05-Jul-11	Pond A1	KM/JP	MT	6	11:04	7:48	20:44	20.73	0.5	13N	429107	7273781
05-Jul-11	Pond A1	KM/JP	MT	7	11:10	7:53	20:43	20.72	0.5	13N	429234	7273686
05-Jul-11	Pond A1	KM/JP	MT	8	11:12	7:55	20:43	20.72	0.5	13N	429203	7273726
05-Jul-11	Pond A1	KM/JP	MT	9	11:13	7:56	20:43	20.72	1	13N	429175	7273740
05-Jul-11	Pond A1	KM/JP	MT	10	11:15	8:00	20:45	20.75	0.4	13N	429182	7273797
05-Jul-11	Pond B	KM/JP	GN	1	15:00	16:30	1:30	1.50	1.5	13N	-	-
06-Jul-11	Pond B	KM/JP	GN	2	9:00	10:10	1:10	1.17	1.5	13N	428876	7274459
06-Jul-11	Pond B	KM/JP	GN	3	10:30	11:20	0:50	0.83	1.2	13N	428872	7274618
05-Jul-11	Pond B	KM/JP	MT	1	14:30	10:30	20:00	20.00	0.6	13N	428846	7274561
05-Jul-11	Pond B	KM/JP	MT	2	14:32	10:33	20:01	20.02	0.4	13N	428826	7274619
05-Jul-11	Pond B	KM/JP	MT	3	14:33	10:36	20:03	20.05	0.5	13N	428893	7274649
05-Jul-11	Pond B	KM/JP	MT	4	14:35	10:40	20:05	20.08	0.6	13N	428922	7274513
05-Jul-11	Pond B	KM/JP	MT	5	14:36	10:43	20:07	20.12	1	13N	428855	7274423
05-Jul-11	Pond B	KM/JP	MT	6	14:38	10:46	20:08	20.13	0.4	13N	428842	7274258
05-Jul-11	Pond B	KM/JP	MT	7	14:39	10:50	20:11	20.18	1	13N	428862	7274228
05-Jul-11	Pond B	KM/JP	MT	8	14:41	10:53	20:12	20.20	0.8	13N	428888	7274198
05-Jul-11	Pond B	KM/JP	MT	9	14:43	10:56	20:13	20.22	0.7	13N	428900	7274218
05-Jul-11	Pond B	KM/JP	MT	10	14:45	11:00	20:15	20.25	0.8	13N	428901	7274273
06-Jul-11	Pond C	KW/MM	GN	1	8:57	10:18	1:21	1.35	4	13N	428685	7273794
06-Jul-11	Pond C	KW/MM	GN	2	10:25	11:35	1:10	1.17	3	13N	428676	7273816
06-Jul-11	Pond C	KW/MM	MT	1	9:20	7:45	22:25	22.42	0.4	13N	428588	7373863
06-Jul-11	Pond C	KW/MM	MT	2	9:24	7:50	22:26	22.43	0.7	13N	-	-
06-Jul-11	Pond C	KW/MM	MT	3	9:27	7:52	22:25	22.42	0.3	13N	428709	7273703
06-Jul-11	Pond C	KW/MM	MT	4	9:30	7:57	22:27	22.45	0.4	13N	428793	7273747
06-Jul-11	Pond C	KW/MM	MT	5	9:32	8:05	22:33	22.55	0.3	13N	428742	7273797
06-Jul-11	Pond C	KW/MM	MT	6	9:35	8:08	22:33	22.55	0.2	13N	428780	7273849
06-Jul-11	Pond C	KW/MM	MT	7	9:37	8:10	22:33	22.55	0.3	13N	428729	7273888
06-Jul-11	Pond C	KW/MM	MT	8	9:38	8:15	22:37	22.62	0.3	13N	428707	7273912
06-Jul-11	Pond C	KW/MM	MT	9	9:41	8:19	22:38	22.63	1	13N	428667	7273945
05-Jul-11	Pond D	KW/MM	GN	1	9:52	11:00	1:08	1.13	2.9	13N	429819	7274308
05-Jul-11	Pond D	KW/MM	GN	2	11:10	12:20	1:10	1.17	3	13N	429722	7274456
05-Jul-11	Pond D	KW/MM	GN	3	12:29	13:45	1:16	1.27	2.5	13N	429801	7274592
05-Jul-11	Pond D	KW/MM	MT	1	10:02	10:55	0:53	24.88	1.5	13N	429830	7274273
05-Jul-11	Pond D	KW/MM	MT	2	10:04	10:57	0:53	24.88	1	13N	429860	7274239
05-Jul-11	Pond D	KW/MM	MT	3	10:05	11:01	0:56	24.93	1	13N	429674	7274340
05-Jul-11	Pond D	KW/MM	MT	4	10:10	11:05	0:55	24.92	1	13N	429730	7274529
05-Jul-11	Pond D	KW/MM	MT	5	10:15	11:08	0:53	24.88	1	13N	429770	7274608

GN = gillnet *- = data not collected* *CPUE = Catch-per-unit-effort*

MT = minnow trap *NA = not applicable*

Appendix 3.1-2. Fish Sampling Locations and Catch Summary in Back River Ponds

Date	Lake	Crew	Method	Net/Trap No.	Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1	Zone	Easting 1	Northing 1
05-Jul-11	Pond D	KW/MM	MT	6	10:19	11:10	0:51	24.85	1.5	13N	429861	7274642
05-Jul-11	Pond D	KW/MM	MT	7	10:21	11:13	0:52	24.87	1	13N	429827	7274503
05-Jul-11	Pond D	KW/MM	MT	8	10:24	11:15	0:51	24.85	1	13N	429831	7274371
05-Jul-11	Pond D	KW/MM	MT	9	10:26	11:19	0:53	24.88	1.5	13N	429819	7274321
06-Jul-11	Pond E	KM/JP	MT	1	12:13	8:05	19:52	19.87	0.4	13N	429043	7275345
06-Jul-11	Pond E	KM/JP	MT	2	12:15	8:02	19:47	19.78	1	13N	429057	7275297
06-Jul-11	Pond E	KM/JP	MT	3	12:17	8:00	19:43	19.72	1.5	13N	429064	7275271
06-Jul-11	Pond E	KM/JP	MT	4	12:20	7:58	19:38	19.63	0.8	13N	429070	7275249
06-Jul-11	Pond E	KM/JP	MT	5	12:22	7:55	19:33	19.55	0.4	13N	429135	7275207
06-Jul-11	Pond E	KM/JP	MT	6	12:25	8:06	19:41	19.68	0.3	13N	429183	7275138
06-Jul-11	Pond E	KM/JP	MT	7	12:33	8:10	19:37	19.62	0.25	13N	429059	7275403
06-Jul-11	Pond E	KM/JP	MT	8	12:35	8:13	19:38	19.63	0.4	13N	429098	7275405
06-Jul-11	Pond E	KM/JP	MT	9	12:40	8:16	19:36	19.60	0.3	13N	429153	7275387
06-Jul-11	Pond E	KM/JP	MT	10	12:44	8:20	19:36	19.60	0.4	13N	429196	7275406
04-Jul-11	Pond F	KM/JP	MT	1	10:56	7:40	20:44	20.73	0.3	13N	431940	7267407
04-Jul-11	Pond F	KM/JP	MT	2	10:59	7:43	20:44	20.73	0.4	13N	431847	7267495
04-Jul-11	Pond F	KM/JP	MT	3	11:04	7:44	20:40	20.67	0.3	13N	731790	7267504
04-Jul-11	Pond F	KM/JP	MT	4	11:12	7:46	20:34	20.57	0.3	13N	731620	7267517
04-Jul-11	Pond F	KM/JP	MT	5	11:17	7:49	20:32	20.53	0.3	13N	431643	7267408
04-Jul-11	Pond F	KM/JP	MT	6	11:23	7:51	20:28	20.47	0.5	13N	431848	7267313
04-Jul-11	Pond F	KM/JP	MT	7	11:27	7:52	20:25	20.42	0.5	13N	-	-
04-Jul-11	Pond F	KM/JP	MT	8	11:29	7:54	20:25	20.42	0.4	13N	431848	7267312
04-Jul-11	Pond F	KM/JP	MT	9	11:31	7:57	20:26	20.43	0.4	13N	431892	7267331
04-Jul-11	Pond F	KM/JP	MT	10	11:35	7:59	20:24	20.40	0.5	13N	431932	7267348
03-Jul-11	Pond G	KW/MM	MT	1	15:21	9:52	18:31	18.52	0.4	13N	432518	7267162
03-Jul-11	Pond G	KW/MM	MT	2	15:32	9:45	18:13	18.22	0.3	13N	432434	7267123
03-Jul-11	Pond G	KW/MM	MT	3	15:39	9:40	18:01	18.02	0.2	13N	432382	7267152
03-Jul-11	Pond G	KW/MM	MT	4	15:43	9:37	17:54	17.90	0.5	13N	432324	7267238
03-Jul-11	Pond G	KW/MM	MT	5	15:50	9:31	17:41	17.68	0.5	13N	432266	7267300
03-Jul-11	Pond G	KW/MM	MT	6	15:54	9:28	17:34	17.57	0.2	13N	432267	7267354
03-Jul-11	Pond G	KW/MM	MT	7	15:58	9:22	17:24	17.40	0.2	13N	432321	7267392
03-Jul-11	Pond G	KW/MM	MT	8	16:01	9:20	17:19	17.32	0.3	13N	432372	7267404
03-Jul-11	Pond G	KW/MM	MT	9	16:06	9:17	17:11	17.18	0.4	13N	432434	7267342
03-Jul-11	Pond G	KW/MM	MT	10	16:07	9:12	17:05	17.08	0.3	13N	432477	7267329
04-Jul-11	Pond H	KM/JP	MT	1	9:35	9:35	0:00	24.00	0.8	13N	432669	7266929
04-Jul-11	Pond H	KM/JP	MT	2	9:40	9:40	0:00	24.00	0.3	13N	432695	7266866
04-Jul-11	Pond H	KM/JP	MT	3	9:41	9:41	0:00	24.00	0.4	13N	432701	7266838
04-Jul-11	Pond H	KM/JP	MT	4	9:55	9:55	0:00	24.00	1	13N	432665	7266835
04-Jul-11	Pond H	KM/JP	MT	5	9:55	9:55	0:00	24.00	0.8	13N	432631	7266838
04-Jul-11	Pond H	KM/JP	MT	6	9:56	9:56	0:00	24.00	0.4	13N	432602	7266834
04-Jul-11	Pond H	KM/JP	MT	7	10:00	10:00	0:00	24.00	0.4	13N	432723	7266941
04-Jul-11	Pond H	KM/JP	MT	8	10:02	10:02	0:00	24.00	0.4	13N	432702	7266976
04-Jul-11	Pond H	KM/JP	MT	9	10:04	10:04	0:00	24.00	0.5	13N	432690	7267009
04-Jul-11	Pond H	KM/JP	MT	10	10:05	10:05	0:00	24.00	0.6	13N	432657	7267041
03-Jul-11	Pond I	KM/JP	MT	1	12:20	8:25	20:05	20.08	0.3	13N	433174	7266387
03-Jul-11	Pond I	KM/JP	MT	2	12:23	8:29	20:06	20.10	0.6	13N	433146	7266378
03-Jul-11	Pond I	KM/JP	MT	3	12:25	8:30	20:05	20.08	1.5	13N	433106	7366355
03-Jul-11	Pond I	KM/JP	MT	4	12:28	8:31	20:03	20.05	0.5	13N	433096	7266302
03-Jul-11	Pond I	KM/JP	MT	5	12:30	8:34	20:04	20.07	0.5	13N	433126	7266245
03-Jul-11	Pond I	KM/JP	MT	6	12:45	8:00	19:15	19.25	0.3	13N	433229	7266371
03-Jul-11	Pond I	KM/JP	MT	7	12:50	8:05	19:15	19.25	0.3	13N	433241	7266350
03-Jul-11	Pond I	KM/JP	MT	8	12:52	8:20	19:28	19.47	0.3	13N	433258	7266320
03-Jul-11	Pond I	KM/JP	MT	9	12:55	8:10	19:15	19.25	0.4	13N	433310	7266342

GN = gillnet *- = data not collected* *CPUE = Catch-per-unit-effort*

MT = minnow trap *NA = not applicable*

Appendix 3.1-2. Fish Sampling Locations and Catch Summary in Back River Ponds

Date	Lake	Crew	Method	Net/Trap No.	Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1	Zone	Easting 1	Northing 1
03-Jul-11	Pond I	KM/JP	MT	10	13:00	8:15	19:15	19.25	0.25	13N	433323	7266230
02-Jul-11	Pond J	KM/JP	MT	1	15:45	8:43	16:58	16.97	0.6	13N	433548	7266947
02-Jul-11	Pond J	KM/JP	MT	2	15:48	8:45	16:57	16.95	0.5	13N	433522	7266965
02-Jul-11	Pond J	KM/JP	MT	3	15:50	8:46	16:56	16.93	0.4	13N	433490	7266958
02-Jul-11	Pond J	KM/JP	MT	4	15:53	8:48	16:55	16.92	1	13N	433482	7266937
02-Jul-11	Pond J	KM/JP	MT	5	16:00	8:55	16:55	16.92	0.6	13N	433551	7266938
02-Jul-11	Pond J	KM/JP	MT	6	16:05	8:58	16:53	16.88	0.3	13N	433607	7266912
02-Jul-11	Pond J	KM/JP	MT	7	16:06	9:00	16:54	16.90	0.4	13N	433620	7266887
02-Jul-11	Pond J	KM/JP	MT	8	16:15	9:10	16:55	16.92	0.4	13N	433607	7266751
02-Jul-11	Pond J	KM/JP	MT	9	16:18	9:12	16:54	16.90	0.4	13N	433556	7266696
02-Jul-11	Pond J	KM/JP	MT	10	16:25	9:15	16:50	16.83	2	13N	433548	7266728
05-Jul-11	Pond K	KW/MM	MT	1	13:00	9:24	20:24	20.40	1	13N	-	-
05-Jul-11	Pond K	KW/MM	MT	2	13:43	9:29	19:46	19.77	0.7	13N	432969	7267311
05-Jul-11	Pond K	KW/MM	MT	3	13:48	9:34	19:46	19.77	0.3	13N	432975	7267384
05-Jul-11	Pond K	KW/MM	MT	4	13:50	9:39	19:49	19.82	0.5	13N	433077	7267322
05-Jul-11	Pond K	KW/MM	MT	5	14:00	9:44	19:44	19.73	0.2	13N	433164	7267155
05-Jul-11	Pond K	KW/MM	MT	6	14:04	9:49	19:45	19.75	0.5	13N	433228	7267067
05-Jul-11	Pond K	KW/MM	MT	7	14:16	9:54	19:38	19.63	0.3	13N	433257	7267012
05-Jul-11	Pond K	KW/MM	MT	8	14:21	9:59	19:38	19.63	0.5	13N	433141	7267077
05-Jul-11	Pond K	KW/MM	MT	9	14:28	10:04	19:36	19.60	0.3	13N	432974	7267291
05-Jul-11	Pond K	KW/MM	MT	10	14:36	10:09	19:33	19.55	1.5	13N	432979	7267295
03-Jul-11	Pond L	KM/JP	GN	1	11:00	13:30	2:30	2.50	3	13N	433163	7266720
03-Jul-11	Pond L	KM/JP	GN	2	14:10	15:00	0:50	0.83	3	13N	433163	7266720
03-Jul-11	Pond L	KM/JP	GN	3	15:10	16:00	0:50	0.83	3	13N	432833	7267144
03-Jul-11	Pond L	KM/JP	MT	1	10:20	7:15	20:55	20.92	1	13N	433359	7266458
03-Jul-11	Pond L	KM/JP	MT	2	10:25	7:15	20:50	20.83	1.5	13N	433244	7266491
03-Jul-11	Pond L	KM/JP	MT	3	10:27	7:18	20:51	20.85	0.3	13N	433183	7266578
03-Jul-11	Pond L	KM/JP	MT	4	10:30	7:21	20:51	20.85	0.4	13N	433104	7266755
03-Jul-11	Pond L	KM/JP	MT	5	10:32	7:24	20:52	20.87	0.6	13N	-	-
03-Jul-11	Pond L	KM/JP	MT	6	10:40	7:28	20:48	20.80	1.5	13N	433270	7266719
03-Jul-11	Pond L	KM/JP	MT	7	10:42	7:31	20:49	20.82	0.6	13N	433343	7266630
03-Jul-11	Pond L	KM/JP	MT	8	10:43	7:34	20:51	20.85	1	13N	433401	7266555
03-Jul-11	Pond L	KM/JP	MT	9	10:45	7:38	20:53	20.88	0.8	13N	433384	7266515
03-Jul-11	Pond L	KM/JP	MT	10	10:47	7:40	20:53	20.88	1.5	13N	433360	7266514

GN = gillnet *- = data not collected* *CPUE = Catch-per-unit-effort*

MT = minnow trap *NA = not applicable*

Appendix 3.1-2. Fish Sampling Locations and Catch Summary in Back River Ponds

Date	Lake	Method	Net/Trap No.	Depth 2	Easting 2	Northing 2	Number of Fish Captured		Gillnet CPUE (# fish/h)	Minnow Trap CPUE (# fish/h/trap)
							Arctic grayling	Slimy sculpin		
04-Jul-11	Pond 1	GN	1	3	-	-	0	0	0.00	NA
04-Jul-11	Pond 1	GN	2	2.5	429363	7270989	0	0	0.00	NA
04-Jul-11	Pond 1	MT	1	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 1	MT	2	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 1	MT	3	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 1	MT	4	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 1	MT	5	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 1	MT	6	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 1	MT	7	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 1	MT	8	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 1	MT	9	-	-	-	0	0	NA	0.00
05-Jul-11	Pond 2	MT	1	-	-	-	0	0	NA	0.00
05-Jul-11	Pond 2	MT	2	-	-	-	0	0	NA	0.00
05-Jul-11	Pond 2	MT	3	-	-	-	0	0	NA	0.00
05-Jul-11	Pond 2	MT	4	-	-	-	0	0	NA	0.00
05-Jul-11	Pond 2	MT	5	-	-	-	0	0	NA	0.00
05-Jul-11	Pond 2	MT	6	-	-	-	0	0	NA	0.00
05-Jul-11	Pond 2	MT	7	-	-	-	0	0	NA	0.00
05-Jul-11	Pond 2	MT	8	-	-	-	0	0	NA	0.00
05-Jul-11	Pond 2	MT	9	-	-	-	0	0	NA	0.00
05-Jul-11	Pond 2	MT	10	-	-	-	0	0	NA	0.00
02-Jul-11	Pond 3	MT	1	-	-	-	0	0	NA	0.00
02-Jul-11	Pond 3	MT	2	-	-	-	0	0	NA	0.00
02-Jul-11	Pond 3	MT	3	-	-	-	0	0	NA	0.00
02-Jul-11	Pond 3	MT	4	-	-	-	0	0	NA	0.00
02-Jul-11	Pond 3	MT	5	-	-	-	0	0	NA	0.00
02-Jul-11	Pond 3	MT	6	-	-	-	0	0	NA	0.00
02-Jul-11	Pond 3	MT	7	-	-	-	0	0	NA	0.00
02-Jul-11	Pond 3	MT	8	-	-	-	0	0	NA	0.00
02-Jul-11	Pond 3	MT	9	-	-	-	0	0	NA	0.00
02-Jul-11	Pond 3	MT	10	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 4	GN	1	-	433206	7268141	0	0	0.00	NA
05-Jul-11	Pond 4	GN	2	4.5	433102	7267973	0	0	0.00	NA
04-Jul-11	Pond 4	MT	1	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 4	MT	2	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 4	MT	3	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 4	MT	4	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 4	MT	5	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 4	MT	6	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 4	MT	7	-	-	-	0	0	NA	0.00
04-Jul-11	Pond 4	MT	8	-	-	-	0	0	NA	0.00
01-Jul-11	Pond 5	MT	1	-	-	-	0	0	NA	0.00
01-Jul-11	Pond 5	MT	2	-	-	-	0	0	NA	0.00
01-Jul-11	Pond 5	MT	3	-	-	-	0	0	NA	0.00
01-Jul-11	Pond 5	MT	4	-	-	-	0	0	NA	0.00
01-Jul-11	Pond 5	MT	5	-	-	-	0	0	NA	0.00
01-Jul-11	Pond 5	MT	6	-	-	-	0	0	NA	0.00
01-Jul-11	Pond 5	MT	7	-	-	-	0	0	NA	0.00
01-Jul-11	Pond 5	MT	8	-	-	-	0	0	NA	0.00
01-Jul-11	Pond 5	MT	9	-	-	-	0	0	NA	0.00
01-Jul-11	Pond 5	MT	10	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A	GN	1	3	-	-	0	0	0.00	NA
05-Jul-11	Pond A	GN	2	2	-	-	0	0	0.00	NA

GN = gillnet *- = data not collected* *CPUE = Catch-per-unit-effort*

MT = minnow trap *NA = not applicable*

Appendix 3.1-2. Fish Sampling Locations and Catch Summary in Back River Ponds

Date	Lake	Method	Net/Trap No.	Depth 2	Easting 2	Northing 2	Number of Fish Captured		Gillnet CPUE (# fish/h)	Minnow Trap CPUE (# fish/h/trap)
							Arctic grayling	Slimy sculpin		
05-Jul-11	Pond A	GN	3	3	-	-	0	0	0.00	NA
05-Jul-11	Pond A	MT	1	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A	MT	2	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A	MT	3	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A	MT	4	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A	MT	5	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A	MT	6	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A	MT	7	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A	MT	8	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A	MT	9	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A	MT	10	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A1	MT	1	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A1	MT	2	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A1	MT	3	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A1	MT	4	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A1	MT	5	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A1	MT	6	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A1	MT	7	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A1	MT	8	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A1	MT	9	-	-	-	0	0	NA	0.00
05-Jul-11	Pond A1	MT	10	-	-	-	0	0	NA	0.00
05-Jul-11	Pond B	GN	1	2	-	-	0	0	0.00	NA
06-Jul-11	Pond B	GN	2	1.5	428991	7274552	0	0	0.00	NA
06-Jul-11	Pond B	GN	3	2	428885	7274557	0	0	0.00	NA
05-Jul-11	Pond B	MT	1	-	-	-	0	0	NA	0.00
05-Jul-11	Pond B	MT	2	-	-	-	0	0	NA	0.00
05-Jul-11	Pond B	MT	3	-	-	-	0	0	NA	0.00
05-Jul-11	Pond B	MT	4	-	-	-	0	0	NA	0.00
05-Jul-11	Pond B	MT	5	-	-	-	0	0	NA	0.00
05-Jul-11	Pond B	MT	6	-	-	-	0	0	NA	0.00
05-Jul-11	Pond B	MT	7	-	-	-	0	0	NA	0.00
05-Jul-11	Pond B	MT	8	-	-	-	0	0	NA	0.00
05-Jul-11	Pond B	MT	9	-	-	-	0	0	NA	0.00
05-Jul-11	Pond B	MT	10	-	-	-	0	0	NA	0.00
06-Jul-11	Pond C	GN	1	2.5	428631	7273854	0	0	0.00	NA
06-Jul-11	Pond C	GN	2	2	428609	7273894	0	0	0.00	NA
06-Jul-11	Pond C	MT	1	-	-	-	0	0	NA	0.00
06-Jul-11	Pond C	MT	2	-	-	-	0	0	NA	0.00
06-Jul-11	Pond C	MT	3	-	-	-	0	0	NA	0.00
06-Jul-11	Pond C	MT	4	-	-	-	0	0	NA	0.00
06-Jul-11	Pond C	MT	5	-	-	-	0	0	NA	0.00
06-Jul-11	Pond C	MT	6	-	-	-	0	0	NA	0.00
06-Jul-11	Pond C	MT	7	-	-	-	0	0	NA	0.00
06-Jul-11	Pond C	MT	8	-	-	-	0	0	NA	0.00
06-Jul-11	Pond C	MT	9	-	-	-	0	0	NA	0.00
05-Jul-11	Pond D	GN	1	4	429779	7274400	0	0	0.00	NA
05-Jul-11	Pond D	GN	2	3	429693	7274360	0	0	0.00	NA
05-Jul-11	Pond D	GN	3	3.5	429760	7274520	0	0	0.00	NA
05-Jul-11	Pond D	MT	1	-	-	-	0	0	NA	0.00
05-Jul-11	Pond D	MT	2	-	-	-	0	1	NA	0.04
05-Jul-11	Pond D	MT	3	-	-	-	0	0	NA	0.00
05-Jul-11	Pond D	MT	4	-	-	-	0	0	NA	0.00
05-Jul-11	Pond D	MT	5	-	-	-	0	0	NA	0.00

GN = gillnet *- = data not collected* *CPUE = Catch-per-unit-effort*

MT = minnow trap *NA = not applicable*

Appendix 3.1-2. Fish Sampling Locations and Catch Summary in Back River Ponds

Date	Lake	Method	Net/Trap No.	Depth 2	Easting 2	Northing 2	Number of Fish Captured		Gillnet CPUE (# fish/h)	Minnow Trap CPUE (# fish/h/trap)
							Arctic grayling	Slimy sculpin		
05-Jul-11	Pond D	MT	6	-	-	-	0	0	NA	0.00
05-Jul-11	Pond D	MT	7	-	-	-	0	0	NA	0.00
05-Jul-11	Pond D	MT	8	-	-	-	0	0	NA	0.00
05-Jul-11	Pond D	MT	9	-	-	-	0	0	NA	0.00
06-Jul-11	Pond E	MT	1	-	-	-	0	0	NA	0.00
06-Jul-11	Pond E	MT	2	-	-	-	0	0	NA	0.00
06-Jul-11	Pond E	MT	3	-	-	-	0	0	NA	0.00
06-Jul-11	Pond E	MT	4	-	-	-	0	0	NA	0.00
06-Jul-11	Pond E	MT	5	-	-	-	0	0	NA	0.00
06-Jul-11	Pond E	MT	6	-	-	-	0	0	NA	0.00
06-Jul-11	Pond E	MT	7	-	-	-	0	0	NA	0.00
06-Jul-11	Pond E	MT	8	-	-	-	0	0	NA	0.00
06-Jul-11	Pond E	MT	9	-	-	-	0	0	NA	0.00
06-Jul-11	Pond E	MT	10	-	-	-	0	0	NA	0.00
04-Jul-11	Pond F	MT	1	-	-	-	0	0	NA	0.00
04-Jul-11	Pond F	MT	2	-	-	-	0	0	NA	0.00
04-Jul-11	Pond F	MT	3	-	-	-	0	0	NA	0.00
04-Jul-11	Pond F	MT	4	-	-	-	0	0	NA	0.00
04-Jul-11	Pond F	MT	5	-	-	-	0	0	NA	0.00
04-Jul-11	Pond F	MT	6	-	-	-	0	0	NA	0.00
04-Jul-11	Pond F	MT	7	-	-	-	0	0	NA	0.00
04-Jul-11	Pond F	MT	8	-	-	-	0	0	NA	0.00
04-Jul-11	Pond F	MT	9	-	-	-	0	0	NA	0.00
04-Jul-11	Pond F	MT	10	-	-	-	0	0	NA	0.00
03-Jul-11	Pond G	MT	1	-	-	-	0	0	NA	0.00
03-Jul-11	Pond G	MT	2	-	-	-	0	0	NA	0.00
03-Jul-11	Pond G	MT	3	-	-	-	0	0	NA	0.00
03-Jul-11	Pond G	MT	4	-	-	-	0	0	NA	0.00
03-Jul-11	Pond G	MT	5	-	-	-	0	0	NA	0.00
03-Jul-11	Pond G	MT	6	-	-	-	0	0	NA	0.00
03-Jul-11	Pond G	MT	7	-	-	-	0	0	NA	0.00
03-Jul-11	Pond G	MT	8	-	-	-	0	0	NA	0.00
03-Jul-11	Pond G	MT	9	-	-	-	0	0	NA	0.00
03-Jul-11	Pond G	MT	10	-	-	-	0	0	NA	0.00
04-Jul-11	Pond H	MT	1	-	-	-	0	0	NA	0.00
04-Jul-11	Pond H	MT	2	-	-	-	0	0	NA	0.00
04-Jul-11	Pond H	MT	3	-	-	-	0	0	NA	0.00
04-Jul-11	Pond H	MT	4	-	-	-	0	0	NA	0.00
04-Jul-11	Pond H	MT	5	-	-	-	0	0	NA	0.00
04-Jul-11	Pond H	MT	6	-	-	-	0	0	NA	0.00
04-Jul-11	Pond H	MT	7	-	-	-	0	0	NA	0.00
04-Jul-11	Pond H	MT	8	-	-	-	0	0	NA	0.00
04-Jul-11	Pond H	MT	9	-	-	-	0	0	NA	0.00
04-Jul-11	Pond H	MT	10	-	-	-	0	0	NA	0.00
03-Jul-11	Pond I	MT	1	-	-	-	0	0	NA	0.00
03-Jul-11	Pond I	MT	2	-	-	-	0	0	NA	0.00
03-Jul-11	Pond I	MT	3	-	-	-	0	0	NA	0.00
03-Jul-11	Pond I	MT	4	-	-	-	0	0	NA	0.00
03-Jul-11	Pond I	MT	5	-	-	-	0	0	NA	0.00
03-Jul-11	Pond I	MT	6	-	-	-	1	0	NA	0.05
03-Jul-11	Pond I	MT	7	-	-	-	0	0	NA	0.00
03-Jul-11	Pond I	MT	8	-	-	-	0	0	NA	0.00
03-Jul-11	Pond I	MT	9	-	-	-	0	0	NA	0.00

GN = gillnet *- = data not collected* *CPUE = Catch-per-unit-effort*

MT = minnow trap *NA = not applicable*

Appendix 3.1-2. Fish Sampling Locations and Catch Summary in Back River Ponds

Date	Lake	Method	Net/Trap No.	Depth 2	Easting 2	Northing 2	Number of Fish Captured		Gillnet CPUE (# fish/h)	Minnow Trap CPUE (# fish/h/trap)
							Arctic grayling	Slimy sculpin		
03-Jul-11	Pond I	MT	10	-	-	-	0	0	NA	0.00
02-Jul-11	Pond J	MT	1	-	-	-	0	0	NA	0.00
02-Jul-11	Pond J	MT	2	-	-	-	0	0	NA	0.00
02-Jul-11	Pond J	MT	3	-	-	-	0	0	NA	0.00
02-Jul-11	Pond J	MT	4	-	-	-	0	0	NA	0.00
02-Jul-11	Pond J	MT	5	-	-	-	0	0	NA	0.00
02-Jul-11	Pond J	MT	6	-	-	-	0	0	NA	0.00
02-Jul-11	Pond J	MT	7	-	-	-	0	0	NA	0.00
02-Jul-11	Pond J	MT	8	-	-	-	0	0	NA	0.00
02-Jul-11	Pond J	MT	9	-	-	-	0	0	NA	0.00
02-Jul-11	Pond J	MT	10	-	-	-	0	0	NA	0.00
05-Jul-11	Pond K	MT	1	-	-	-	0	0	NA	0.00
05-Jul-11	Pond K	MT	2	-	-	-	0	0	NA	0.00
05-Jul-11	Pond K	MT	3	-	-	-	0	0	NA	0.00
05-Jul-11	Pond K	MT	4	-	-	-	0	0	NA	0.00
05-Jul-11	Pond K	MT	5	-	-	-	0	0	NA	0.00
05-Jul-11	Pond K	MT	6	-	-	-	0	0	NA	0.00
05-Jul-11	Pond K	MT	7	-	-	-	0	0	NA	0.00
05-Jul-11	Pond K	MT	8	-	-	-	0	0	NA	0.00
05-Jul-11	Pond K	MT	9	-	-	-	0	0	NA	0.00
05-Jul-11	Pond K	MT	10	-	-	-	0	0	NA	0.00
03-Jul-11	Pond L	GN	1	2	-	-	7	0	3.02	NA
03-Jul-11	Pond L	GN	2	3	-	-	2	0	2.59	NA
03-Jul-11	Pond L	GN	3	1.8	-	-	2	0	2.59	NA
03-Jul-11	Pond L	MT	1	-	-	-	0	0	NA	0.00
03-Jul-11	Pond L	MT	2	-	-	-	0	0	NA	0.00
03-Jul-11	Pond L	MT	3	-	-	-	0	0	NA	0.00
03-Jul-11	Pond L	MT	4	-	-	-	0	0	NA	0.00
03-Jul-11	Pond L	MT	5	-	-	-	0	0	NA	0.00
03-Jul-11	Pond L	MT	6	-	-	-	0	0	NA	0.00
03-Jul-11	Pond L	MT	7	-	-	-	0	0	NA	0.00
03-Jul-11	Pond L	MT	8	-	-	-	0	0	NA	0.00
03-Jul-11	Pond L	MT	9	-	-	-	0	0	NA	0.00
03-Jul-11	Pond L	MT	10	-	-	-	0	0	NA	0.00

GN = gillnet *- = data not collected* *CPUE = Catch-per-unit-effort*

MT = minnow trap *NA = not applicable*

Appendix 3.1-3

Individual Fish Data from Back River Ponds, 2011

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Appendix 3.1-3. Individual Fish Data from Back River Ponds, 2011

Date	Crew	Site No.	Sampling Method	Sample No.	Species Code	FL (mm)	Wt (g)	Sex	Maturity	Reproductive Status	Aging structure		Age	Comments
											Otoliths	Scales		
03-Jul-11	KM/JP	Pond L	GN1	1	AG	290	-	-	-	-	-	Y	7	
03-Jul-11	KM/JP	Pond L	GN1	2	AG	330	-	-	-	-	-	Y	7	
03-Jul-11	KM/JP	Pond L	GN1	3	AG	298	-	-	-	-	-	Y	6	
03-Jul-11	KM/JP	Pond L	GN1	4	AG	268	-	-	-	-	-	Y	5	
03-Jul-11	KM/JP	Pond L	GN1	5	AG	224	-	-	-	-	-	Y	4	
03-Jul-11	KM/JP	Pond L	GN1	6	AG	279	-	-	-	-	-	Y	6	
03-Jul-11	KM/JP	Pond L	GN2	7	AG	302	-	M	M	G	Y	Y	6	Dead - lots of parasites/worms
03-Jul-11	KM/JP	Pond L	GN2	8	AG	213	-	F	M	G	Y	Y	5	Dead - parasites
03-Jul-11	KM/JP	Pond L	GN3	9	AG	320	-	-	-	-	-	Y	7	
03-Jul-11	KM/JP	Pond L	GN3	10	AG	289	-	F	-	-	-	Y	7	
04-Jul-11	KM/JP	Pond 1	MT10	11	SLSC	62	2	-	-	-	-	-	-	

Species:

AG = Arctic grayling

SLSC = Slimy sculpin

Sex:

M = male

F = female

Maturity:

M = mature

I = immature

Reproductive Status:

G = green

R = ripe

S = spawning

Appendix 3.2-1

Shoreline Substrate and Habitat Data for Back River Lakes, 2011

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Appendix 3.2-1. Shoreline Substrate and Habitat Data for Back River Lakes

				Substrate Composition (%)				
Lake	Habitat Unit ID	Lake Area (ha)	Dominant Substrate	Bedrock	Boulder	Cobble	Fines	Gravel
Goose	1	320.2	Boulder	40	40	15	5	0
Goose	2	320.2	Cobble	0	40	50	10	0
Goose	3	320.2	Fines	0	0	40	50	10
Goose	4	320.2	Cobble	0	40	50	10	0
Goose	5	320.2	Fines	0	0	0	100	0
Goose	6	320.2	Fines	0	10	0	80	10
Goose	7	320.2	Cobble	0	40	50	10	0
Goose	8	320.2	Gravel	0	0	20	10	70
Goose	9	320.2	Fines	0	10	20	50	20
Goose	10	320.2	Fines	0	10	30	30	20
Goose	11	320.2	Cobble	0	0	60	10	30
Goose	12	320.2	Cobble	0	40	50	10	0
Goose	13	320.2	Fines	0	20	0	80	0
Goose	14	320.2	Gravel	0	0	10	30	60
Goose	15	320.2	Cobble	0	0	60	10	30
Goose	16	320.2	Cobble	0	10	90	0	0
Goose	17	320.2	Fines	0	10	0	80	10
Goose	18	320.2	Fines	0	0	40	50	10
Goose	19	320.2	Cobble	0	40	50	10	0
Goose	20	320.2	Boulder	40	40	15	5	0
Goose	21	320.2	Bedrock	100	0	0	0	0
Llama	1	36.7	Boulder	15	60	25	0	0
Llama	2	36.7	Cobble	0	10	80	10	0
Llama	3	36.7	Cobble	0	15	80	5	0
Llama	4	36.7	Boulder	0	85	5	0	0
Llama	5	36.7	Cobble	0	15	80	5	0
Llama	6	36.7	Boulder	0	85	15	0	0
Llama	7	36.7	Cobble	0	20	80	0	0
Llama	8	36.7	Fines	0	0	20	80	0
Llama	9	36.7	Fines	0	0	20	80	0
Ref Lake B	1	36.0	Boulder	0	80	20	0	0
Ref Lake B	2	36.0	Cobble	0	25	60	0	15
Ref Lake B	3	36.0	Boulder	10	70	20	0	0
Umwelt	1	20.2	Cobble	0	25	60	5	10
Umwelt	2	20.2	Cobble	0	10	50	20	20

Appendix 3.2-2

Gear Locations and Catch Summary for MMER-Sampled Lakes in the Back River Project Area, 2011

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Appendix 3.2-2. Gear Locations and Catch Summary for MMER-Sampled Lakes in the Back River Project Area, 2011

Date	Lake	Crew	Method	Net/Trap No.	Time In	Time Out	Effort (h)	Effort (decimal h)	Zone	Easting 1	Northing 1	Easting 2	Northing 2	Number of Fish Captured		CPUE
														Lake Trout	Round Whitefish	(# fish/100 m^2/h)
27-Aug-11	Goose	KW	GN	1	10:10	10:50	0:40	0.67	13N	433845	7270698	433877	7270589	2	0	3.23
27-Aug-11	Goose	KW	GN	2	10:15	11:10	0:55	0.92	13N	433947	7270444	433966	7270346	1	0	1.18
27-Aug-11	Goose	KW	GN	3	11:00	11:45	0:45	0.75	13N	433983	7270671	434069	7270624	0	0	0.00
27-Aug-11	Goose	KW	GN	4	11:30	12:30	1:00	1.00	13N	434338	7270692	434231	7270676	1	0	1.08
27-Aug-11	Goose	KW	GN	5	14:40	15:15	0:35	0.58	13N	434414	7270143	434329	7270107	0	0	0.00
27-Aug-11	Goose	KW	GN	6	14:50	15:40	0:50	0.83	13N	434372	7270852	434393	7270776	0	0	0.00
27-Aug-11	Goose	KW	GN	7	15:30	18:15	2:45	2.75	13N	-	-	-	-	1	0	0.39
27-Aug-11	Goose	KW	GN	8	15:50	18:45	2:55	2.92	13N	-	-	-	-	1	0	0.37
25-Aug-11	REFB	KW	GN	1	10:00	10:30	0:30	0.50	13N	441836	7258735	441855	7258646	0	1	2.16
25-Aug-11	REFB	KW	GN	2	10:45	11:15	0:30	0.50	13N	441868	7258498	441987	7258502	0	0	0.00
25-Aug-11	REFB	KW	GN	3	11:05	11:45	0:40	0.67	13N	441966	7258305	442050	7258383	2	0	3.23
25-Aug-11	REFB	KW	GN	4	11:35	12:20	0:45	0.75	13N	441967	7258843	441947	7258734	1	0	1.44
25-Aug-11	REFB	KW	GN	5	12:05	13:05	1:00	1.00	13N	441916	7258716	442162	7258652	2	4	6.47
25-Aug-11	REFB	KW	GN	6	13:05	14:15	1:10	1.17	13N	442152	7258619	442040	7258801	2	3	4.62
25-Aug-11	REFB	KW	GN	7	14:10	15:10	1:00	1.00	13N	441759	7258906	441770	7258824	0	3	3.23
25-Aug-11	REFB	KW	GN	8	14:25	15:30	1:05	1.08	13N	441704	7259113	442732	7259018	0	2	1.99
26-Aug-11	Umwelt	KW	GN	1	9:45	10:35	0:50	0.83	13N	428655	7271237	428728	7271167	0	0	0.00
26-Aug-11	Umwelt	KW	GN	2	9:50	11:25	1:35	1.58	13N	428881	7270968	428950	7270898	0	2	1.36
26-Aug-11	Umwelt	KW	GN	3	10:45	11:45	1:00	1.00	13N	428756	7271234	428817	7271168	0	0	0.00
26-Aug-11	Umwelt	KW	GN	4	13:45	14:30	0:45	0.75	13N	428752	7271083	428846	7271124	0	0	0.00
23-Aug-11	Llama	KW	GN	1	10:25	10:48	0:23	0.38	13N	428581	7271986	428696	7272006	0	0	0.00
23-Aug-11	Llama	KW	GN	2	11:13	12:10	0:57	0.95	13N	428629	7272521	428683	7272377	0	0	0.00
23-Aug-11	Llama	KW	GN	3	12:25	13:50	1:25	1.42	13N	428619	7272258	428681	7272168	1	0	0.76
23-Aug-11	Llama	KW	GN	4	14:06	15:00	0:54	0.90	13N	428729	7272343	428781	7272251	1	0	1.20
24-Aug-11	Llama	KW	GN	5	8:40	10:40	2:00	2.00	13N	428833	7272325	428806	7272246	1	0	0.54
24-Aug-11	Llama	KW	GN	6	8:50	10:25	1:35	1.58	13N	428529	7272084	428605	7272009	1	0	0.68
24-Aug-11	Llama	KW	GN	7	10:10	11:10	1:00	1.00	13N	428753	7272070	428160	7272156	1	0	1.08
24-Aug-11	Llama	KW	GN	8	12:00	13:20	1:20	1.33	13N	428607	7272426	428694	7272505	0	0	0.00
24-Aug-11	Llama	KW	GN	9	12:10	13:40	1:30	1.50	13N	428552	7272541	428655	7272562	0	0	0.00
24-Aug-11	Llama	KW	GN	10	13:30	15:00	1:30	1.50	13N	428552	7272135	428613	7272219	1	1	1.44
24-Aug-11	Llama	KW	GN	11	13:50	15:20	1:30	1.50	13N	428697	7272128	428762	7272202	0	0	0.00

GN = gillnet

- = data not recorded

Appendix 3.2-3

Individual Fish Data from MMER-Sampled Lakes in the Back River Project Area, 2011

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Appendix 3.2-3. Individual Fish Data from MMER-Sampled Lakes in the Back River Project Area, 2011

Date	Site	Sample No.	Species	Sex	Maturity	Fork Length (mm)	Total Weight (g)	Condition	Somatic weight (g)	Gonad Weight (g)	Liver Weight (g)	Stomach Weight (g)	Eggs Taken (Y/N)	Age Structure (S/F/O)	Parasites (Y/N)	Comment
25-Aug-11	REFB	1	WF	-	-	395	811	1.316	-	-	-	-	-	-	-	
25-Aug-11	REFB	2	LT	M	SP	480	1133	1.024	989.3	37.4	9.6	96.7	-	SFO	-	
25-Aug-11	REFB	3	LT	M	MTC	435	910	1.106	769.0	31.7	9.1	100.2	-	SFO	-	
25-Aug-11	REFB	4	WF	-	-	394	651	1.064	-	-	-	-	-	-	-	
25-Aug-11	REFB	5	WF	-	-	393	663	1.092	-	-	-	-	-	-	-	
25-Aug-11	REFB	6	WF	-	-	379	661	1.214	-	-	-	-	-	-	-	
25-Aug-11	REFB	7	LT	F	MTC	503	1063	0.835	925.4	13.7	9.4	114.5	Y	SFO	-	
25-Aug-11	REFB	8	LT	F	MTC	422	678	0.902	630.9	4.5	4.2	38.4	Y	SFO	-	
25-Aug-11	REFB	9	LT	F	MTC	512	1185	0.883	1024.6	10.7	13.7	136.0	Y	SFO	-	
25-Aug-11	REFB	10	LT	F	MTC	529	1512	1.021	1420.5	15.6	9.3	66.7	N	SFO	-	
25-Aug-11	REFB	11	LT	F	MTC	490	1261	1.072	1174.5	13.1	7.8	65.6	Y	SFO	-	
26-Aug-11	Umwelt	1	WF	-	-	255	135.8	0.819	-	-	-	-	-	-	-	
26-Aug-11	Umwelt	2	WF	-	-	263	138.3	0.760	-	-	-	-	-	-	-	
27-Aug-11	Goose	1	LT	U	IM	315	349	1.117	329.0	-	2.4	17.6	-	SFO	Y	Tape worms
27-Aug-11	Goose	2	LT	F	IM	443	869	1.000	820.0	0.6	5.4	43.0	N	SFO	-	
27-Aug-11	Goose	3	LT	F	MTC	384	626	1.106	584.8	2.1	3.7	35.5	N	SFO	-	
27-Aug-11	Goose	4	LT	M	MTC	496	1424	1.167	1311.4	43.8	12.0	56.9	-	SFO	-	
27-Aug-11	Goose	5	LT	F	MTC	448	869	0.966	823.4	3.3	4.0	38.2	N	SFO	-	
27-Aug-11	Goose	6	LT	F	IM	333	360	0.975	340.5	0.7	2.5	16.3	N	SFO	-	
23-Aug-11	Llama	2	LT	M	IM	592	1950	0.940	1846.3	8.8	12.9	82.1	-	SFO	Y	
23-Aug-11	Llama	3	LT	U	IM	331	340	0.938	322.8	-	2.0	15.2	-	SFO	Y	
23-Aug-11	Llama	4	LT	F	IM	483	1141	1.013	1092.7	6.6	4.1	37.6	Y	SFO	Y	
23-Aug-11	Llama	5	LT	M	MT	567	1726	0.947	1611.4	40.3	9.5	64.8	-	SFO	Y	
23-Aug-11	Llama	6	WF	M	-	470	1018	0.981	961.7	12.2	7.9	36.2	-	SFO	Y	

Species:
LT = lake trout
WF = round whitefish
Sex:
M = male
F = female
Maturity:
IM = immature
MTC = maturing
MT = mature
SP = spawning
Age structure:
S = scale
F = pelvic fin clip
O = otolith
- = data not collected

Appendix 3.2-4

Tissue Analysis Results from Lake Trout in the Back River Project Area, 2011

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Appendix 3.2-4a. Lake Trout Tissue Quality Results from the Back River Project Area, 2011

Sample ID	LL1	LL2	LL3	LL4	LL5	LL6	RFB1	RFB2	RFB7	RFB8
Date Sampled	23-AUG-11	23-AUG-11	24-AUG-11	24-AUG-11	24-AUG-11	24-AUG-11	25-AUG-11	25-AUG-11	25-AUG-11	25-AUG-11
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1053002-1	L1053002-2	L1053002-3	L1053002-4	L1053002-5	L1053002-6	L1053002-7	L1053002-8	L1053002-9	L1053002-10
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests										
% Moisture	73.9	77.1	75.8	74.5	76.5	75.1	78.3	75.7	76.8	76.5
Metals										
Aluminum (Al)-Total	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Antimony (Sb)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	0.019	0.054	0.020	0.038	0.042	0.016	<0.010	<0.010	<0.010	0.013
Barium (Ba)-Total	0.065	0.015	0.026	0.023	<0.010	0.014	<0.010	<0.010	0.014	0.042
Beryllium (Be)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total	165	85.8	107	95.6	57.6	75.0	68.1	71.2	81.0	68.2
Chromium (Cr)-Total	0.13	0.14	0.19	0.27	0.11	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	<0.020	<0.020	<0.020
Copper (Cu)-Total	0.303	0.329	0.305	0.329	0.294	0.319	0.275	0.341	0.192	0.359
Lead (Pb)-Total	0.065	<0.020	0.066	0.024	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Lithium (Li)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	306	280	307	275	274	297	264	296	285	268
Manganese (Mn)-Total	0.153	0.089	0.104	0.094	0.065	0.078	0.139	0.111	0.118	0.378
Mercury (Hg)-Total	0.152	0.404	0.153	0.245	0.373	0.214	0.178	0.093	0.197	0.224
Molybdenum (Mo)-	<0.010	<0.010	<0.010	0.014	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel (Ni)-Total	<0.10	<0.10	<0.10	0.11	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	0.41	0.54	0.38	0.41	0.45	0.49	0.37	0.36	0.27	0.42
Strontium (Sr)-Total	0.198	0.067	0.120	0.103	0.052	0.093	0.066	0.072	0.096	0.069
Thallium (Tl)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	0.013	<0.010	<0.010	<0.010	<0.010
Tin (Sn)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total	4.72	4.77	4.53	4.30	3.91	3.92	4.05	3.99	4.88	4.13

Appendix 3.2-4a. Lake Trout Tissue Quality Results from the Back River Project Area, 2011

Sample ID	RFB9	RFB10	RFB11	GL1	GL2	GL3	GL4	GL5	GL6
Date Sampled	25-AUG-11	25-AUG-11	25-AUG-11	27-AUG-11	27-AUG-11	27-AUG-11	27-AUG-11	27-AUG-11	27-AUG-11
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1053002-11	L1053002-12	L1053002-13	L1053002-14	L1053002-15	L1053002-16	L1053002-17	L1053002-18	L1053002-19
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests									
% Moisture	78.4	76.5	78.3	76.4	77.8	74.5	74.8	77.6	75.9
Metals									
Aluminum (Al)-Total	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Antimony (Sb)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	<0.010	0.019	0.013	0.016	0.023	0.014	0.022	0.035	0.013
Barium (Ba)-Total	0.013	<0.010	0.012	0.025	0.013	0.013	<0.010	0.010	0.021
Beryllium (Be)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total	92.2	71.1	85.1	190	73.6	79.5	54.9	59.7	121
Chromium (Cr)-Total	<0.10	<0.10	<0.10	0.11	0.22	0.12	0.15	0.12	0.13
Cobalt (Co)-Total	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Copper (Cu)-Total	0.225	0.256	0.211	0.278	0.357	0.361	0.359	0.268	0.291
Lead (Pb)-Total	<0.020	<0.020	<0.020	0.215	0.073	0.050	0.212	0.110	0.208
Lithium (Li)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	265	286	249	289	257	292	275	276	287
Manganese (Mn)-Total	0.099	0.092	0.122	0.122	0.099	0.104	0.087	0.097	0.113
Mercury (Hg)-Total	0.324	0.362	0.237	0.175	0.471	0.288	0.549	0.433	0.214
Molybdenum (Mo)-	<0.010	<0.010	<0.010	<0.010	0.014	<0.010	<0.010	<0.010	<0.010
Nickel (Ni)-Total	<0.10	<0.10	<0.10	<0.10	0.12	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	0.25	0.42	0.33	0.40	0.34	0.34	0.33	0.41	0.33
Strontium (Sr)-Total	0.097	0.058	0.066	0.219	0.066	0.077	0.043	0.049	0.134
Thallium (Tl)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	<0.010
Tin (Sn)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total	4.32	3.84	4.06	4.59	4.68	4.17	3.93	4.40	3.84

Appendix 3.2-4b. Detection Limits for Tissue Quality Analyses

Sample ID	LL1	LL2	LL3	LL4	LL5	LL6	RFB1	RFB2	RFB7	RFB8
Date Sampled	23-AUG-11	23-AUG-11	24-AUG-11	24-AUG-11	24-AUG-11	24-AUG-11	25-AUG-11	25-AUG-11	25-AUG-11	25-AUG-11
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1053002-1	L1053002-2	L1053002-3	L1053002-4	L1053002-5	L1053002-6	L1053002-7	L1053002-8	L1053002-9	L1053002-10
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests										
% Moisture	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Metals										
Aluminum (Al)-Total	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Antimony (Sb)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Arsenic (As)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Barium (Ba)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Beryllium (Be)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Bismuth (Bi)-Total	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
Cadmium (Cd)-Total	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
Calcium (Ca)-Total	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Chromium (Cr)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Cobalt (Co)-Total	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Copper (Cu)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Lead (Pb)-Total	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Lithium (Li)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Magnesium (Mg)-Total	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Manganese (Mn)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Mercury (Hg)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Molybdenum (Mo)-	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Nickel (Ni)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Selenium (Se)-Total	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Strontium (Sr)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Thallium (Tl)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Tin (Sn)-Total	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Uranium (U)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Vanadium (V)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Zinc (Zn)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Appendix 3.2-4b. Detection Limits for Tissue Quality Analyses

Sample ID	RFB9	RFB10	RFB11	GL1	GL2	GL3	GL4	GL5	GL6
Date Sampled	25-AUG-11	25-AUG-11	25-AUG-11	27-AUG-11	27-AUG-11	27-AUG-11	27-AUG-11	27-AUG-11	27-AUG-11
Time Sampled	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	L1053002-11	L1053002-12	L1053002-13	L1053002-14	L1053002-15	L1053002-16	L1053002-17	L1053002-18	L1053002-19
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests									
% Moisture	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Metals									
Aluminum (Al)-Total	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Antimony (Sb)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Arsenic (As)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Barium (Ba)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Beryllium (Be)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Bismuth (Bi)-Total	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
Cadmium (Cd)-Total	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
Calcium (Ca)-Total	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Chromium (Cr)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Cobalt (Co)-Total	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Copper (Cu)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Lead (Pb)-Total	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
Lithium (Li)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Magnesium (Mg)-Total	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Manganese (Mn)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Mercury (Hg)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Molybdenum (Mo)-	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Nickel (Ni)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Selenium (Se)-Total	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Strontium (Sr)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Thallium (Tl)-Total	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Tin (Sn)-Total	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Uranium (U)-Total	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Vanadium (V)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Zinc (Zn)-Total	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Appendix 3.2-5

Diet Analysis Results for the Back River Project Area, 2011

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Appendix 3.2-5a. Diet Analysis Results (by Number of Prey Items) for the Back River Project, 2011

Stomach Number			Ref B-1	Ref B-2	Ref B-7	Ref B-8	Ref B-9	Ref B-10	Ref B-11	Goose-1	Goose-2	Goose-3	Goose-4	Goose-5	Goose-6	Llama-1	Llama-2	Llama-3	Llama-4	Llama-5	Llama-6	
Date			25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	23-Aug-11	23-Aug-11	24-Aug-11	24-Aug-11	24-Aug-11	24-Aug-11	
Sample No.			110525	110488	110489	110490	110491	110492	110493	110494	110495	110496	110497	110498	110499	110500	110501	110502	110503	110504	110505	
Fullness (%)			100	100	90	50	100	90	50	75	90	100	40	20	90	75	5	10	10	10	2	
Digestion (%)			25	40	50	25	25	50	50	25	25	25	50	25	25	25	75	75	90	50	25	
Actual Weight (mg)			25468	38600	29563	9135	44712	7653	7963	4240	6000	10008	2614	1856	3747	3923	427	517	1584	1196	558	
Species/Group	Stage	Origin																				Total
CRUSTACEA																						
CLADOCERA																						0
Daphnidae																						0
Daphnia middendorffiana		Z						615													350	965
Chydoridae																						0
Eurycercus	A	B				4			1		1	1					3	11	12	11		44
COPEPODA																						0
Heterocope septentriona	A	Z															2	4			1	7
INSECTA																						0
HEMIPTERA																						0
Hemiptera	A	W																1				1
Corixidae																						0
Corisella	A	W						1	1				2				4		4		1	13
TRICHOPTERA																						0
Trichoptera damaged	A	D							1													1
Limnephilidae	P	B	24	35	88	236	10	205	130	6	46	256	16				5		4			1061
Limnephilidae	A	D			1					3			9					1				14
Grensia	L	B					1												1			2
COLEOPTERA																						0
Coleoptera damaged	A	D				1																1
Dytiscidae	A	W															2					2
Colymbetes	A	W											1						1			2
HYMENOPTERA																						0
Apidae	A	D			1								1									2
DIPTERA																						0
Nematocera	P	D											2									2
Chironomidae																						0
Chironomidae damaged	P	B														4	4	4	16	1		29
Tanypodinae																						0
Procladius	L	B				1																1

Abbreviation	*Description*	*Abbreviation*	*Description*
A	*adult*	*N**	*nymph too small to be identified further*
cop	*copepodite (juvenile copepod)*	*P*	*pupa (second juvenile of homometabolous insect)*
dam	*damaged*	*I to V*	*first through fifth copepodite stages*
E	*egg*	*B*	*Benthic/epibenthic*
F	*female*	*D*	*Drift*
juv	*juvenile*	*TERR*	*Terrestrial*
L	*larva (first juvenile of homometabolous insect)*	*W*	*Water column*
*L**	*larva too small to be identified further*	*Z*	*Zooplankton*
M	*male*	*Estimated Weight*	*Used when parts add up to more than the actual weight recorded, usually when the sample is heavily digested.*
N	*nymph (juvenile of hemimetabolous insect)*	*X*	*Present (in fish diet studies)*

Appendix 3.2-5a. Diet Analysis Results (by Number of Prey Items) for the Back River Project, 2011

Stomach Number			Ref B-1	Ref B-2	Ref B-7	Ref B-8	Ref B-9	Ref B-10	Ref B-11	Goose-1	Goose-2	Goose-3	Goose-4	Goose-5	Goose-6	Llama-1	Llama-2	Llama-3	Llama-4	Llama-5	Llama-6	
Date			25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	23-Aug-11	23-Aug-11	24-Aug-11	24-Aug-11	24-Aug-11	24-Aug-11	
Sample No.			110525	110488	110489	110490	110491	110492	110493	110494	110495	110496	110497	110498	110499	110500	110501	110502	110503	110504	110505	
Fullness (%)			100	100	90	50	100	90	50	75	90	100	40	20	90	75	5	10	10	10	2	
Digestion (%)			25	40	50	25	25	50	50	25	25	25	50	25	25	25	75	75	90	50	25	
Actual Weight (mg)			25468	38600	29563	9135	44712	7653	7963	4240	6000	10008	2614	1856	3747	3923	427	517	1584	1196	558	
Species/Group	**Stage**	**Origin**																				**Total**
Chironomini																						0
Phaenopsectra	L	B																		1		1
Orthocladinae	P	B														2						2
Psectrocladius	P	B																2				2
Diamesinae		B																				0
Monodiamesa	P	B														21	1	2	1	4		29
Protanypus	P	B														5	8			2	2	17
MOLLUSCA																						0
Bivalvia																						0
Sphaeridae																						0
Pisidium		B									3	1										4
Sphaerium		B	600	1025	880		870			1				54	1			1				3432
Gastropoda																						0
Valvatidae																						0
Valvata sincera sincera		B									1			2								3
FISH																						0
Fish	damaged												1					1	1	1		4
Gasterostidae																						0
Pungitius pungitius		W						1	1	3	7	1			5	8						26
NON-FOOD ITEMS																						0
Case materials				X								X										0
Plant											X		X									0
Pebble											X											0
TOTAL			624	1060	970	242	881	822	134	13	58	259	32	56	6	40	29	27	40	20	354	5667

Abbreviation	Description	Abbreviation	Description
A	*adult*	*N**	*nymph too small to be identified further*
cop	*copepodite (juvenile copepod)*	*P*	*pupa (second juvenile of homometabolous insect)*
dam	*damaged*	*I to V*	*first through fifth copepodite stages*
E	*egg*	*B*	*Benthic/epibenthic*
F	*female*	*D*	*Drift*
juv	*juvenile*	*TERR*	*Terrestrial*
L	*larva (first juvenile of homometabolous insect)*	*W*	*Water column*
*L**	*larva too small to be identified further*	*Z*	*Zooplankton*
M	*male*	*Estimated Weight*	*Used when parts add up to more than the actual weight recorded, usually when the sample is heavily digested.*
N	*nymph (juvenile of hemimetabolous insect)*	*X*	*Present (in fish diet studies)*

Appendix 3.2-5b. Diet Analysis Results (by Biomass of Prey Items) for the Back River Project, 2011

Stomach Number			Ref B-1	Ref B-2	Ref B-7	Ref B-8	Ref B-9	Ref B-10	Ref B-11	Goose-1	Goose-2	Goose-3	Goose-4	Goose-5	Goose-6	Llama-1	Llama-2	Llama-3	Llama-4	Llama-5	Llama-6	
Date			25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	23-Aug-11	23-Aug-11	24-Aug-11	24-Aug-11	24-Aug-11	24-Aug-11	
Sample No.			110525	110488	110489	110490	110491	110492	110493	110494	110495	110496	110497	110498	110499	110500	110501	110502	110503	110504	110505	
Fullness (%)			100	100	90	50	100	90	50	75	90	100	40	20	90	75	5	10	10	10	2	
Digestion (%)			25	40	50	25	25	50	50	25	25	25	50	25	25	25	75	75	90	50	25	
Actual Weight (mg)			25468	38600	29563	9135	44712	7653	7963	4240	6000	10008	2614	1856	3747	3923	427	517	1584	1196	558	
Species/Group	Stage	Origin																				Total
CRUSTACEA																						
CLADOCERA																						0
Daphnidae																						0
Daphnia middendorffiana		Z						615													512	1127
Chydoridae																						0
Eurycercus	A	B				25			7		4	4					18	77	84	75		294
COPEPODA																						0
Heterocope septentriona	A	Z															2	4			1	7
INSECTA																						0
HEMIPTERA																						0
Hemiptera	A	W																4				4
Corixidae																						0
Corisella	A	W						13	13				70				160		120		35	411
TRICHOPTERA																						0
Trichoptera damaged	A	D							102													102
Limnephilidae	P	B	1200	1709	4395	9099	400	6311	4870	247	2181	9746	780				125		160			41223
Limnephilidae	A	D			53					188			397					48				686
Grensia	L	B					10												10			20
COLEOPTERA																						0
Coleoptera damaged	A	D				5																5
Dytiscidae	A	W															18					18
Colymbetes	A	W											200						200			400
HYMENOPTERA																						0
Apidae	A	D			500								500									1000
DIPTERA																						0
Nematocera	P	D											6									6
Chironomidae																						0
Chironomidae damaged	P	B														16	40	40	160	10		266
Tanypodinae																						0
Procladius	L	B				6																6

Abbreviation	*Description*	*Abbreviation*	*Description*
A	*adult*	*N**	*nymph too small to be identified further*
cop	*copepodite (juvenile copepod)*	*P*	*pupa (second juvenile of homometabolous insect)*
dam	*damaged*	*I to V*	*first through fifth copepodite stages*
E	*egg*	*B*	*Benthic/epibenthic*
F	*female*	*D*	*Drift*
juv	*juvenile*	*TERR*	*Terrestrial*
L	*larva (first juvenile of homometabolous insect)*	*W*	*Water column*
*L**	*larva too small to be identified further*	*Z*	*Zooplankton*
M	*male*	*Estimated Weight*	*Used when parts add up to more than the actual weight recorded, usually when the sample is heavily digested.*
N	*nymph (juvenile of hemimetabolous insect)*	*X*	*Present (in fish diet studies)*

Appendix 3.2-5b. Diet Analysis Results (by Biomass of Prey Items) for the Back River Project, 2011

Stomach Number			Ref B-1	Ref B-2	Ref B-7	Ref B-8	Ref B-9	Ref B-10	Ref B-11	Goose-1	Goose-2	Goose-3	Goose-4	Goose-5	Goose-6	Llama-1	Llama-2	Llama-3	Llama-4	Llama-5	Llama-6	
Date			25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	25-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	27-Aug-11	23-Aug-11	23-Aug-11	24-Aug-11	24-Aug-11	24-Aug-11	24-Aug-11	
Sample No.			110525	110488	110489	110490	110491	110492	110493	110494	110495	110496	110497	110498	110499	110500	110501	110502	110503	110504	110505	
Fullness (%)			100	100	90	50	100	90	50	75	90	100	40	20	90	75	5	10	10	10	2	
Digestion (%)			25	40	50	25	25	50	50	25	25	25	50	25	25	25	75	75	90	50	25	
Actual Weight (mg)			25468	38600	29563	9135	44712	7653	7963	4240	6000	10008	2614	1856	3747	3923	427	517	1584	1196	558	
Species/Group	Stage	Origin																				Total
Chironomini																						0
Phaenopsectra	L	B																		3		3
Orthocladinae	P	B														8						8
Psectrocladius	P	B																1				1
Diamesinae		B																				0
Monodiamesa	P	B														192	11	15	10	32		260
Protanypus	P	B														41	53			9	10	113
MOLLUSCA																						0
Bivalvia																						0
Sphaeridae																						0
Pisidium		B									37	34										71
Sphaerium		B	24268	36276	24615		44302			26				1816	42			31				131376
Gastropoda																						0
Valvatidae																						0
Valvata sincera sincera		B									21			40								61
FISH																						0
Fish	damaged												200					297	840	1067			2404
Gasterostidae																						0
Pungitius pungitius		W						714	2971	3779	3711	177			3705	3666						18723
NON-FOOD ITEMS																						0
Case materials				615								47										662
Plant											13		885									898
Pebble											33											33
TOTAL			25468	38600	29563	9135	44712	7653	7963	4240	6000	10008	3038	1856	3747	3923	427	517	1584	1196	558	200188

Abbreviation	Description	Abbreviation	Description
A	*adult*	*N**	*nymph too small to be identified further*
cop	*copepodite (juvenile copepod)*	*P*	*pupa (second juvenile of homometabolous insect)*
dam	*damaged*	*I to V*	*first through fifth copepodite stages*
E	*egg*	*B*	*Benthic/epibenthic*
F	*female*	*D*	*Drift*
juv	*juvenile*	*TERR*	*Terrestrial*
L	*larva (first juvenile of homometabolous insect)*	*W*	*Water column*
*L**	*larva too small to be identified further*	*Z*	*Zooplankton*
M	*male*	*Estimated Weight*	*Used when parts add up to more than the actual weight recorded, usually when the sample is heavily digested.*
N	*nymph (juvenile of hemimetabolous insect)*	*X*	*Present (in fish diet studies)*

Appendix V6-6C

Back River Project: 2012 Fish and Fish Habitat Baseline Report

Rescan™
an ERM company

Sabina Gold & Silver Corp.

BACK RIVER PROJECT
2012 Fish and Fish Habitat Baseline Report







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December 2012

BACK RIVER PROJECT

2012 FISH AND FISH HABITAT BASELINE REPORT

December 2012
Project #833-002-04

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Prepared by:

Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

Rescan™
Engineers and Scientists

Executive Summary

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. Exploration programs were run out of both the Goose and George camps in 2012.

The 2012 baseline program was designed around potential infrastructure and known deposits at the Goose Property, the George Property, and the Marine Laydown Area. It was assumed that access from the Marine Laydown Area to George and Goose properties would be by winter road, and that access between the George and Goose properties would also be by winter road.

This report presents the results from the freshwater fish and fish habitat portion of the 2012 baseline program. The broad objective of the 2012 fish and fish habitat baseline program was to collect baseline data from areas anticipated to be either directly or indirectly influenced by proposed future infrastructure and deposits.

Surveys of stream fish habitat and community composition were conducted at 31 sites along proposed mine roads and receiving environment areas in June and July 2012. Of these, 20 were identified as streams with defined channels and the potential to provide fish habitat. The remaining sites were identified as non-classified drainages (NCDs) with no defined channel and little to no potential to provide fish habitat. The stream sites covered a wide variety of habitat types and stream sizes; however, most of the streams were small, low-gradient drainages with abundant instream cover. Habitat at most of the stream sites was determined to be important, mainly for Arctic grayling rearing and migration.

Six fish species were captured or observed in Project area streams in 2012: Arctic grayling, lake trout, round whitefish, burbot, ninespine stickleback, and slimy sculpin. Grayling and sculpin were the most commonly captured species in streams. Recently emerged grayling fry were observed in early July in three of the surveyed streams, indicating that these streams are used for spawning and rearing.

A proposed tailings storage area in the Moby Watershed was surveyed in August 2012 using the Sensitive Habitat Inventory Methodology (SHIM). A total of 7.8 km of stream fish habitat was surveyed, 4.1 km of which was on the mainstem of Moby Outflow, while 3.7 km was on tributaries. In total, nine streams or drainages were surveyed. The majority of the Moby Outflow mainstem was characterized as important or critical fish habitat for Arctic grayling, the primary species present. This habitat rating was based on the channel size, abundant cover, and potential for spawning and rearing. Tributaries of Moby Outflow generally had marginal habitat quality due to shallow depths, poorly defined banks, and presence of NCD habitat units. Despite these ratings, juvenile Arctic grayling were observed throughout the streams in the area. The only sections where fish were not observed were the upper reaches of Moby Outflow and Moby Tributary 2, where cascades and boulder fields block fish passage from downstream reaches.

A total of 19 lakes were surveyed for fish habitat and species composition in the Back River Project Area in 2012. At each lake, shoreline substrate and habitat were assessed; and a combination of gillnets and beach seines were used to sample for fish. Most of the lakes in the Project area have boulder and cobble-dominated shorelines with sparse aquatic vegetation. The maximum depth of the lakes surveyed ranged from less than 2 m to 16.5 m, but most lakes surveyed had maximum depths of 4 to 6 m.

Based on sampling, visual observations, and connectivity with other lakes, all of the lakes sampled in 2012 were fish-bearing. No fish were captured at Occurrence Lake, Lytle Lake, or Pond 19; however, fish were observed at Pond 19 and have been captured in the past at the other lakes. Of all species, lake trout have the greatest species distribution within the study area. Lake cisco, Arctic char, and longnose sucker were each captured in one lake only. Gander Lake contained the greatest diversity of fish species, with seven species captured. Only one species was captured in Goose Lake, Sleigh Lake and Rascal Lake. Arctic char were only captured at Reference C Lake, which is located approximately 30 km north of the George property, outside of the Project footprint.

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Engineers and Scientists

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BACK RIVER PROJECT
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Appendix 3.3-4. Tissue Metal Analysis — Raw Data, 2012

Appendix 3.3-5. Tissue Metal Analysis — Replicate Results, 2012

Appendix 3.3-6. Tissue Metal Analysis — Quality Control Results, 2012

Appendix 3.3-7. Diet Data, 2012

Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

ANCOVA	Analysis of covariance
ANOVA	Analysis of variance
CPUE	Catch-per-unit-effort
FHAP	Fish habitat assessment procedure
GLM	General linear model
MMER	Metal Mining Effluent Regulations
SHIM	Sensitive habitat inventory methodology
YOY	Young-of-the-year

1. Introduction

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1. Introduction

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold and Silver Corporation (Sabina) located in the West Kitikmeot region of Nunavut. Exploration programs were run out of both the Goose and George camps in 2012 (Figure 1-1).

For 2012, Sabina contracted Rescan Environmental Services (Rescan) to conduct a comprehensive baseline program that covered the geographical area of the Goose Property, the George Property, and a Marine Laydown Area located on the southern part of Bathurst Inlet. The following components were included in the 2012 baseline program:

- Meteorology
- Air Quality and Dust
- Noise
- Hydrology and Bathymetry
- Freshwater Water Quality, Sediment Quality, Aquatic Biology
- Freshwater Fish and Fish Habitat
- Marine Water Quality, Sediment Quality, Aquatic Biology
- Marine Fish and Fish Habitat
- Wildlife (Terrestrial and Marine)
- Wildlife DNA Study (Grizzly Bear and Wolverine)
- Ecosystem Mapping
- Vegetation and Wetlands (including Rare Plants)
- Soils and Terrain
- Country Foods
- Archaeology
- Socio-Economics
- Land Use
- Metal Leaching/Acid Rock Drainage (ML/ARD)

The 2012 baseline program was designed around potential infrastructure and known deposits at the Goose Property, the George Property, and the Marine Laydown Area. It was assumed that access from the Marine Laydown Area to George and Goose properties would be by winter road, and that access between the George and Goose properties would also be by winter road.

This report presents the results from the freshwater fish and fish habitat portion of the 2012 baseline program. The broad objective of the 2012 freshwater fish and fish habitat baseline program was to collect baseline data from areas anticipated to be either directly or indirectly influenced by proposed future infrastructure and deposits. The specific objectives of the fish and fish habitat baseline program in 2012 were to:



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Back River Project Location

Figure 1-1

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- assess fish habitat and fish presence at stream crossings located on proposed site roads;
- assess fish habitat and community composition in lakes and streams that could be affected by mine development at the Goose and George properties;
- collect baseline tissue metal samples and stomach content samples from potential receiving environment lakes in the Goose and George areas; and
- assess and map fish habitat within the footprint of a proposed tailings storage area in the Moby Lake Watershed.

Chapter 2 of this report presents the methods, and Chapter 3 of this report presents the results. A brief summary is provided in Chapter 4. All raw data collected are included as appendices to this report.

2. Methods

2. Methods

2.1 STUDY AREA

Fish habitat and community assessment locations in 2012 were chosen based on their proximity to proposed mine infrastructure and their potential to be used for fish habitat compensation projects. Streams and lakes were surveyed in the vicinity of the Goose and George areas. In the Goose area, the study area extended from Reference B Lake in the southeast to Llama Lake in the north, and from Moby Lake in the west to Goose Lake in the east. In the George area, the study area extended from Komatic Lake in the south to George Lake in the north and from Lytle Lake in the west to Dragon Lake in the east. Figure 2.1-1 shows an overview of the 2012 study area and the locations of proposed infrastructure.

2.2 OVERVIEW OF PROGRAM

Stream surveys were conducted at potential site road crossings, at the inflows and outflows of select lakes, and within the proposed tailings storage area. Stream surveys at road crossings and lake inflows and outflows were conducted using methods based on the Fish Habitat Assessment Procedures (FHAP) (Johnston and Slaney 1996). Within the proposed tailings storage area, stream surveys were based on the sensitive habitat inventory methodology (SHIM) (Mason and Knight 2001), which also included FHAP surveys. Figures 2.2-1 and 2.2-2 show the locations of stream surveys conducted at proposed mine site road crossings and at lake inlets and outlets within the Goose and George properties.

Lake surveys were conducted on lakes and ponds in the vicinity of proposed Project infrastructure. These included previously surveyed lakes (Goose, Llama, Umwelt, Reference B), as well as numerous lakes for which no previous surveys had been conducted. Lethal sampling was conducted on seven lakes to collect baseline data that could be used for future studies under the *Metal Mining Effluent Regulations*. Locations of all of the lakes sampled in 2012 are presented in Figures 2.2-3a and 2.2-3b. Table 2.2-1 presents a summary of the assessments conducted at each lake in the Goose and George properties.

Table 2.2-1. Overview of Assessments Conducted at Lakes in the Goose and George Properties

Lake	Fish Habitat	Fish Community	Tissue Metals
Goose Property			
Goose Lake	X	X	X
Llama Lake	X	X	X
Umwelt Lake	X	X	X
Gander Lake	X	X	X
Big Lake	X	X	
Moby Lake	X	X	
Rascal Lake	X	X	
Rabbit Lake	X	X	
Swan Lake	X	X	
Fox Lake	X	X	
Pond 19	X	X	

(continued)

Table 2.2-1. Overview of Assessments Conducted at Lakes in the Goose and George Properties (completed)

Lake	Fish Habitat	Fish Community	Tissue Metals
Reference B Lake	X	X	X
George Property			
George Lake	X	X	X
Lytle Lake	X	X	
Occurrence Lake	X	X	
Sleigh Lake	X	X	
Dragon Lake	X	X	
Komatic Lake	X	X	
Reference C Lake	X	X	X

2.3 STREAMS

2.3.1 Fish Habitat

Fish habitat was surveyed using methods based on the Fish Habitat Assessment Procedures (Johnston and Slaney 1996). Representative sections of each reach were chosen and individual habitat units were measured with respect to length, bankfull and wetted width and depth, substrate composition, residual pool depth, bank stability, bank height and instream cover. Barriers to fish migration were also noted and measured, where appropriate.

2.3.2 Sensitive Habitat Inventory Methodology (SHIM)

All streams located within the proposed tailings storage area footprint downstream of Moby Lake were ground-truthed, mapped, and habitat assessed through the implementation of the Sensitive Habitat Inventory Mapping (SHIM) protocol. The SHIM method is intended as a standard for watercourse and fish habitat mapping in British Columbia (Mason and Knight 2001) and was adapted for use in Arctic streams by Rescan. This method attempts to ensure the collection and mapping of reliable, high quality, current, and spatially accurate information about fish habitats and watercourses.

Streams and wetlands were located in the field and their precise locations were mapped with a differential GPS unit. Moving in an upstream direction, streams were mapped, barriers were identified, and habitat assessments were conducted. Detailed fish habitat data was collected in the field as streams and wetlands were mapped. The spatial data was tied to fish habitat data collected in the field. Habitat data collected was based on the Fish Habitat Assessment Procedures (FHAP; (Johnston and Slaney 1996).

Detailed fish habitat assessments were conducted at representative sites for each stream and reach. Habitat assessment surveys ranged from 29 m to 168 m in length. The length of the habitat assessment site was dependent on the length of the reach and the homogeneity of habitat within the reach. Reaches with a wide variety of habitat types were generally surveyed for a greater distance in order to capture the full range of variation within the reach. At each site, UTM coordinates were recorded with a differential GPS unit. Temperature (°C), pH, and conductivity (µS/cm) were recorded using electronic meters.

FHAP assessments involved differentiating the stream into separate habitat units such as riffles, cascades, glides, and pools; then recording an array of habitat attributes for each unit. These attributes included data on substrate composition, cover for fish, and fish habitat type. A complete list of the attributes measured is presented in Table 2.3-1.

PROJECT #0833-002 GIS # BAC-15-030 December 05 2012

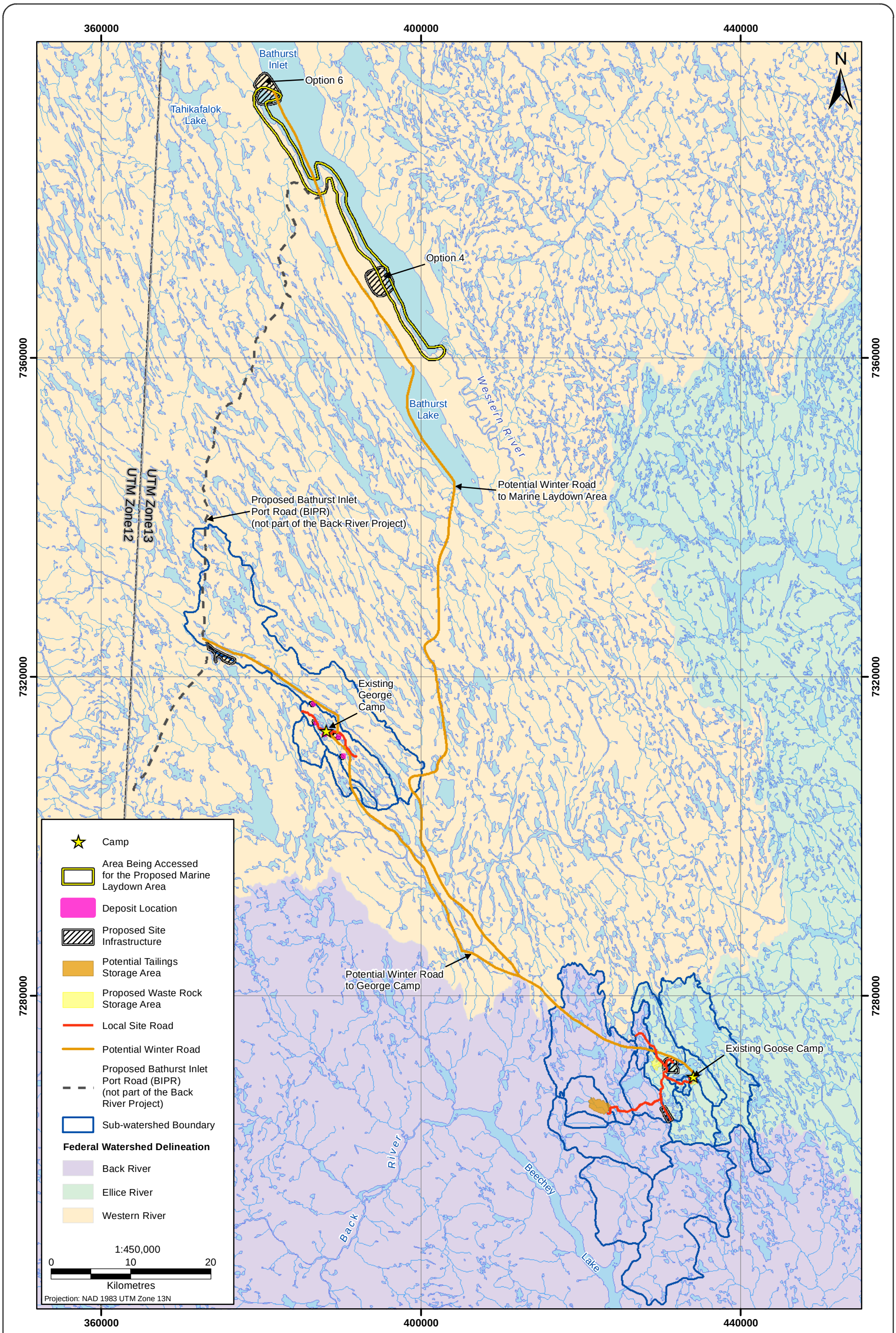


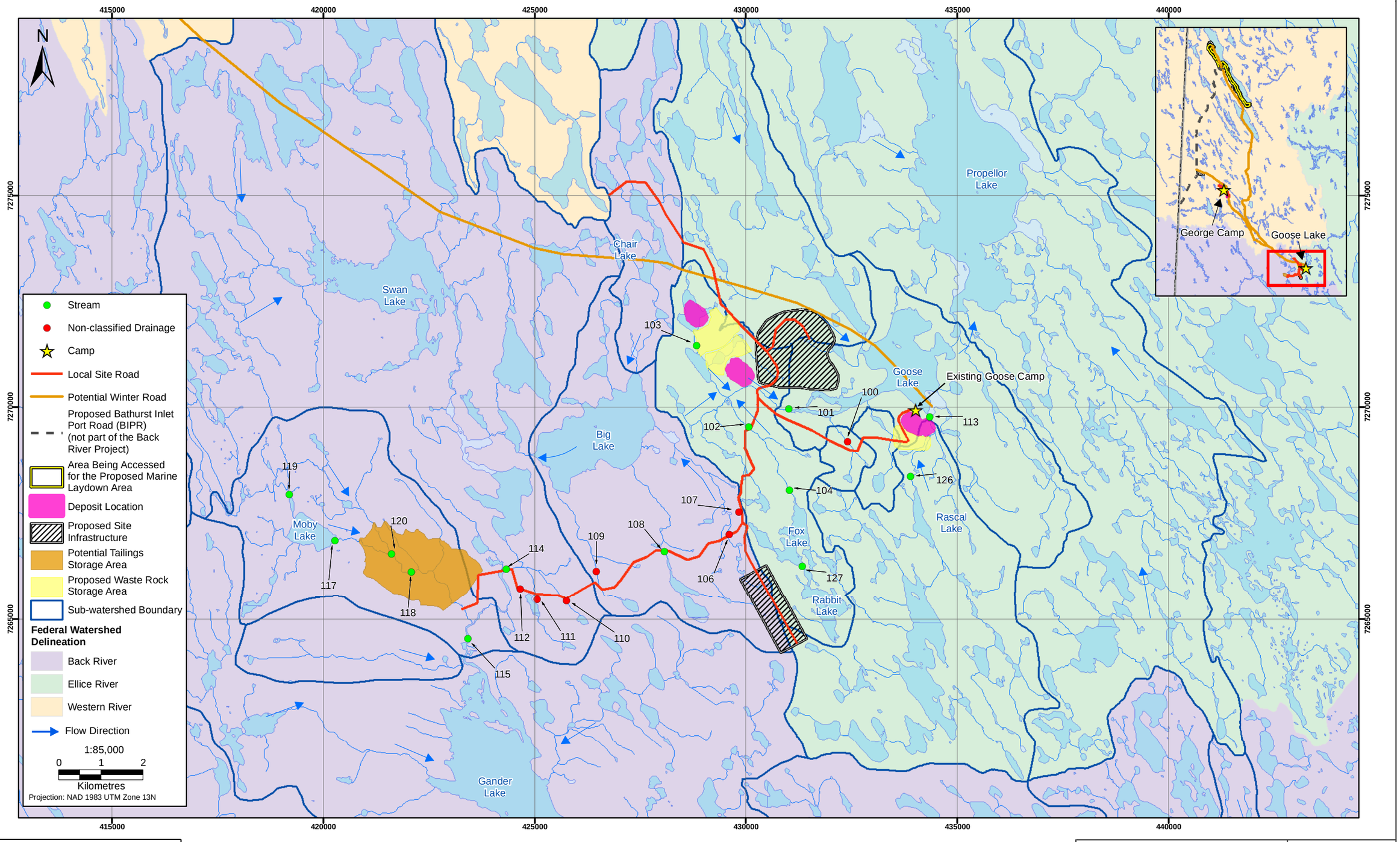
Figure 2.1-1

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Overview of the 2012 Project Area

Figure 2.1-1

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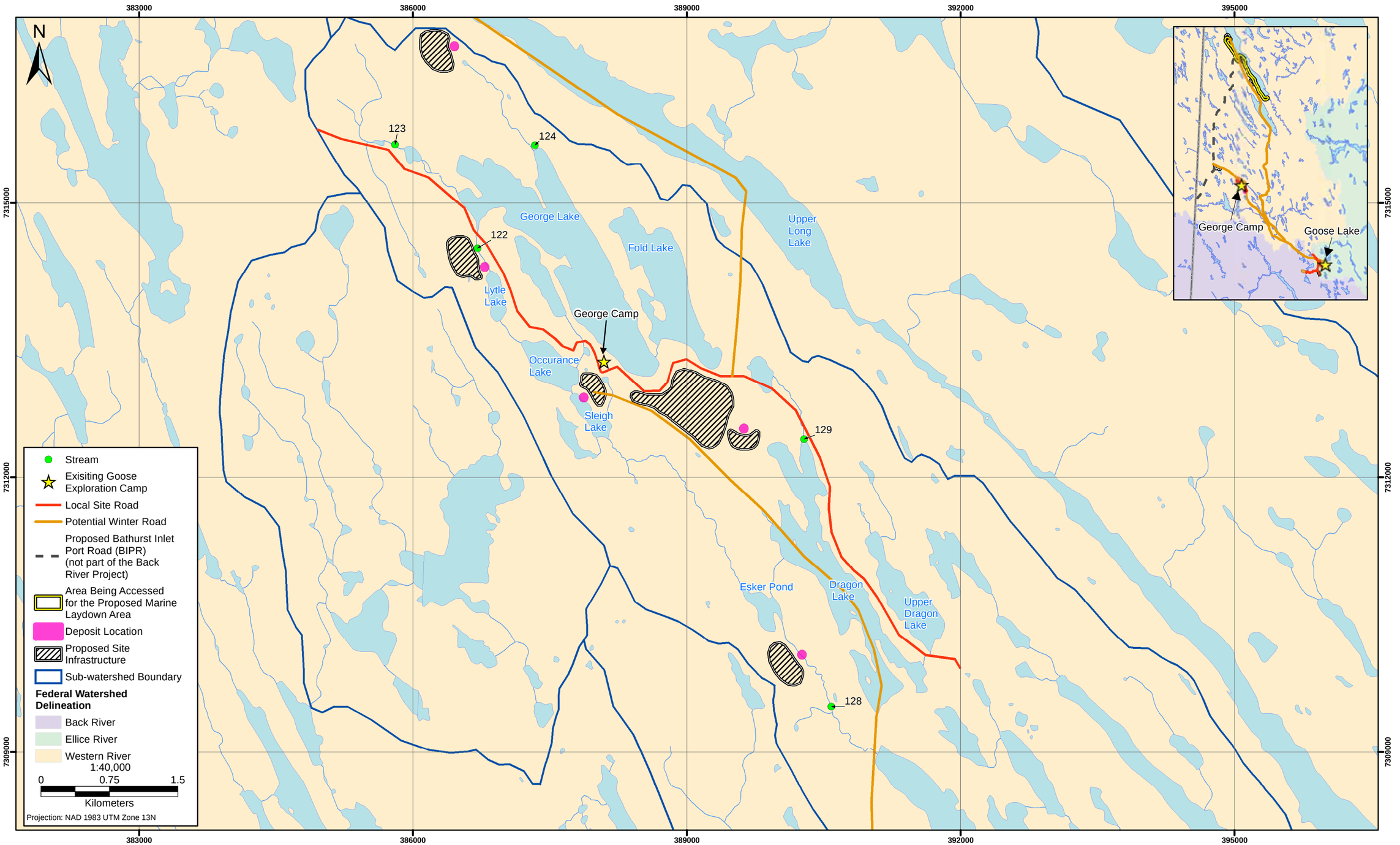


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Figure 2.2-1

Stream Fish Habitat Survey Locations within the Goose Property



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Figure 2.2-2

Stream Fish Habitat Survey Locations within the George Property

PROJECT # 833-002-04 GIS # BAC-06-050a December 12, 2012

420000 430000 440000 450000

7280000 7270000 7260000

N

Swan
Swan Lake
Chair
Chair Lake
Wasp Lake
Giraffe
Leaf Lake
Propellor Lake
Propellor
Llama Lake
Giraffe Lake
Mam Lake
Goose Lake
Umwelt Lake
Big Lake
Big
Moby
Moby Lake
Gander Pond
Goose
Llama
Fox Lake
Echo Lake
Rascal Lake
Pond 19
Rabbit Lake
Wolf
Gander
Gander Lake
Reference
Reference B Lake

Bathurst Inlet
Bathurst Lake
Existing George Camp
Potential Winter Road to George Camp
Main Map
Existing Goose Camp
UTM Zone12
UTM Zone13
1:2,000,000

Lake Survey Location
Fish Community
Fish Habitat
Tissue Metals/Biology
Exisiting Goose Exploration Camp
Existing Airstrip
Potential Underground Development Access
Area Being Accessed for the Proposed Marine Laydown Area
Proposed Open Pit
Proposed Site Infrastructure
Potential Tailings Storage Area
Proposed Waste Rock Storage Area
Local Site Road
Potential Winter Road
Proposed Bathurst Inlet Port Road (BIPR) (not part of the Back River Project)
Sub-watershed Boundary

Federal Watershed Delineation
Back River
Ellice River
Western River

1:100,000
0 2.5 5
Kilometres
Projection: NAD 1983 UTM Zone 13N

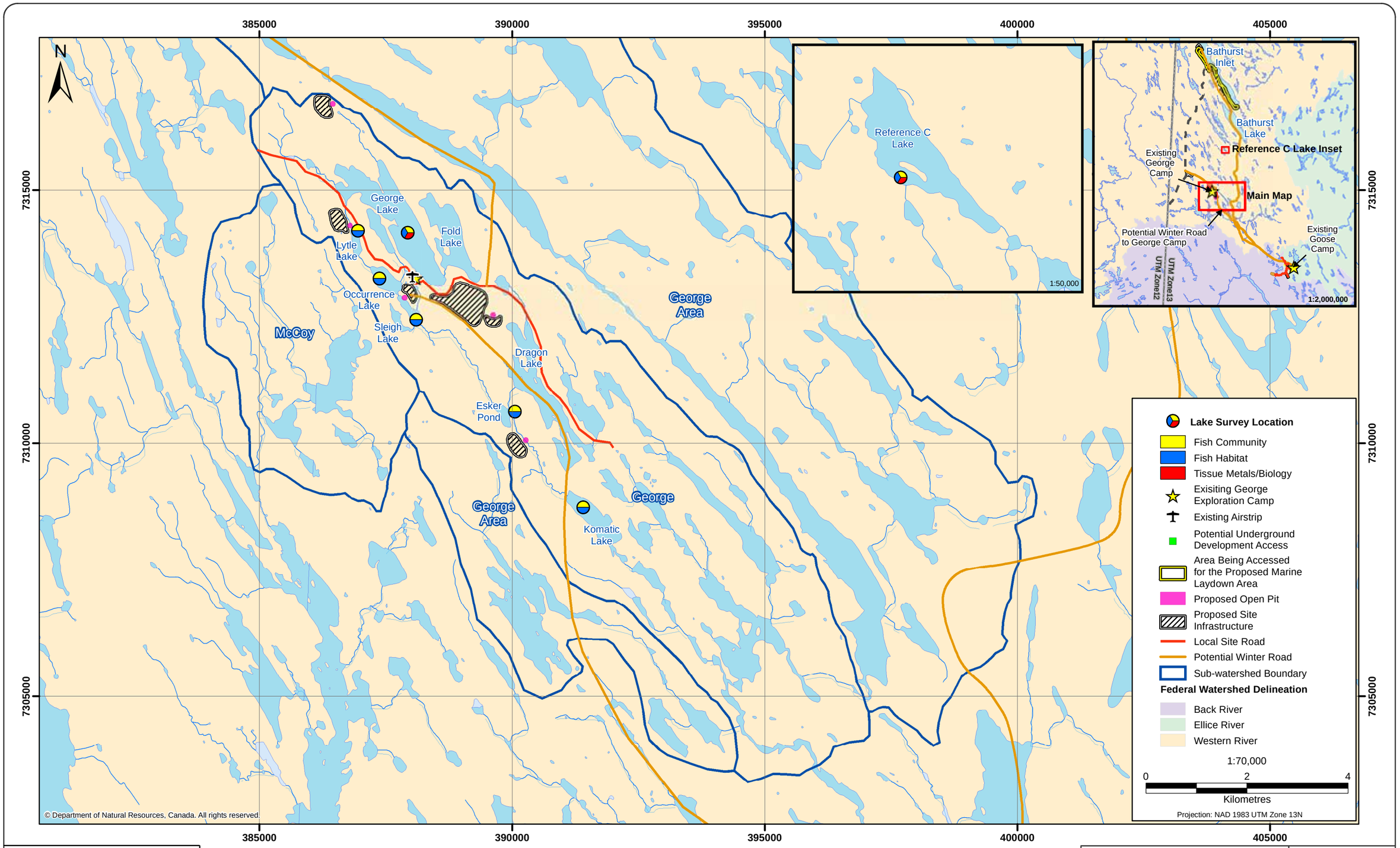
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Figure 2.2-3a

2012 Lake Survey Locations within the Goose Property

PROJECT # 833-002-04 GIS # BAC-06-050b December 12, 2012



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Figure 2.2-3b

2012 Lake Survey Locations within the George Property

Table 2.3-1. FHAP Attributes Assessed and Measured at Stream Sites

Habitat Type	Substrate Type	Physical Measurements	Habitat	Cover
% Pool	% Sand	Length (m)	Pool Type	% Deep Pool
% Riffle	% Gravel	Wetted Depth (m)	Pool Residual Depth (m)	% Boulder
% Glide	% Cobble	Bankfull Depth (m)	Fish Passage Barriers	% Instream Vegetation
% Cascade	% Boulder	Wetted Width (m)	Bank Stability	% Overhanging Vegetation
	% Bedrock	Bankfull Width (m)		% Undercut Bank
		Gradient (%)		
		Bank Height (m)		
		Temperature (°C)		
		pH		
		Conductivity (µS/cm)		

Data were collected with a measuring tape, meter stick, or visual estimation. Stream habitat within each reach was separated into the following habitat units:

- Pool — low velocity area with smooth, non-turbulent flow, low gradient (near 0%), and a concave bottom;
- Glide — an area of smooth, non-turbulent flowing water with moderate velocity and gradient less than 4%;
- Riffle — an area of turbulent, fast-flowing water with a gradient less than 4%; and
- Cascade — high gradient (> 4%) area of turbulent, fast-flowing water.

In addition, Arctic streams often have habitat features that don't appear in southern streams. These include boulder fields (large fields of rock with no defined channel and often no open water), seepages (wide, unconfined drainages with pooled and/or flowing water), and ponds (large pools with moderately defined banks).

For the purposes of this report, each stream and tributary was described according to the following characteristics:

- Channel characteristics — length assessed, number of reaches, channel morphology, bankfull width, wetted width, bankfull depth, wetted depth, residual pool depth and gradient;
- Instream habitat characteristics — habitat unit ratio, weighted substrate composition, weighted cover composition, bank height, and bank stability; and
- Habitat quality characteristics — spawning, rearing and overwintering habitat quality, and overall habitat quality.

2.3.3 Fish Community

Each section of stream evaluated for fish community was sampled using backpack electrofishing and visual observation. Each section sampled was approximately 100 m long. The sections were sampled in a single pass with no use of stop nets because species composition, rather than density, was the primary purpose of sampling. Electrofishing effort in seconds, voltage (V), frequency (Hz), and pulse width (ms) was recorded for each site.

For the drainages in the tailings storage area, visual observation was the primary method of confirming fish presence. Visual observation was used because the primary objective of the survey in the tailings storage area was to characterize fish habitat quality. Also, visual observation was very effective at detecting fish presence due to the low water levels and the abundance of juvenile Arctic grayling fry.

2.3.4 Biology

The primary objective of stream sampling was to confirm fish presence and species composition. Each captured fish was identified to species, counted, and measured for fork length (to the nearest 1 mm) and total weight (to the nearest 1 g). If external parasites were observed, then their presence was recorded. All fish were released back to the stream from which they were captured.

2.4 LAKES

2.4.1 Fish Habitat

Fish habitat was assessed in each lake through a visual survey of the shoreline and littoral zone. The substrate of each zone was recorded as a percent of surface area covered by a type of substrate (e.g., 50% boulder and 50% fines). Substrate types were defined by their average particle diameter: fines (< 2 mm diameter), gravel (2 to 64 mm), cobble (64 to 256 mm), boulder (256 to 4,000 mm), and bedrock (> 4,000 mm). The extent of the littoral zone (shallow shoreline area) and any shoals or shallow zones in the lake were mapped. Any emergent or submergent vegetation that may provide cover for fish was also recorded. Inflows and outflows were identified and photographs were taken of representative habitat types. Maximum depth was estimated using a hand-held depth sounder.

2.4.2 Fish Community

The fish community in each lake was sampled using a combination of gillnets (for pelagic areas) and beach seines (for shallow, shoreline areas). Each gillnet consisted of a standard gang of six panels of different mesh sizes (25 mm, 76 mm, 51 mm, 89 mm, 38 mm and 64 mm) (RIC 2001). Each panel was 15.2 m long, and the panels were sewn together to make a net that is 91.2 m long and 2.4 m deep. Gillnets were deployed by boat and left to fish for up to two hours. Sampling at each lake began with short sets of one hour to minimize fish mortality. If no fish were captured, the set time was increased to maximize the probability of capturing fish. No overnight gillnet sets were used due to the shallow depth of the ponds and the possibility that birds could become entangled in the nets if left unattended. Figures 2.4-1 to 2.4-16 show the locations where sampling gear was set in each lake in the Goose and George properties in 2012.

2.4.3 Biology

2.4.3.1 Field Measurements

Captured fish were identified to species, measured for fork length to the nearest 1 mm and weighed to the nearest 1 g. Age structures were taken from lake trout (*Salvelinus namaycush*), round whitefish (*Prosopium cylindraceum*), Arctic char (*S. alpinus*), and Arctic grayling (*Thymallus arcticus*) for age determination. Age structures were sent to North South Consultants in Winnipeg, MB for analysis.

In addition to length, weight, and age, gonad weight, egg size, fecundity (total number of eggs per female), liver weight, external condition and sex were recorded for some fish captured in selected lakes in the Goose and George properties. These measurements could be used to determine survival, energy use and storage, gonadosomatic index, liversomatic index and condition factor among fish of both sexes for future monitoring programs. For 2012, baseline data collection was based on methods and metrics outlined in the MMER Guidance Document (Environment Canada 2011). These baseline data will provide useful information during the environmental assessment process and can be used if and when the proposed Project is developed. Table 2.4-1 presents a list of lakes where tissue samples were collected, along with the justification for each lake.

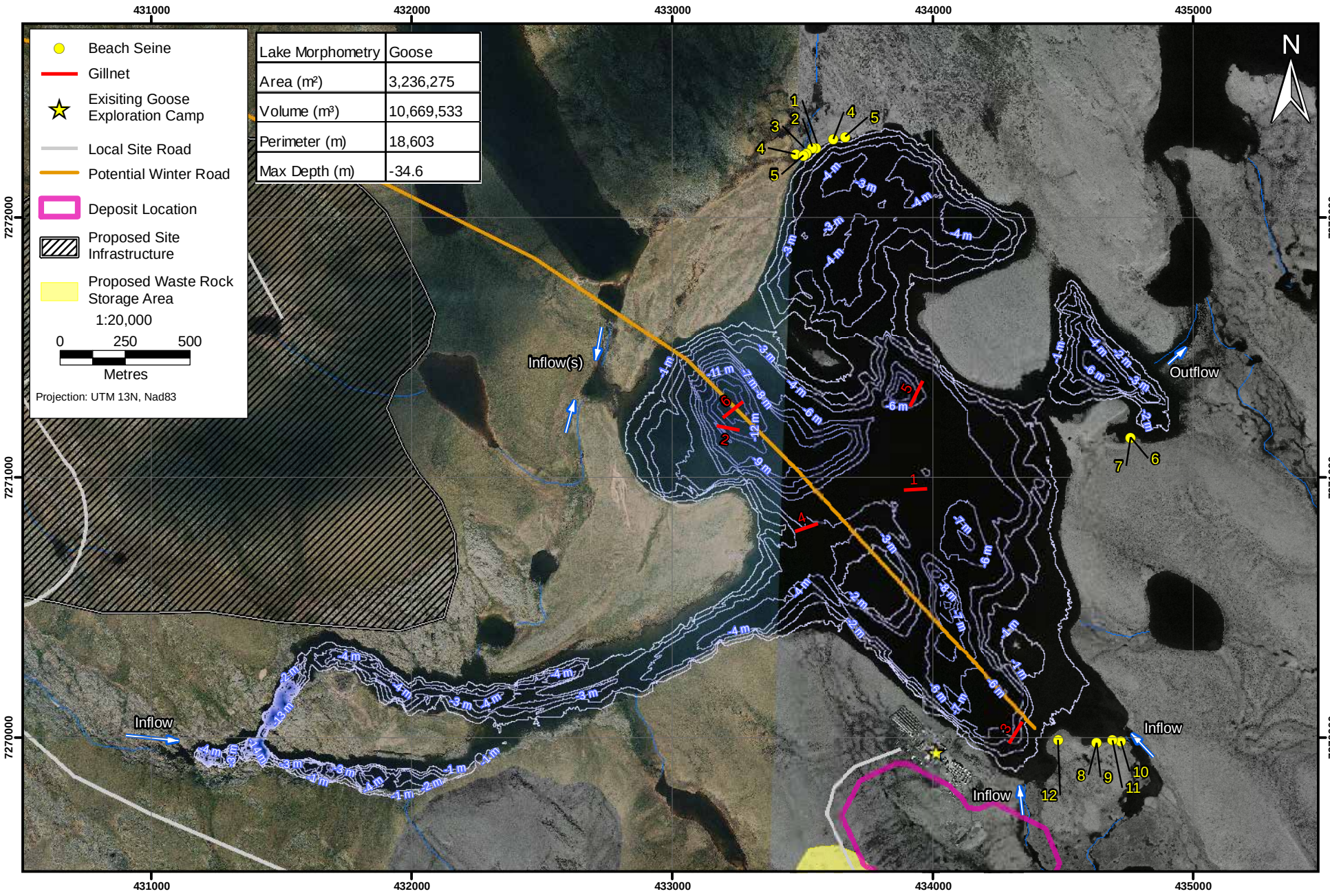


Figure 2.4-1

Sabina Gold & Silver Corp.

Goose Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-1

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Table 2.4-1. Sampling Locations for Fish Tissue Metal Samples, 2012

Site	Species Collected	Rationale
Goose Property		
Goose Lake	Lake trout	Downstream of proposed Goose Pit
Llama Lake	Lake trout, Round whitefish	Within footprint of proposed Llama Pit
Umwelt Lake	Lake trout	Downstream of proposed Llama Pit
Gander Lake	Round whitefish	Downstream of proposed tailings management facility
Reference B Lake	Lake trout, Round whitefish	Reference for Goose area lakes
George Property		
George Lake	Lake trout	Adjacent to proposed Project infrastructure
Reference C Lake	Lake trout	Reference for George area lakes

2.4.3.2 Tissue Metals

Fish tissue metal samples were collected for lake trout from the following lakes: Goose, George, Llama, Reference B, and Reference C Lakes. Round whitefish tissue metal samples were collected from Llama, Gander, and Reference B Lakes.

All lake trout and round whitefish collected for tissue sampling were filleted and the bones and skin were removed. Fillets were placed in sterile Whirl-Pak bags and frozen. Dissecting tools were cleaned between each sample. Tissue samples were sent to ALS Environmental in Burnaby, BC for analysis.

In the lab, tissue samples were homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis was by Inductively Coupled Plasma – Mass Spectrometry (ICPMS). Mercury concentrations were analyzed by atomic fluorescence spectrophotometry.

2.4.3.3 Diet

The stomachs of each sacrificed lake trout were removed from oesophagus to intestine and placed in sterile Whirl-Pak bags. Samples were preserved with 10% buffered formalin and sent to Cordillera Consulting for analysis. Diet contents were enumerated, and contents were identified to the lowest possible taxonomic level.

2.5 DATA ANALYSIS

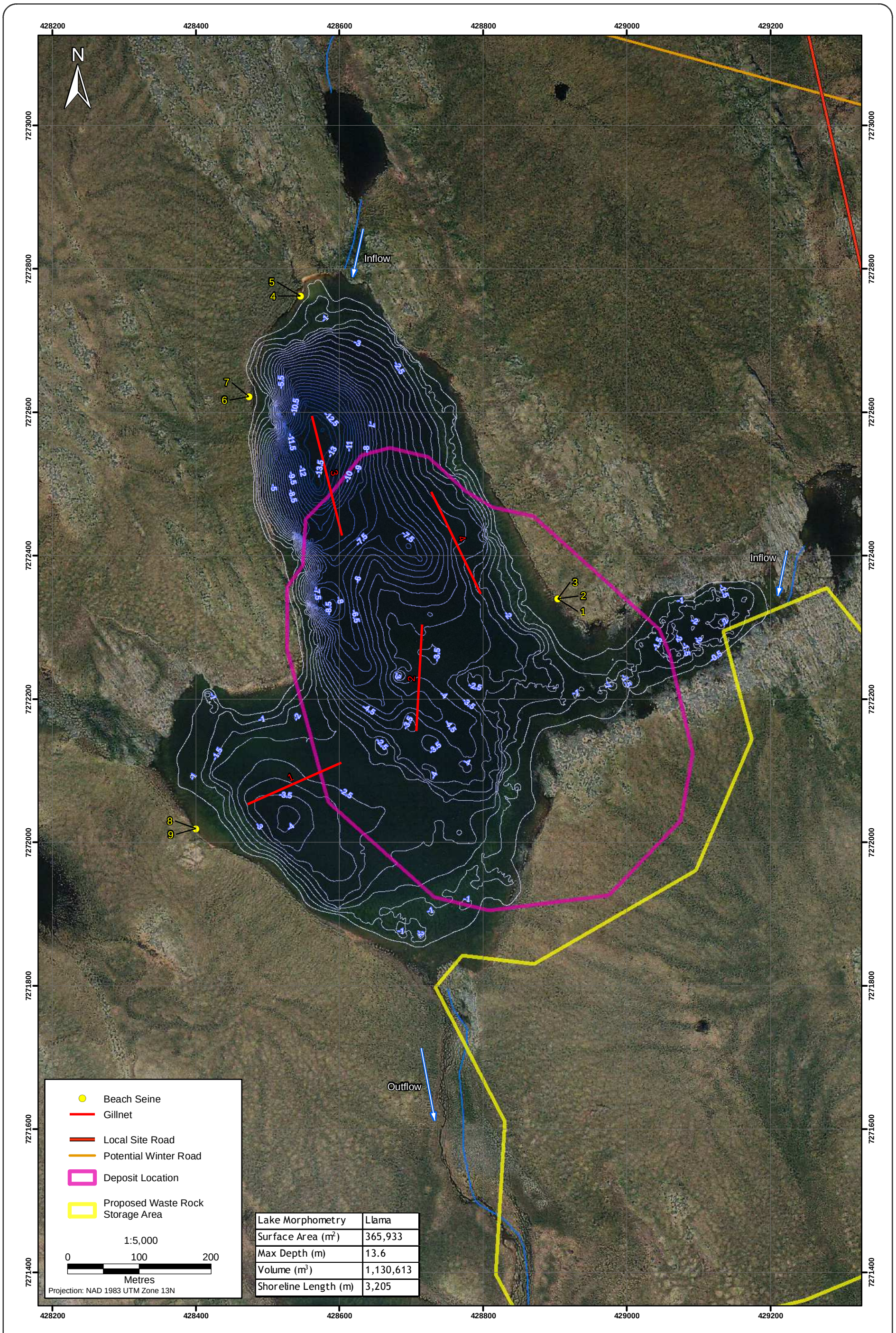
2.5.1 Fish Habitat

Fish habitat data collected in streams were based on measurements made over a representative segment of each reach surveyed. Values for each habitat unit were weighted according to the proportion of the reach length occupied by that unit so that individual habitat units did not have a disproportionate effect on reach-wide averages.

2.5.2 Fish Community

Fish community composition was characterized and compared among sites using catch-per-unit-effort (CPUE). CPUE is an index of relative abundance that can be used to compare fish populations among different areas. It is defined as the number of fish captured per sampling device per unit time. For electrofishing, CPUE was calculated as the number of fish caught per 100 electrofishing seconds. CPUE for gillnetting was calculated as the number of fish captured per 100 m^2 of net per hour. For beach seining, CPUE was calculated as the number of fish captured per 100 m^2 of seined area. Where less than 10 sampling sets were conducted, CPUE data was bootstrapped to provide more accurate summary statistics.

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Lake Morphometry	Llama
Surface Area (m^2)	365,933
Max Depth (m)	13.6
Volume (m^3)	1,130,613
Shoreline Length (m)	3,205

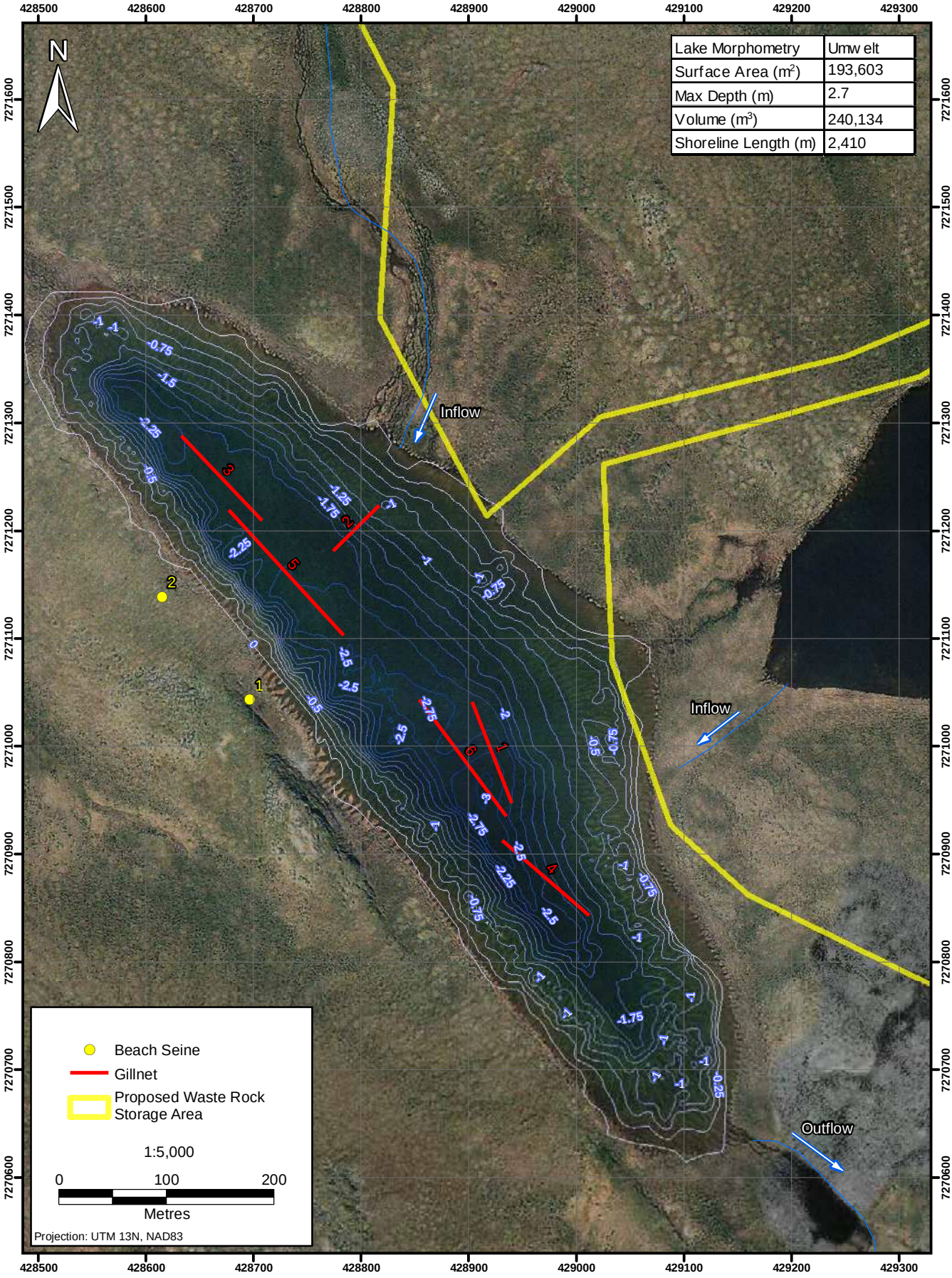
Figure 2.4-2

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Llama Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-2

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Umwelt Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-3

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2.5.3 Biology

Basic fish measurements such as length and weight were compared for each species among sites. Fork length was measured for lake trout, Arctic grayling, Arctic char, round whitefish, and lake cisco (*Coregonus artedii*). Total length was measured for slimy sculpin (*Cottus cognatus*), ninespine stickleback (*Pungitius pungitius*), burbot (*Lota lota*), and longnose sucker (*Catostomus catostomus*). Where fewer than ten samples were collected, data was bootstrapped to provide more accurate summary statistics. Measurements were ln-transformed to meet assumptions of normality, and data was plotted so that outliers could be identified and fixed or eliminated. Length and weight were compared among sites using analysis of variance (ANOVA). Post-hoc comparisons between individual sites were assessed using Bonferroni adjustments.

Energy storage is assessed through the analysis of fish condition and relative liver size. Fish condition may be assessed by two methods. The first method involves comparing length-weight regressions among waterbodies and is generally considered to be more robust than comparisons of indices such as condition factor (Environment Canada 2011). The length-weight relationship was first tested using a regression analysis for captured fish from each lake with weight as the dependent variable and length as the independent variable. If the regressions were significant, a general linear model (GLM) was used to test for equality of regression slopes among lakes. A significant interaction between lake and fork length indicates that the slopes of the regressions are not equal and cannot be compared; however, if the interaction term is not significant, then weight-at-length can be compared using an analysis of covariance (ANCOVA).

Condition factor was used to compare fish condition among lakes if the slopes of the length-weight regressions were not equal. Condition (K) is calculated using the following equation:

$$Condition\ (K) = \frac{weight\ (g) x\ 10^5}{length\ (mm)^3}$$

Condition factor was ln-transformed to meet assumptions of normality and compared among lakes using an ANOVA.

Relative liver size was compared among lakes using a Pearson product moment correlation analysis. The analysis used liver weight as the dependent variable and fish total weight as the independent variable. This analysis is used in cases of low sample size to look for relationships between variables. This method was also used to look for relationships between fish total weight and gonad weight.

The relationship between age and size of each species is determined using growth models. For each species, three growth models are run: a standard von Bertalanffy model, a modified von Bertalanffy model with the age where length equals zero fixed at zero, and a linear model. The standard equation for the von Bertalanffy model is:

$$L_t = L_\infty(1 - e^{(-K(t-t_0))})$$

where L_t is the length at age t, L_∞ is the asymptotic length, K is a growth constant, and t_0 is the age at which length equals zero. The equation for the modified von Bertalanffy model is:

$$L_t = L_\infty(1 - e^{(-K(t))})$$

Akaike weights are presented for each model to show the goodness of fit for each model, and the significance of each parameter in the model is shown to determine which model best describes the data.

PROJECT #0833-002-04 GIS # BAC-06-043g December 12 2012



Lake Morphometry	Gander
Surface Area (m^2)	6,296,254
Max Depth (m)	3.2
Volume (m^3)	10,320,720
Shoreline Length (m)	22,370

Figure 2.4-4

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Gander Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-4

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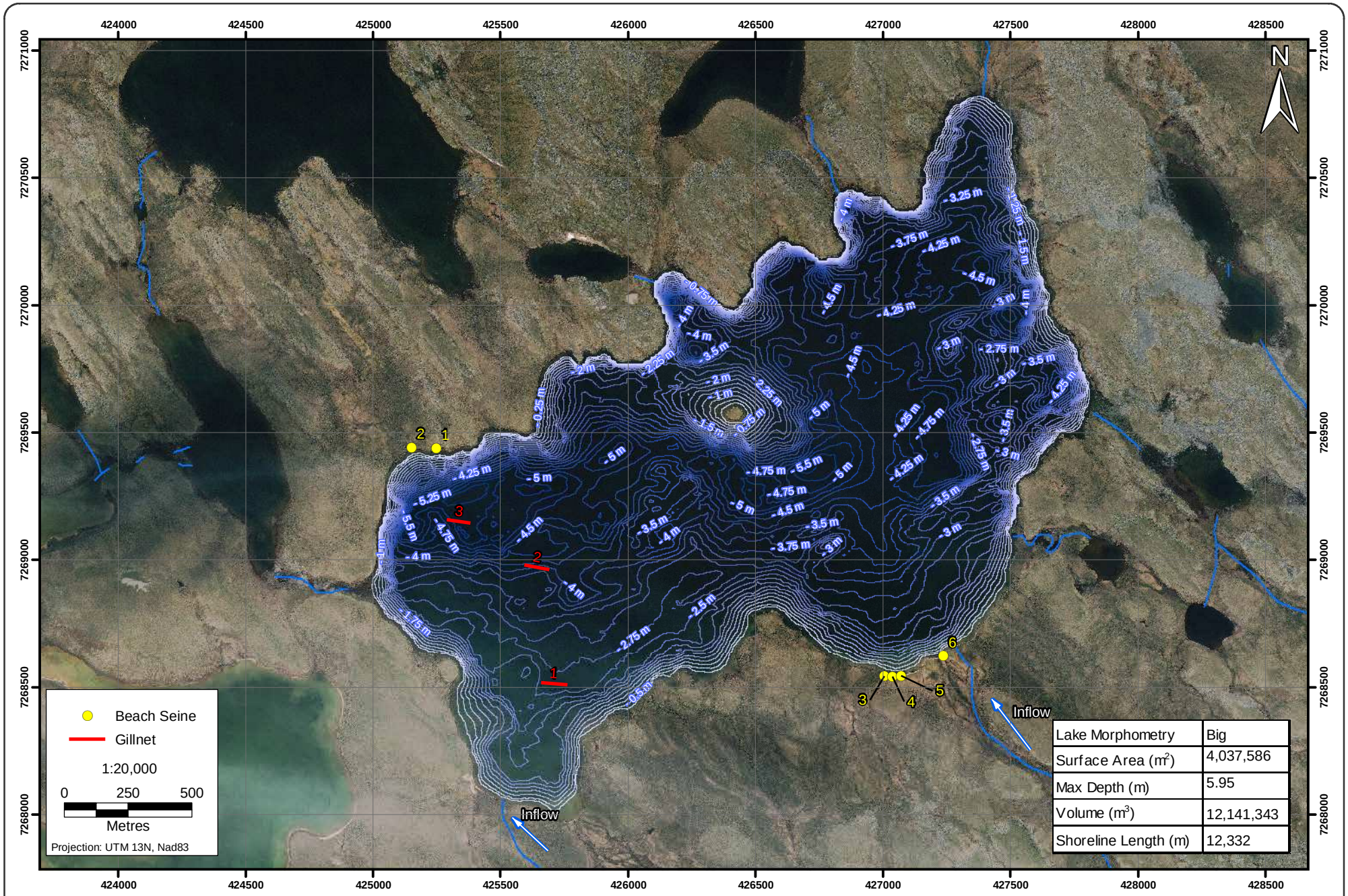


Figure 2.4-5

Big Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-5

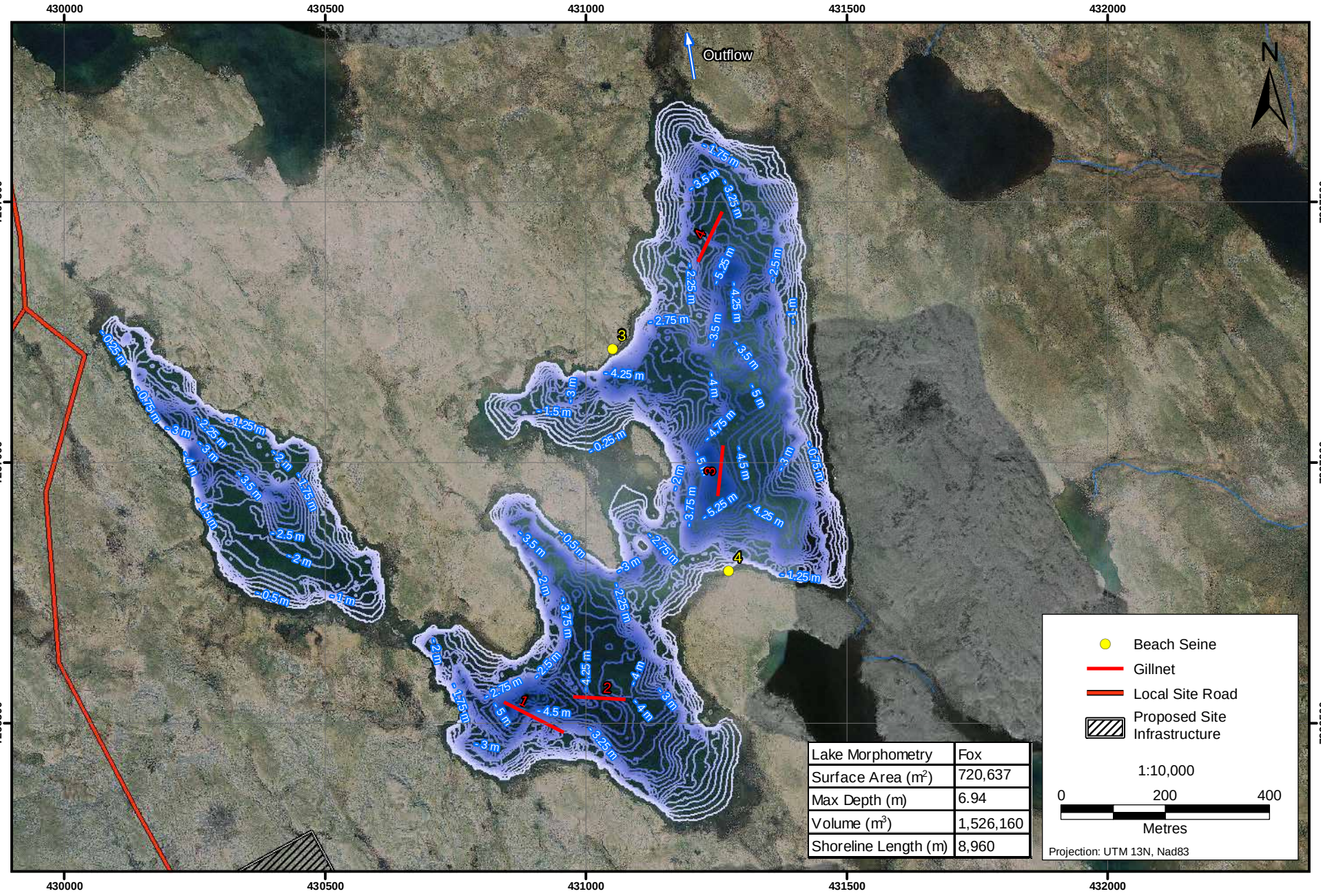


Figure 2.4-6

Sabina GOLD & SILVER CORP.

Fox Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-6

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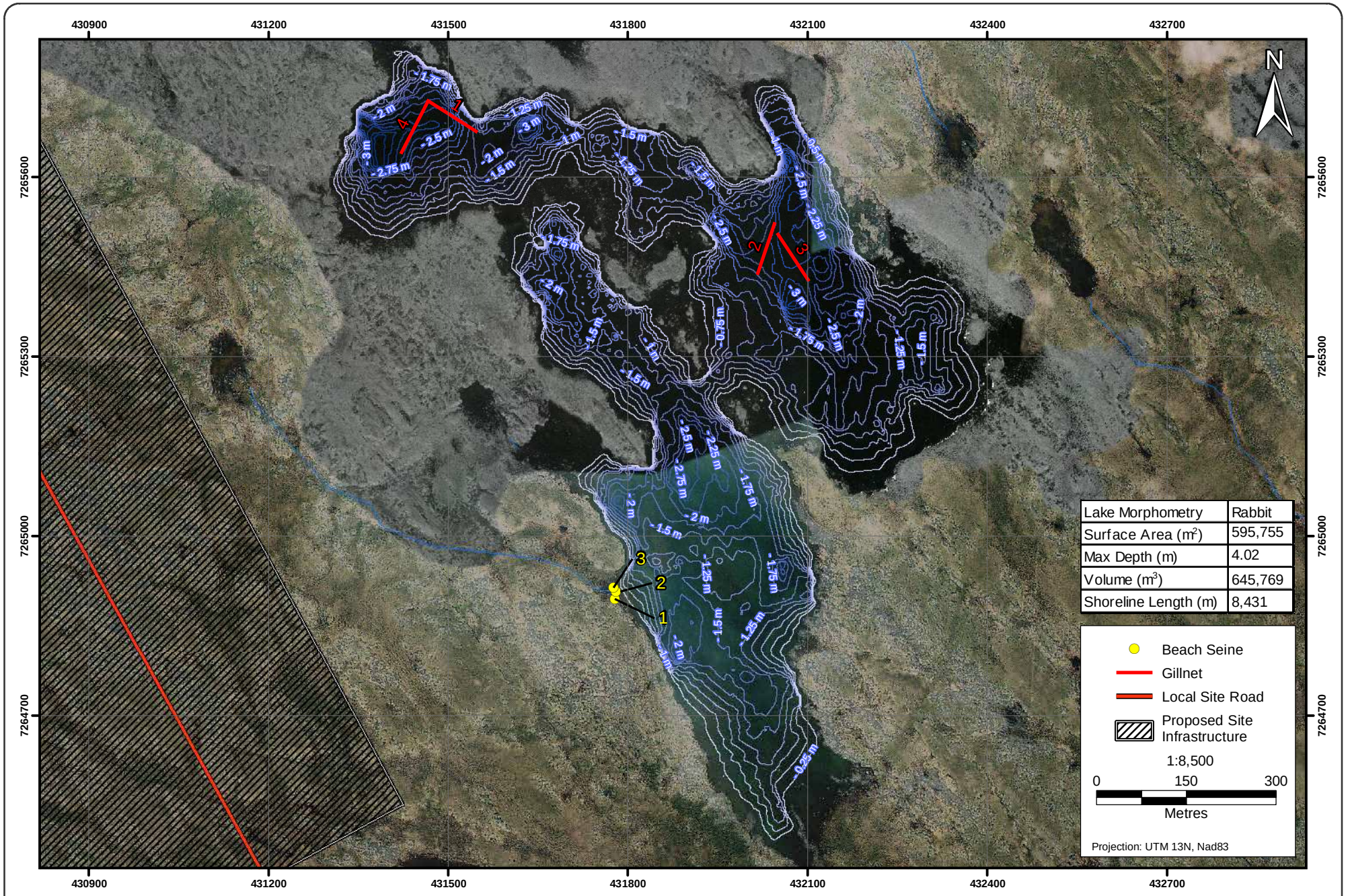


Figure 2.4-7

Sabina GOLD & SILVER CORP.

Rabbit Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-7

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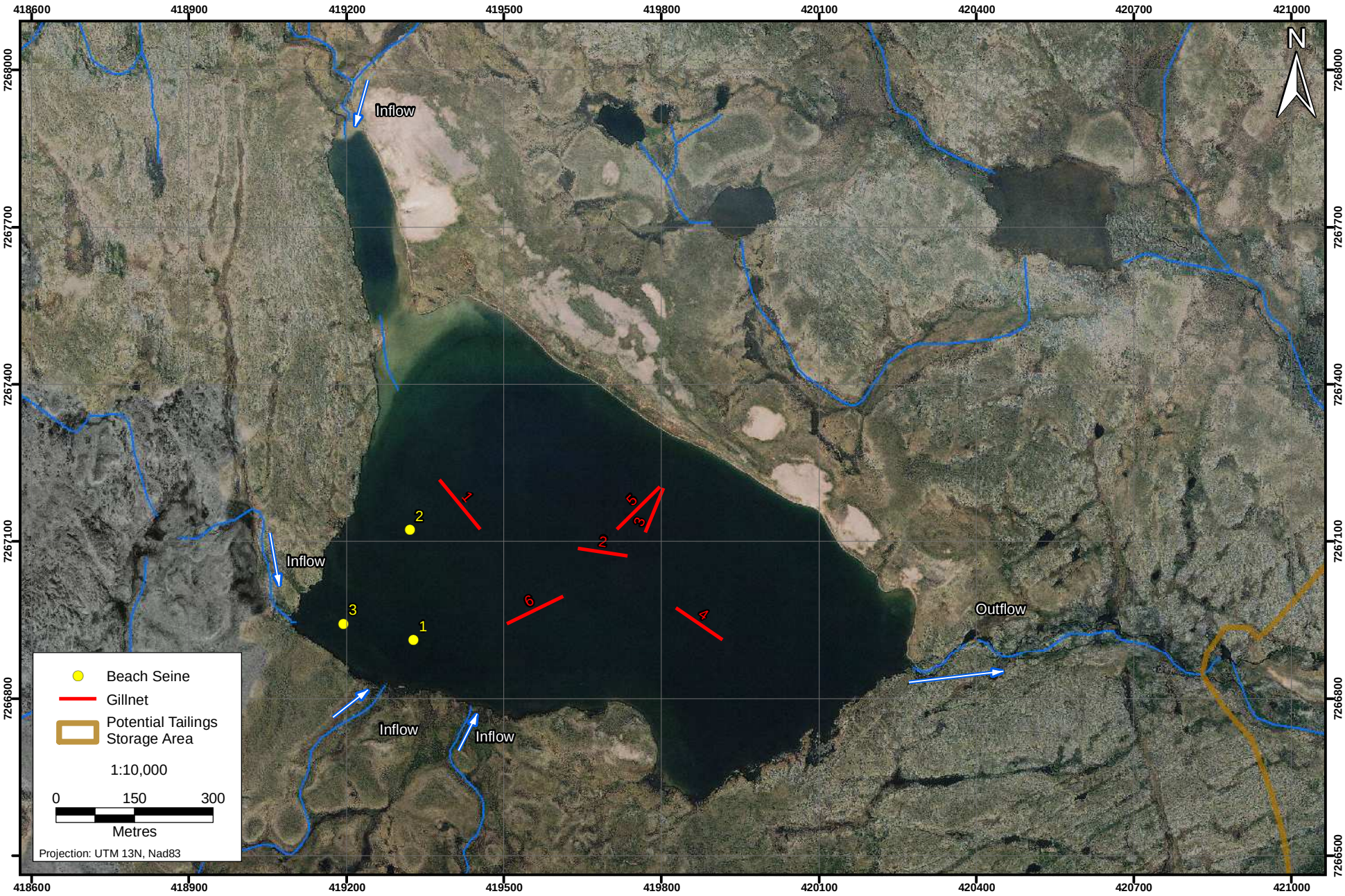


Figure 2.4-8

Sabina Gold & Silver Corp.

Moby Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-8

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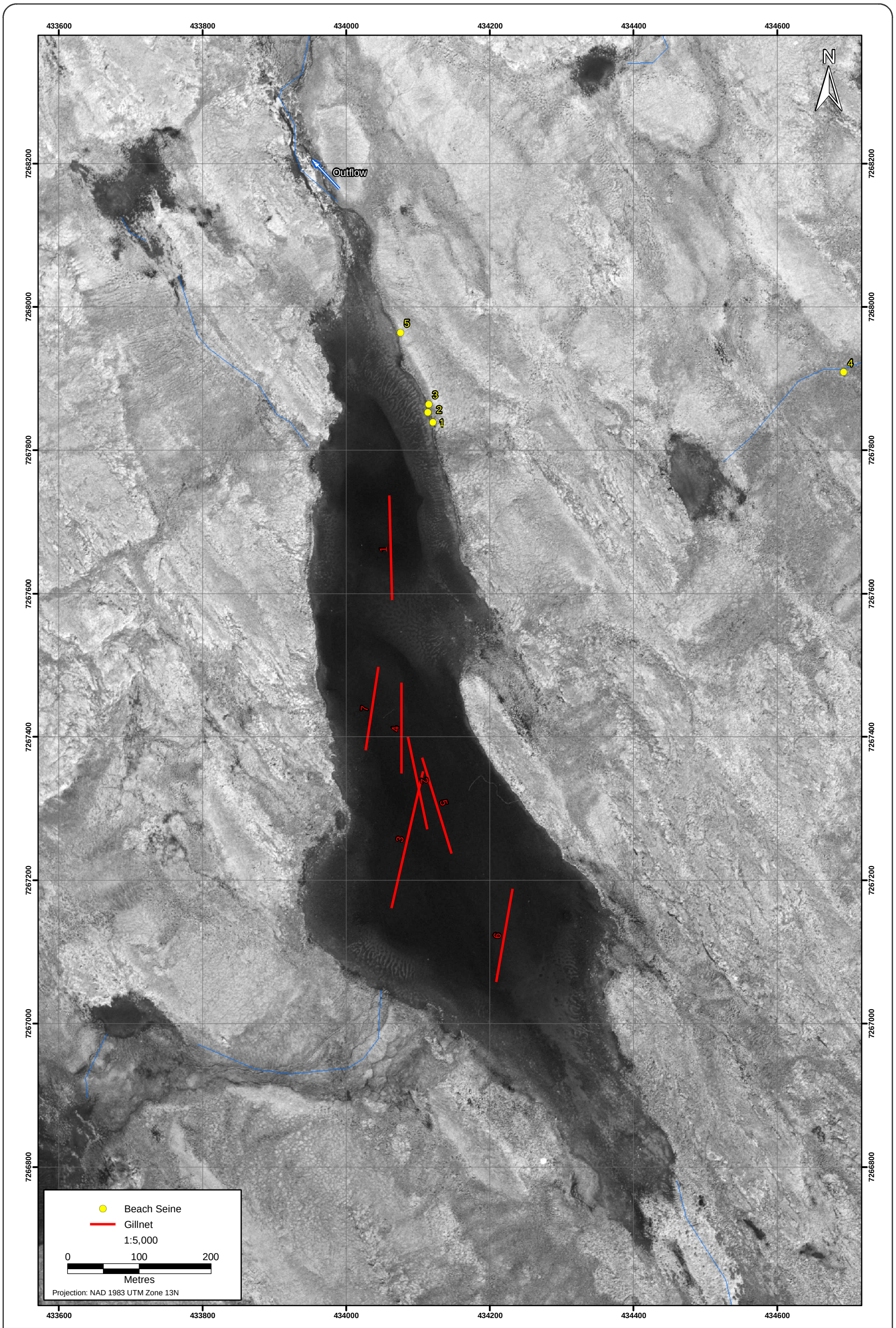


Figure 2.4-9

Sabina GOLD & SILVER CORP.

Rascal Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-9

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PROJECT # 0833-002-04 GIS # BAC-06-043o December 12 2012

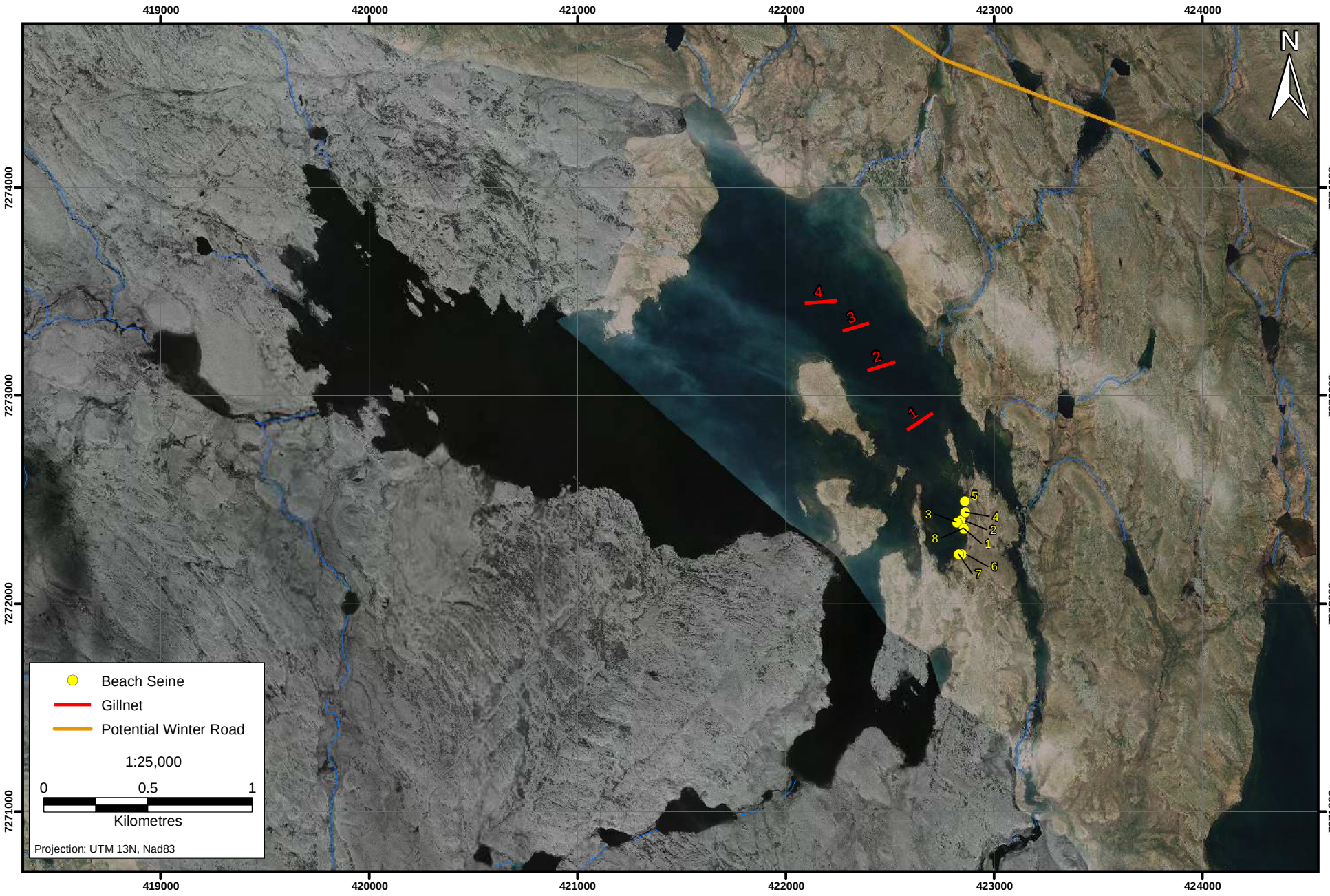


Figure 2.4-10

Sabina GOLD & SILVER CORP.

Swan Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-10

Rescan™ Engineers & Scientists

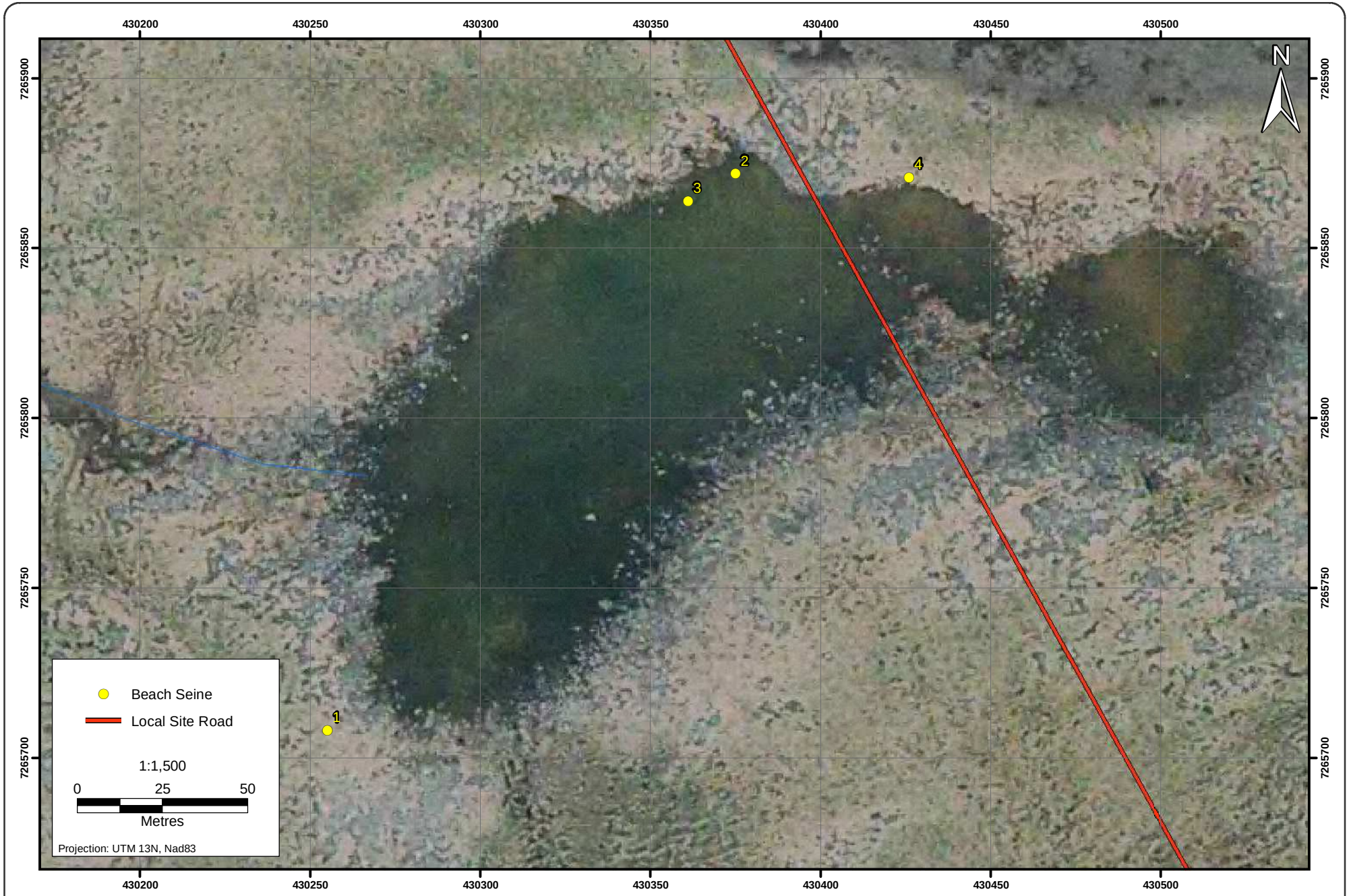


Figure 2.4-11

Sabina GOLD & SILVER CORP.

Pond 19 Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-11

Rescan™ Engineers & Scientists

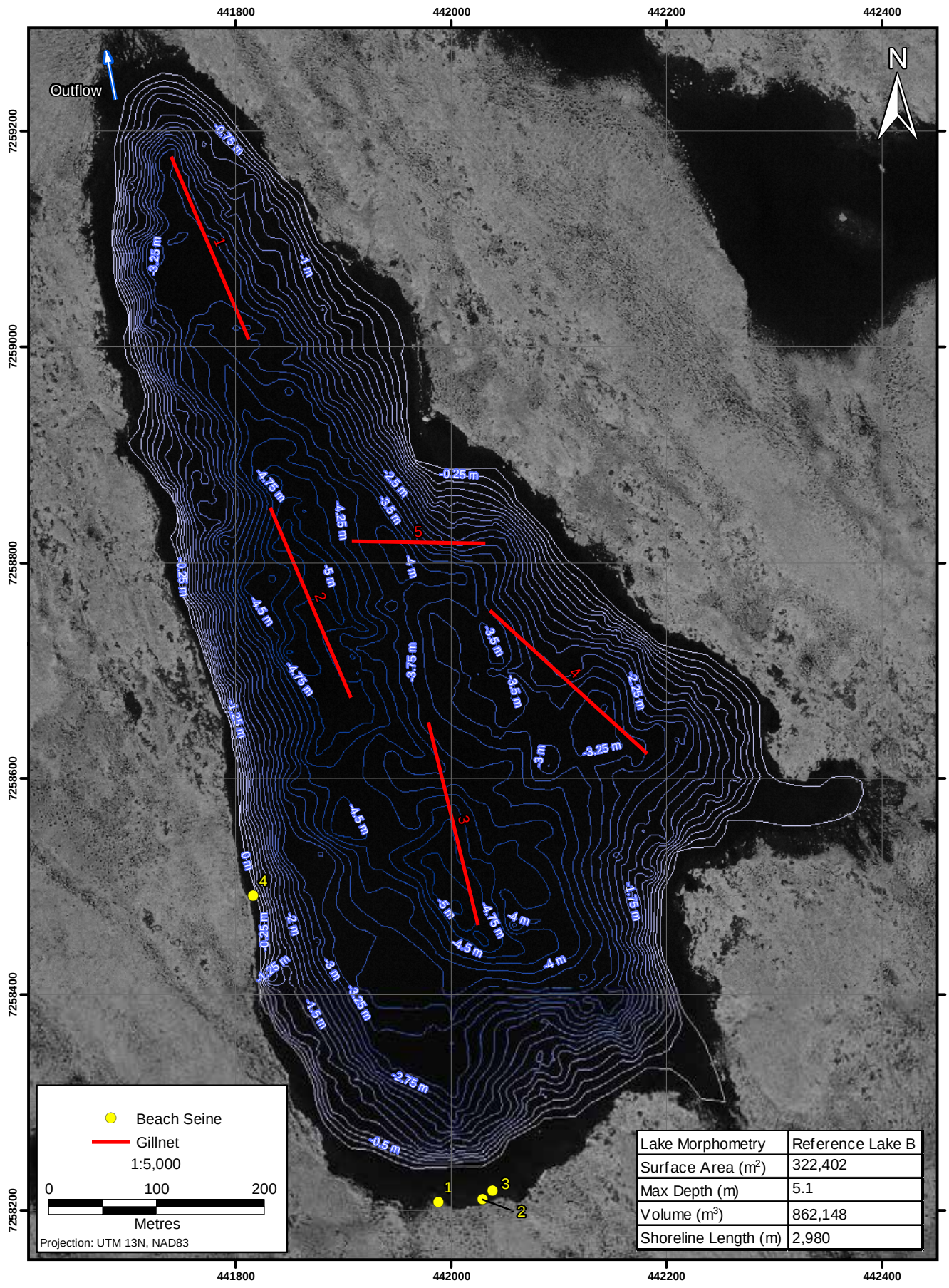


Figure 2.4-12

Reference B Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Tissue metal concentrations were compared to fish fork length using a Pearson product moment correlation analysis. If the results indicated a significant relationship between fish size and tissue metal concentration, a general linear model was used to compare the slopes of the relationships and to look for differences in tissue metal concentrations across all given sizes. If there was a significant effect of the interaction between fish length and lake on tissue metal concentration, no further statistical comparisons could be conducted. If there was no significant interaction, then tissue metal concentration (corrected for fish fork length) was compared among lakes using analysis of covariance (ANCOVA). If there was no significant relationship between fish fork length and tissue metal concentration, then the mean tissue metal concentration was compared among lakes using analysis of variance (ANOVA).

2.6 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance and quality control was implemented at several stages of the field program in order to ensure accurate data collection and analysis. In the field, practice sessions were held with crew leaders at the beginning of each sampling trip to ensure that sampling and data collection was being conducted in a standard manner. Scales and electronic measuring devices (conductivity and pH meters) were calibrated prior to the beginning of the field trip.

Fish tissue samples were collected in the field using clean tools and plastic cutting boards to reduce the transfer of materials between fish. Tissue samples were subjected to quality control analyses in the lab as well, with duplicate samples being analyzed to test for relative percent differences. The results of quality control analyses conducted in the lab are presented in Table 2.6-1.

Table 2.6-1. Tests of Variability of Fish Tissue Metal Concentrations

Qualifier	Number of Potential RPD	Percent of Samples
RPD	24	32
DUP-H	4	5
J	1	1
RPD-NA	46	61
Total	**75**	**100**

RPD = Relative Percent Difference
RPD-NA = PRD Not available because one of both values were at or below the MDL
J = Absolute difference between duplicates
RPD not available because one or both values were less than five times greater than the MDL
DUP-H = Duplicate results outside of ALS data quality objectives due to sample heterogeneity

Upon entry of the data into databases, the data was checked against field cards to verify the accuracy of data entry and to check for transcription errors. Finally, biological data were plotted to identify any outliers that may have resulted from transcription errors that occurred in the field.

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Lake Morphometry	George
Surface Area (m^2)	1665297
Max Depth (m)	15.42
Volume (m^3)	5190010
Shoreline Length (m)	10978

Lake Morphometry	Lytle
Surface Area (m^2)	77,020
Max Depth (m)	1.6
Volume (m^3)	64,723
Shoreline Length (m)	1,517

Lake Morphometry	Occurrence
Surface Area (m^2)	200,051
Max Depth (m)	1.9
Volume (m^3)	226,450
Shoreline Length (m)	2,162

Lake Morphometry	Sleigh
Surface Area (m^2)	86,433
Max Depth (m)	1.31
Volume (m^3)	62,446
Shoreline Length (m)	1,833

Beach Seine
Gillnet
Local Site Road
Potential Winter Road
Deposit Location
Proposed Site Infrastructure
1:10,000
0 250 500
Metres
Projection: NAD 1983 UTM Zone 13N

Figure 2.4-13

George, Sleigh, Lytle and Occurrence Lakes Gillnet and Beach Seine Sampling Locations, George Property, 2012

Figure 2.4-13

PROJECT # 0833-002-04 GIS # BAC-06-043i December 12 2012

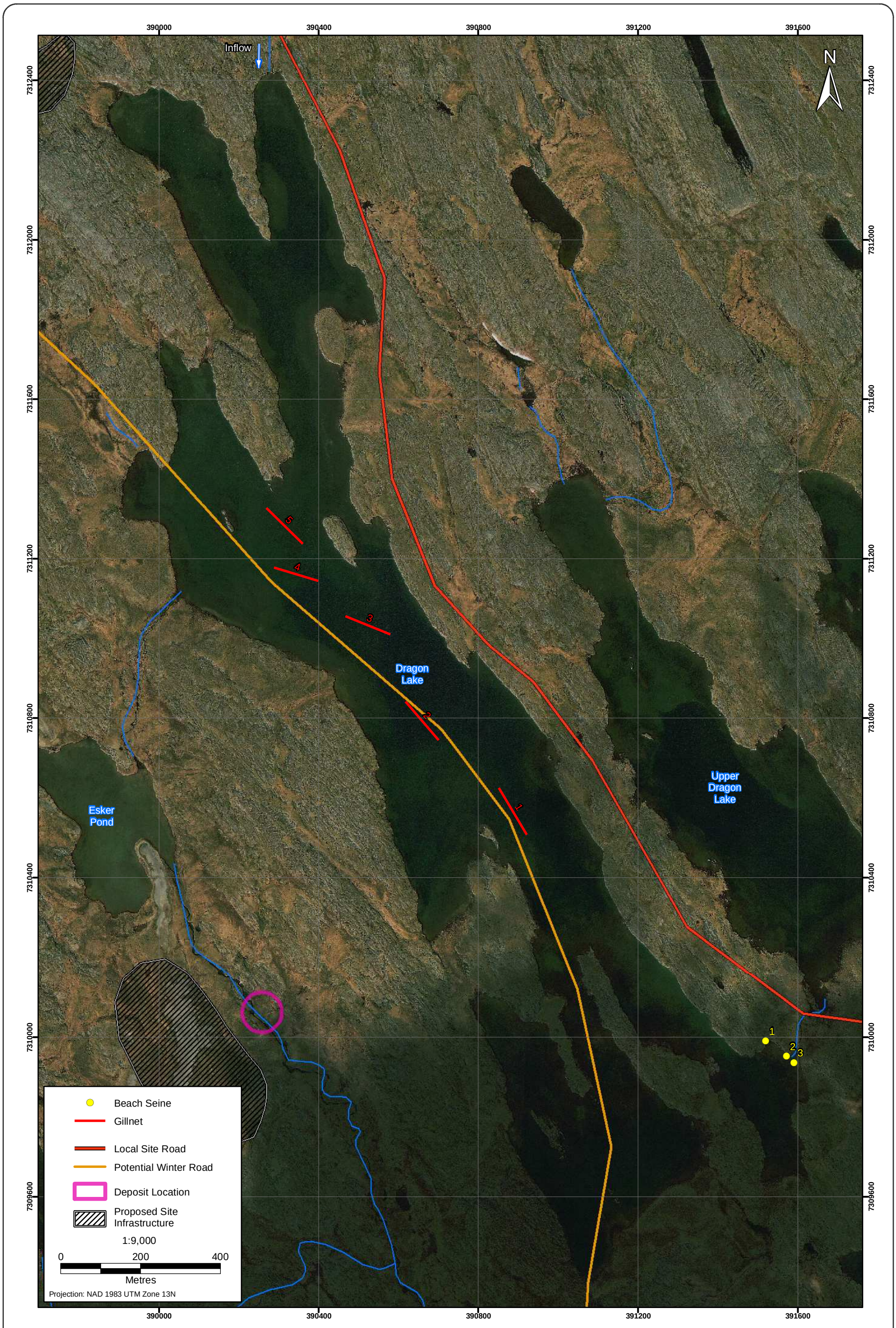


Figure 2.4-14

Sabina GOLD & SILVER CORP.

Dragon Lake Gillnet and Beach Seine Sampling Locations, George Property, 2012

Figure 2.4-14

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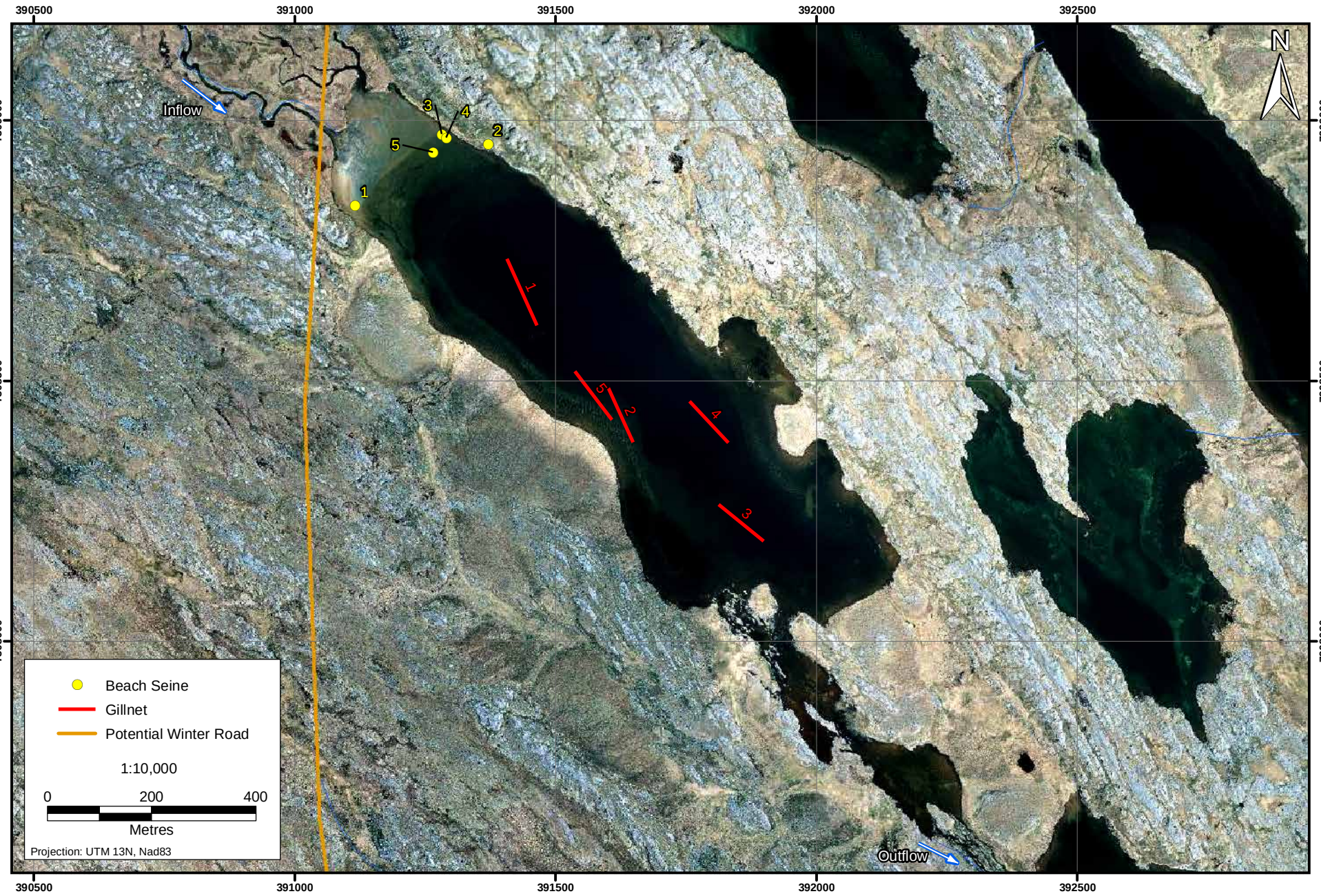


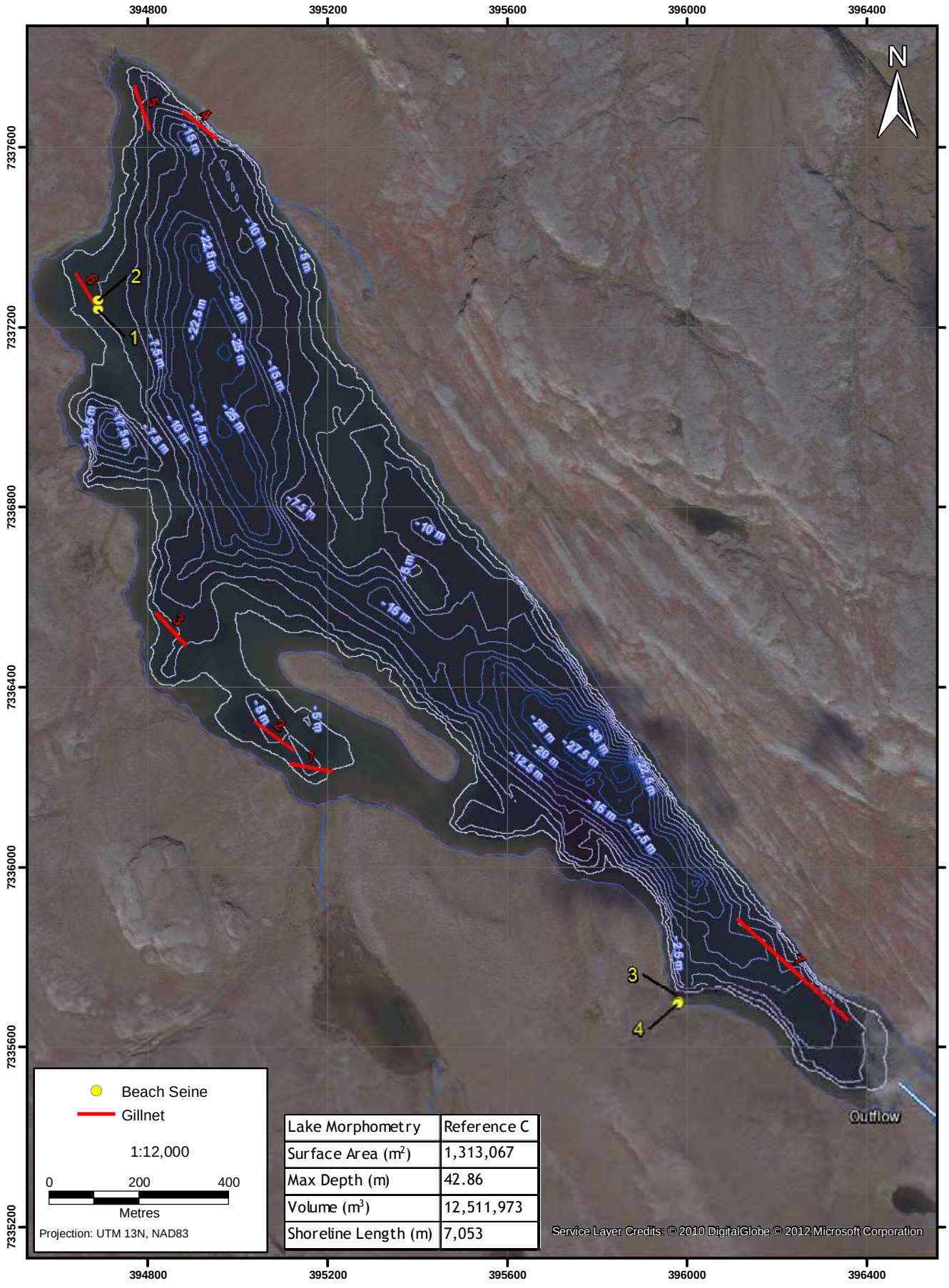
Figure 2.4-15

Sabina Gold & Silver Corp.

Komatic Lake Gillnet and Beach Seine Sampling Locations, George Property, 2012

Figure 2.4-15

Rescan™ Engineers & Scientists



Lake Morphometry	Reference C
Surface Area (m^2)	1,313,067
Max Depth (m)	42.86
Volume (m^3)	12,511,973
Shoreline Length (m)	7,053

Sabina

Reference C Lake Gillnet and Beach Seine Sampling Locations, George Property, 2012

Figure 2.4-16

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3. Results and Discussion

3. Results and Discussion

3.1 STREAMS

3.1.1 Stream Fish Habitat

3.1.1.1 Overview

A total of 20 mine site streams were surveyed in late June and early July 2012, primarily along proposed all-weather site roads, although some streams that flow into or out of lakes were also surveyed. Appendix 3.1-1 presents the habitat assessment data for each stream site surveyed. The surveyed distance at each site ranged from 50 to 370 m and depended on the length of the reach and the homogeneity of habitat within it. Highly variable reaches or reaches with large individual habitat units were generally surveyed for a longer distance in order to capture the full range of variation with the reach. In addition to the 20 stream sites, 11 sites were assessed and determined to be NCDs with no defined channel, overland or sub-surface flow, and little to no fish habitat potential.

Table 3.1-1 presents a summary of the physical characteristics of the streams surveyed. Mean bankfull width at the surveyed stream sites ranged from 1.4 to 50 m while wetted width ranged from 1.3 to 50 m. Mean bankfull depth ranged from 0.3 to 1.1 m and wetted depths ranged from 0.2 to 1.0 m. The mean gradient at all sites was low, ranging from 0 to 3%.

Table 3.1-1. Physical Characteristics of Surveyed Streams, 2012

Description	Site #	Survey Distance (m)	Weighted Mean Slope (%)	Weighted Mean Depth (m)		Weighted Mean Width (m)	
				Wetted	Bankfull	Wetted	Bankfull
Goose Property							
Umwelt Outflow	101	106.0	1.1	0.8	-[1]	11.6	-[1]
Fox Outflow	102	65.7	1.5	0.3	0.5	2.8	3.2
Llama Outflow	103	110.4	1.3	0.2	0.3	3.6	3.7
Fox Outflow	104	103.0	3.0	0.2	0.4	10.7	11.4
Unnamed	108	128.7	1.2	0.2	0.2	1.7	2.2
Goose Inflow	113	128.5	1.4	0.3	0.5	5.0	5.0
Gander River	114	370.6	1.0	0.4	0.6	21.8	28.8
Gander River	115	200.0	0.0	0.7	1.0	50.0	50.0
Moby Outflow	117	169.6	2.1	0.4	0.6	10.1	12.5
Moby Outflow	118	226.0	0.4	0.6	0.9	6.4	7.0
Moby Inflow	119	108.8	0.5	0.7	0.9	2.1	3.0
Moby Tributary 2	120	83.0	0.5	0.3	0.5	2.2	2.4
Reference B Outflow	125	160.8	0.3	0.2	0.3	1.7	1.7
Rascal Outflow	126	230.0	1.1	0.5	0.6	19.8	23.4
Rabbit Outflow	127	50.4	0.4	0.2	0.3	3.0	6.7

(continued)

Table 3.1-1. Physical Characteristics of Surveyed Streams, 2012 (completed)

Description	Site #	Survey Distance (m)	Weighted Mean Slope (%)	Weighted Mean Depth (m)		Weighted Mean Width (m)	
				Wetted	Bankfull	Wetted	Bankfull
George Property							
George Outflow	122	184.5	1.7	0.3	0.5	14.5	22.5
George Inflow	123	151.6	0.5	0.4	0.5	3.7	3.9
George Inflow 2	124	95.4	0.7	0.3	0.4	3.1	3.3
Slave Outflow	128	115.0	0.0	1.0	1.1	3.3	3.6
Dragon Inflow	129	115.9	2.7	0.3	0.5	1.3	1.4

[1] *no defined banks*

Riffles and glides were the most common habitat types at stream survey sites. Glide habitat comprised up to 100% of the length of the stream sections surveyed. Riffles comprised up to 68% of the length of the habitat surveyed (Table 3.1-2). Of the 20 surveyed streams, 14 sites contained measurable pools (Table 3.1-3). Among these sites, mean residual pool depth ranged from 0.3 to 1.0 m. Total mean cover composition ranged from 5 to 62% in mine site streams (Table 3.1-4). The most common forms of cover were boulders. Undercut banks were also present in several streams.

Table 3.1-2. Habitat Unit Composition of Surveyed Streams, 2012

Description	Site #	Percent Composition					
		Pool	Glide	Riffle	Cascade	Boulder garden	Pond
Goose Property							
Umwelt Outflow	101	40.6	0.0	59.4	0.0	0.0	0.0
Fox Outflow	102	24.0	8.4	67.6	0.0	0.0	0.0
Llama Outflow	103	0.0	47.9	52.1	0.0	0.0	0.0
Fox Outflow	104	4.4	28.6	47.1	19.9	0.0	0.0
Unnamed	108	11.7	34.9	25.5	0.0	28.0	0.0
Goose Inflow	113	0.0	29.6	47.1	23.3	0.0	0.0
Gander River	114	0.0	44.4	55.6	0.0	0.0	0.0
Gander River	115	0.0	100.0	0.0	0.0	0.0	0.0
Moby Outflow	117	6.3	5.0	39.3	24.6	0.0	24.8
Moby Outflow	118	44.7	37.6	17.7	0.0	0.0	0.0
Moby Inflow	119	32.0	63.2	0.0	4.8	0.0	0.0
Moby Tributary 2	120	4.8	66.0	29.2	0.0	0.0	0.0
Reference B Outflow	125	5.6	61.9	32.5	0.0	0.0	0.0
Rascal Outflow	126	0.0	65.2	26.1	8.7	0.0	0.0
Rabbit Outflow	127	0.0	80.4	19.6	0.0	0.0	0.0
George Property							
George Outflow	122	6.0	31.7	62.3	0.0	0.0	0.0
George Inflow	123	7.2	59.5	33.3	0.0	0.0	0.0
George Inflow 2	124	2.8	57.8	39.4	0.0	0.0	0.0
Slave Outflow	128	60.0	40.0	0.0	0.0	0.0	0.0
Dragon Inflow	129	15.5	15.1	26.7	42.6	0.0	0.0

Table 3.1-3. Pool Characteristics of Surveyed Streams, 2012

Description	Site #	Number of Pools	Mean Maximum Depth (m)	Mean Crest Depth (m)	Mean Residual Depth (m)
Goose Property					
Umwelt Outflow	101	2	1.5	0.5	1.0
Fox Outflow	102	2	0.6	0.3	0.4
Llama Outflow	103	0	n/a	n/a	n/a
Fox Outflow	104	1	0.6	0.2	0.4
Unnamed	108	2	0.6	0.2	0.4
Goose Inflow	113	0	n/a	n/a	n/a
Gander River	114	0	n/a	n/a	n/a
Gander River	115	0	n/a	n/a	n/a
Moby Outflow	117	2	0.6	0.2	0.4
Moby Outflow	118	5	1.3	0.5	0.9
Moby Inflow	119	6	1.0	0.4	0.6
Moby Tributary 2	120	1	0.6	0.3	0.3
Reference B Outflow	125	1	0.5	0.2	0.3
Rascal Outflow	126	0	n/a	n/a	n/a
Rabbit Outflow	127	0	n/a	n/a	n/a
George Property					
George Outflow	122	1	0.8	0.3	0.5
George Inflow	123	2	0.6	0.2	0.4
George Inflow 2	124	1	0.6	0.2	0.5
Slave Outflow	128	5	1.2	0.6	0.6
Dragon Inflow	129	3	0.6	0.2	0.4

Table 3.1-4. Weighted Mean Cover Composition at Mine Site Streams, 2012

		Cover Composition					
Description	Site #	Pool (%)	Boulder (%)	Instream Vegetation (%)	Overhanging Vegetation (%)	Undercut Bank (%)	Total Cover (%)
Goose Property							
Umwelt Outflow	101	3	37	0	0	0	**40**
Fox Outflow	102	0	5	0	7	8	**20**
Llama Outflow	103	0	5	14	0	3	**22**
Fox Outflow	104	0	58	0	0	4	**62**
Unnamed	108	0	14	10	0	5	**29**
Goose Inflow	113	0	15	0	0	5	**20**
Gander River	114	0	37	7	0	1	**45**
Gander River	115	0	5	0	0	0	**5**
Moby Outflow	117	28	22	0	2	0	**52**
Moby Outflow	118	26	5	0	0	6	**36**

(continued)

Table 3.1-4. Weighted Mean Cover Composition at Surveyed Streams, 2012 (completed)

Description	Site #	Cover Composition					Total Cover (%)
		Pool (%)	Boulder (%)	Instream Vegetation (%)	Overhanging Vegetation (%)	Undercut Bank (%)	
Moby Inflow	119	5	0	0	0	23	**28**
Moby Tributary 2	120	0	2	0	0	7	**9**
Reference B Outflow	125	0	15	1	0	1	**16**
Rascal Outflow	126	0	46	0	0	0	**46**
Rabbit Outflow	127	0	2	10	0	1	**14**
George Property							
George Outflow	122	0	45	0	0	0	**45**
George Inflow	123	0	4	13	0	2	**18**
George Inflow 2	124	0	14	4	0	1	**19**
Slave Outflow	128	19	2	6	0	6	**32**
Dragon Inflow	129	3	9	9	4	11	**36**

3.1.1.2 Goose Property

Site 101 – Umwelt Outflow

Site 101 is located on the inflow to Goose Lake from the entire Llama Watershed. At this location, the stream is located in a scoured canyon created by glacial outflow floods, leaving a wider than natural channel; thus, no bankfull width or depth were measured. This section is characterized by extensive boulder fields and sub-surface flow. A 4 m high rock barrier was present approximately 100 m upstream from the inflow to Goose Lake, making this section impassable for upstream (and likely downstream) fish migration (Plate 3.1-1). This section has pool-riffle morphology with a mean gradient of 1.1% (exclusive of the barrier). Two pools were measured, with a mean residual pool depth of 1.0 m. Boulders provided the majority of the instream cover. Overall habitat quality for this site is marginal due to the presence of barriers and sub-surface flow.

Site 102 – Fox Outflow

Site 102 is a potential stream crossing site that is located within the Llama Watershed approximately 2 km downstream of Fox Lake on the main outflow stream. It has riffle-pool morphology with a mean gradient of 1.5%, bankfull width of 3.2 m and bankfull depth of 0.5 m (Plate 3.1-2). Two pools were measured, with a mean residual pool depth of 0.4 m. The majority of the survey site length was made up of riffle habitat units, followed by pools and glides. Cover composition was moderate and dominated by overhanging vegetation, undercut banks, and boulders. Overall, this site contains important fish habitat due to the presence of some deep pools and cover.

Site 103 – Llama Outflow

Site 103 was located on the stream connecting Llama Lake to Umwelt Lake. This stream was surveyed to provide additional baseline information on areas potentially affected by mine infrastructure. This section has riffle-pool morphology with a mean gradient of 1.3%. The mean bankfull width is 3.7 m and the mean bankfull depth is 0.3 m. No pools were measured, and the habitat unit composition shows that the survey section was composed mainly of riffles, followed by glides (Plate 3.1-3). Instream cover was moderate

and dominated by instream vegetation, followed by boulders and undercut banks. This stream section contains important fish habitat due to the sufficient flow and connectivity to Umwelt and Llama Lakes.



Plate 3.1-1. Rock cascade barrier on Site 101 — Umwelt Outflow, looking upstream. June 2012.



Plate 3.1-2. Riffle-pool morphology on the Fox Outflow stream, Site 102. June 2012.



Plate 3.1-3. Aerial view of Llama Lake Outflow (Site 103) looking upstream. June 2012.

Site 104 – Fox Outflow

Site 104 is located at the outflow of Fox Lake, immediately downstream of the lake. This section has cascade-pool morphology with a mean gradient of 3%. The bankfull width averages 11.4 m and the bankfull depth averages 0.4 m. One pool was measured, and it had a residual pool depth of 0.4 m. Approximately 20% of the survey site length was composed of cascade habitat units (Plate 3.1-4). Riffles and glides made up the majority of habitat units by length. Instream cover was high and dominated by boulders. Arctic grayling fry were observed rearing among the boulders downstream of the lake. Overall, the habitat in this section is important due to the presence of deep pools and boulder habitat for rearing grayling.

Site 108

Site 108 is located along the proposed all-weather road to the tailings storage area southwest of Goose Lake. It is located at the outlet of a small, unnamed lake that flows into Big Lake in the Gander Watershed. This small stream has riffle-pool morphology with a mean gradient of 1.2%, a mean bankfull width of 2.2 m and a mean bankfull depth of 0.2 m. Two pools were measured, with a mean residual pool depth of 0.4 m. The habitat unit composition is dominated by glide habitat, followed by boulder garden, riffles, and a small proportion of pools. Instream cover is high and is dominated by boulders and instream vegetation (Plate 3.1-5). Several adult Arctic grayling were observed in isolated sections of the stream and may have become trapped when water levels decreased during or after the spawning season. This site contains important fish habitat; however, stranding may be an issue in low discharge years.

Site 113 – Goose Inflow

Site 113 is located on a tributary to Goose Lake downstream of Rascal Lake and flows through the Goose main deposit. This site is on a moderate-size stream with riffle-pool morphology and a mean gradient of 1.4%. The mean bankfull width at the survey site is 5.0 m and the mean bankfull depth is

0.5 m. No pools were measured or observed. The habitat is composed mainly of riffles, followed by glides and cascades (Plate 3.1-6). Instream cover is moderate and dominated by boulders. This stream section contains important fish habitat, particularly for rearing Arctic grayling. This section may also provide good habitat for grayling spawning.



Plate 3.1-4. Cascade habitat unit at Site 104 (Fox Lake Outflow). June 2012.



Plate 3.1-5. Site 108 looking downstream at an isolated channel section where adult grayling were observed. June 2012.



Plate 3.1-6. Riffle habitat at Site 113, looking upstream. June 2012.

Site 114 – Gander Inflow

Site 114 is located in the Gander Watershed on the main inflow to Gander Lake at the proposed crossing of the all-weather road to the tailings storage area. The river in this location has riffle-pool morphology and a mean gradient of 1.0%. The mean bankfull width is 28.8 m and the mean bankfull depth is 0.4 m. No pools were measured or observed. The habitat unit composition of this section is made up of riffles and glides (Plate 3.1-7). Instream cover is high and dominated by boulders. Habitat in this stream is important for rearing, migration and potentially for spawning.

Site 115 – Gander Inflow

Site 115 is also located on the main inflow to Gander Lake, downstream of the confluence with Moby Outflow. This section of river has a very low gradient of 0% where it flows into Gander Lake, and a large channel morphology. The mean bankfull width was estimated to be 50 m and the mean bankfull depth was estimated to be 1.0 m. No pools were measured or observed, and the habitat unit composition was made up entirely of glides. Instream cover in this section was low and made up of sparse boulder cover. Habitat quality in this section is important because it is likely used for migration; however, there is limited value for spawning and rearing due to the low cover abundance and the homogeneity of the habitat.

Site 117 – Moby Outflow

Site 117 is located at the outlet of Moby Lake on Moby Outflow. This site has cascade-pool morphology with a mean gradient of 2.0%. The mean bankfull width is 12.5 m and the mean bankfull depth is 0.6 m (Plate 3.1-8). Two pools were measured, with a mean residual pool depth of 0.4 m. The majority of the site length was composed of riffle habitat, followed by cascades and ponds. A small percentage of pools and glides were also measured. Instream cover was abundant and dominated by deep ponds

(pools) and boulders. Habitat quality in this section is marginal due to the presence of potential cascade barriers and potential for a loss of stream connectivity during low water periods.



Plate 3.1-7. Riffle habitat upstream of Gander Lake (Site 114) looking downstream. June 2012.



Plate 3.1-8. Cascade-pool sequence at Site 117 (Moby Outflow), looking upstream. June 2012.

Site 118 – Moby Outflow

Site 118 is also located on Moby Outflow in the middle of the proposed tailings storage area. This section of stream was also covered extensively in specific tailings storage area assessment (Section 3.2 of this report). This section of stream has riffle-pool morphology with a mean gradient of 0.4%, a mean bankfull width of 7.0 m and a mean bankfull depth of 0.9 m. Five pools were measured, with a mean residual pool depth of 0.9 m. The habitat unit composition of this section is composed mainly of pools and glides, with a smaller proportion of riffles (Plate 3.1-9). Instream cover is high and dominated by deep pools. This section of stream contains important fish habitat for rearing and potentially for spawning. Deep pools may also have the potential for overwintering.



Plate 3.1-9. Deep glide habitat at Site 118 on Moby Outflow, looking upstream. June 2012.

Site 119 – Moby Inflow

Site 119 is located on the main tributary to Moby Lake, which enters from the north. The stream has riffle-pool morphology with a mean gradient of 0.5%, a mean bankfull width of 3.0 m and a mean bankfull depth of 0.9 m. Six pools were measured, with a mean residual pool depth of 0.6 m. The habitat unit composition of the survey site was composed mainly of glides and pools. Instream cover was high and dominated by undercut banks (Plate 3.1-10). This stream contains important habitat for rearing.

Site 120 – Moby Tributary 2

Site 120 is located on the main tributary (Tributary 2) to Moby Outflow and was assessed extensively in the specific tailings storage area assessment in Section 3.2 of this report. This section has riffle-pool morphology, with a gradient of 0.5%, a mean bankfull width of 2.4 m and a mean bankfull depth of 0.5 m. One pool was measured with a residual pool depth of 0.3 m. The habitat unit composition is dominated by glides, followed by riffles (Plate 3.1-11). Instream cover is low and dominated by

undercut banks. Habitat quality in this section is important for migration; however, the low abundance of instream cover limits its value for rearing.



Plate 3.1-10. Undercut banks at Site 119, the inflow to Moby Lake. June 2012.



Plate 3.1-11. Low cover at Site 120 (Moby Tributary 2), looking upstream. June 2012.

Site 125 – Reference B Outflow

Site 125 is the outflow stream from Reference B Lake, south of the Goose Area. This stream was surveyed to provide more information on the habitat quality of Reference B Lake. The stream has riffle-pool morphology with a mean gradient of 0.3%, a mean bankfull width of 1.7 m and a mean bankfull depth of 0.3 m. One pool was measured with a residual pool depth of 0.3 m. The habitat unit composition is dominated by glide habitat, followed by riffles and pools. Instream cover is moderate and dominated by boulders.

Site 126 – Rascal Outflow

Site 126 is located at the outflow from Rascal Lake. This stream has riffle-pool morphology with a mean gradient of 1.1%. This wide, braided channel has a mean bankfull width of 23.4 m and a bankfull depth of 0.6 m. No pools were measured or observed. Downstream of Rascal Lake, the stream splits, with part of the flow travelling down a relatively well-defined channel to Goose Lake, while the remainder of the flow travels through a boulder field towards Pond 5 (surveyed in 2011; Plate 3.1-12). Stream habitat in this section is dominated by glide habitat, followed by riffles and cascades. Instream cover is abundant and dominated by boulders. Recently emerged Arctic grayling fry were observed rearing in the crevices between boulders at the upstream end of the boulder field in early July 2012. This stream section contains important (possibly critical) habitat for Arctic grayling. Spawning was confirmed in this section by the presence of recently emerged fry, and the boulders provide important cover for these young fish.



Plate 3.1-12. Aerial view of Site 126 (Rascal Outflow) looking downstream towards Goose Lake. July 2012.

Site 127 – Rabbit Outflow

Site 127 is located on the stream connecting Rabbit Lake to Fox Lake, south of Goose Lake. This stream has riffle-pool morphology with a mean gradient of 0.4%. The mean bankfull width of the stream is 6.7 m and the mean bankfull depth of the stream is 0.3 m. No pools were measured. The habitat is dominated

by glide habitat units, followed by riffles (Plate 3.1-13). Instream cover is moderately abundant and dominated by instream vegetation. Young of the year grayling were observed in this stream in July 2012. This section contains important habitat for spawning grayling and rearing juveniles.



Plate 3.1-13. Glide habitat at Site 127 (Rabbit Lake Outflow) looking downstream towards Fox Lake. July 2012.

3.1.1.3 George Property

Site 122 – George Outflow

Site 122 is located at the outflow of George Lake. This stream is characterized by riffle-pool morphology with a mean gradient of 1.7%. Close to the lake, the stream is relatively confined, with well-defined banks; however, as the stream proceeds towards Lytle Lake, it flows through a wide boulder garden with poorly defined banks (Plate 3.1-14). The mean bankfull width is 22.5 m and the mean bankfull depth is 0.5 m. One pool was measured, and the residual pool depth was 0.5 m. The habitat unit composition is dominated by riffle habitat, followed by glides and a small number of pools. Instream cover is high and is dominated by boulders. This site contains important fish habitat for rearing; however, migration may be limited by the presence of the boulder field during low water periods.

Site 123 – George Inflow

Site 123 is located northwest of George Lake on a small tributary, and was surveyed in anticipation of a potential site road to the deposit north of George Lake. This stream has riffle-pool morphology with a mean gradient of 0.5%, a mean bankfull width of 3.9 m, and a mean bankfull depth of 0.5 m. Two pools were measured, with a mean residual pool depth of 0.4 m. The habitat unit composition is dominated by glides, followed by riffles and pools (Plate 3.1-15). Instream cover is moderate and dominated by instream vegetation, followed by boulders. This stream contains marginal fish habitat for rearing based on the poorly defined banks and relatively low quality instream cover. Spawning is not likely due to soft substrates.



Plate 3.1-14. Site 122 (George Lake Outflow) looking downstream towards Lytle Lake. July 2012.



Plate 3.1-15. Glide habitat at Site 123, looking upstream. July 2012.

Site 124 – George Inflow 2

Site 124 is located at the northeast inflow to George Lake, on a stream that drains the Lone Cow Pond deposit area. It has poorly defined channel with riffle-pool morphology and a mean gradient of 0.7%. The mean bankfull width is 3.3 m and the mean bankfull depth is 0.4 m. One pool was measured with a

residual pool depth of 0.5 m. The habitat unit composition is dominated by glide habitat, followed by riffles and a small proportion of pools (Plate 3.1-16). Instream cover abundance is moderate and dominated by boulders, followed by instream vegetation. This stream is well-defined for approximately 150 m upstream of the lake, then turns into a NCD further upstream. Habitat quality in this stream is marginal due to the poorly defined channel and relatively short useable length.



Plate 3.1-16. Poorly defined channel of Site 124, looking downstream towards George Lake. July 2012.

Site 128 – Slave Outflow

Site 128 is located on the outflow stream from Slave Lake in the George Watershed. This stream was surveyed because it is located downstream from one of the deposits in the George area. It has riffle-pool morphology with a mean gradient of 0%, a mean bankfull width of 3.6% and a mean bankfull depth of 1.1%. Five pools were measured, with a mean residual pool depth of 0.6 m. Pools dominated the habitat unit composition, followed by glides. Instream cover is abundant and dominated by deep pools. This stream contains important habitat for Arctic grayling rearing and possibly for spawning.

Site 129 – Dragon Inflow

Site 129 is located at the northeast inflow to Dragon Lake in the George Watershed. It was surveyed as a potential site road crossing. The stream has cascade-pool morphology with a mean gradient of 2.7%. The mean bankfull width is 1.4 m and the mean bankfull depth is 0.5 m. Three pools were measured and had a mean gradient of 0.4 m. The habitat unit composition was dominated by cascade habitat, followed by riffles, glides and pools. Instream cover is abundant and varied, and is dominated by undercut banks, followed by instream vegetation, boulders, overhanging vegetation and pools. Habitat quality in this stream is important for rearing based on the abundant cover and varied habitat.

3.1.2 Stream Fish Community

3.1.2.1 Species Composition

Six fish species were captured or observed in surveyed streams in 2012: Arctic grayling, lake trout, round whitefish, burbot (Plate 3.1-17), ninespine stickleback, and slimy sculpin. Appendix 3.1-2 presents the sampling effort and catch summary. Appendix 3.1-3 presents the individual fish data. Table 3.1-5 presents the life history periodicity for these species. Arctic grayling spawn in the spring in small streams over a variety of substrates ranging from mud to boulders, although gravel is preferred (Scott and Crossman 1973; Hubert et al. 1985; Stewart et al. 2007). Juveniles tend to rear in these streams for most of the summer, while adults migrate back to lakes after spawning (Hubert et al. 1985). Overwintering of both adults and juveniles occurs in larger rivers and lakes downstream of the spawning areas (Stewart et al. 2007).



Plate 3.1-17. Juvenile burbot captured in the outflow of Reference B Lake (Site 125). June 2012.

Lake trout are generally incidental in streams and rivers, since they spend most of their life cycle in lakes. Streams and rivers are most often used as migration corridors between lakes; however, in the Arctic lake trout have been known to use fluvial habitat more extensively (Scott and Crossman 1973). In the Back River Project area, most lake trout captured in streams were near the inlets or outlets of lakes.

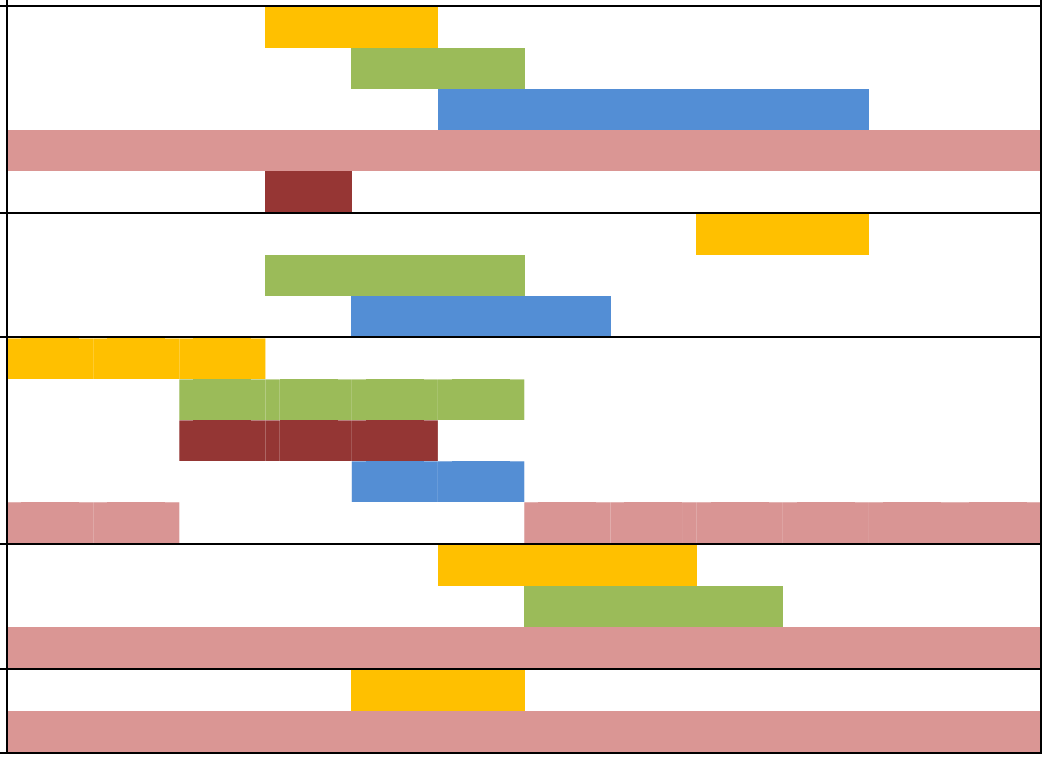
Burbot generally inhabit deep waters in lakes; however, they migrate into the shallow littoral zones to spawn in the winter (Scott and Crossman 1973). Burbot in northern Canada often spend the early summer feeding in river channels, along lake shorelines, and sometimes in weedy tributary streams. By July, most burbot have returned to the deepest portions of the lakes.

Round whitefish are typically a lake-dwelling species (Scott and Crossman 1973). The one round whitefish captured in a stream was a young-of-the-year and was captured close to a lake. This may have been an incidental capture of a fish that strayed from its typical habitat.

Ninespine sticklebacks were captured in small streams and shallow lake margins with abundant instream vegetation and slow to moderate current. Slimy sculpin were captured in a variety of habitats in the Project area, including small streams and large lakes. Slimy sculpin tend to prefer rocky substrates in both lakes and rivers (Scott and Crossman 1973). It is not known if sticklebacks or sculpins undertake migrations to overwintering habitat.

Table 3.1-5. Fish Life History Periodicity Table for Species Captured in Streams, 2012

Species	Life Stage	Habitat	Month
			Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Arctic grayling	Spawning	Streams/Rivers	
	Emergence	Streams/Rivers	
	Fry rearing/migration	Streams/Rivers	
	Rearing/overwintering	Rivers/Lakes	
	Adult migration	Streams/Rivers	
Lake trout	Spawning	Lakes	
	Hatching	Lakes	
	Fry emergence	Lakes	
Burbot	Spawning	Lakes	
	Hatching	Lakes	
	Migration	Rivers	
	Rearing/feeding	Streams/Lakes	
	Overwintering	Lakes	
Ninespine stickleback	Spawning	Streams/Lakes	
	Hatching	Streams/Lakes	
	Rearing/overwintering	Streams/Lakes	
Slimy sculpin	Spawning	Streams/Lakes*	
	Rearing/overwintering	Streams/Lakes*	



Information compiled from Scott and Crossman (1973) and from field observations.
** Limited data known about the life history of the slimy sculpin in the Arctic.*

CPUE

Fish were captured by electrofishing in 10 of the 18 streams sampled. Visual observations confirmed fish presence at Site 108 (an unnamed stream in the Big Watershed), but no fish were captured by electrofishing. Among the sites where fish were captured, electrofishing CPUE ranged from 0.16 fish/100 s at Site 122 (George Lake Outflow) to 2.4 fish/100 s (Slave Lake Outflow) and averaged 1.39 fish/100 s (Table 3.1-6). Slimy sculpin were the most widespread species in surveyed streams, followed by Arctic grayling. Grayling may be more widespread than indicated in the sampling results because they may have been incubating during the first part of the sampling trip. Recently emerged Arctic grayling fry were observed in Fox Outflow, Rabbit Outflow and Site 108 (Big Watershed) at the end of the sampling trip, suggesting that the trip was timed too early to catch young-of-the-year grayling in most streams. Stream reconnaissance for fish habitat compensation in August resulted in visual observations of juvenile grayling in almost all of the streams visited.

3.1.3 Biology

Table 3.1-7 presents the mean fork length, total weight, and condition of fish species captured in surveyed streams in 2012.

Arctic grayling captured in surveyed streams in 2012 ranged in size from 65 to 171 mm. Mean fork lengths at each site ranged from 85 mm at Site 103 (Llama Lake Outflow) to 134 mm at Site 129 (Slave Lake Outflow). Mean total weights ranged from 7.0 g at Site 125 (Reference B Outflow) to 33.3 g at Site 129 (Slave Lake Outflow). Mean condition factor for Arctic grayling at all sites was within normal values for salmonid fishes and ranged from 0.99 to 1.10 g/mm^3.

Mean slimy sculpin length ranged from 48 mm at Site 113 (Rascal Lake Outflow) to 125 mm at Site 123 (George Lake Inflow). Mean total weight for sculpins ranged from 1.0 g at Site 127 (Rabbit Lake Outflow) to 13.0 g at Site 123 (George Lake Inflow).

3.2 TAILINGS STORAGE AREA STREAMS

3.2.1 Watershed Setting

The proposed tailings storage area that was included in the 2012 field program was located within the Moby Lake Watershed, downstream of Moby Lake. It would be accessed by an all-weather road that crosses the Gander River just upstream of the confluence with Moby Outflow.

Moby Lake is the dominant waterbody at the headwaters of the Moby Watershed, with a surface area of 59 ha. Two other small, unnamed ponds are also present in the watershed: one that flows into Moby Lake from the southeast, and another that flows from the northeast into Moby Outflow downstream of Moby Lake. Moby Outflow flows eastward out of Moby Lake, first passing through a steep, rocky section punctuated by boulder fields, then through a wide, low-gradient valley until it reaches Gander River approximately 1 km upstream of Gander Lake. Several small seepage tributaries also enter Moby Outflow, most of which originate along the bottom of the ridge lines that mark the valley walls (Plate 3.2-1). The seepage tributaries feature sections of defined channel, as well as wide areas of undefined overland flow.

A total of 7.8 km of stream fish habitat was surveyed, 4.1 km of which was on the mainstem of Moby Outflow, while 3.7 km was on tributaries. In total, 9 streams or drainages were surveyed. Figure 3.2-1 shows the labeled stream reaches covered by the SHIM survey in 2012. Some streams that appear on the map were not observed from the ground; however, revisiting the site during higher discharge conditions may confirm if the streams exist or not. Appendix 3.2-1 presents the SHIM data for each reach surveyed. Appendix 3.2-2 presents FHAP data for each sites surveyed within each reach.

Table 3.1-6. Summary of Electrofishing CPUE and Visual Observations of Fish in Surveyed Streams, 2012

Site Name	Site No.	Electro-fishing Effort (s)	Electrofishing (No. of Fish Captured)							Electrofishing	Visual Observation (No.)		
			Arctic Grayling	Burbot	Lake Trout	Lake Whitefish	Ninespine Stickleback	Slimy Sculpin	Total	CPUE (fish/100 s)	Arctic Grayling	Lake Trout	Total
Goose Property													
Umwelt Outflow	101	466	-	-	-	-	-	-	0	0			0
Fox Outflow	102	641	-	-	-	-	-	-	0	0			
Llama Outflow	103	923	11	-	-	1	-	6	18	1.95			
Fox Outflow	104	1,000	4	-	-	-	-	1	5	0.50	60		60
Unnamed	108	365	-	-	-	-	-	-	0	0	5		5
Goose Inflow	113	1,133	-	-	-	-	8	15	23	2.03			
Gander River	114	993	-	-	-	-	-	-	0	0			
Moby Outflow	117	443	-	-	-	-	-	-	0	0			
Moby Outflow	118	604	-	-	-	-	-	-	0	0			
Moby Inflow	119	531	-	-	1	-	-	4	5	0.94			
Moby Tributary 2	120	656	-	-	-	-	-	-	0	0			
Reference B Outflow	125	570	1	1	-	-	-	-	2	0.35			
Rabbit Outflow	127	731	2	-	-	-	-	-	2	0.27			
George Property													
George Outflow	122	608	-	-	1	-	-	-	1	0.16		2	2
George Inflow	123	604	-	-	9	-	-	-	9	1.49			
George Inflow 2	124	430	-	-	-	-	-	-	0	0			
Slave Outflow	129	637	4	-	1	-	-	10	15	2.35			

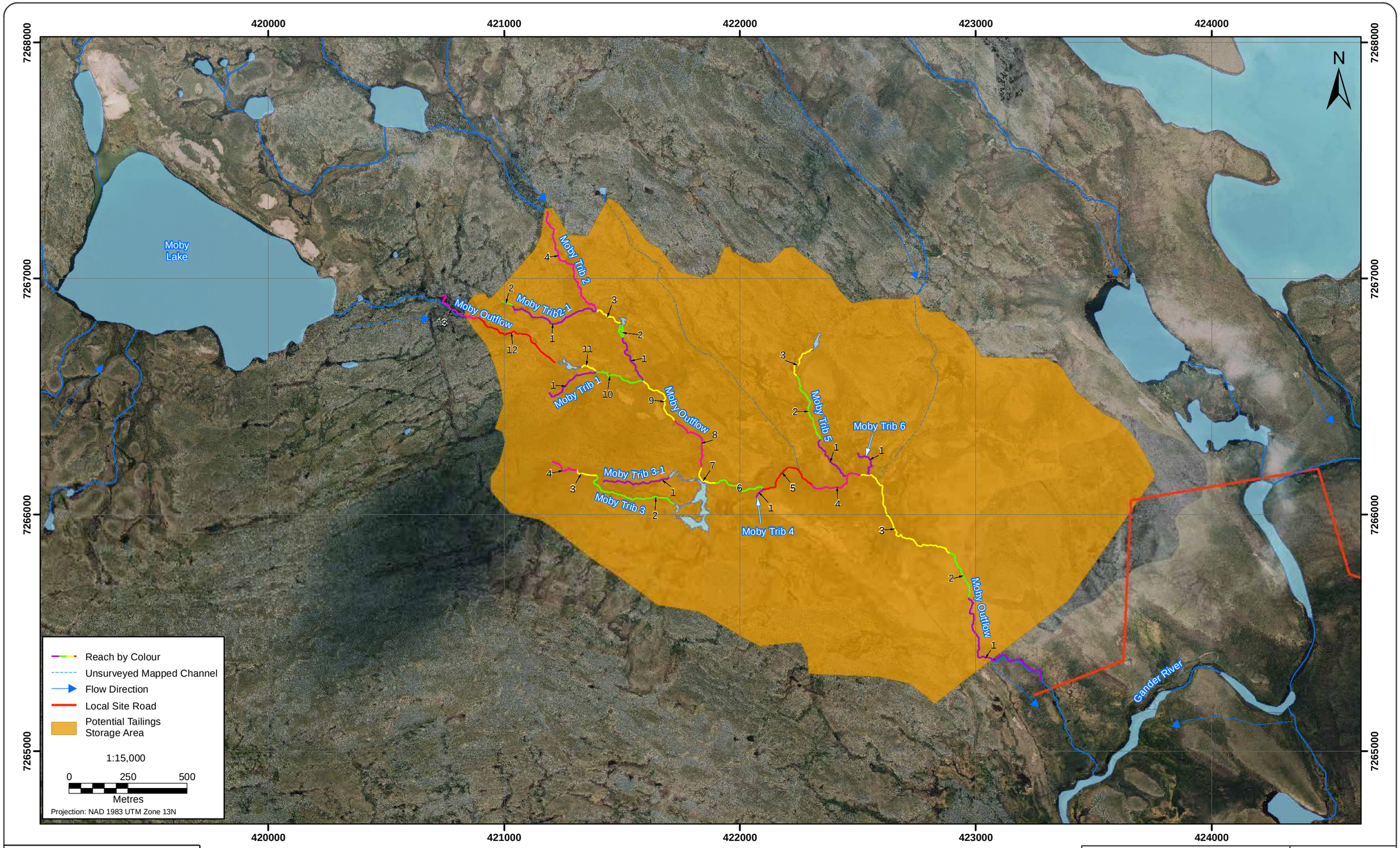
CPUE = catch-per-unit-effort

Table 3.1-7. Summary of Mean Fork Length, Total Weight and Condition of Fish Captured in Surveyed Streams, 2012

Description	Site	Species	n	Fork Length (mm)					Total Weight (g)					Condition (K)				
				Mean	SE	SD	Min	Max	Mean	SE	SD	Min	Max	Mean	SE	SD	Min	Max
Goose Property																		
Llama Outflow	103	Arctic grayling	11	85	7	23	67	123	7.9	0.6	7	2	21	1.02	0.04	0.15	0.66	1.17
		Slimy sculpin	6	61	4	11	50	78	2.8	0.1	1	2	4	1.26	0.11	0.27	0.84	1.60
		Round whitefish	1	67	-	-	67	67	3.0	-	-	3	3	1.00	-	-	1.00	1.00
Fox Outflow	104	Arctic grayling	4	133	2	4	128	137	22.8	0.1	1	21	24	0.99	0.07	0.14	0.82	1.10
		Slimy sculpin	1	64	-	-	64	64	2.0	-	-	2	2	0.76	-	-	0.76	0.76
Goose Inflow	113	Slimy sculpin	15	48	3	11	30	67	1.2	0.1	0	1	2	0.75	0.05	0.15	0.54	0.96
		Ninespine stickleback	8	41	3	10	30	60	1.0	-	-	1	1	0.46	-	-	0.46	0.46
Moby Inflow	119	Lake trout	1	275	-	-	275	275	216.0	-	-	216	216	1.04	-	-	1.04	1.04
		Slimy sculpin	4	59	2	5	53	63	1.8	0.1	1	1	2	0.83	0.07	0.15	0.67	1.03
Reference B Outflow	125	Arctic grayling	1	86	-	-	86	86	7.0	-	-	7	7	1.10	-	-	1.10	1.10
		Burbot	1	90	-	-	90	90	5.0	-	-	5	5	0.69	-	-	0.69	0.69
Rabbit Outflow	127	Slimy sculpin	1	52	-	-	52	52	1.0	-	-	1	1	0.71	-	-	0.71	0.71
George Property																		
George Outflow	122	Lake trout	1	166	-	-	166	166	42.0	-	-	42	42	0.92	-	-	0.92	0.92
George Inflow	123	Lake trout	8	145	6	18	121	162	27.6	0.9	12	11	40	0.85	0.04	0.12	0.59	0.95
		Slimy sculpin	1	125	-	-	125	125	13.0	-	-	13	13	0.67	-	-	0.67	0.67
Dragon Inflow	129	Arctic grayling	4	134	25	50	65	171	33.3	1.9	24	3	54	1.09	0.01	0.02	1.06	1.12
		Lake trout	1	91	-	-	91	91	7.0	-	-	7	7	0.93	-	-	0.93	0.93
		Slimy sculpin	10	65	3	8	50	75	2.2	0.1	1	1	4	0.81	0.10	0.31	0.44	1.60

SD = standard deviation, SE = standard error, n = number of sample size
Dashes indicated that data could not be calculated due to the low sample size

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Figure 3.2-1

Stream Reaches Surveyed within the Proposed Tailings Storage Area

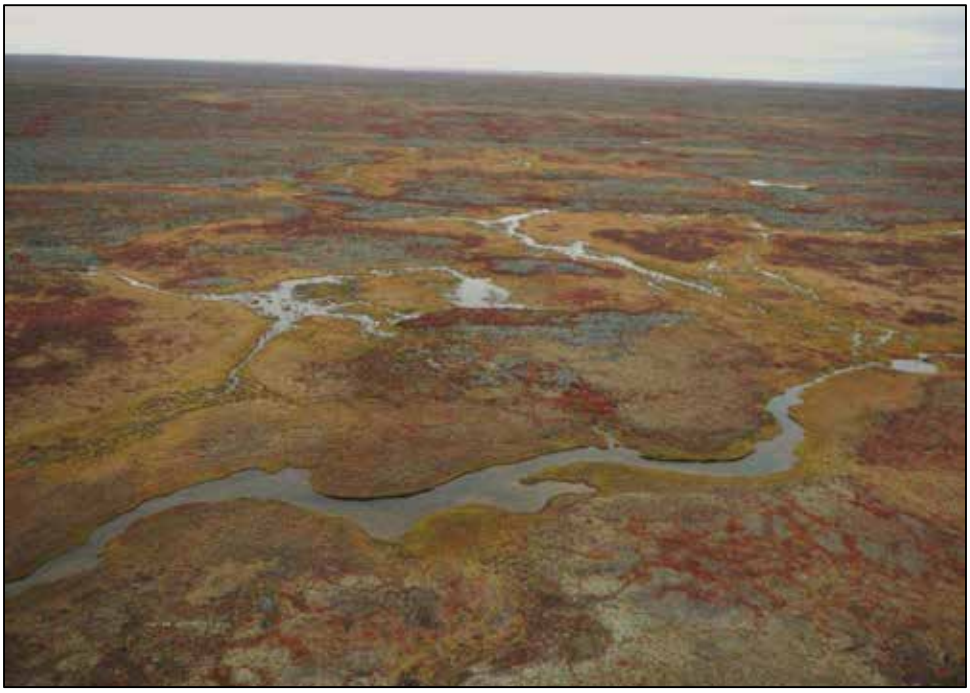


Plate 3.2-1. Moby Outflow (foreground) with seepage tributaries along the south bank (looking south). September 2, 2012.

3.2.2 Detailed Reach Descriptions

Moby Outflow

Reach one of Moby Outflow is located at the downstream end of the proposed tailings storage area. It is 706 m long and consists of glide morphology, with a relatively narrow bankfull width (2.5 m) and a relatively deep bankfull depth (1.3 m). The gradient is nearly flat at 0.1%. Glide and pool habitat units make up over 95% of the reach length and the substrate is uniformly dominated by fine silt and clay substrate (Plate 3.2-2). Instream cover is abundant at 41% and is dominated by instream vegetation, deep pools, and undercut banks. The banks are stable, with low erosion and few areas of slumping.

Reach two of Moby Outflow is 230 m long and has riffle-pool morphology. It has a wider channel width (4.7 m) and slightly shallower depth (1.1 m) than reach 1 (Plate 3.2-3). Riffle habitat makes up approximately 22% of the reach lake, although the reach is still dominated by glide and pool habitat. This reach has a higher proportion of gravel substrates and trace amounts of boulder substrate, which is typical of this stream morphology. Total instream cover is slightly lower than reach one, but continues to be dominated by deep pools, undercut banks, and instream vegetation. Bank stability is lower than reach 1, but still largely stable. Some sections of the banks showed signs of weakness, including cracks and slumping (Plate 3.2-4).

Reach 3 of Moby Outflow is 630 m long, with glide morphology. The mean bankfull width is 6.8 m and the bankfull depth is 1.1 m. The gradient is slightly higher than previous reaches due to the presence of a few cascades that break up the glide habitat (Plate 3.2-5). The reach is dominated by pool habitat, followed by glides, cascades, and riffles. Fines continued to dominate the substrate composition, followed by boulders, and small amounts of gravel and cobble. Instream cover is very high and dominated by instream vegetation, followed by boulder, deep pools, and undercut banks. The banks are stable with few signs or erosion or slumping.



Plate 3.2-2. Typical glide habitat in reach 1 of Moby Outflow, looking upstream. Note the fine substrate and steep banks. August 2012.



Plate 3.2-3. Deep pool with trace amounts of boulder substrate and instream vegetation cover in reach 2 of Moby Outflow. August 2012.



Plate 3.2-4. Parallel cracks along the banks of reach 2 of Moby Outflow are often a precursor to slumping. August 2012.



Plate 3.2-5. Boulder-dominated cascade habitat unit in reach 3 of Moby Outflow, looking upstream.

Reach 4 of Moby Outflow is 260 m long and also consists of glide channel morphology; however, the bankfull width is larger than previous reaches (8.3 m) and the bankfull depth is markedly lower (0.7 m) (Plate 3.2-6). This reach has a flat gradient and consists entirely of glide and pool habitat units. Fine silts and clays dominate the substrate and instream cover is low, composed mainly of sparse instream vegetation. The banks are stable and relatively low compared to previous reaches.



Plate 3.2-6. Low banks, fine sediments, and shallow depth characterize reach 4 of Moby Outflow. Photo looking upstream towards a small tributary. August 2012.

In reach 5 of Moby Outflow, the gradient begins to increase as the stream transitions to riffle-pool morphology (Plate 3.2-7). The reach is 297 m long with a mean bankfull width of 4.1 m and bankfull depth of 1.0 m. Pools and riffles dominate this reach, followed by glide habitat units. Fine sediment continues to dominate the substrate, although there is a small amount of gravel and cobble present. Instream cover is high, and is dominated by instream vegetation and undercut banks, followed by deep pools. The banks of this reach are low and stable.

Reach 6 of Moby Outflow is 248 m long, with a bankfull width of 5.8 m and a bankfull depth of 0.7 m. The gradient was relatively high (0.9%) for this glide morphology reach, reflecting the frequent short riffles that broke up the glide sections (Plate 3.2-8). Habitat unit composition showed that there were roughly equal portions of glide, pool and riffle habitat throughout the reach. Fine sediment dominated the substrate; however, there was also a relatively high percentage of boulder substrate (33%). Instream cover was moderate and dominated by boulders, followed by undercut banks and instream vegetation. Bank height was low and stable, and banks were frequently narrower than the wetted width of the stream.

Reach 7 of Moby Outflow is a riffle-pool segment 130 m long, with a mean bankfull width of 3.8 m and a mean bankfull depth of 0.8 m. The gradient is low, averaging 0.2%. Glide habitat dominates the habitat unit composition, followed by pools and riffles. The substrate is dominated by fine sediment, with a small proportion of boulder and gravel (Plate 3.2-9). Cover is moderate and is dominated by

undercut banks, followed by smaller proportions of deep pools and boulders. The banks surrounding this reach are low and stable.



Plate 3.2-7. Riffle and glide habitat units along reach 5 of Moby Outflow, looking upstream. August 2012.



Plate 3.2-8. Riffle habitat at the start of reach 6 of Moby Outflow, looking upstream. August 2012.



Plate 3.2-9. Reach 7 of Moby Outflow, looking upstream. August 2012.

Reach 8 of Moby Outflow is 279 m long and composed of glide channel morphology. The gradient is flat at 0%, the bankfull width averages 5.2 m and the bankfull depth averages 0.8 m. Glides make up the majority of the habitat units in this reach, followed by small proportions of pools and riffles. Fines also dominate the substrate. Instream cover is low and made up predominantly of instream vegetation. The bank height is also low and the banks are stable.

Reach 9 of Moby Outflow is a riffle-pool section with a length of 253 m and a mean gradient of 0.3%. The mean bankfull width is 5.0 m and the mean bankfull depth is 0.6 m. Glides make up the majority of habitat units, followed by pools, cascades and riffles. This is the first section in Moby Outflow with a significant proportion of gravel substrates (35%; Plate 3.2-10). Fines, cobble and gravel are also found in the substrate of this reach. Cover in this reach is low and composed mainly of boulders and undercut banks. The bank height through this section is moderate and the banks are stable.

Reach 10 of Moby Outflow is also a riffle-pool reach with a length of 241 m; however, this section has a smaller bankfull width (1.6 m) and bankfull depth (0.4 m) than the previous reach. The reach starts at the confluence of Moby Outflow and its dominant tributary, Tributary 2 (Plate 3.2-11). The gradient of this reach averages 0.7%. The composition of habitat units is roughly evenly split between glide (40%) and riffle (37%), with pools making up the remaining reach length. Gravel, fines and cobble are present in roughly equal amounts in the substrate, with a small percentage of boulders present as well. Instream cover is low and mainly dominated by undercut banks, followed by small percentages of boulder and instream vegetation. The banks of this reach are low and stable.

Reach 11 of Moby Outflow is a short cascade-pool section with a mean gradient of 4.5%. The mean bankfull width is 2.0 m and the mean bankfull depth is 0.5 m. Cascades dominate the habitat unit composition, followed by riffles, pools and glides. A 4 m long cascade at the downstream end of the reach is a potential fish passage barrier due to the high gradient and velocity (Plate 3.2-12). The substrate in this reach is dominated by boulder and bedrock, followed by cobble and a small percentage of fines. Instream cover is moderately abundant and dominated by boulder cover. The banks of this section are high and very stable due to a high proportion of bedrock.



Plate 3.2-10. Gravel substrate in reach 9 of Moby Outflow, looking upstream. August 2012.



Plate 3.2-11. Beginning of reach 10 of Moby Outflow, looking upstream. August 2012.



Plate 3.2-12. Cascade and potential barrier to fish migration at the lower end of Reach 11, looking upstream. August 2012.

Reach 12 of Moby Outflow consists of a boulder garden 442 m long with no defined channel (Plate 3.2-13). Some isolated pools were observed at the lower end of this reach; however, they were few and far between. Grayling fry were observed in a few of the pools at the downstream end; however, as the pools got further apart and shallower, grayling were no longer observed. No other measurements were taken in this section.



Plate 3.2-13. Reach 12 of Moby Outflow consists of a boulder garden with no defined channel.

Upstream of the boulder garden, Moby Outflow again becomes more confined as it flows through a riffle-pool reach 258 m long. The mean bankfull width of this section is 3.0 m and the mean bankfull depth is 0.4 m. No pools were found in this reach, and the stream channel was composed of glide and riffle habitat units (Plate 3.2-14). Boulder substrate predominated in this section, followed by cobble and small amounts of gravel and bedrock. Instream cover was high and mainly composed of boulder cover. The banks of the channel are moderately high and stable.



Plate 3.2-14. Riffle-pool reach at the upstream end of Moby Outflow near the outflow of Moby Lake, looking upstream. August 2012.

Moby Tributary 1

Moby Tributary 1 consists of a single riffle-pool reach 263 m long. It enters Moby Outflow just downstream of Reach 11 and starts with a small waterfall that is a potential barrier to fish passage (Plate 3.2-15). The habitat unit composition is dominated by pools, followed by riffles and glides. Fines dominate the substrate, followed by a small percentage of boulders. Instream cover is high and dominated by undercut banks, followed by boulder and instream vegetation. The banks are moderately low and stable.

Moby Tributary 2

Moby Tributary 2 is the main tributary to Moby Outflow and consists of three defined reaches. The first reach has riffle-pool morphology and is 248 m long with a gradient of 0.4%. The mean bankfull width is 2.6 m and the mean bankfull depth is 0.5 m (Plate 3.2-16). Shallow glides, followed by riffles and pools dominate the habitat unit composition. The substrate is a mix of fines and cobble, with lesser proportions of gravel, boulder and bedrock. Instream cover is moderate and dominated by undercut banks, followed by small proportions of boulder, pool, and instream vegetation. The banks are low and stable.

The second reach of Moby Tributary 2 is a cascade-pool reach 58 m long with a gradient of 1.5%. The bankfull width is 2.0 m and the bankfull depth is 0.4 m. Glides dominate the habitat unit composition, followed by riffles and cascades (Plate 3.2-17). No pools were found. The substrate is

dominated by cobble and boulder. Instream cover is moderate and made up mainly of boulder cover. The banks are moderately high and stable.



Plate 3.2-15. Narrow channel of Moby Tributary 1, looking upstream. August 2012.



Plate 3.2-16. Reach 1 of Moby Tributary 2, looking upstream from the confluence with Moby Outflow. August 2012.



Plate 3.2-17. Riffle habitat in reach 2 of Moby Tributary 2, looking upstream. August 2012.

The uppermost reach of Moby Tributary 2 is a glide reach with a length of 149 m, a mean bankfull width of 6.8 m and a mean bankfull depth of 0.7 m (Plate 3.2-18). The reach is composed of glide and pool habitat units and has a mean gradient of 0%. Fines dominated the substrate, along with small proportions of boulder, gravel, and cobble. Instream cover is moderate, with the most abundant forms being instream vegetation and boulders. The banks are moderately low and stable. Upstream of this reach is a boulder field with no defined channel. The boulder field continues beyond the boundary of the proposed tailings storage area.

Moby Tributary 2-1

A small stream enters Moby Tributary 2 at the upstream end of Reach 1. This stream consists of a single riffle-pool reach 445 m long, with a gradient of 0.3% (Plate 3.2-19). The mean bankfull width is 1.8 m and the mean bankfull depth is 0.4 m. The stream consists mainly of glide and pool habitat, with a small percentage of riffle habitat. Fines dominate the substrate, followed by a small amount of gravel. Instream cover is low and predominately made up of undercut bank. The banks are low and mostly stable. Upstream of this reach is a boulder field with no fish habitat.

Moby Tributary 3

Moby Tributary 3 arises from springs along the base of the rock ridge southwest of Moby Outflow. It is comprised of four reaches, including a wide undefined NCD where the stream meets Moby Outflow (Plate 3.2-20).

In the second reach of Moby tributary 3, the channel steepens to riffle-pool morphology with a mean gradient of 0.8%, a mean bankfull width of 1.9 m, and a mean bankfull depth of 0.3 m. The habitat is composed of glide and riffle units, with a smaller percentage of pools. Some cobble and boulder substrate is present; however, the reach continues to be dominated by fine sediment. Cover abundance

is moderate and dominated by instream vegetation, pools, and undercut banks. The banks of this reach are low and somewhat unstable (Plate 3.2-21).



Plate 3.2-18. Reach 3 of Moby Tributary 2 is dominated by glide habitat. Looking upstream. August 2012.



Plate 3.2-19. Moby Tributary 2-1 looking upstream. August 2012.



Plate 3.2-20. Wide, shallow non-classified drainage on Moby Tributary 3, looking upstream. September 2012.



Plate 3.2-21. Glide and riffle habitat in reach 2 of Moby Tributary 3, looking upstream. September 2012.

The third reach of Moby Tributary 3 is also a NCD with no defined channel; however, there is abundant surface flow allowing for fish passage (Plate 3.2-22). This section has a mean gradient of 3%, and the wetted width at the time of the survey averaged 3.0 m.



Plate 3.2-22. Non-classified-drainage reach of Moby Tributary 3, looking upstream.

The fourth reach of Moby Tributary 3 has riffle-pool morphology and a mean gradient of 1.0%. The mean bankfull width is 1.4 m and the mean bankfull depth is 0.2 m (Plate 3.2-23). The reach is dominated by glide habitat, followed by riffles and the substrate composition is made up of fines and boulders. No instream cover was recorded in this reach. The banks of this reach are low and unstable. This reach arises from springs along the base of the ridge line, and Arctic grayling fry were observed throughout the stream to its point of origin.

Moby Tributary 3-1

Moby Tributary 3-1 flows into Moby Tributary 3 near its confluence with Moby Outflow and consists of a single reach. This reach has glide morphology with a mean gradient of 0.3%, a mean bankfull width of 1.6 m, and a very shallow bankfull depth of 0.1 m. The stream is poorly defined with low, unstable banks (Plate 3.2-24). The habitat is composed of glide, riffle, and undefined seepage units and the substrate is composed entirely of fine silt. Instream cover is provided by aquatic vegetation, which is abundant.

Moby Tributary 4

Moby Tributary 4 contains one short reach that drains a large seepage area south of Moby Outflow. This reach is just over 50 m long and has riffle-pool morphology with a mean gradient of 1.2% (Plate 3.2-25). This reach has a mean bankfull width of 2.3 m and a mean bankfull depth of 0.3 m. The habitat in this reach is varied, but is dominated mainly by glide habitat, followed by cascades, riffles and pools. Cobble and fines dominate the substrate, followed by boulders and bedrock. Instream

cover is moderate and composed mainly of instream vegetation and boulders. The banks of this section are moderately high and somewhat unstable.



Plate 3.2-23. Glide habitat at the upstream end of Moby Tributary 3, looking upstream. September 2012.



Plate 3.2-24. Reach 1 of Moby Tributary 3-1 showing low banks and glide habitat, looking upstream. September 2012.



Plate 3.2-25. Moby Tributary 4, looking upstream from the confluence with Moby Outflow. September 2012.

Moby Tributary 5

Moby Tributary 5 arises from the ridgeline north of Moby Outflow and contains three distinct reaches. The first reach is an undefined NCD, 226 m long with a mean gradient of 3.0% (Plate 3.2-26).

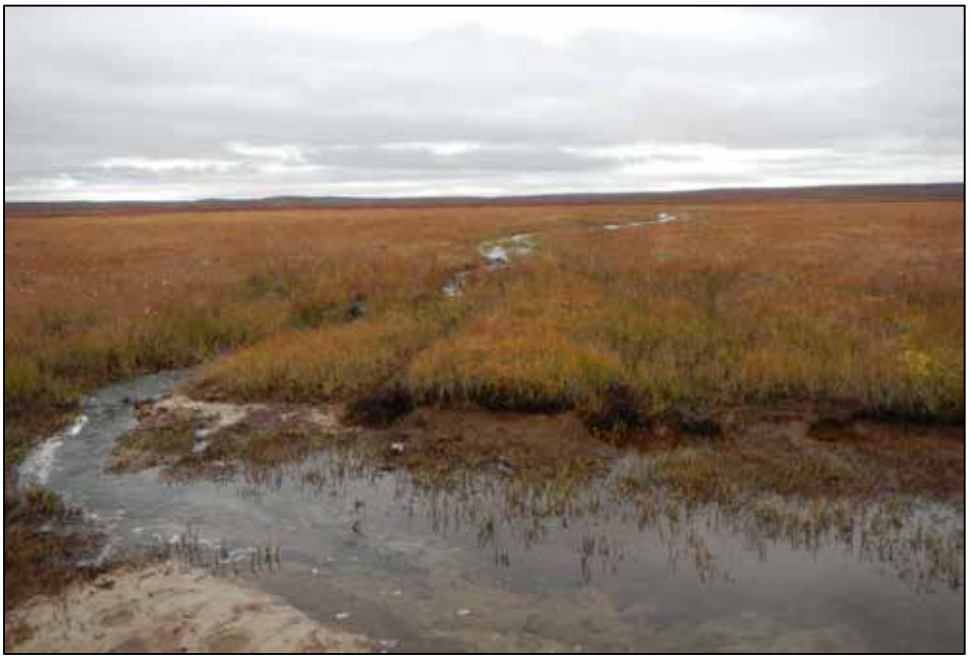


Plate 3.2-26. Reach 1 of Moby Tributary 5 at the confluence with Moby Outflow (foreground). September 2012.

The second reach of Moby Tributary 5 is a well-defined riffle-pool channel with a mean bankfull width of 1.3 m and a mean bankfull depth of 0.3 m. The habitat units are composed primarily of glides, followed by pools and riffles. The substrate is almost entirely composed of fine sediment; however, some small patches of pea gravel were noted that may provide good spawning habitat (Plate 3.2-27). Instream cover abundance is low, with undercut banks providing the only cover. The banks of this reach are somewhat low and unstable.



Plate 3.2-27. Reach 2 of Moby Tributary 5, looking upstream. September 2012.

The third reach of Moby Tributary 5 arises from a spring at the base of the ridgeline (Plate 3.2-28). It has riffle-pool morphology, with a mean gradient of 0.5%, mean bankfull width of 1.1 m and mean bankfull depth of 0.3 m. Glides make up the majority of habitat units, followed by riffles, and fines make up the majority of the substrate. Cover in this section is moderate and composed of undercut banks. The banks are somewhat low and unstable.

Moby Tributary 6

The final tributary of Moby Outflow that was surveyed in 2012 consists of a single, short seepage with no defined banks and a gradient of 1%. No fish habitat was observed in this reach (Plate 3.2-29).

3.2.3 Fish Habitat Summary

Channel Characteristics

Table 3.2-1 presents of summary of the physical channel characteristics for each reach in the Moby Outflow Watershed. The main outflow of Moby Outflow within the proposed tailings storage area footprint consisted of 13 distinct reaches ranging in length from 78 m to 706 m. The majority of the stream length consisted of glide reaches (2.1 km) followed by riffle/pool segments (1.4 km; Figure 3.2-2). The remaining length of the stream consisted of boulder garden, NCD and cascade/pool reaches. There were six tributaries to Moby Outflow within the tailings storage area, two of which had tributaries of their

own. Within the tributary streams, riffle-pool morphology dominated, followed by NCD, boulder garden and glide morphology.



Plate 3.2-28. Reach 3 of Moby Tributary 3 looking upstream towards the source. September 2012.



Plate 3.2-29. Seepage reach of Moby Tributary 6 looking upstream from Moby Outflow. September 2012.

Table 3.2-1. Physical Reach Characteristics of the Assessed Streams within the Moby Watershed

Attribute	Descriptor	Moby Outflow									
		1	2	3	4	5	6	7	8	9	10
Morphology	n/a	Glide	Riffle/Pool	Glide	Glide	Riffle/Pool	Glide	Riffle/Pool	Glide	Riffle/Pool	Riffle/Pool
Reach Length	m	706.1	229.8	630.0	260.0	297.4	247.6	129.7	278.6	253.4	263.0
Mean Gradient	%	0.1	0.2	0.4	0.0	0.6	0.9	0.2	0.0	0.3	5.1
Mean Bankfull Width	m	2.5	4.7	6.8	8.3	4.1	5.8	3.8	5.2	5.0	0.8
Mean Wetted Width	m	2.2	3.9	6.1	7.2	3.5	6.0	3.2	5.0	4.6	0.5
Mean Bankfull Depth	m	1.3	1.1	1.1	0.7	1.0	0.7	0.8	0.8	0.6	0.4
Mean Wetted Depth	m	1.1	1.0	0.9	0.5	0.8	0.5	0.6	0.6	0.4	0.2
Bankfull area	m^2	1,763.7	1,087.8	4,279.2	2,156.9	1,218.5	1,435.9	496.1	1,439.7	1,265.1	212.4

Attribute	Descriptor	Moby Outflow *(cont'd)*			Tributary 1	Tributary 2			Tributary 2-1
		11	12	13	1	1	2	3	1
Morphology	n/a	Cascade/Pool	Boulder Garden	Riffle/Pool	Riffle/Pool	Riffle/Pool	Cascade/Pool	Glide	Riffle/Pool
Reach Length	m	77.9	442.3	258.2	263.0	247.5	57.9	149.1	444.6
Mean Gradient	%	4.5	2.0	0.8	5.1	0.4	1.5	0.0	0.3
Mean Bankfull Width	m	2.0	0.0	3.0	0.8	2.6	2.0	6.8	1.8
Mean Wetted Width	m	1.5	0.0	1.9	0.5	1.9	1.7	6.3	0.9
Mean Bankfull Depth	m	0.5	0.0	0.4	0.4	0.5	0.4	0.7	0.4
Mean Wetted Depth	m	0.3	0.0	0.2	0.2	0.4	0.2	0.6	0.3
Bankfull area	m^2	154.3	0.0	776.2	212.4	633.2	114.9	1013.9	794.4

Attribute	Descriptor	Tributary 3			Tributary 3-1	Tributary 4	Tributary 5			Tributary 6
		2	3	4	1	1	1	2	3	1
Morphology	n/a	Riffle/Pool	NCD	Riffle/Pool	Glide	Riffle/Pool	NCD	Riffle/Pool	Riffle/Pool	NCD
Reach Length	m	440.2	99.2	136.6	316.3	50.9	225.9	327.7	171.0	152.8
Mean Gradient	%	0.8	3.0	1.0	0.3	1.2	3.0	0.5	0.5	1.0
Mean Bankfull Width	m	1.9	0.0	1.4	1.6	2.3	0.0	1.3	1.1	0.0
Mean Wetted Width	m	1.1	3.0	1	1.5	1.6	0.0	0.8	0.6	0.0
Mean Bankfull Depth	m	0.3	0.0	0.3	0.1	0.3	0.0	0.3	0.3	0.0
Mean Wetted Depth	m	0.2	0.2	0.2	0.1	0.2	0.0	0.2	0.2	0.0
Bankfull area	m^2	828.0	0.0	191.2	513.4	118.8	0.0	434.3	180.1	0.0

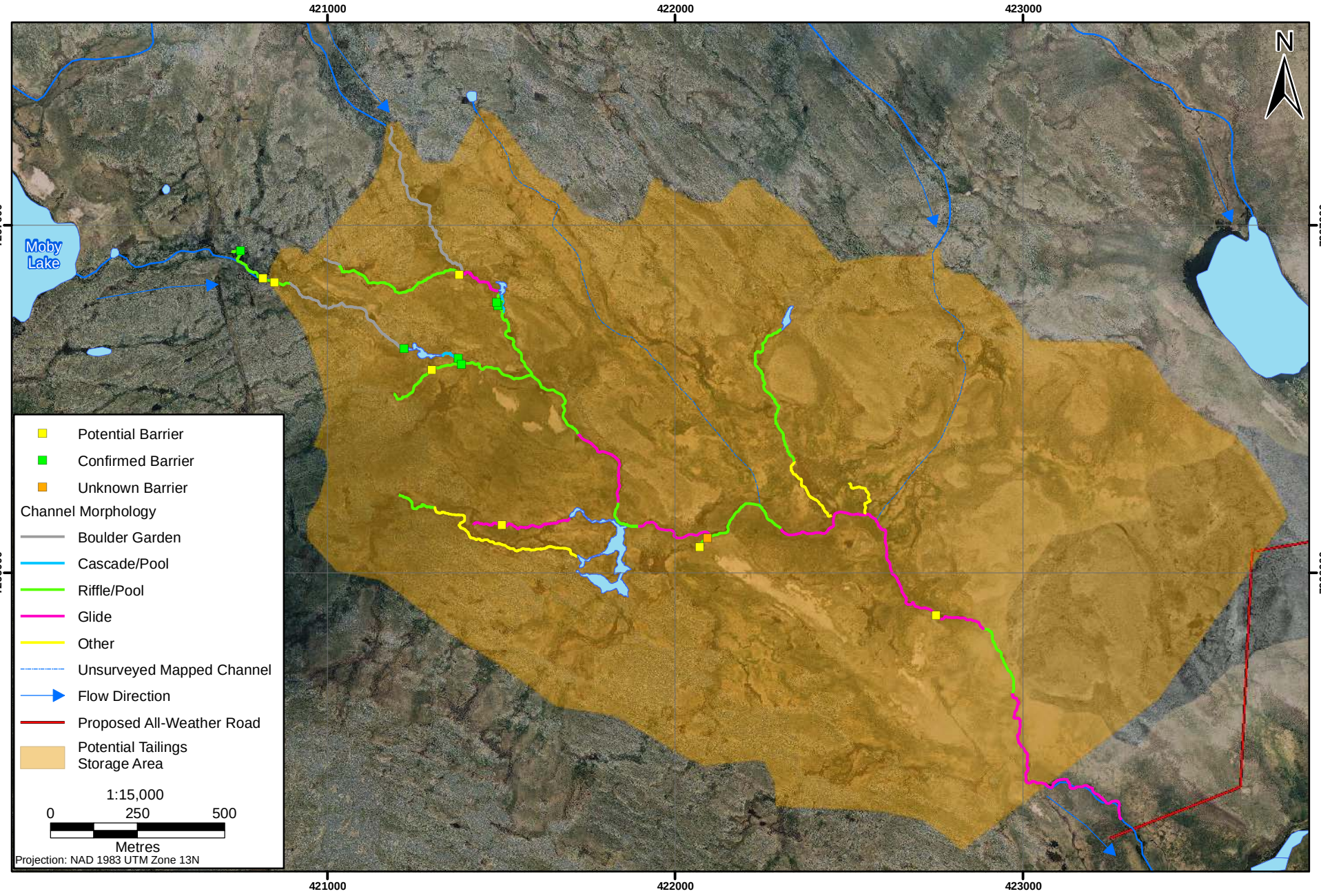


Figure 3.2-2

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Potential Tailings Storage Area: Channel Morphology

Figure 3.2-2

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Stream gradients within the Moby Watershed were generally very low, with average reach gradients ranging from 0 to 5.1%. Stream gradients were generally lowest in glide reaches and highest in cascade/pool and riffle/pool reaches.

Bankfull and wetted widths and depths were generally highest in Moby Outflow and in Tributary 2. The majority of the tributaries to Moby Outflow consisted of small, shallow channels. The highest bankfull widths were generally found in the middle reaches of Moby Outflow where wide, moderately shallow glides predominated. The highest bankfull depths were observed in the lower reaches of Moby Outflow where the stream was confined to a deep, narrow box-channel with vertical or undercut banks.

Instream Habitat

Pool and glide habitat units made up the majority of reaches in Moby Outflow (proportioned by length) (Table 3.2-2). Up to 52% of the reach length in Moby Outflow was made up of pool habitat, while glide habitat occupied up to 90% of the reach length. Glide and riffle habitat were more abundant in the tributary streams. Glide habitat made up between 49 and 56% of the reach length in Tributary 2, while pools occupied 0 to 44% of the reach length. Glide and riffle habitat also dominated the channelized portions of Tributaries 3, 4 and 5.

Fine substrates dominated the majority of reaches in the Moby Outflow drainage area within the footprint of the proposed tailings storage area, both in the main stem of Moby Outflow and in its tributaries (Table 3.2-3). Gravels were relatively scarce throughout the watershed, only occurring in a few reaches. Gravels, an important spawning substrate for Arctic grayling, occurred in the highest concentrations in reaches 9 and 10 of Moby Outflow (35 and 36%, respectively), and in lesser concentrations in reaches 2 and 5 of Moby Outflow (16 and 11%), and reach 1 of Tributary 2 (17%).

Instream cover for fish was relatively abundant in the lower reaches of Moby Outflow and Tributaries 2 and 3 (Table 3.2-4). Pools, instream vegetation and undercut banks were the dominant cover types in these reaches. In the higher reaches of the Moby Watershed streams, boulder cover became more abundant, as well as overhanging vegetation; however, total cover decreased.

Bank stability was generally moderate along most of Moby Outflow (Table 3.2-5). Highly stable banks were found in the upstream bedrock and boulder-dominated reaches. Low banks and low stability were observed throughout many of the tributary streams, particularly where the banks were poorly defined.

Habitat Quality

Habitat quality for Arctic grayling, the main species utilizing stream habitat in the Project area, was assessed within each reach for spawning, rearing and overwintering use, as well as overall habitat quality. Figures 3.2-3 to 3.2-5 show summaries of the spawning, rearing, overwintering and overall habitat quality in each of the reaches surveyed in the proposed tailings storage area.

In Moby Outflow, most of the reaches contained poor to fair spawning habitat due to the general lack of gravel substrates; however, juvenile grayling were observed throughout the stream, suggesting that spawning may be more widespread than the habitat quality indicates. Only two reaches with good quality spawning habitat were recorded in the Moby watershed. Arctic grayling prefer to spawn over gravel substrates (Scott and Crossman 1973; Hubert et al. 1985); however, spawning has been recorded over a variety of substrates ranging from mud to boulder (Stewart et al. 2007).

Overwintering habitat in streams in generally uncommon in the Arctic because most streams freeze to the bottom. The deep channel width and abundant cover in the lower reaches of Moby Outflow may allow for some limited overwintering of smaller fish; however, grayling tend to migrate downstream to lakes or larger rivers for overwintering (Stewart et al. 2007). Thus, the actual importance of this habitat for overwintering is unknown.

Table 3.2-2. Habitat Unit Composition of Assessed Streams within the Moby Watershed

Attribute	Descriptor	Moby Outflow									
		1	2	3	4	5	6	7	8	9	10
Habitat Unit Ratio (%)	Cascade	0.0	0.0	10.6	0.0	0.0	0.0	0.0	0.0	7.0	0.0
	Glide	51.9	44.0	36.8	70.0	21.2	38.1	49.7	89.6	62.4	40.6
	Pool	45.0	34.5	51.4	30.0	40.7	30.4	30.7	7.1	27.1	22.0
	Riffle	3.1	21.6	1.2	0.0	38.1	31.4	19.6	3.3	3.4	37.4
	Undefined	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Attribute	Descriptor	Moby Outflow *(cont'd)*			Tributary 1	Tributary 2			Tributary 2-1
		11	12	13	1	1	2	3	1
Habitat Unit Ratio (%)	Cascade	35.7	0.0	0.0	5.5	0.0	20.9	0.0	0.0
	Glide	16.0	0.0	62.2	18.2	49.3	40.7	56.0	48.4
	Pool	20.2	0.0	0.0	47.4	22.2	0.0	44.0	36.3
	Riffle	28.1	0.0	37.8	28.9	28.5	38.4	0.0	15.4
	Undefined	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0

Attribute	Descriptor	Tributary 3			Tributary 3-1	Tributary 4	Tributary 5			Tributary 6
		2	3	4	1	1	1	2	3	1
Habitat Unit Ratio (%)	Cascade	0.0	0.0	0.0	0.0	21.5	0.0	0.0	0.0	0.0
	Glide	43.3	0.0	84.5	38.6	52.1	0.0	41.5	63.3	0.0
	Pool	18.1	0.0	0.0	0.0	10.7	0.0	30.6	4.1	0.0
	Riffle	38.5	0.0	15.5	34.3	15.7	0.0	27.9	32.6	0.0
	Undefined	0.0	100.0	0.0	27.1	0.0	100.0	0.0	0.0	100.0

Table 3.2-3. Substrate Composition of Assessed Streams within the Moby Watershed

Attribute	Descriptor	Moby Outflow									
		1	2	3	4	5	6	7	8	9	10
Habitat - Weighted Substrate Composition - % by unit area	Fines	100.0	82.3	76.4	99.2	87.3	64.3	89.7	93.1	40.4	33.2
	Gravel	0.0	16.4	6.2	0.8	10.8	0.0	0.9	6.7	34.6	36.3
	Cobble	0.0	0.0	2.6	0.0	1.9	3.1	0.0	0.1	13.6	26.4
	Boulder	0.0	1.3	14.8	0.0	0.0	32.6	9.5	0.0	11.3	4.1
	Bedrock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Attribute	Descriptor	Moby Outflow *(cont'd)*			Tributary 1	Tributary 2			Tributary 2-1
		11	12	13	1	1	2	3	1
Habitat - Weighted Substrate Composition - % by unit area	Fines	4.6	0	0.0	85.8	33.2	0.0	78.0	88.8
	Gravel	0.0	0	5.9	0.0	16.6	3.3	5.6	11.2
	Cobble	15.8	0	38.4	0.5	28.6	57.8	4.5	0.0
	Boulder	53.1	80	50.8	13.6	18.6	38.9	11.9	0.0
	Bedrock	26.5	20	4.8	0.0	1.5	0.0	0.0	0.0

Attribute	Descriptor	Tributary 3			Tributary 3-1	Tributary 4	Tributary 5			Tributary 6
		2	3	4	1	1	1	2	3	1
Habitat - Weighted Substrate Composition - % by unit area	Fines	82.2	100.0	90.0	100.0	25.0	100.0	99.2	99.1	100.0
	Gravel	0.3	0.0	0.0	0.0	0.0	0.0	0.8	0.9	0.0
	Cobble	6.7	0.0	0.0	0.0	46.2	0.0	0.0	0.0	0.0
	Boulder	10.8	0.0	10.0	0.0	20.2	0.0	0.0	0.0	0.0
	Bedrock	0.0	0.0	0.0	0.0	8.6	0.0	0.0	0.0	0.0

Table 3.2-4. Instream Cover Composition of Assessed Streams within the Moby Watershed

Attribute	Descriptor	Moby Outflow									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Habitat - Weighted Substrate Composition - % by unit area	Pool	14.9	12.9	8.3	0.0	8.1	0.0	4.8	2.1	0.0	0.0
	Boulder	0.0	0.0	12.2	0.0	0.0	12.7	1.7	0.0	4.8	1.0
	Instream Veg	17.7	8.1	31.8	8.6	18.5	2.9	0.9	11.0	0.7	0.3
	Overhang Veg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Undercut Bank	8.4	13.1	5.0	0.0	15.8	4.4	14.9	0.9	2.7	8.6
	Total	*41.0*	*34.1*	*57.2*	*8.6*	*42.5*	*19.9*	*22.3*	*14.1*	*8.2*	*9.8*

Attribute	Descriptor	Moby Outflow *(cont'd)*			Tributary 1	Tributary 2			Tributary 2-1
		11	**12**	**13**	**1**	**1**	**2**	**3**	**1**
Habitat - Weighted Substrate Composition - % by unit area	Pool	**11**	**12**	**13**	0.0	2.2	0.0	0.8	0.0
	Boulder	0.0	0.0	0.0	5.2	5.5	15.7	7.9	0.0
	Instream Veg	20.9	0.0	28.6	4.1	1.8	0.0	8.3	3.3
	Overhang Veg	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0
	Undercut Bank	0.0	0.0	2.9	15.0	10.9	2.4	4.4	11.5
	Total	1.4	0.0	0.0	*24.3*	*20.5*	*19.9*	*21.3*	*14.8*

Attribute	Descriptor	Tributary 3			Tributary 3-1	Tributary 4	Tributary 5			Tributary 6
		2	**3**	**4**	**1**	**1**	**1**	**2**	**3**	**1**
Habitat - Weighted Substrate Composition - % by unit area	Pool	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Boulder	6.3	0.0	0.0	0.0	8.5	0.0	0.0	0.0	0.0
	Instream Veg	7.9	0.0	0.0	40.0	13.1	0.0	0.0	0.0	0.0
	Overhang Veg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Undercut Bank	1.5	0.0	0.0	0.0	0.0	0.0	4.6	14.5	0.0
	Total	*15.7*	*0.0*	*0.0*	*40.0*	*21.6*	*0.0*	*4.6*	*14.5*	*0.0*

Veg = vegetation

Table 3.2-5. Bank Height and Stability of Assessed Streams within the Moby Watershed

Attribute	Descriptor	Moby Outflow									
		1	2	3	4	5	6	7	8	9	10
Left Bank Height	m	0.28	0.36	0.30	0.22	0.20	0.26	0.25	0.18	0.20	0.19
Right Bank Height	m	0.36	0.27	0.34	0.23	0.20	0.16	0.18	0.22	0.25	0.18
Left Bank Stability	0 = unstable, 0.5 = stable, 1.0 = highly stable	0.50	0.43	0.50	0.50	0.50	0.50	0.45	0.50	0.50	0.50
Right Bank Stability		0.50	0.43	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

Attribute	Descriptor	Moby Outflow *(cont'd)*			Tributary 1	Tributary 2			Tributary 2-1
		11	12	13	1	1	2	3	1
Left Bank Height	m	0.63	n/a	0.34	0.21	0.21	0.33	0.24	0.15
Right Bank Height	m	0.80	n/a	0.28	0.18	0.23	0.30	0.19	0.13
Left Bank Stability	0 = unstable, 0.5 = stable, 1.0 = highly stable	0.75	n/a	0.50	0.50	0.50	0.50	0.44	0.46
Right Bank Stability		0.81	n/a	0.60	0.50	0.50	0.50	0.50	0.42

Attribute	Descriptor	Tributary 3			Tributary 3-1	Tributary 4	Tributary 5			Tributary 6
		2	3	4	1	1	1	2	3	1
Left Bank Height	m	0.13	n/a	0.10	0.10	0.28	n/a	0.15	0.14	n/a
Right Bank Height	m	0.15	n/a	0.10	0.10	0.25	n/a	0.11	0.13	n/a
Left Bank Stability	0 = unstable, 0.5 = stable, 1.0 = highly stable	0.23	n/a	0.25	0.14	0.38	n/a	0.32	0.30	n/a
Right Bank Stability		0.35	n/a	0.25	0.00	0.38	n/a	0.43	0.40	n/a

LB = left bank, RB = right bank

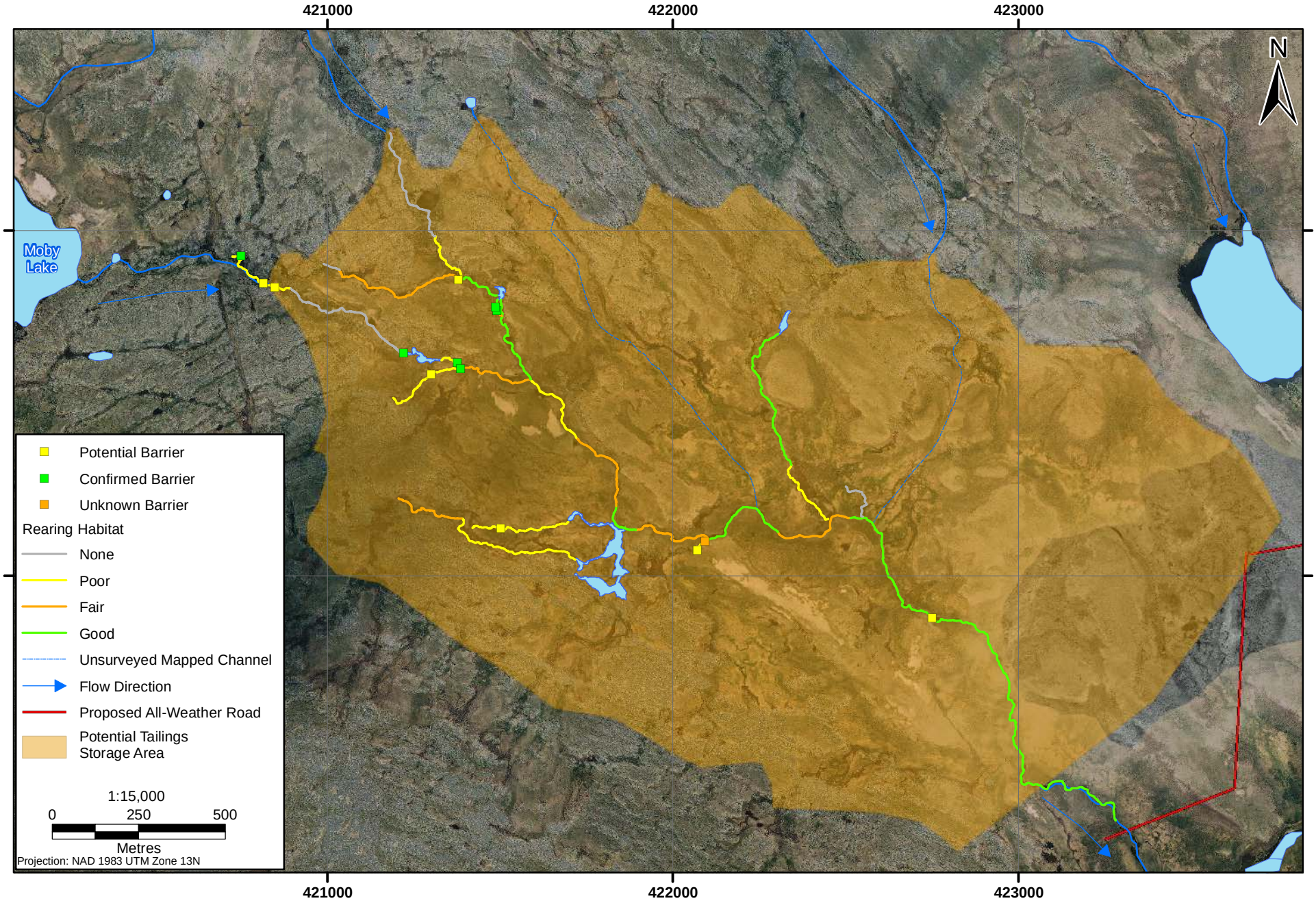


Figure 3.2-3

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Potential Tailings Storage Area: Rearing Habitat

Figure 3.2-3

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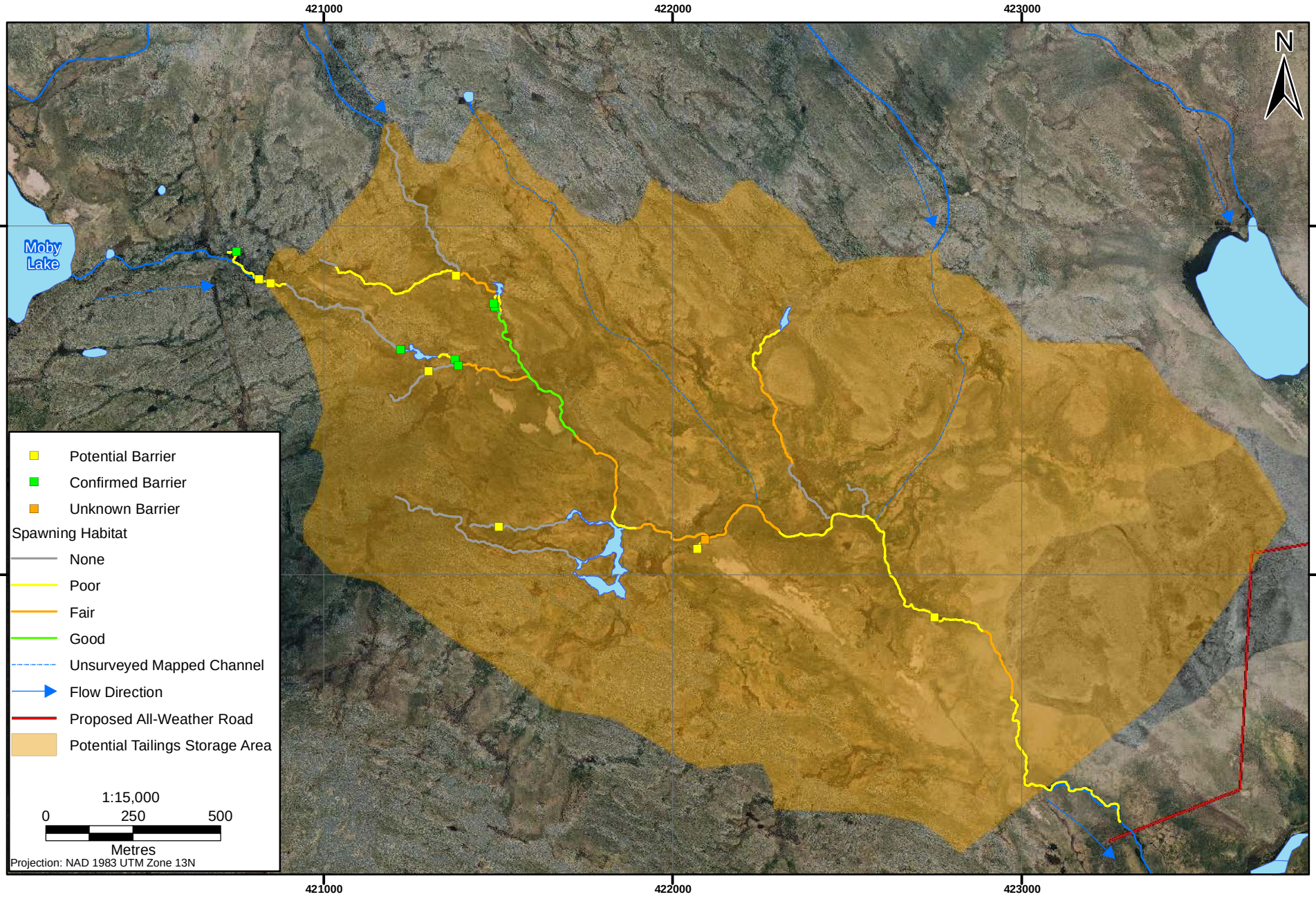


Figure 3.2-4

Sabina GOLD & SILVER CORP.

Potential Tailings Storage Area: Spawning Habitat

Figure 3.2-4

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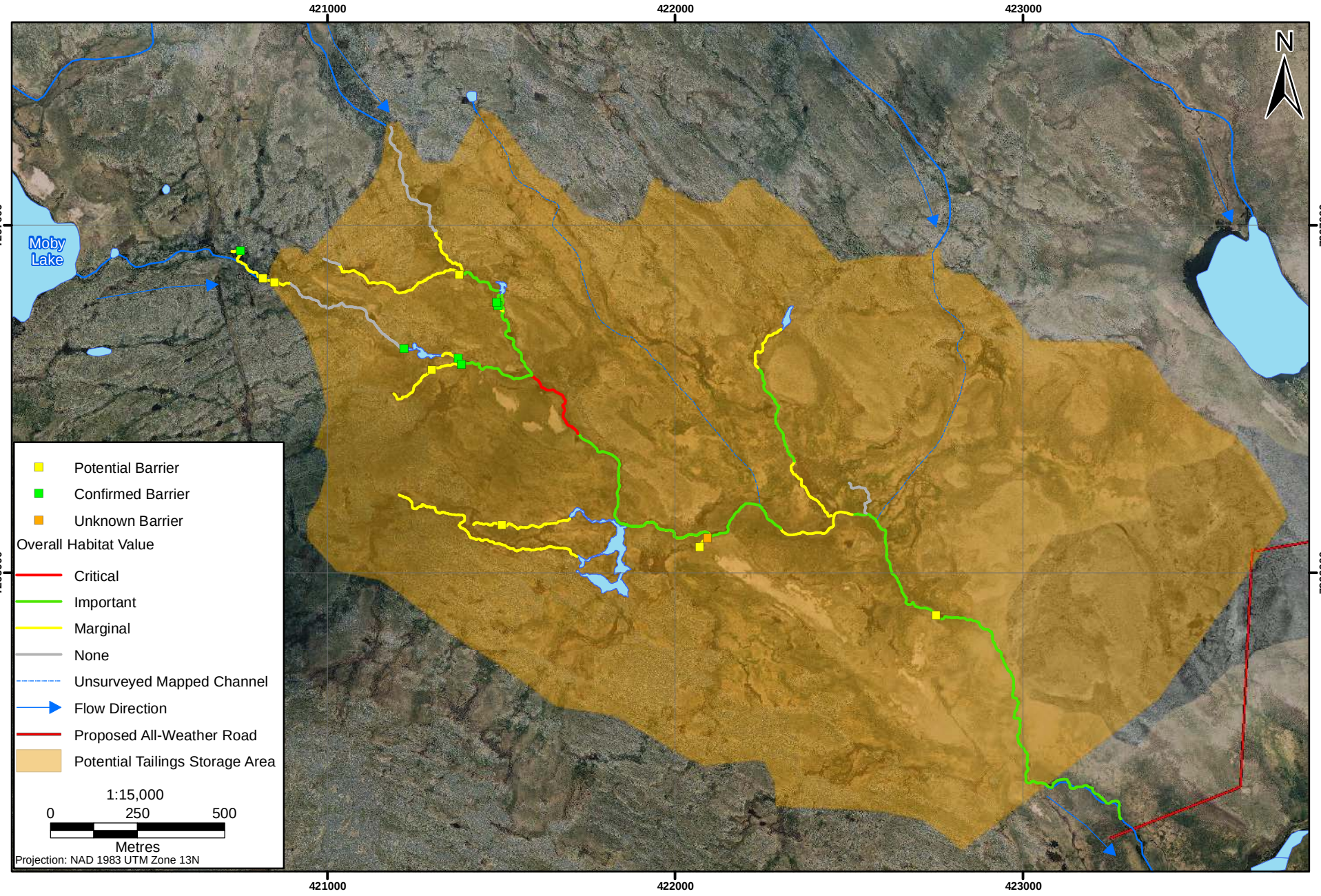


Figure 3.2-5

Sabina GOLD & SILVER CORP.

Potential Tailings Storage Area: Overall Habitat

Figure 3.2-5

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Rearing habitat quality for grayling was fair to good throughout most of the Moby Outflow drainage area, particularly in the lower reaches of Moby Outflow and its tributary streams. Poor habitat was found in many of the tributary streams, particularly where the channels were poorly defined and shallow. Despite the poor habitat quality, young-of-the-year grayling were observed throughout the watershed downstream of major boulder fields (barriers to migration). Juvenile grayling were observed using a wide variety of habitat types, and many grayling were observed to be potentially stranded in isolated pools in the lower reaches of boulder fields where the discharge decreased over the summer. This introduces the possibility that some habitat types in the watershed could be associated with high mortality of young-of-the-year (YOY) grayling if they become trapped as water levels decline over the summer.

Overall habitat quality was considered to be important in most of Moby Outflow and in the lower reaches of its tributaries.

3.3 LAKES

3.3.1 Fish Habitat

3.3.1.1 Overview

Fish habitat was surveyed in 19 lakes in the Back River Project area: 12 in the Goose property and 7 in the George property. Appendix 3.3-1 presents the substrate zone data for each of the lakes.

The littoral zones of most of the lakes surveyed were dominated by boulder substrate, followed by fines. Many lakes featured a rocky shoreline, which transitioned into a mud substrate several meters offshore where the zone of ice scour ended (usually between 1.5 and 2 m depth). Plate 3.3-1 shows the abrupt transition between boulder habitat and mud substrate along the shoreline of Umwelt Lake.



Plate 3.3-1. Abrupt transition zone between boulder/cobble shoreline and mud substrate at Umwelt Lake. July 26, 2012.

Shoreline cover for fish was sparse and mainly dominated by boulders in most lakes. Boulder substrate is used by lake trout and round whitefish for spawning, and also provides some cover for juvenile fish and forage species such as slimy sculpin. In some areas, ice scour formed small bays along the shoreline where Arctic grayling were frequently caught during beach seines. This phenomenon was especially apparent along the shores of Umwelt and Llama Lakes.

Aquatic vegetation was generally sparse, with moss and algae being the most common types of the vegetation noted, followed by vascular vegetation. Most lakes had little to no aquatic vegetation along the shoreline.

Habitat quality in the survey lakes is likely limited by depth, since overwintering habitat generally determines fish distribution. Maximum depths at surveyed lakes ranged from less than 2 m to over 16 m, but most lakes had a maximum depth between 4 and 6 m.

3.3.1.2 Goose Property

Goose Lake

Goose Lake has been surveyed in 2010 and 2011, as well as in 2012. The main inflows to Goose Lake Lake come from the Llama Watershed (which includes Umwelt Lake, Llama Lake and Fox Lake), the Giraffe Watershed (which includes Giraffe Lake and several unnamed ponds), and the Wolf Watershed (which includes Rascal Lake and Wolf Lake), and the outflow flows into Propeller Lake in the northeast (Figure 3.3-1). The shoreline of Goose Lake is dominated by boulder and cobble substrate, with areas of fines in the northwest and southeast near inflows (Plate 3.3-2). The "gooseneck" area around the inflow from Umwelt Lake is dominated by bedrock and boulder substrate with steep shorelines (Plate 3.3-3). Sparse aquatic vegetation was present in the shallow areas in the southeast part of the lake, but cover is generally low throughout. Some shoreline erosion was present along the south shore.



Plate 3.3-2. Boulder-cobble shoreline along the south shore of Goose Lake. July 2012.

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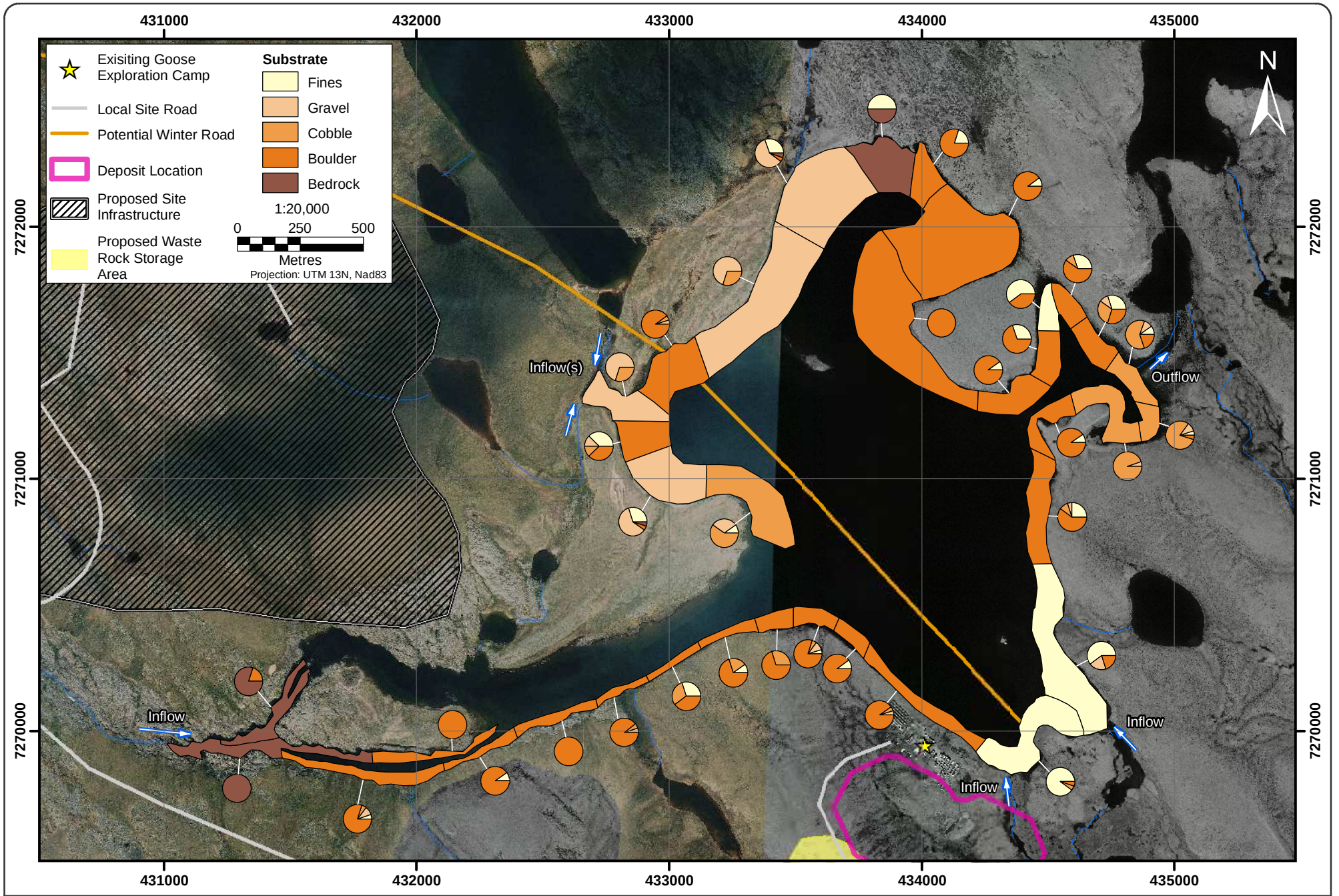


Figure 3.3-1

Sabina Gold & Silver Corp.

Shoreline Fish Habitat Substrates Zones, Goose Lake, 2012

Figure 3.3-1

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Plate 3.3-3. Bedrock and boulder shoreline in the "gooseneck" area of Goose Lake, looking southwest. July 2012.

Llama Lake

Llama Lake was surveyed in 2010 and 2011, as well as in 2012. Llama Lake is the headwater lake of the Llama Watershed (Figure 3.3-2). The outflow flows towards Umwelt Lake in the south. Llama Lake will be lost due to the development of the Llama Deposit. The shoreline is dominated by cobble and boulder substrate. Parts of the shoreline feature "fingers" of coarse substrate interspersed with "bays" of fines and gravels (Plate 3.3-4). Juvenile Arctic grayling were frequently caught in these small bays and they may provide important rearing habitat for this species.

Umwelt Lake

Umwelt Lake is located downstream of Llama Lake in the Llama Watershed and was surveyed in 2010, 2011, and 2012. The maximum depth is 3 m, and it has two inflows and one outflow. The shoreline is dominated by cobble substrate (Plate 3.3-5) and, like Llama Lake, features miniature "bays" of finer substrates where Arctic grayling were frequently captured in beach seine hauls. Throughout the lake, the coarse shoreline substrate abruptly gave way to fine sediment at a depth of approximately 2 m, and this fine substrate dominated the benthic portion of the lake away from the shorelines (Figure 3.3-3).

Gander Lake

Gander Lake is located in the Gander Watershed, and was surveyed for the first time in 2012. It is a large, shallow lake with a maximum depth of approximately 2.5 m. The main inflow and outflow is Gander River, which flows in from the north and out to the south towards Back River. Several other small tributaries are present along the shoreline as well. The shoreline substrate is dominated by boulder and cobble, which gives way to fine silt at a depth of approximately 2 m (Figure 3.3-4). Sparse aquatic vegetation is present in some bays where fine sediments dominate the shoreline (Plate 3.3-6). Several islands in the north end of the lake feature loose gravel shorelines on the exposed side (towards the lake) and fine substrates on the sheltered side (towards the shore).

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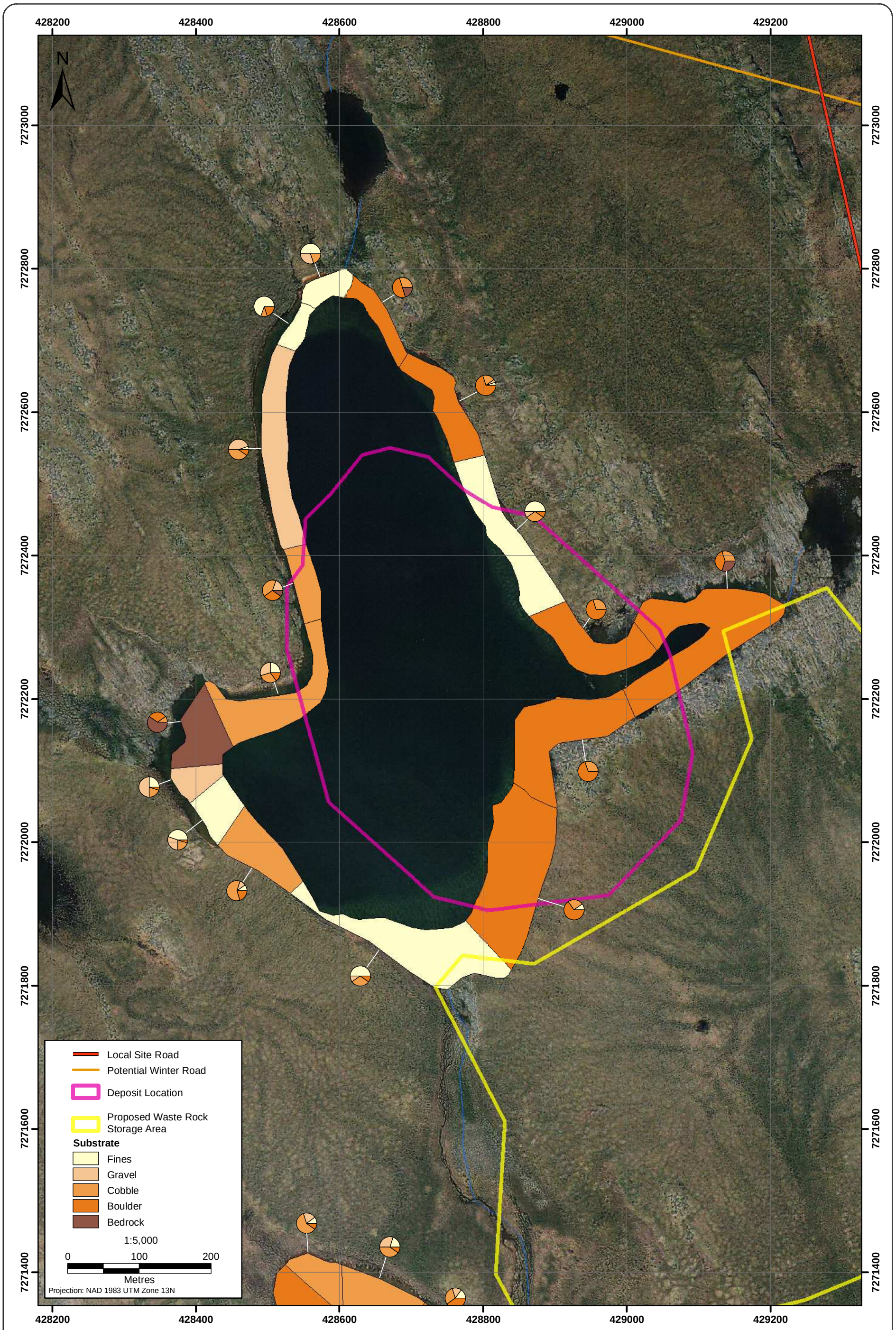


Figure 3.3-2

Sabina GOLD & SILVER CORP.

Shoreline Fish Habitat Substrates Zones, Llama Lake, 2012

Figure 3.3-2

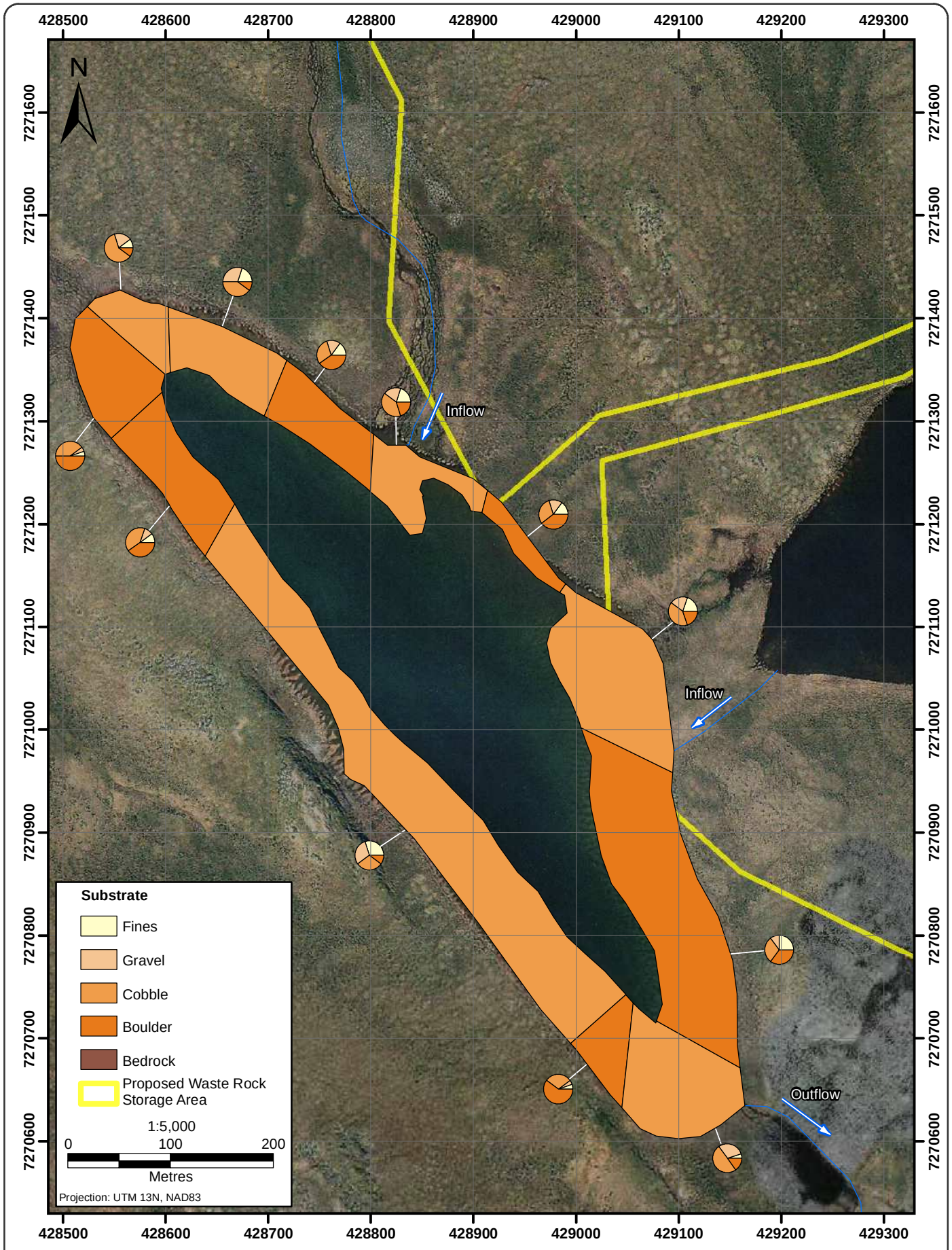
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Plate 3.3-4. Boulder-cobble shoreline of Llama Lake with "bays" of finer substrates. July 2012.



Plate 3.3-5. Boulder substrate along the shoreline of Umwelt Lake. July 2012.



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Shoreline Fish Habitat Substrates Zones, Umwelt Lake, 2012

Figure 3.3-3

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PROJECT #0833-002-04 GIS # BAC-06-044d November 19 2012

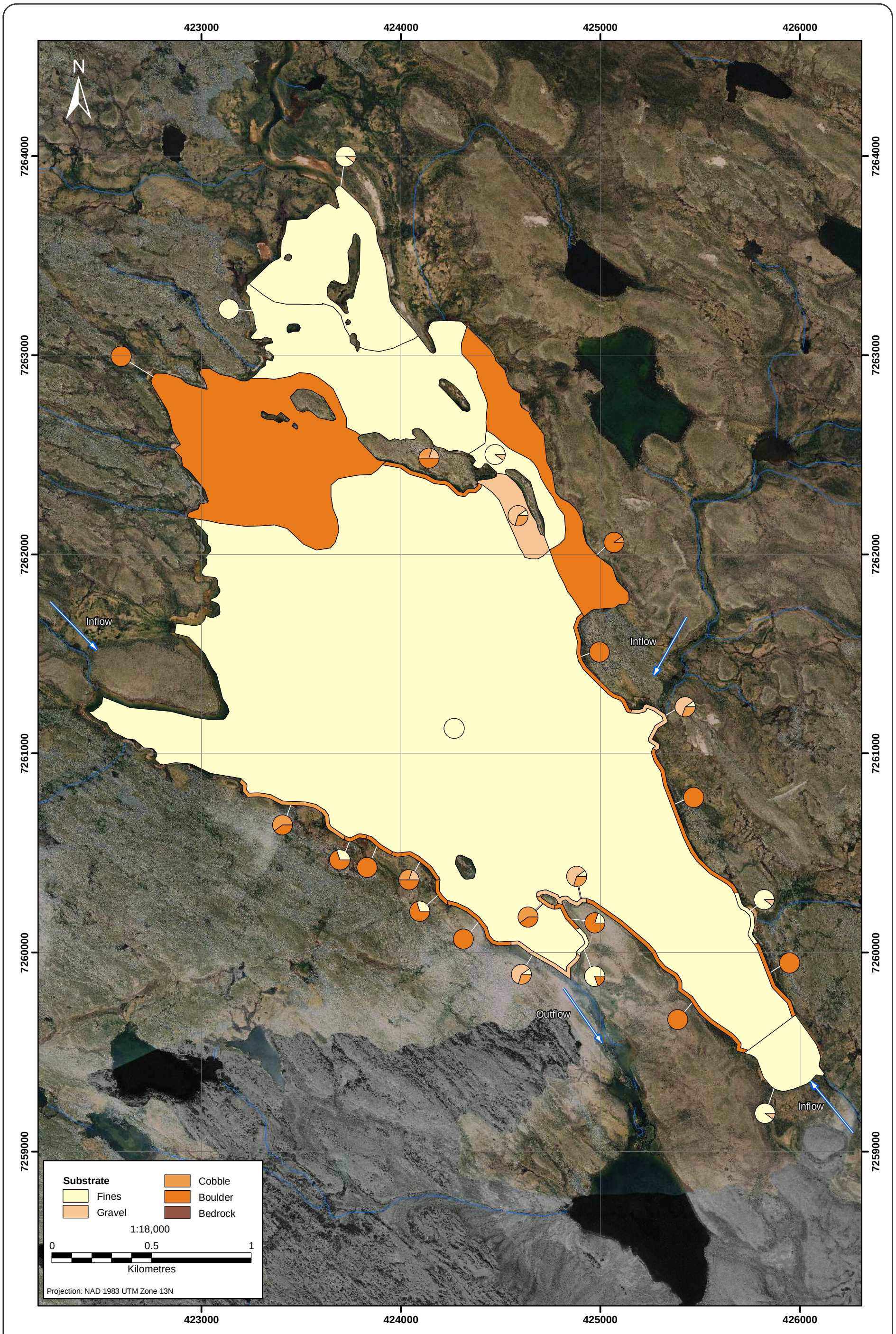


Figure 3.3-4

Sabina GOLD & SILVER CORP.

Shoreline Fish Habitat Substrates Zones, Gander Lake, 2012

Figure 3.3-4

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Plate 3.3-6. Sparse moss and emergent vegetation in a sheltered bay of Gander Lake. July 2012.

Big Lake

Big Lake is located west of Umwelt Lake in the Big Watershed. It has a maximum depth of approximately 6.2 m (estimated from gillnet sets). The shoreline is dominated by cobble and gravel substrates, with occasional areas of bedrock, boulder and fines (Plate 3.3-7, Figure 3.3-5). Sparse moss and vascular aquatic vegetation are present in several areas along the shore.



Plate 3.3-7. Boulder and bedrock along the shoreline of Big Lake. August 2012.

PROJECT # 0833-002-04 GIS # BAC-06-044h December-11-12

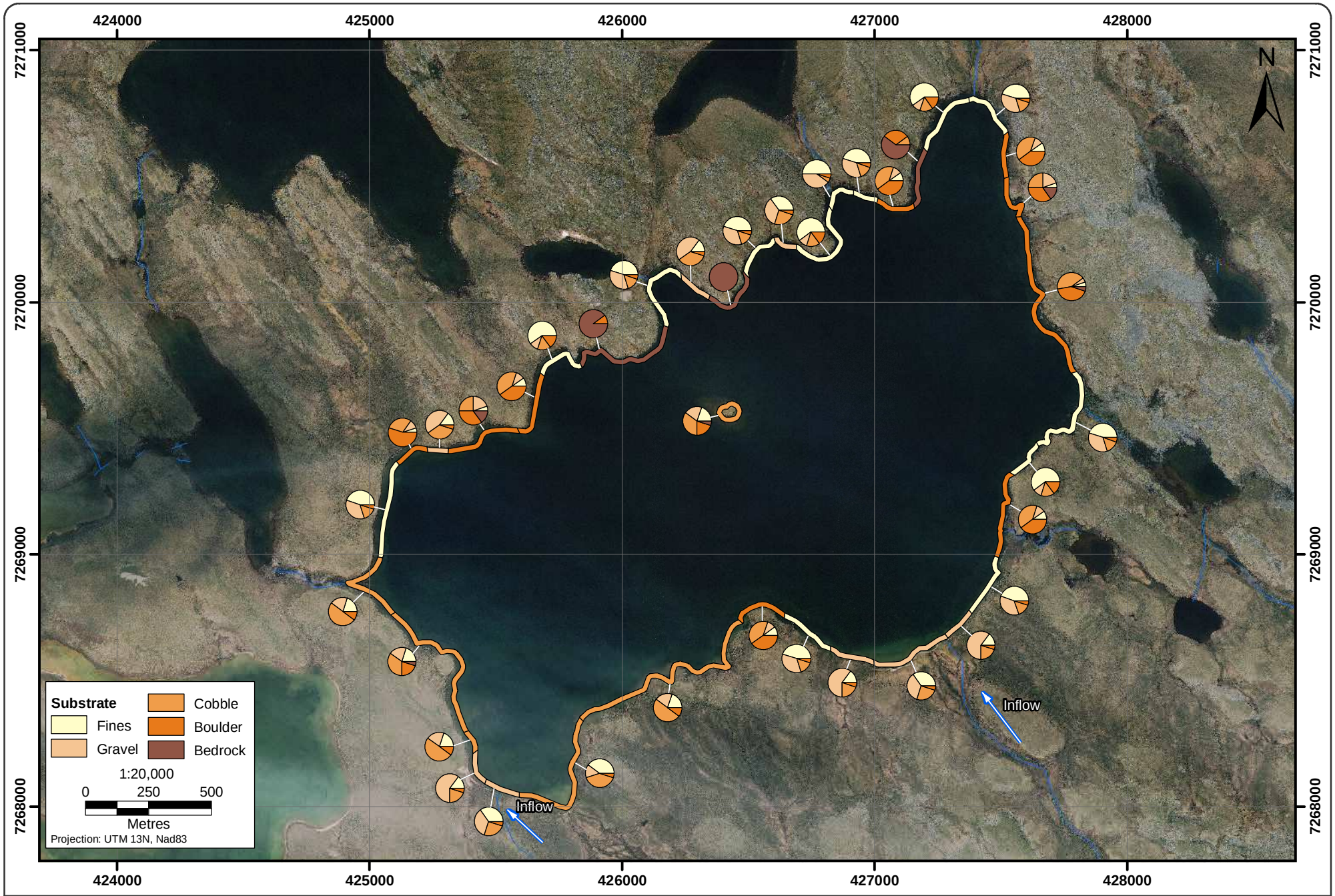


Figure 3.3-5

Sabina GOLD & SILVER CORP.

Shoreline Fish Habitat Substrates Zones, Big Lake, 2012

Figure 3.3-5

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Fox Lake

Fox Lake is located south of Goose Lake in the Llama Watershed and flows north, joining Umwelt Outflow before eventually reaching Goose Lake. It has a convoluted shoreline that is dominated by boulder and bedrock, punctuated by areas of fines and gravel (Figure 3.3-6). The maximum depth is approximately 5.4 m, based on depths taken during gillnetting. Some sparse moss vegetation was recorded along the south side of the lake.

Rabbit Lake

Rabbit Lake is located upstream of Fox Lake in the Llama Watershed. Previous maps showed it as part of the Wolf watershed; however, field studies confirmed that the outflow connects Rabbit Lake to Fox Lake. The shoreline of Rabbit Lake is dominated by bedrock and boulders, which give way to fines at a depth of approximately 2 m (Figure 3.3-7). The convoluted, shallow shoreline provides abundant boulder cover for juvenile fish (Plate 3.3-8). The lake is shallow, with a maximum depth of approximately 3 m.



Plate 3.3-8. Boulder-dominated shoreline of Rabbit Lake from the air. August 2012.

Moby Lake

Moby Lake is located in the Moby Watershed. It is a deep lake, with a maximum depth of approximately 12.5 m. Much of the shoreline is dominated by boulder substrate, with fines occurring along the northern shore, as well as near the inflows (Plate 3.3-9, Figure 3.3-8). A large esker dominates the landscape along the northeast shoreline. No aquatic vegetation was observed in the lake.

Rascal Lake

Rascal Lake is located in the Wolf Watershed, which flows into Goose Lake from the south. Like other lakes in the area, the shoreline is dominated by boulder substrate, followed by cobble and fines (Figure 3.3-9). The maximum depth is approximately 4 m. No aquatic vegetation was recorded around the perimeter.

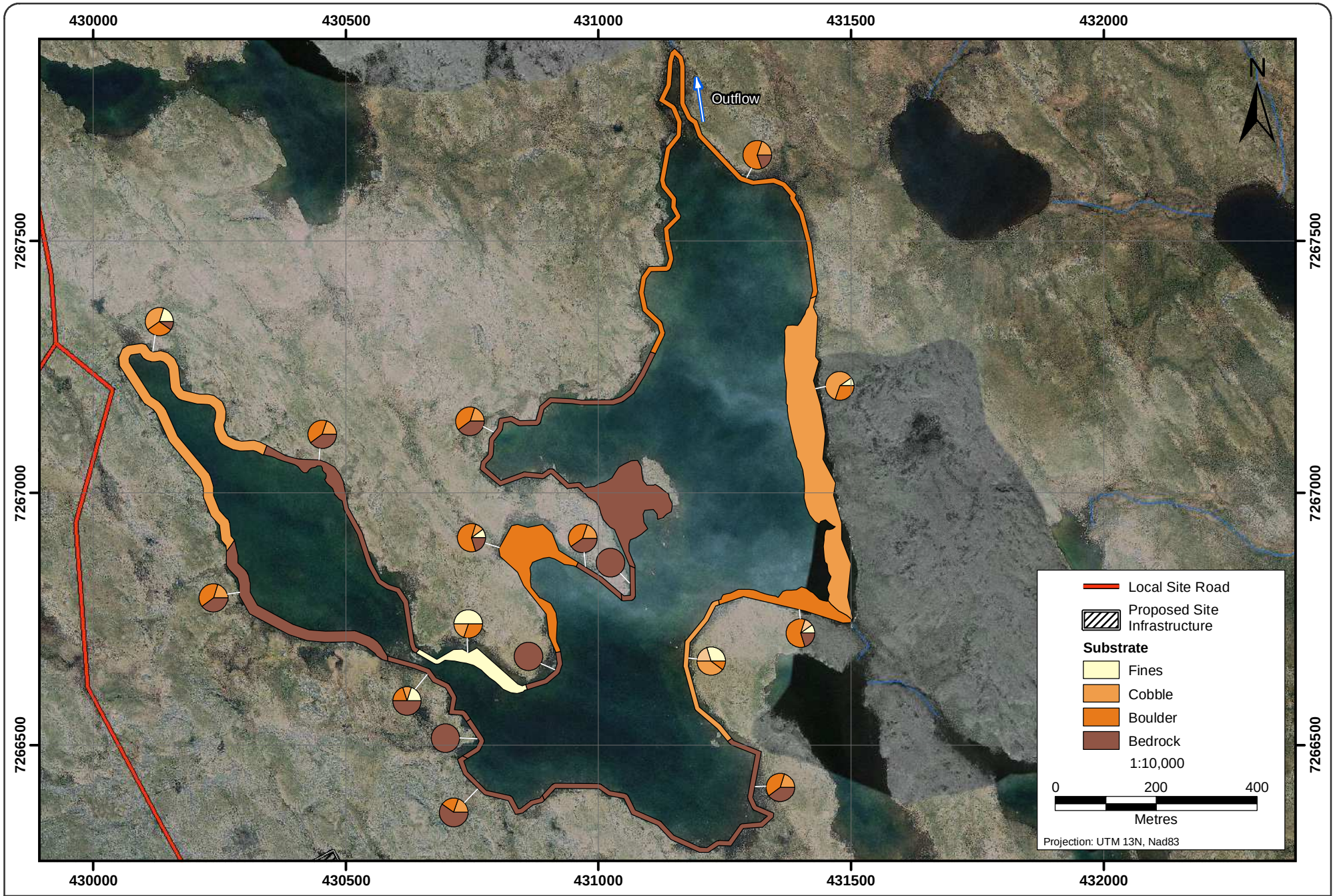


Figure 3.3-6

Sabina GOLD & SILVER CORP.

Shoreline Fish Habitat Substrates Zones, Fox Lake, 2012

Figure 3.3-6

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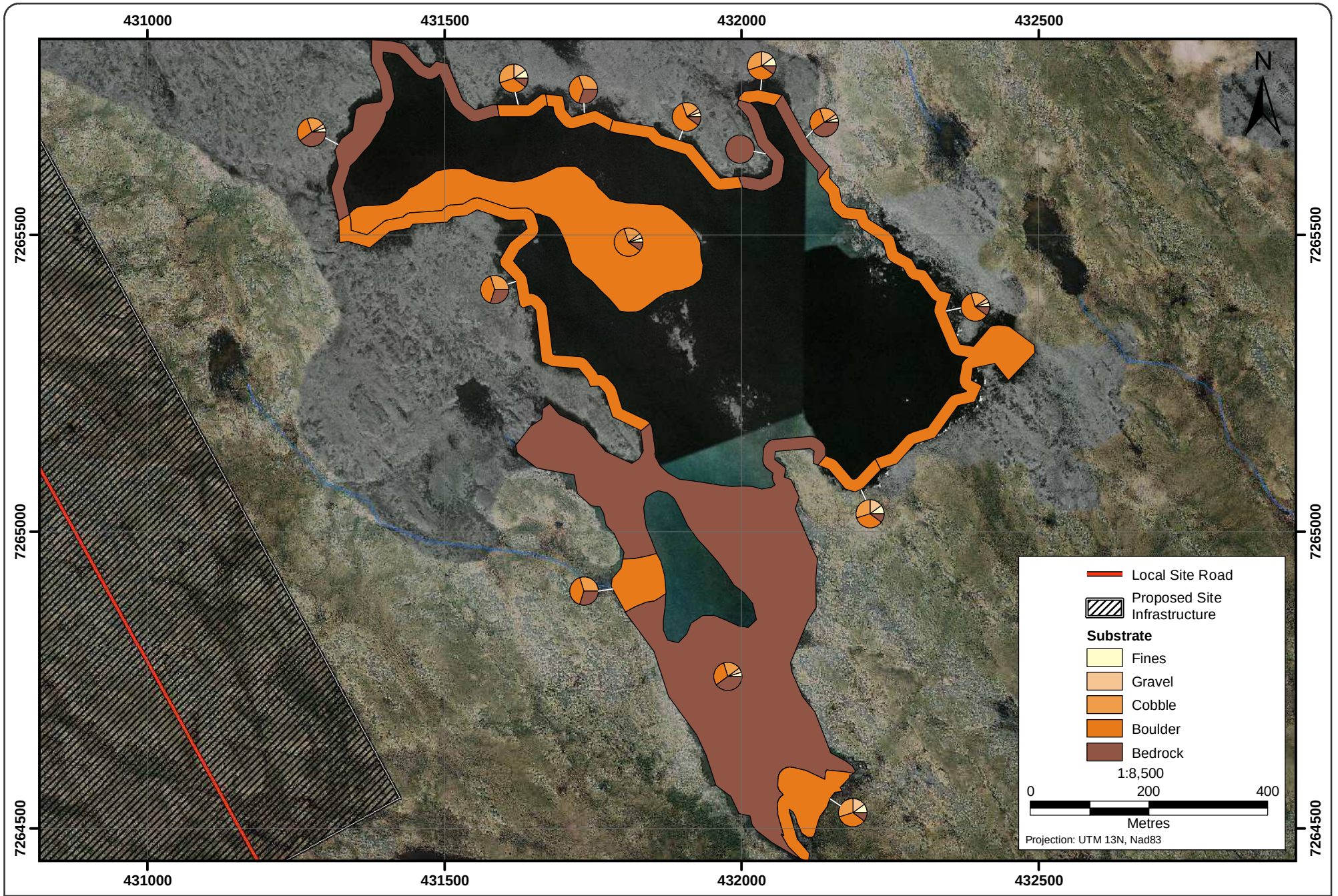


Figure 3.3-7

Sabina GOLD & SILVER CORP.

Shoreline Fish Habitat Substrates Zones, Rabbit Lake, 2012

Figure 3.3-7

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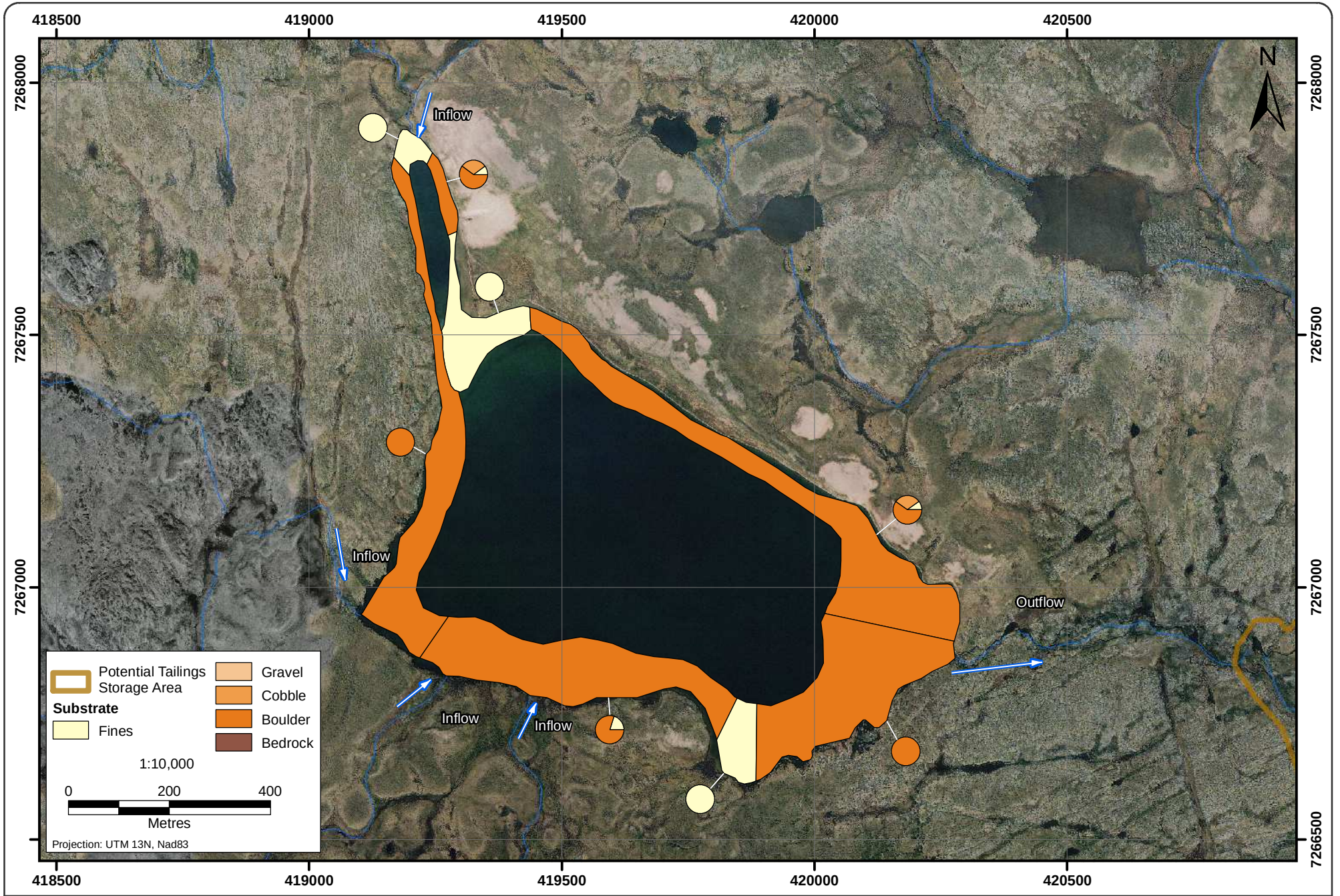


Figure 3.3-8

Sabina Gold & Silver Corp.

Shoreline Fish Habitat Substrates Zones, Moby Lake, 2012

Figure 3.3-8

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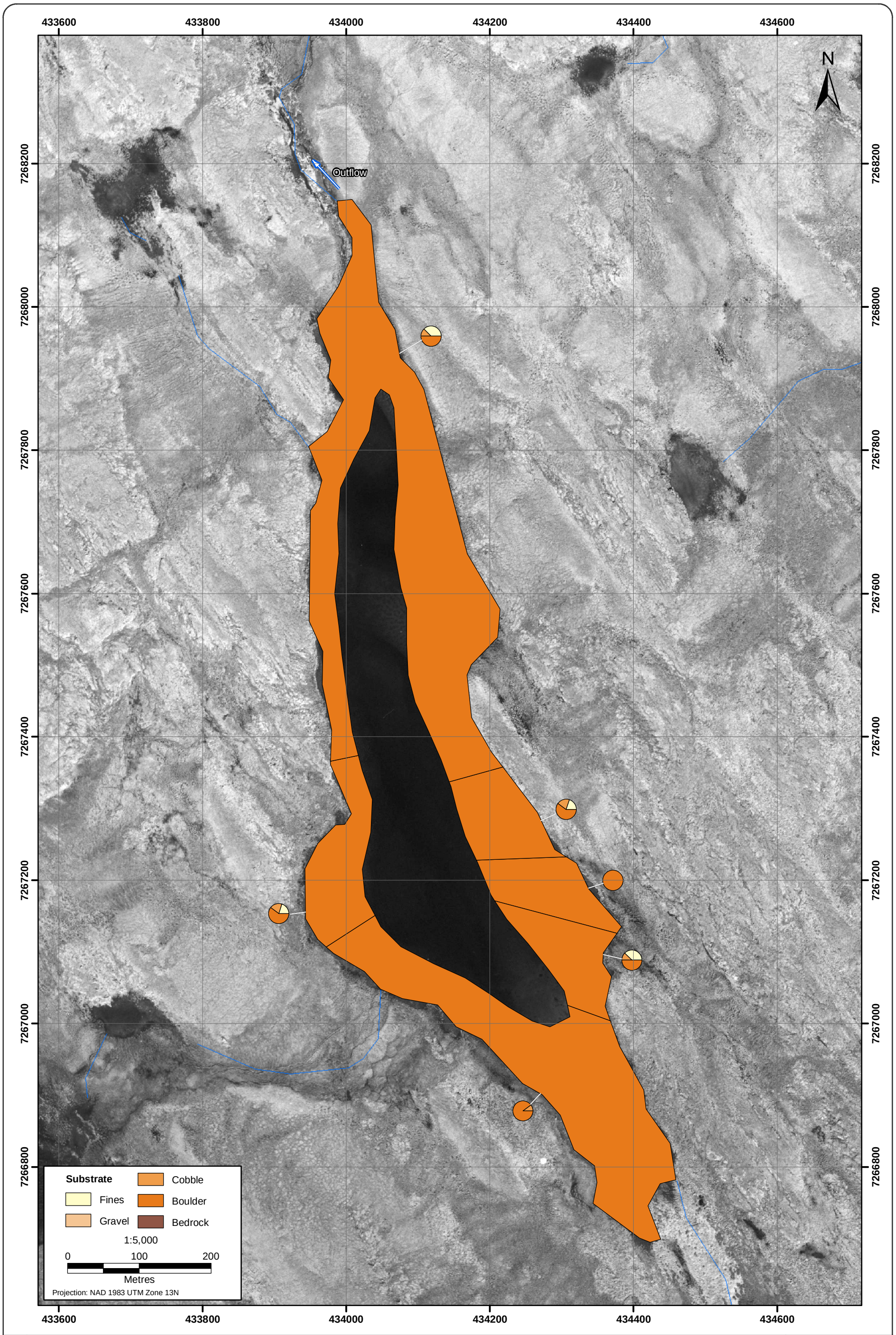


Figure 3.3-9

Sabina GOLD & SILVER CORP.

Shoreline Fish Habitat Substrates Zones, Rascal Lake, 2012

Figure 3.3-9

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Plate 3.3-9. Boulder-cobble shoreline along the east shore of Moby Lake. July 2012.

Swan Lake

Swan Lake is a large lake located in the middle of the Swan Watershed(Figure 3.3-10). The maximum depth is approximately 6 m (based on gillnet sets), and the shoreline is dominated by boulder substrate, with patches of bedrock and fines. No aquatic vegetation was recorded.

Pond 19

Pond 19 is a small waterbody located southwest of Fox Lake within the footprint of a proposed tailings storage area. The maximum depth is less than 2 m. The shoreline is mainly composed of boulder and cobble substrates with little to no aquatic vegetation (Figure 3.3-11).

Reference B Lake

Reference B Lake is located southeast of the Goose area and serves as a reference site. It was also surveyed in 2010, 2011, and 2012. The shoreline is dominated by boulder and cobble substrates, and some sparse moss and vascular aquatic vegetation are present (Plate 3.3-10, Figure 3.3-12). The maximum depth is approximately 5.4 m.

3.3.1.3 George Property

George Lake

George Lake is located adjacent to George Camp and lies near the headwaters of that watershed. It is a deep lake with a maximum depth of 15.4 m; however, much of the lake is less than 5 m deep. The shoreline is mainly composed of cobble and boulder substrate, with some areas of bedrock (Plate 3.3-11, Figure 3.3-13). Sparse moss was present along some sections of the shoreline.

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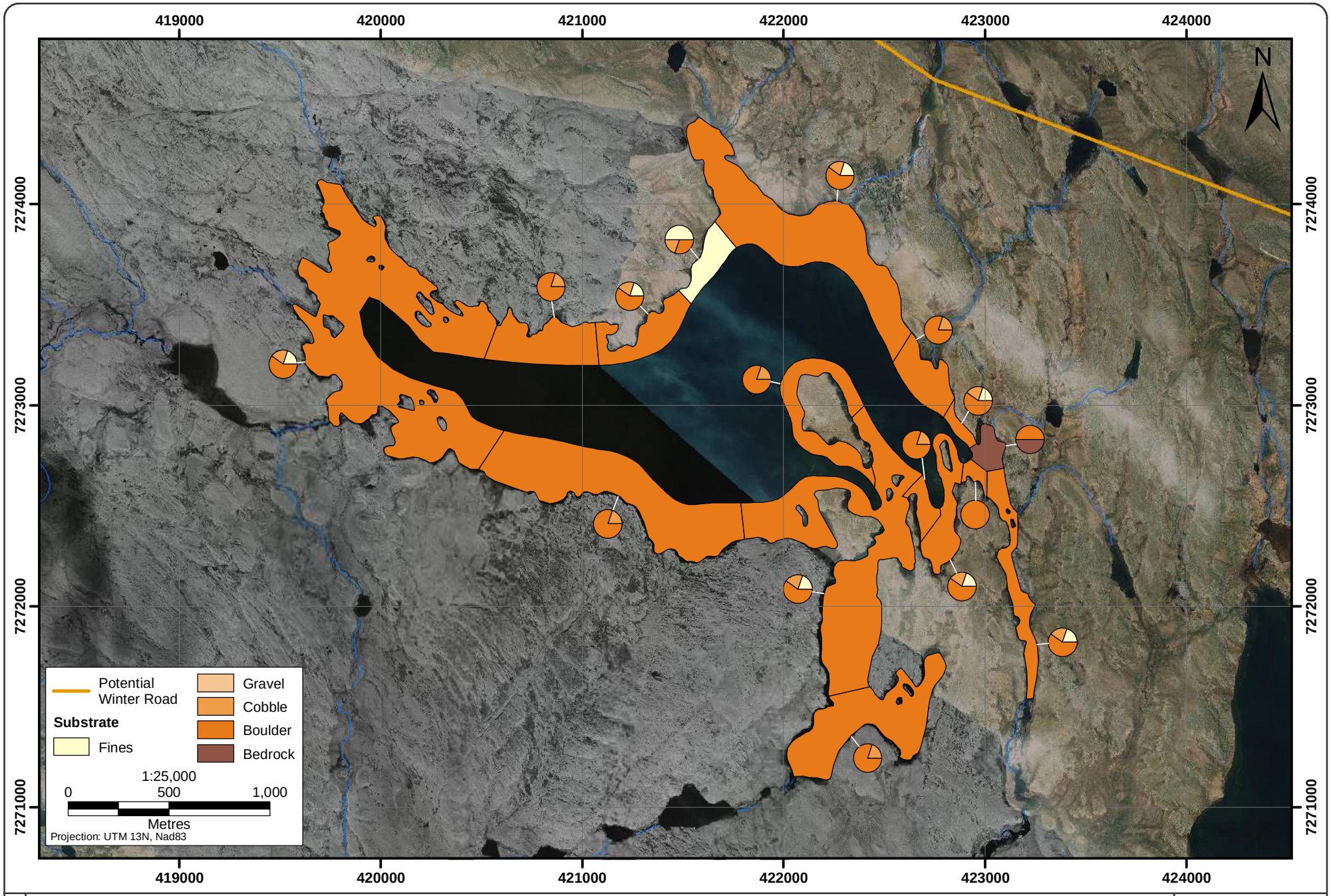


Figure 3.3-10

Sabina GOLD & SILVER CORP.

Shoreline Fish Habitat Substrates Zones, Swan Lake, 2012

Figure 3.3-10

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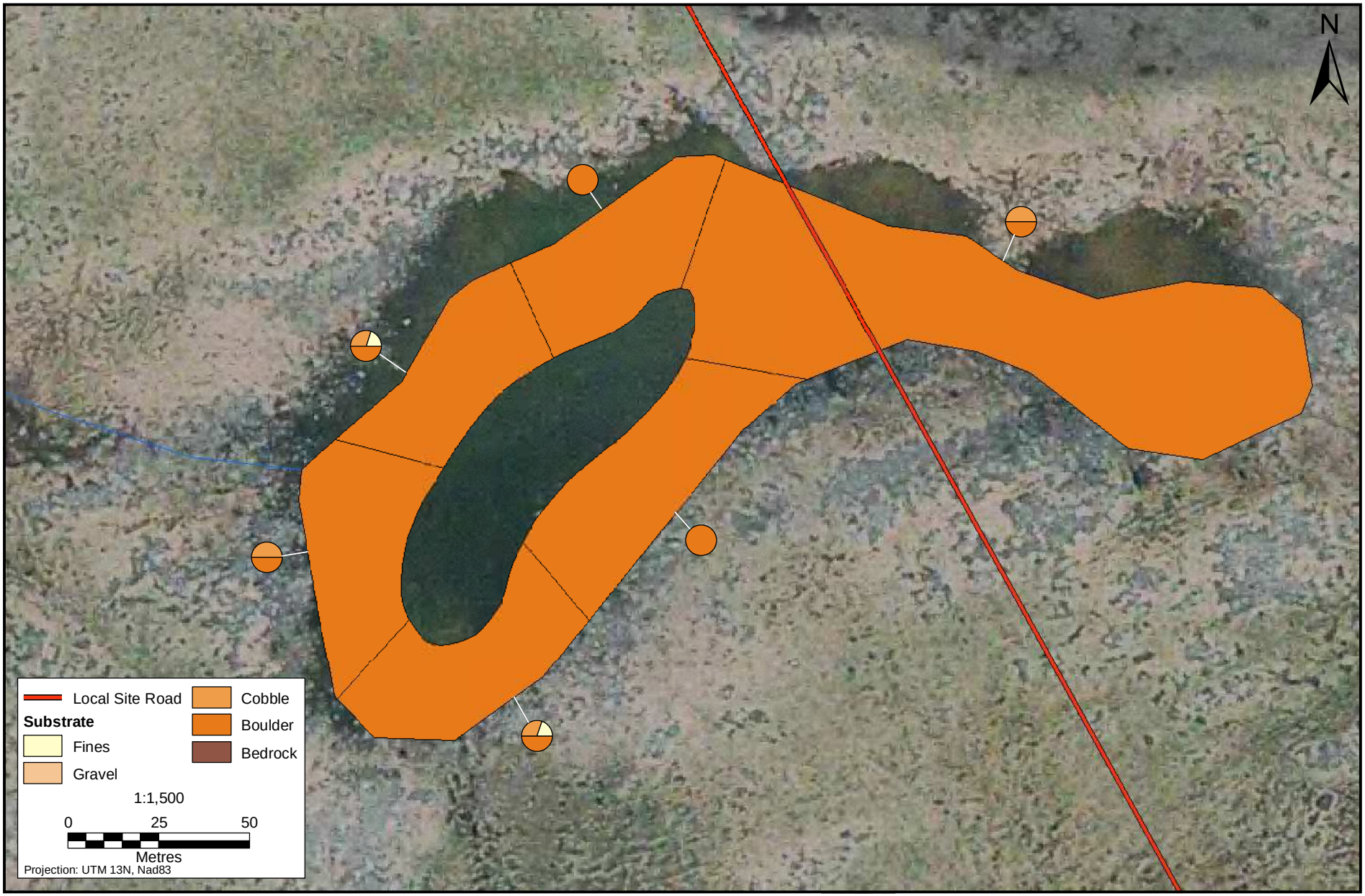


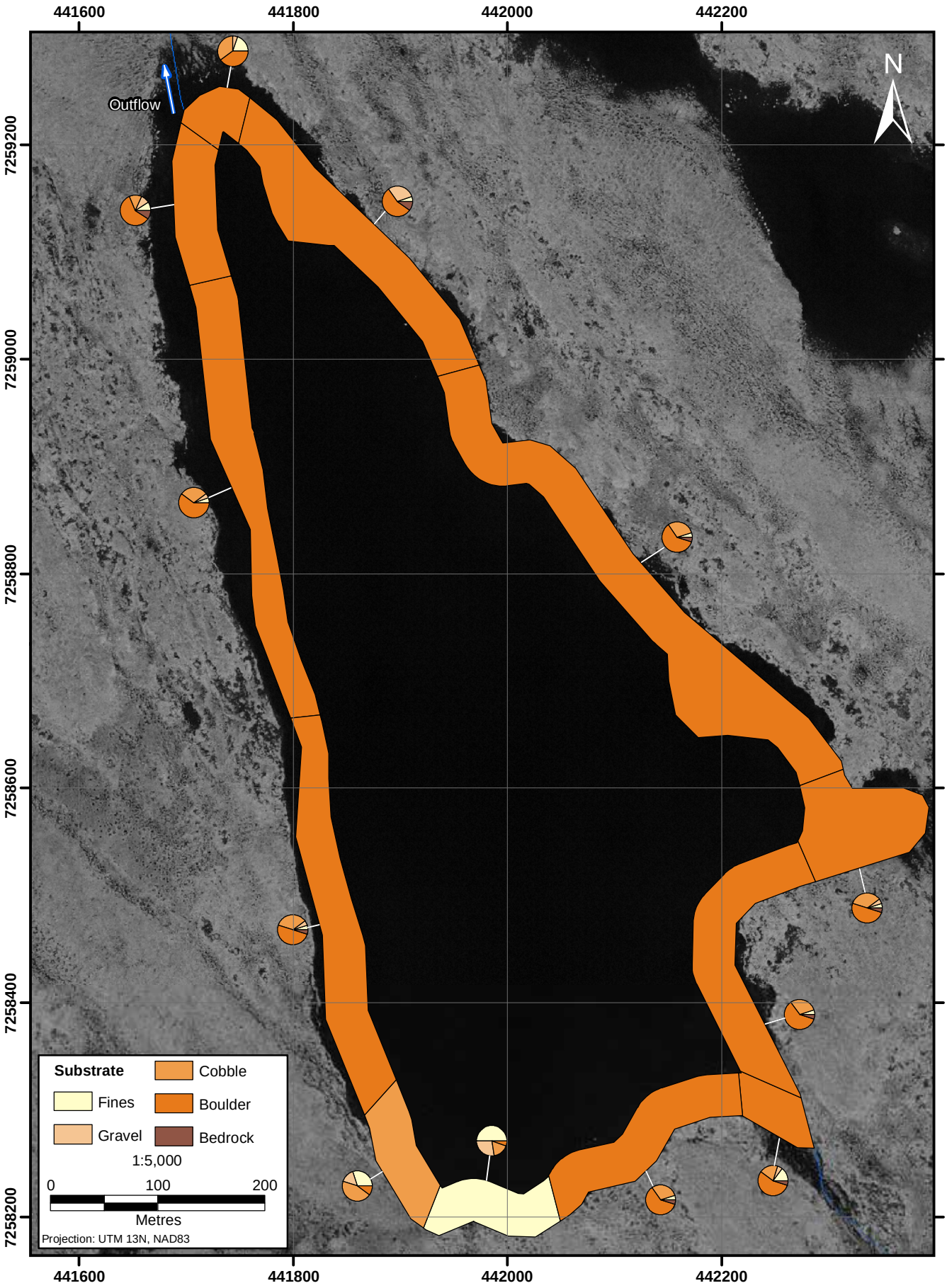
Figure 3.3-11

Sabina GOLD & SILVER CORP.

Shoreline Fish Habitat Substrates Zones, Pond 19, 2012

Figure 3.3-11

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Shoreline Fish Habitat Substrates Zones, Reference B Lake, 2012

Figure 3.3-12

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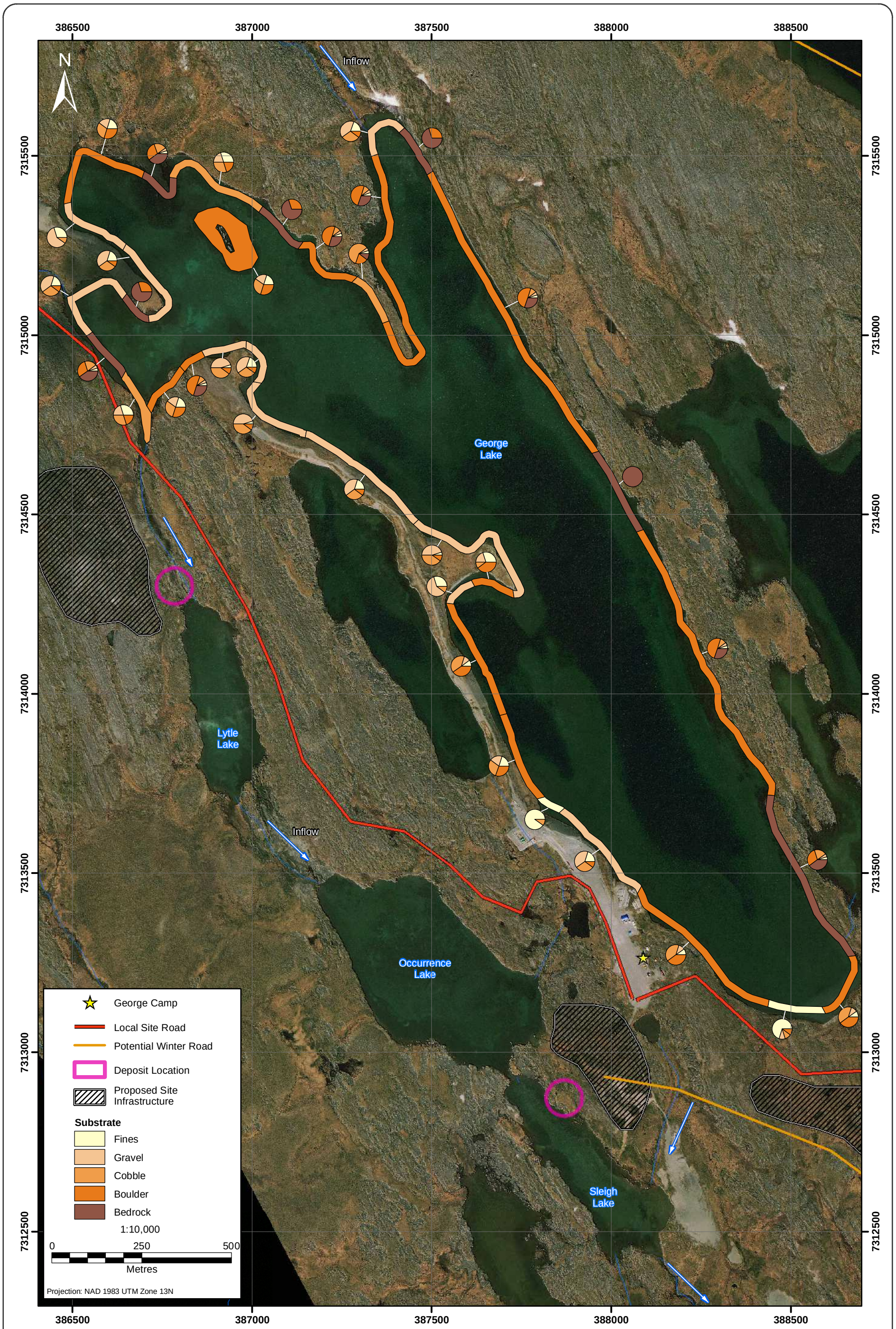


Figure 3.3-13

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Shoreline Fish Habitat Substrates Zones, George Lake, 2012

Figure 3.3-13

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Plate 3.3-10. Boulder-dominated shoreline of Reference B Lake. July 2012.



Plate 3.3-11. Cobble-dominated shoreline (with beach seine for scale), George Lake. August 2012.

Lytle Lake

Lytle Lake is located just downstream of George Lake in the same watershed. It is a small, shallow lake with a maximum depth of less than 2 m. The shoreline is dominated by cobble and boulder and some sparse sedge vegetation is present near the outflow (Plate 3.3-12, Figure 3.3-14). Habitat quality in this lake is poor due to the shallow depth.



Plate 3.3-12. Lytle Lake, looking west with the outflow on the left. August 2012.

Occurrence Lake

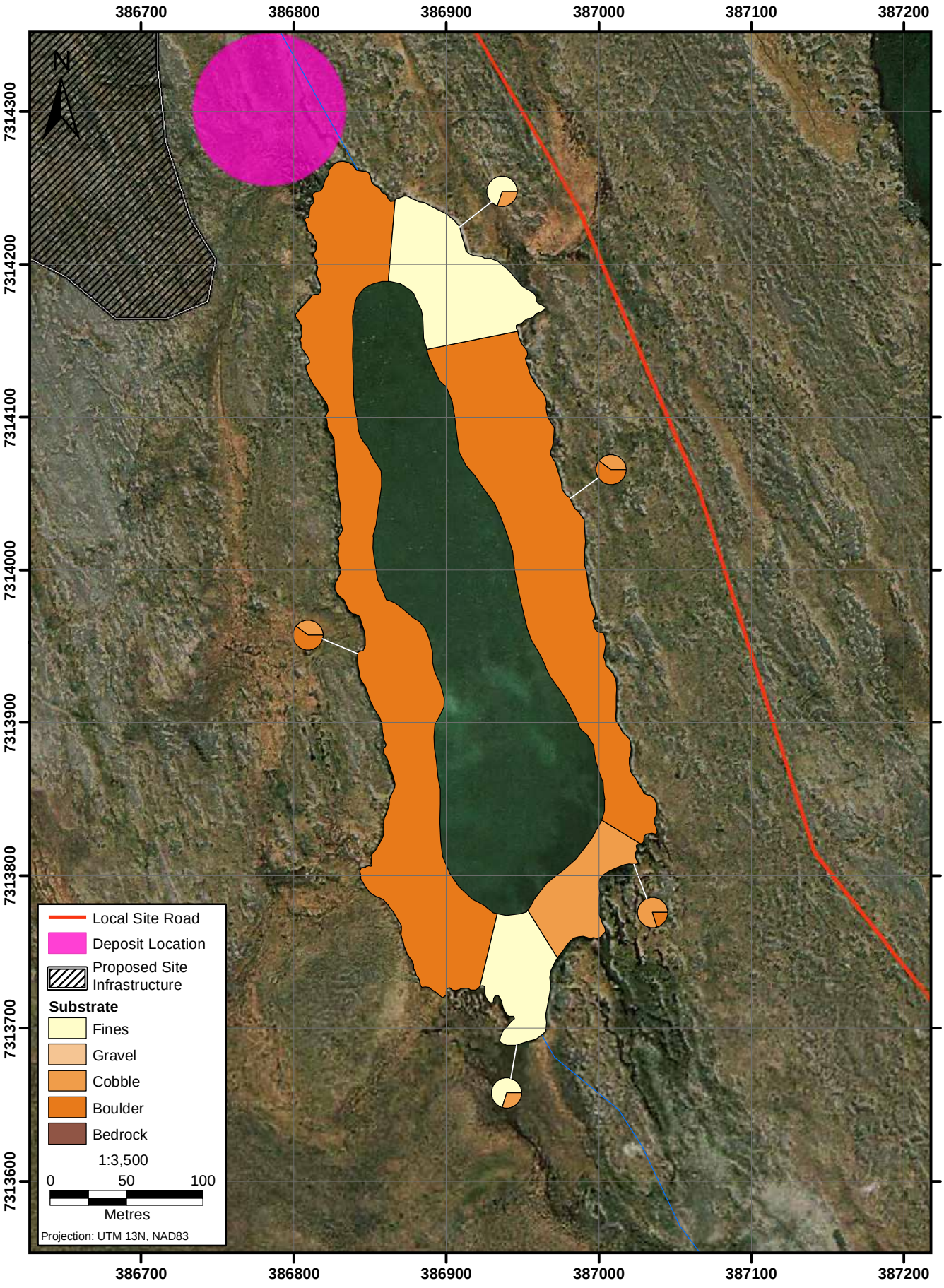
Occurrence Lake is located downstream of Lytle Lake in the George Watershed. It is also a relatively small, shallow lake with a maximum depth of approximately 1.7 m. The shoreline is dominated by boulder and cobble with some sections of bedrock (Plate 3.3-13, Figure 3.3-15). Sparse vascular vegetation is present near the outflow.

Sleigh Lake

Sleigh Lake is another small lake downstream of Occurrence Lake in the George Watershed. It is a small, shallow lake with a maximum depth of less than 2 m. Much of the shoreline is dominated by fine sediment, followed by boulder and cobble (Figure 3.3-16). Sparse sedge vegetation was present in shallow areas with silt substrate.

Dragon Lake

Dragon Lake is a large lake located south of George Lake, and is a tributary to the George Watershed. It has a maximum depth of approximately 4 m (determined through gillnetting). The shoreline is dominated by boulder and cobble substrates (Figure 3.3-17), and no aquatic vegetation was recorded.



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Shoreline Fish Habitat Substrates Zones, Lytle Lake, 2012

Figure 3.3-14

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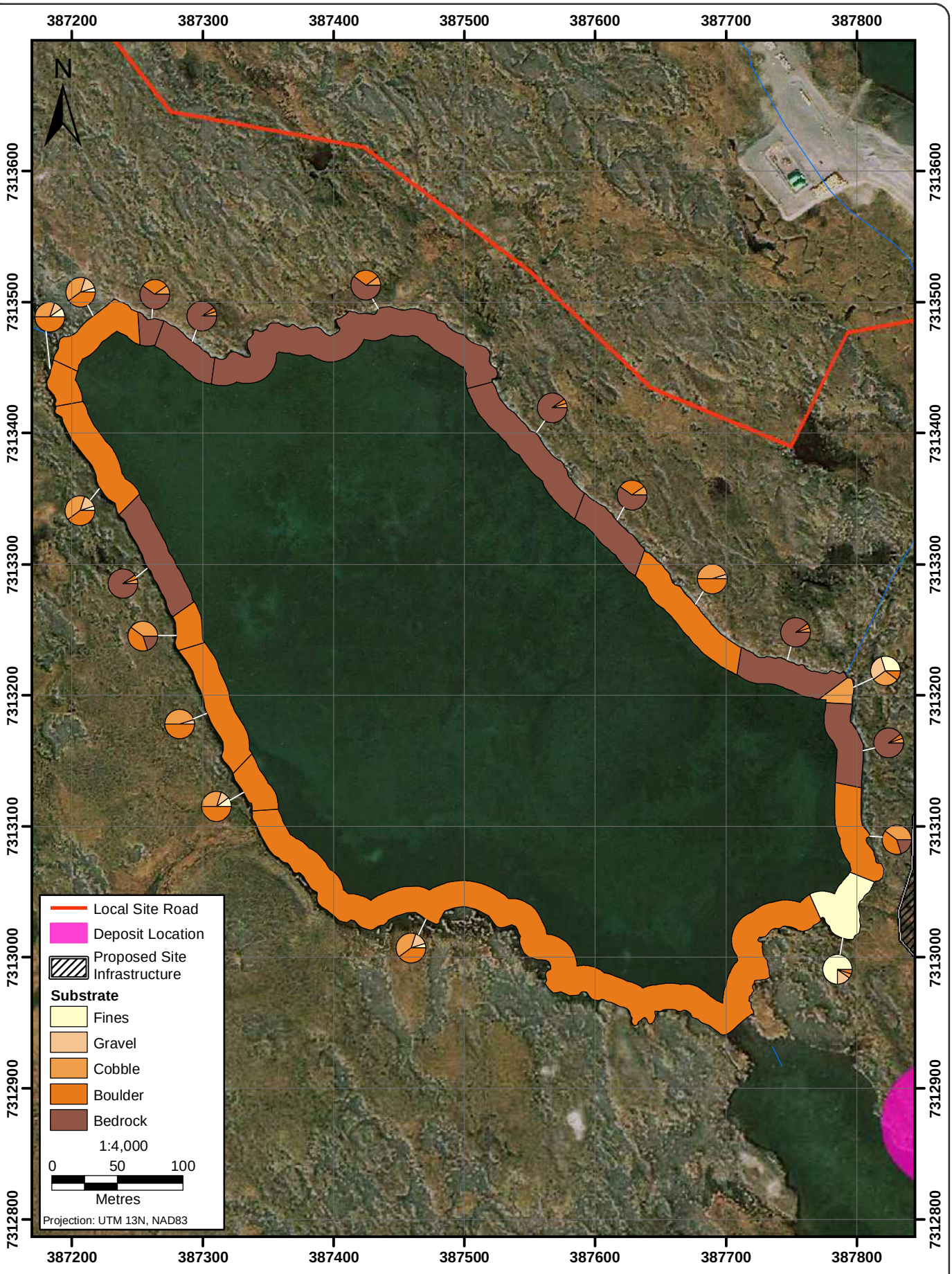
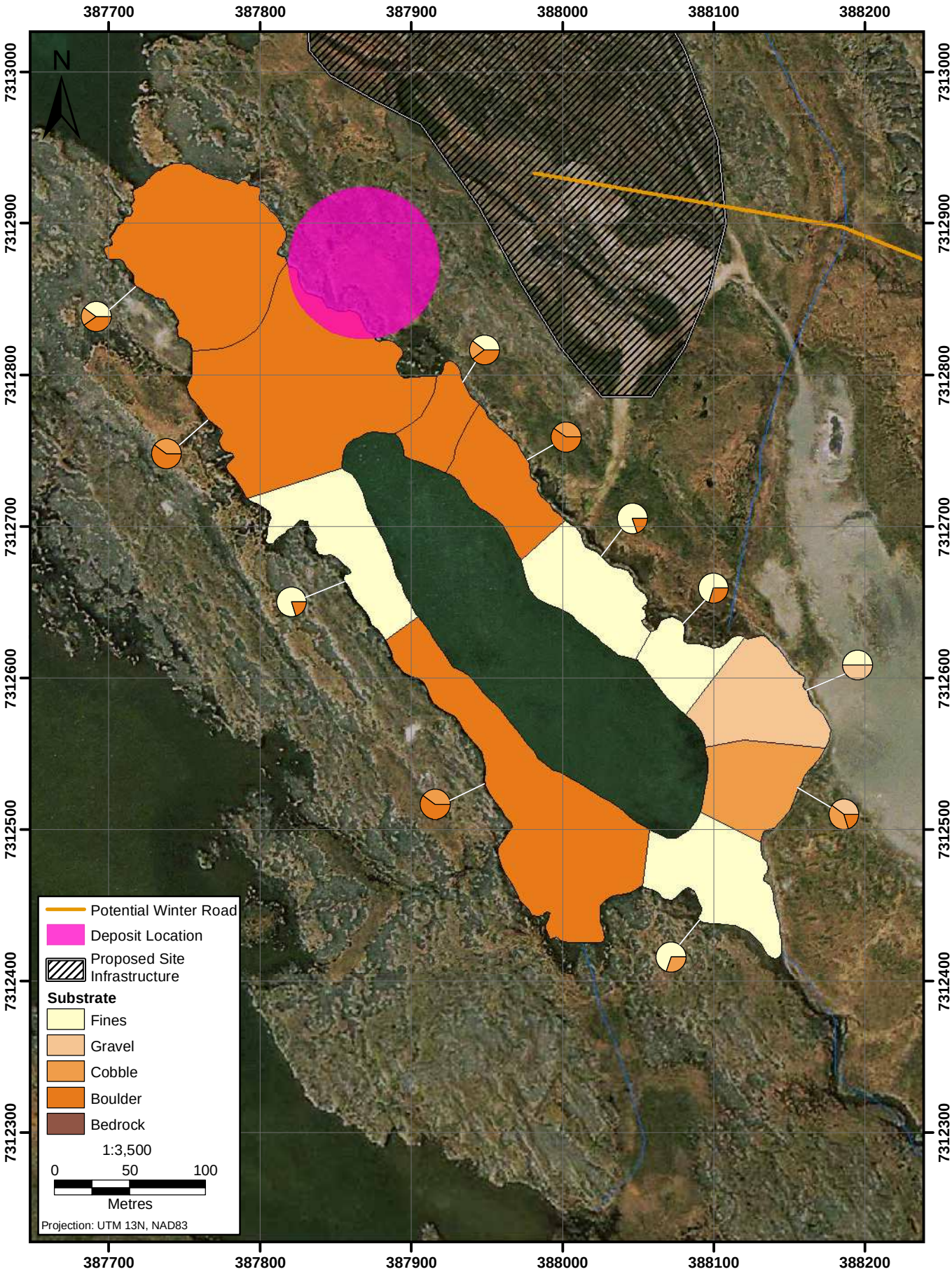


Figure 3.3-15

Shoreline Fish Habitat Substrates Zones, Occurrence Lake, 2012

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Shoreline Fish Habitat Substrates Zones, Sleigh Lake, 2012

Figure 3.3-16

Rescan Engineers & Scientists



Plate 3.3-13. Shoreline of Occurrence Lake, with boulder substrate. August 2012.

Komatic Lake

Komatic Lake is a small waterbody located south of Dragon Lake in the George Watershed (Figure 3.3-18). The maximum depth was estimated from gillnet sets to be approximately 5 m. The shoreline is composed mainly of fine sediment, punctuated with boulder and cobble substrates (Plate 3.3-14). No aquatic vegetation was noted.



Plate 3.3-14. Fine sediment and boulders along the Komatic Lake shoreline. August 2012.

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Figure 3.3-17

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Shoreline Fish Habitat Substrates Zones, Dragon Lake, 2012

Figure 3.3-17

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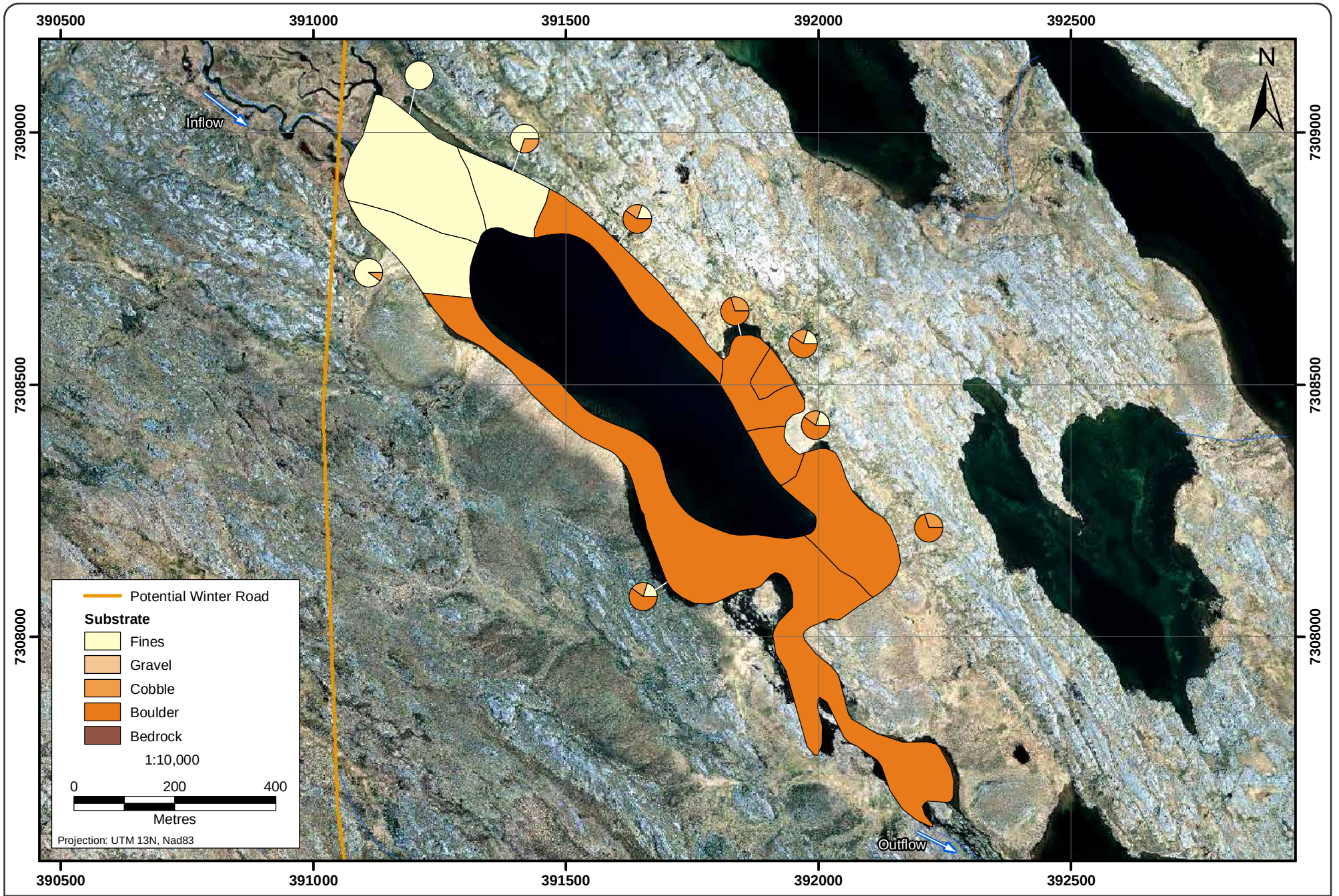


Figure 3.3-18

Sabina GOLD & SILVER CORP.

Shoreline Fish Habitat Substrates Zones, Komatic Lake, 2012

Figure 3.3-18

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Reference C Lake

Reference C Lake is located north of George Lake and serves as a reference site. The maximum depth is approximately 8.9 m (estimated from gillnet sets). The shoreline of the lake is mainly composed of boulder and cobble substrate, with patches of bedrock (Figure 3.3-19). Sparse moss vegetation was present in some of the habitat zones, and willows lined the shoreline in contrast to most of the Project lakes (Plate 3.3-15).



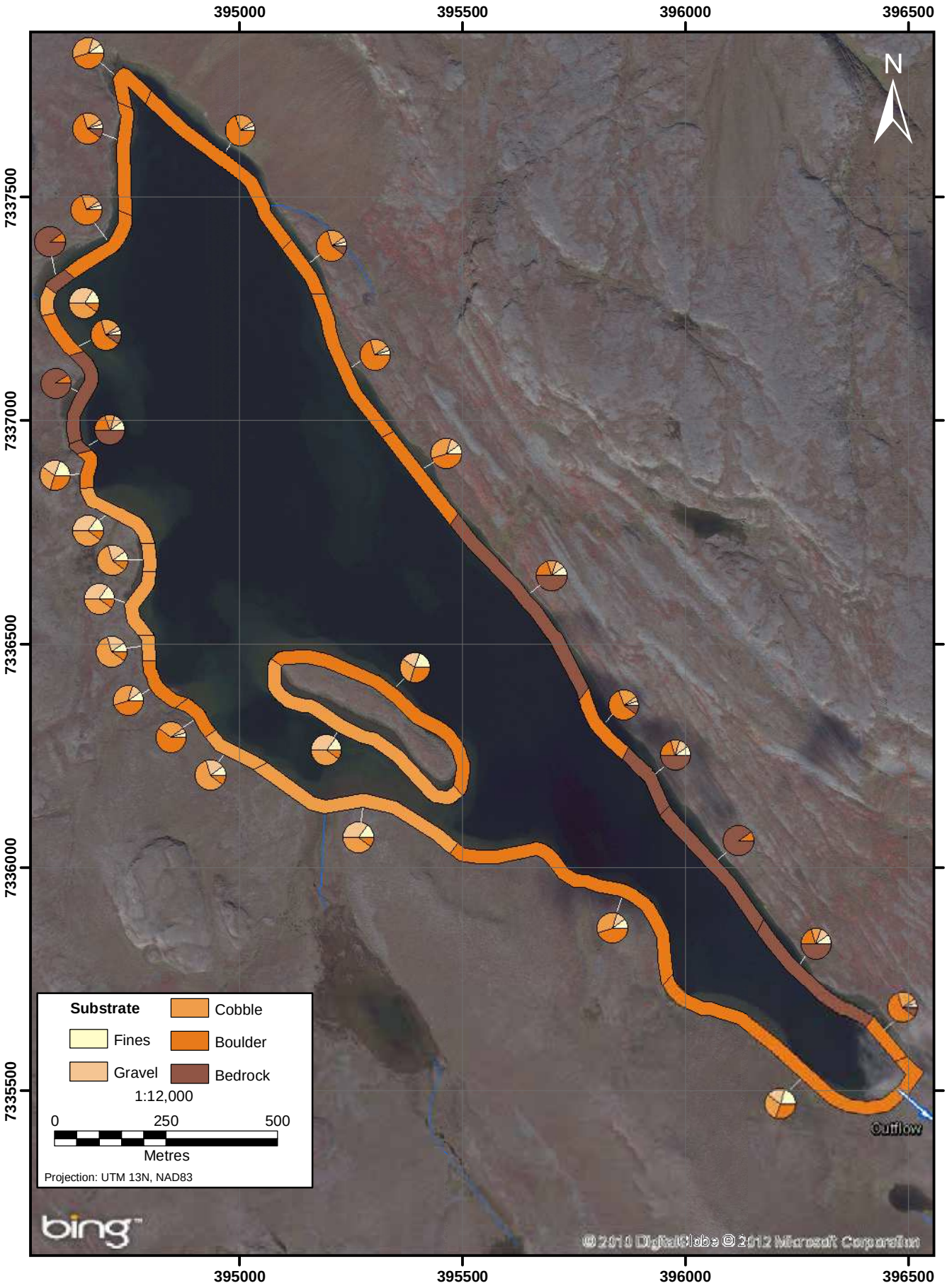
Plate 3.3-15. Willow riparian vegetation and boulder substrate along the shoreline of Reference C Lake.

3.3.2 Fish Community

Species Composition

A total of eight fish species were captured in lakes within the Goose and George properties in 2012. Appendix 3.3-2 presents the sampling effort and species summary for each lake. Appendix 3.3-3 presents the individual fish data. Table 3.3-1 shows a summary of the fish species and numbers captured in surveyed lakes in 2012. Lake trout (Plate 3.3-16) were the most widespread species. Lake cisco (Plate 3.3-17), Arctic char (Plate 3.3-18), and longnose sucker (Plate 3.3-19) were each captured in one lake only. Gander Lake contained the greatest diversity of fish species, with seven species captured. Only one species was captured in Goose Lake, Sleigh Lake and Rascal Lake. Occurrence Lake, Lytle Lake and Pond 19 were the only lakes sampled where no fish were captured; however, fish were observed in Pond 19.

Table 3.3-2 presents the life history periodicity for species captured in the Project area in 2012. Arctic char, lake cisco, lake trout and round whitefish (Plate 3.3-20) tend to be fall spawners, leaving their eggs to incubate over the winter. These species require lakes and large rivers that do not freeze to the bottom for spawning. Arctic grayling (Plate 3.3-21) and longnose sucker are spring spawners and spawn mainly in streams and rivers. Upon hatching, young Arctic grayling stay in the stream for the summer to rear and to feed, while the juvenile longnose suckers migrate immediately to lakes. Both species overwinter in lakes that do not freeze to the bottom. Ninespine stickleback (Plate 3.3-22) and slimy sculpin (Plate 3.3-23) are summer spawners; however, little is known about their spawning habits in the Arctic. Their distribution and presence in smaller streams may suggest that they are able to overwinter in smaller streams, utilizing microhabitat features that do not freeze.



Sabina

Shoreline Fish Habitat Substrates Zones, Reference C Lake, 2012

Figure 3.3-19

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Table 3.3-1. Number of Fish Captured in Surveyed Lakes, 2012

Lake	Fish Community Composition (No.)								Grand Total (No.)
	Arctic Char	Arctic Grayling	Lake Cisco	Lake Trout	Longnose Sucker	Ninespine Stickleback	Round Whitefish	Slimy Sculpin	
Goose Property									
Goose Lake	-	2	-	6	-	8	51	4	71
Llama Lake	-	-	-	5	-	-	37	2	44
Umwelt Lake	-	34	-	1	-	-	-	-	35
Gander Lake	-	18	84	2	7	43	14	1	169
Big Lake	-	-	-	7	-	-	12	-	19
Fox Lake	-	-	-	11	-	-	3	-	14
Rabbit Lake	-	1	-	4	-	5	-	-	10
Moby Lake	-	-	-	22	-	-	-	18	40
Rascal Lake	-	-	-	11	-	-	-	-	11
Swan Lake	-	-	-	10	-	-	1	-	11
Pond 19	-	-	-	-	-	-	-	-	0
Reference B Lake	-	-	-	15	-	-	10	-	25
George Property									
George Lake	-	2	-	11	-	-	-	2	15
Sleigh Lake	-	8	-		-	-	-	-	8
Occurrence Lake	-	-	-	-	-	-	-	-	0
Lytle Lake	-	-	-	-	-	-	-	-	0
Dragon Lake	-	2	-	22	-	-	15	-	39
Komatic Lake	-	-	-	8	-	-	5	4	17
Reference C Lake	6	-	-	12	-	-	-	-	18

Dashes indicate that no fish were captured



Plate 3.3-16. Lake trout captured Rabbit Lake. August 2012.



Plate 3.3-17. Lake cisco captured in Gander Lake. July 2012.



Plate 3.3-18. Arctic char captured in Reference C Lake. August 2012. This species was not captured in any lakes within the Goose or George properties.

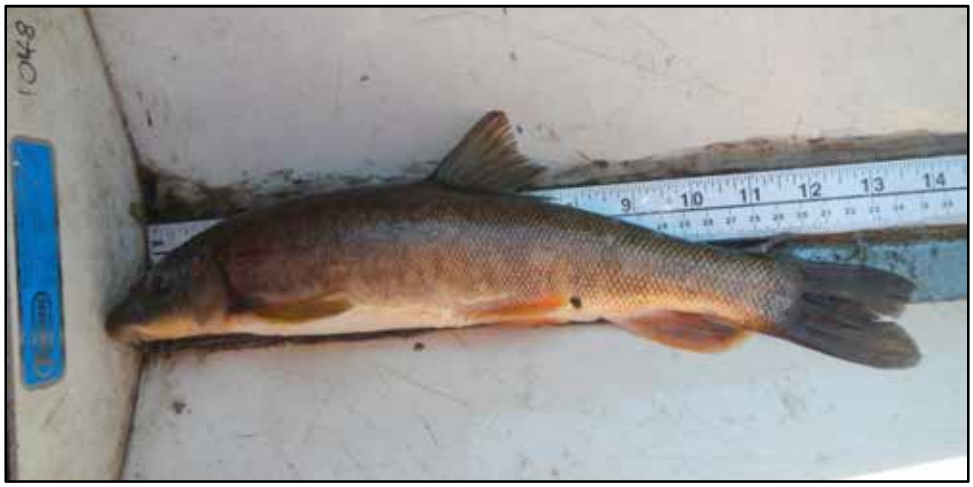


Plate 3.3-19. Longnose sucker captured in Gander Lake. July 2012.



Plate 3.3-20. Round whitefish captured in Gander Lake. August 2012.



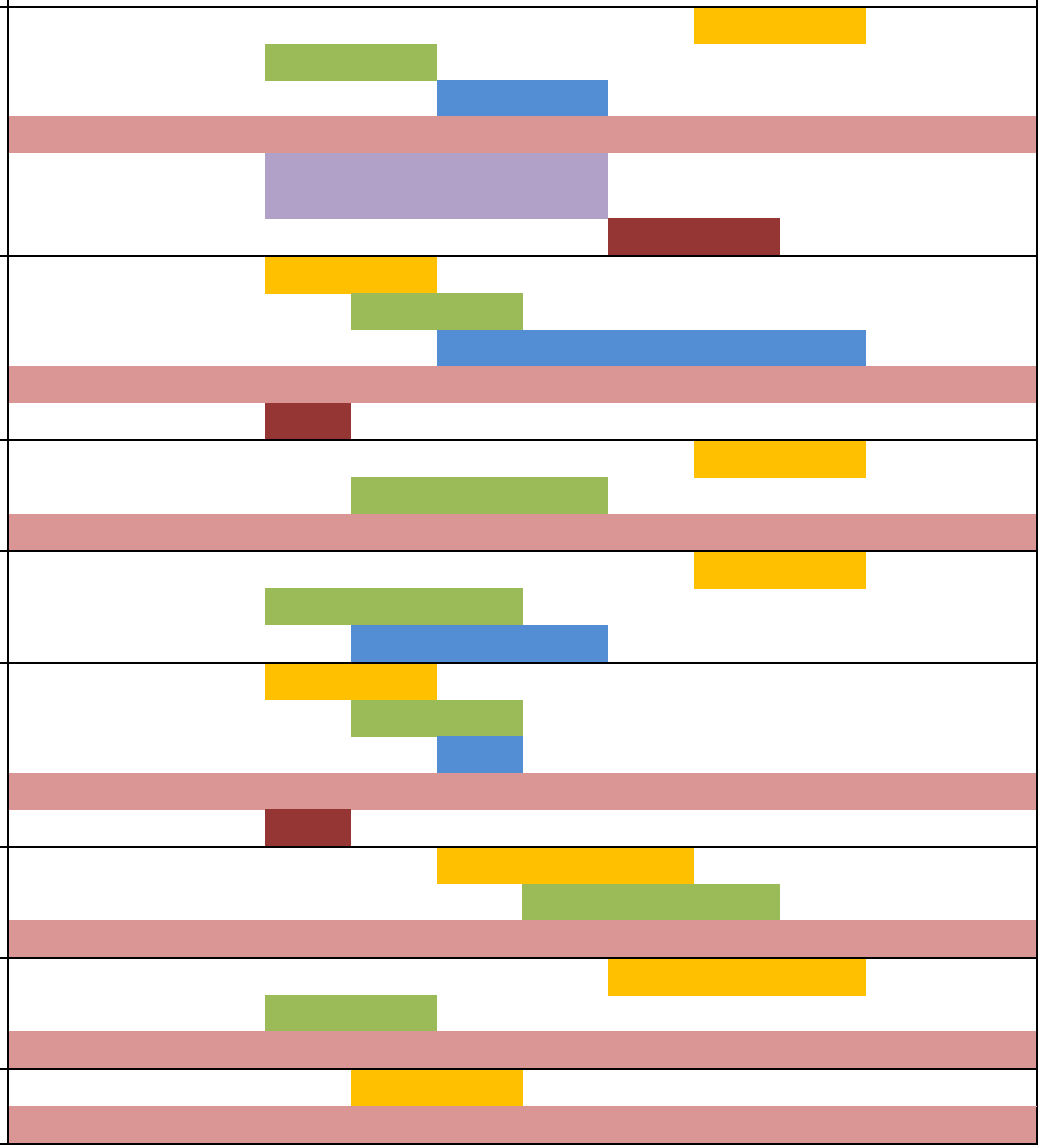
Plate 3.3-21. Arctic grayling captured in Rascal Lake. August 2012.



Plate 3.3-22. Ninespine stickleback captured in Gander Lake. August 2012.

Table 3.3-2. Fish Life History Periodicity Table for Species Captured in Lakes 2012

Species	Life stage	Habitat	Month
			Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Arctic char (Reference C Lake only)	Spawning	Rivers	
	Hatching	Rivers	
	Fry emergence	Rivers	
	Rearing/overwintering	Lakes	
	Outmigration (anadromous forms only)	Marine	
	Upstream migration	Rivers	
Arctic grayling	Spawning	Streams/Rivers	
	Hatching	Streams/Rivers	
	Fry rearing/migration	Streams/Rivers	
	Rearing/overwintering	Rivers/Lakes	
	Adult migration	Streams/Rivers	
Lake cisco	Spawning	Lakes	
	Hatching/fry emergence	Lakes	
	Rearing/overwintering	Lakes	
Lake trout	Spawning	Lakes	
	Hatching	Lakes	
	Fry emergence	Lakes	
Longnose sucker	Spawning	Streams	
	Hatching	Streams	
	Fry emergence/migration	Streams	
	Rearing/overwintering	Lakes	
	Adult migration	Streams	
Ninespine stickleback	Spawning	Streams/Lakes	
	Hatching	Streams/Lakes	
	Rearing/overwintering	Streams/Lakes	
Round whitefish	Spawning	Lakes	
	Hatching	Lakes	
	Rearing/overwintering	Lakes	
Slimy Sculpin	Spawning	Streams/Lakes*	
	Rearing/overwintering	Streams/Lakes*	



Information compiled from Scott and Crossman (1973) and from field observations.
** Very little is known about the life history of the slimy sculpin in the Arctic.*

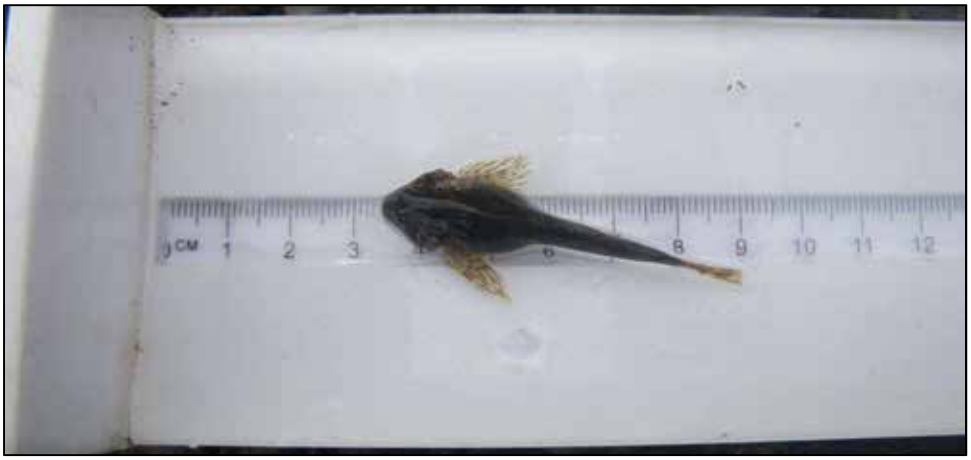


Plate 3.3-23. Slimy sculpin captured in Komatic Lake. August 2012.

CPUE

Catch-per-unit-effort was recorded for gillnetting and beach seining effort in all lakes. Total gillnet effort in each lake ranged from 4 h in Swan Lake to 11.8 h in Gander Lake, and the number of gillnet sets ranged from 3 in Big Lake to 11 in Gander Lake. The mean effort per gillnet set was 1.1 h. Standard and bootstrap mean CPUE is presented for each lake and each species in Table 3.3-3. Gillnet CPUE in surveyed lakes was lowest in Occurrence Lake (no fish captured) and highest in Gander Lake (5.94 fish/100 m^2/h).

Table 3.3-3. Gillnet Standard and Bootstrap CPUE Summary Statistics, 2012

		Standard CPUE (No. fish/100 m^2/h)						Bootstrap CPUE (No. fish/100 m^2/h)				
Lake	Species	n	Mean	SD	SE	Lower CI	Upper CI	n	Mean	SD	Lower CI	Upper CI
Goose Property												
Goose Lake	Lake trout	6	0.29	0.34	0.14	0.00	0.79	6	0.29	0.13	0.08	0.56
	Total	*6*	*0.29*	*0.34*	*0.14*	*0.00*	*0.79*	*6*	*0.29*	*0.13*	*0.07*	*0.56*
Llama Lake	Lake trout	4	0.40	0.47	0.24	0.00	0.90	4	0.40	0.20	0.00	0.80
	Round whitefish	4	0.98	1.05	0.53	0.02	2.22	4	0.98	0.46	0.13	1.83
	Total	*4*	*1.38*	*1.06*	*0.53*	*0.29*	*2.28*	*4*	*1.37*	*0.46*	*0.47*	*2.28*
Umwelt Lake	Arctic grayling	6	0.07	0.17	0.07	0.00	0.37	6	0.07	0.06	0.00	0.21
	Lake trout	6	0.05	0.12	0.05	0.00	0.27	6	0.05	0.05	0.00	0.15
	Total	*6*	*0.12*	*0.19*	*0.08*	*0.00*	*0.41*	*6*	*0.12*	*0.07*	*0.00*	*0.26*
Gander Lake	Arctic grayling	11	0.61	0.61	0.18	0.00	1.48	11	0.61	0.17	0.29	0.96
	Lake cisco	11	4.40	10.04	3.03	0.00	27.34	11	4.36	2.91	0.34	10.85
	Lake trout	11	0.08	0.18	0.06	0.00	0.46	11	0.08	0.05	0.00	0.21
	Longnose sucker	11	0.31	0.83	0.25	0.00	2.23	11	0.31	0.24	0.00	0.87
	Round whitefish	11	0.53	1.26	0.38	0.00	3.43	11	0.54	0.36	0.00	1.32
	Total	*11*	*5.94*	*10.00*	*3.02*	*0.46*	*28.38*	*11*	*5.95*	*2.87*	*1.43*	*12.25*
Big Lake	Lake trout	3	0.84	0.53	0.30	0.33	1.33	3	0.85	0.25	0.30	1.36
	Total	*3*	*0.84*	*0.53*	*0.30*	*0.33*	*1.33*	*3*	*0.85*	*0.25*	*0.30*	*1.36*

(continued)

Table 3.3-3. Gillnet Standard and Bootstrap CPUE Summary Statistics, 2012 (completed)

		Standard CPUE (No. fish/100 m^2/h)						Bootstrap CPUE (No. fish/100 m^2/h)				
Lake	Species	n	Mean	SD	SE	Lower CI	Upper CI	n	Mean	SD	Lower CI	Upper CI
Fox Lake	Arctic grayling	4	0.11	0.21	0.11	0.00	0.40	4	0.11	0.09	0.00	0.32
	Lake trout	4	1.00	0.91	0.46	0.03	1.82	4	0.99	0.39	0.23	1.77
	Total	*4*	*1.11*	*1.04*	*0.52*	*0.03*	*2.12*	*4*	*1.11*	*0.46*	*0.23*	*1.98*
Rabbit Lake	Lake trout	4	0.43	0.04	0.02	0.40	0.48	4	0.43	0.02	0.41	0.46
	Total	*4*	*0.43*	*0.04*	*0.02*	*0.40*	*0.48*	*4*	*0.43*	*0.02*	*0.41*	*0.46*
Moby Lake	Lake trout	6	1.91	1.15	0.47	0.69	3.67	6	1.92	0.43	1.16	2.77
	Total	6	1.91	1.15	0.47	0.69	3.67	6	1.91	0.43	1.16	2.79
Rascal Lake	Lake trout	7	0.19	0.23	0.09	0.00	0.46	7	0.19	0.08	0.06	0.36
	Total	*7*	*0.19*	*0.23*	*0.09*	*0.00*	*0.46*	*7*	*0.19*	*0.08*	*0.06*	*0.36*
Swan Lake	Lake trout	4	1.02	0.68	0.34	0.46	1.79	4	1.02	0.29	0.46	1.58
	Round whitefish	4	0.34	0.69	0.34	0.00	1.27	4	0.34	0.30	0.00	1.03
	Total	*4*	*1.36*	*0.65*	*0.32*	*0.52*	*1.83*	*4*	*1.36*	*0.28*	*0.80*	*1.83*
Reference B Lake	Lake trout	5	0.88	0.72	0.32	0.03	1.66	5	0.89	0.29	0.32	1.44
	Round whitefish	5	0.71	0.62	0.28	0.02	1.36	5	0.71	0.24	0.22	1.20
	Total	*5*	*1.59*	*0.50*	*0.22*	*1.05*	*2.25*	*5*	*1.59*	*0.20*	*1.22*	*2.01*
George Property												
George Lake	Lake trout	6	0.84	1.80	0.73	0.00	4.00	6	0.85	0.67	0.00	2.34
	Total	*6*	*0.84*	*1.80*	*0.73*	*0.00*	*4.00*	*6*	*0.85*	*0.67*	*0.00*	*2.34*
Occurrence Lake	*Total*	*6*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*6*	*0.00*	*0.00*	*0.00*	*0.00*
Dragon Lake	Lake trout	5	2.31	2.04	0.91	0.06	4.61	5	2.31	0.81	0.69	3.92
	Total	*5*	*2.31*	*2.04*	*0.91*	*0.06*	*4.61*	*5*	*2.30*	*0.83*	*0.69*	*3.92*
Komatic Lake	Lake trout	5	0.70	0.50	0.22	0.04	1.28	5	0.70	0.20	0.35	1.06
	Round whitefish	5	0.27	0.59	0.27	0.00	1.19	5	0.27	0.24	0.00	0.80
	Total	*5*	*0.97*	*0.85*	*0.38*	*0.04*	*2.12*	*5*	*0.97*	*0.34*	*0.35*	*1.67*
Reference C Lake	Arctic char	7	0.35	0.44	0.17	0.00	0.95	7	0.35	0.16	0.10	0.66
	Lake trout	7	0.59	0.43	0.16	0.05	1.28	7	0.59	0.15	0.31	0.90
	Total	*7*	*0.94*	*0.56*	*0.21*	*0.37*	*1.92*	*7*	*0.94*	*0.20*	*0.60*	*1.38*

CPUE = catch-per-unit-effort (fish/100 m^2 of gillnet/h)
n = sample size (number of net sets)
SD = standard deviation
SE = standard error
CI = confidence interval (95%)

Beach seining was conducted at most of the lakes visited in order to collect small and juvenile fish that often occupy the littoral zone of lakes. The amount of habitat seined depended largely on the availability of shoreline with suitable substrate for seining. Rocky shorelines result in lower captured rates due to the requirement that the net be lifted over boulders. Between 2 and 14 seine hauls were conducted at each lake in 2012. The area seined during each haul ranged from 39 m^2 to 420 m^2, again depending on the substrate and ease of deployment for the seine.

No fish were captured by seining in Lytle, Moby, Occurrence, Reference B, and Reference C Lakes, or in Pond 19; however, all of these lakes except for Pond 19 were confirmed to be fish-bearing either through gillnet sampling or from historical reports. Small fish (possibly sticklebacks or grayling) were observed in Pond 19, but could not be captured due to the shallow depth and rocky shoreline that made effective beach seining and gillnetting impossible. Among the lakes where fish were captured during seining, CPUE (corrected for the area of shoreline seined) ranged from 0.10 fish/100 m^2 to 4.5 fish/100 m^2. Table 3.3-4 presents a summary of the standard and bootstrapped beach seine CPUE for each species at each lake sampled.

Table 3.3-4. Beach Seine Standard and Bootstrap CPUE Summary Statistics, 2012

		Standard CPUE (no. fish/100 m^2)						Bootstrap CPUE (no. fish/100 m^2)			
Lake	Species	n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property											
Goose Lake	Arctic grayling	12	0.06	0.16	0.04	0.00	0.43	0.06	0.04	0.00	0.17
	Ninespine stickleback	12	0.19	0.32	0.09	0.00	0.86	0.19	0.09	0.04	0.38
	Round whitefish	12	1.92	3.26	0.94	0.00	8.83	1.93	0.89	0.33	3.84
	Slimy sculpin	12	0.04	0.14	0.04	0.00	0.36	0.04	0.04	0.00	0.13
	Total	*12*	*2.22*	*3.43*	*0.99*	*0.00*	*9.24*	*2.22*	*0.94*	*0.58*	*4.22*
Llama Lake	Round whitefish	9	0.98	2.65	0.88	0.00	6.57	0.97	0.83	0.00	2.76
	Slimy sculpin	9	0.19	0.38	0.13	0.00	0.93	0.19	0.12	0.00	0.44
	Total	*9*	*1.17*	*2.60*	*0.87*	*0.00*	*6.60*	*1.17*	*0.82*	*0.11*	*2.96*
Umwelt Lake	Arctic grayling	2	4.52	4.04	2.86	1.81	7.24	4.53	2.01	1.67	7.38
	Total	*2*	*4.52*	*4.04*	*2.86*	*1.81*	*7.24*	*4.48*	*2.02*	*1.67*	*7.38*
Gander Lake	Arctic grayling	11	0.04	0.13	0.04	0.00	0.33	0.04	0.04	0.00	0.12
	Ninespine stickleback	11	0.16	0.54	0.16	0.00	1.33	0.16	0.15	0.00	0.48
	Total	*11*	*0.20*	*0.67*	*0.20*	*0.00*	*1.67*	*0.20*	*0.19*	*0.00*	*0.61*
Big Lake	Round whitefish	6	6.84	6.67	2.72	0.00	15.00	6.83	2.47	2.05	11.62
	Total	*6*	*6.84*	*6.67*	*2.72*	*0.00*	*15.00*	*6.85*	*2.51*	*2.05*	*11.62*
Fox Lake	Lake trout	2	0.50	0.71	0.50	0.02	0.98	0.50	0.35	0.00	1.00
	Round whitefish	2	1.00	1.41	1.00	0.05	1.95	1.00	0.71	0.00	2.00
	Total	*2*	*1.50*	*2.12*	*1.50*	*0.07*	*2.93*	*1.50*	*1.05*	*0.00*	*3.00*
Rabbit Lake	Arctic grayling	3	0.51	0.89	0.51	0.00	1.46	0.51	0.42	0.00	1.54
	Ninespine stickleback	3	2.56	2.35	1.36	0.15	4.54	2.58	1.10	0.00	4.62
	Total	*3*	*3.08*	*3.08*	*1.78*	*0.15*	*6.00*	*3.10*	*1.45*	*0.00*	*6.15*

(continued)

Table 3.3-4. Beach Seine Standard and Bootstrap CPUE Summary Statistics, 2012 (completed)

		Standard CPUE (no. fish/100 m^2)						Bootstrap CPUE (no. fish/100 m^2)			
Lake	Species	n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Moby Lake	*Total*	*3*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Rascal Lake	Lake trout	4	1.00	1.08	0.54	0.04	2.39	1.00	0.47	0.25	2.00
	Total	*5*	*0.80*	*1.04*	*0.46*	*0.00*	*2.35*	*0.80*	*0.42*	*0.10*	*1.70*
Swan Lake	Lake trout	8	0.10	0.29	0.10	0.00	0.69	0.10	0.10	0.00	0.31
	Total	*8*	*0.10*	*0.29*	*0.10*	*0.00*	*0.69*	*0.11*	*0.10*	*0.00*	*0.31*
Pond 19	*Total*	*4*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Reference B Lake	*Total*	*4*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
George Property											
George Lake	Slimy sculpin	10	0.21	0.45	0.14	0.00	1.17	0.21	0.13	0.00	0.51
	Total	*10*	*0.21*	*0.45*	*0.14*	*0.00*	*1.17*	*0.21*	*0.13*	*0.00*	*0.51*
Lytle Lake	*Total*	*12*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Occurrence Lake	*Total*	*4*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
Sleigh Lake	Arctic grayling	12	0.29	0.62	0.18	0.00	1.73	0.29	0.17	0.00	0.67
	Total	*12*	*0.29*	*0.62*	*0.18*	*0.00*	*1.73*	*0.29*	*0.17*	*0.00*	*0.67*
Dragon Lake	Arctic grayling	3	0.50	0.00	0.00	0.50	0.50	0.50	0.00	0.50	0.50
	Round whitefish	3	2.50	3.91	2.25	0.03	6.68	2.51	1.83	0.00	7.00
	Total	*3*	*3.00*	*3.91*	*2.25*	*0.53*	*7.18*	*3.00*	*1.83*	*0.50*	*7.50*
Komatic Lake	Round whitefish	6	0.17	0.26	0.11	0.00	0.50	0.16	0.10	0.00	0.33
	Slimy sculpin	6	0.33	0.41	0.17	0.00	0.94	0.34	0.15	0.08	0.67
	Total	*6*	*0.50*	*0.55*	*0.22*	*0.00*	*1.00*	*0.50*	*0.20*	*0.17*	*0.83*
Reference C Lake	*Total*	*4*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*

CPUE = catch-per-unit-effort (fish/100 m^2 of seined area)
n = sample size (number of net sets)
SD = standard deviation
SE = standard error
CI = confidence interval (95%)

3.3.3 Biology

Energy Storage

Tables 3.3-5 to 3.3-8 present summaries of the standard and bootstrapped mean fork length, weight and condition of fish species captured by each sampling method (gillnet and beach seine) in each of the sampled lakes in the Back River Project area. Weight and condition data are not available for Big Lake and Reference B Lake due to a scale malfunction that resulted in inaccurate weights for the fish collected.

Table 3.3-5. Summary of Standard and Bootstrapped Mean Fork Length of Fish Captured by Gillnet in Lakes, 2012

Lake	Species	n	Standard Fork Length (mm)					Bootstrapped Fork Length (mm)			
			Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property											
Goose Lake	Lake trout	5	385.6	62.1	27.8	312.5	449.0	385.3	24.8	336.6	432.6
Llama Lake	Lake trout	5	334.0	51.8	23.1	269.5	399.7	333.8	20.8	292.0	375.4
	Round whitefish	9	315.9	88.6	29.5	151.8	413.0	316.4	27.8	257.7	366.1
Umwelt Lake	Arctic grayling	1	255.0	NA	NA	255.0	255.0	NA	NA	NA	NA
	Lake trout	1	405.0	NA	NA	405.0	405.0	NA	NA	NA	NA
Gander Lake	Arctic grayling	15	293.5	59.7	15.4	157.8	354.5	293.6	14.7	261.5	317.8
	Lake cisco	83	150.4	36.3	4.0	103.1	223.0	150.4	4.0	143.0	158.4
	Lake trout	2	407.5	130.8	92.5	319.6	495.4	407.3	64.9	315.0	500.0
	Longnose sucker	7	296.9	48.2	18.2	219.5	350.6	297.2	17.0	261.6	327.9
	Round whitefish	14	219.6	60.3	16.1	114.8	312.6	219.6	15.6	187.9	249.2
Big Lake	Lake trout	7	469.1	50.7	19.2	404.0	542.5	469.2	17.5	435.4	504.1
Fox Lake	Lake trout	11	383.2	98.5	29.7	296.3	590.0	383.1	28.1	337.7	444.6
	Round whitefish	1	315.0	NA	NA	315.0	315.0	NA	NA	NA	NA
Rabbit Lake	Lake trout	4	415.0	14.1	7.1	405.0	433.5	415.0	6.1	405.0	427.5
Moby Lake	Lake trout	22	377.6	117.4	25.0	214.1	595.7	377.7	24.5	330.8	426.8
Rascal Lake	Lake trout	3	335.3	75.6	43.7	254.6	379.0	335.5	35.5	248.0	379.0
Swan Lake	Lake trout	9	332.7	79.8	26.6	247.0	488.0	332.7	24.9	290.7	387.2
	Round whitefish	1	154.0	NA	NA	154.0	154.0	NA	NA	NA	NA
Reference B Lake	Lake trout	15	461.3	60.9	15.7	340.8	544.5	461.3	15.0	430.9	489.5
	Round whitefish	10	323.2	81.9	25.9	207.4	414.8	323.2	24.7	273.9	370.1
George Property											
Dragon Lake	Lake trout	22	427.6	70.7	15.1	306.6	594.3	427.7	14.7	399.5	457.5
George Lake	Lake trout	9	547.6	134.2	44.7	433.4	778.4	548.2	42.3	473.3	640.6
Komatic Lake	Lake trout	8	527.5	64.3	22.7	439.4	614.8	527.6	21.2	486.9	568.8
	Round whitefish	3	460.7	23.6	13.6	435.8	478.5	460.6	11.1	434.0	479.0
Reference C Lake	Arctic char	6	393.2	48.0	19.6	313.3	437.5	393.1	17.9	354.2	422.7
	Lake trout	12	498.1	180.7	52.2	179.2	760.0	498.0	49.8	398.2	591.0

n = sample size
SD = standard deviation
SE = standard error
CI = confidence interval (95%)
NA = not applicable

Table 3.3-6. Summary of Standard and Bootstrapped Mean Fork Length of Fish Captured by Beach Seine in Lakes, 2012

			Standard Fork Length (mm)					Bootstrapped Fork Length (mm)			
Lake	Species	N	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property											
Goose Lake	Arctic grayling	2	65.5	26.2	18.5	47.9	83.1	65.4	13.1	47.0	84.0
	Lake trout	1	133.0	NA	NA	133.0	133.0	NA	NA	NA	NA
	Ninespine stickleback	8	46.9	5.2	1.8	38.2	54.1	46.9	1.7	43.4	50.3
	Round whitefish	51	65.4	32.3	4.5	30.0	133.8	65.3	4.4	56.9	74.4
	Slimy sculpin	4	50.3	11.3	5.7	35.4	59.6	50.3	4.9	39.3	58.0
Llama Lake	Round whitefish	28	37.2	3.0	0.6	32.4	42.3	37.2	0.6	36.1	38.3
	Slimy sculpin	2	61.5	4.9	3.5	58.2	64.8	61.5	2.5	58.0	65.0
Umwelt Lake	Arctic grayling	33	45.3	16.6	2.9	33.2	104.4	45.3	2.8	40.6	51.7
Gander Lake	Arctic grayling	3	107.0	51.7	29.8	56.0	153.8	107.5	24.4	53.0	156.0
	Ninespine stickleback	30	32.8	18.4	3.4	15.5	61.3	32.8	3.3	26.5	39.5
	Round whitefish	1	113.0	NA	NA	113.0	113.0	NA	NA	NA	NA
	Slimy sculpin	1	42.0	NA	NA	42.0	42.0	NA	NA	NA	NA
Big Lake	Round whitefish	12	53.2	2.2	0.6	48.8	56.2	53.2	0.6	51.9	54.3
Fox Lake	Round whitefish	2	93.0	7.1	5.0	88.3	97.8	93.0	3.5	88.0	98.0
Rabbit Lake	Arctic grayling	1	51.0	NA	NA	51.0	51.0	NA	NA	NA	NA
	Ninespine stickleback	5	37.6	9.3	4.2	32.0	52.1	37.6	3.7	32.6	45.8
Rascal Lake	Arctic grayling	6	88.2	26.9	11.0	50.9	106.0	88.1	10.1	69.5	105.7
	Round whitefish	2	56.0	4.2	3.0	53.2	58.9	56.0	2.1	53.0	59.0
Swan Lake	Ninespine stickleback	1	22.0	NA	NA	22.0	22.0	NA	NA	NA	NA
George Property											
George Lake	Arctic grayling	2	65.0	1.4	1.0	64.1	66.0	65.0	0.7	64.0	66.0
	Lake trout	2	51.5	0.7	0.5	51.0	52.0	51.5	0.4	51.0	52.0
	Slimy sculpin	2	54.0	11.3	8.0	46.4	61.6	54.1	5.7	46.0	62.0
Sleigh Lake	Arctic grayling	8	60.6	3.5	1.2	55.5	64.8	60.6	1.1	58.4	62.9
Dragon Lake	Arctic grayling	2	46.0	4.2	3.0	43.2	48.9	46.0	2.1	43.0	49.0
	Round whitefish	15	107.1	18.6	4.8	66.5	126.5	107.1	4.6	97.1	114.9
Komatic Lake	Round whitefish	2	57.0	0.0	0.0	57.0	57.0	57.0	0.0	57.0	57.0
	Slimy sculpin	4	53.0	7.1	3.6	43.8	58.9	53.0	3.1	46.5	58.0

n = sample size
SD = standard deviation
SE = standard error
CI = confidence interval (95%)
NA = not applicable

Table 3.3-7. Summary of Standard and Bootstrapped Mean Total Weight of Fish Captured by Gillnet in Lakes, 2012

			Standard Total Weight (g)					Bootstrapped Total Weight (g)			
Lake	Species	n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property											
Goose Lake	Lake trout	5	629.60	272.92	122.06	338.50	928.30	630.00	109.58	413.20	846.00
Llama Lake	Lake trout	5	373.40	169.65	75.87	190.70	604.60	373.07	68.33	247.80	512.40
	Round whitefish	9	408.67	237.69	79.23	37.00	719.00	409.04	74.53	262.11	550.12
Umwelt Lake	Arctic grayling	1	197.00	NA	NA	197.00	197.00	NA	NA	NA	NA
Gander Lake	Arctic grayling	12	335.33	161.05	46.49	65.25	568.75	336.94	42.47	254.93	417.39
	Lake cisco	83	48.33	46.58	5.11	12.05	133.85	48.37	5.06	39.19	58.88
	Lake trout	1	405.00	NA	NA	405.00	405.00	405.00	NA	405.00	405.00
	Longnose sucker	7	392.43	176.00	66.52	136.80	610.80	392.62	62.19	268.71	511.57
	Round whitefish	13	152.38	110.89	30.76	17.40	373.00	152.98	28.58	99.66	211.26
Fox Lake	Lake trout	10	460.20	146.79	46.42	264.50	620.00	461.66	41.83	374.71	543.12
	Round whitefish	1	323.00	NA	NA	323.00	323.00	NA	NA	NA	NA
Moby Lake	Lake trout	22	805.27	705.25	150.36	105.08	2,475.80	804.42	148.18	537.81	1,112.74
Rascal Lake	Lake trout	3	412.00	221.65	127.97	186.15	601.30	411.48	103.77	172.00	609.00
Swan Lake	Lake trout	7	471.71	343.84	129.96	137.90	1,079.30	464.21	105.44	278.95	684.78
	Round whitefish	1	30.00	NA	NA	30.00	30.00	NA	NA	NA	NA
George Property											
George Lake	Lake trout	8	1,344.50	379.58	134.20	900.98	1,981.78	1,344.18	118.69	1,122.29	1,582.03
Dragon Lake	Lake trout	22	755.27	335.68	71.57	290.90	1,621.75	755.12	70.57	628.36	903.78
Komatic Lake	Lake trout	7	1,156.43	299.37	113.15	770.90	1,587.25	1,156.26	96.20	969.89	1,348.46
	Round whitefish	3	1,020.33	78.53	45.34	946.75	1,095.90	1,020.17	37.04	943.00	1,100.00
Reference C Lake	Arctic char	6	637.17	197.83	80.76	318.38	846.38	636.09	73.85	479.50	763.50
	Lake trout	10	1,191.30	831.63	262.98	92.70	2,610.00	1,196.83	222.43	787.22	1,640.86

n = sample size (number of fish)
SD = standard deviation
SE = standard error
CI = confidence interval (95%)
NA = not applicable due to low sample size

Table 3.3-8. Summary of Standard and Bootstrapped Mean Total Weight of Fish Captured by Beach Seine in Lakes, 2012

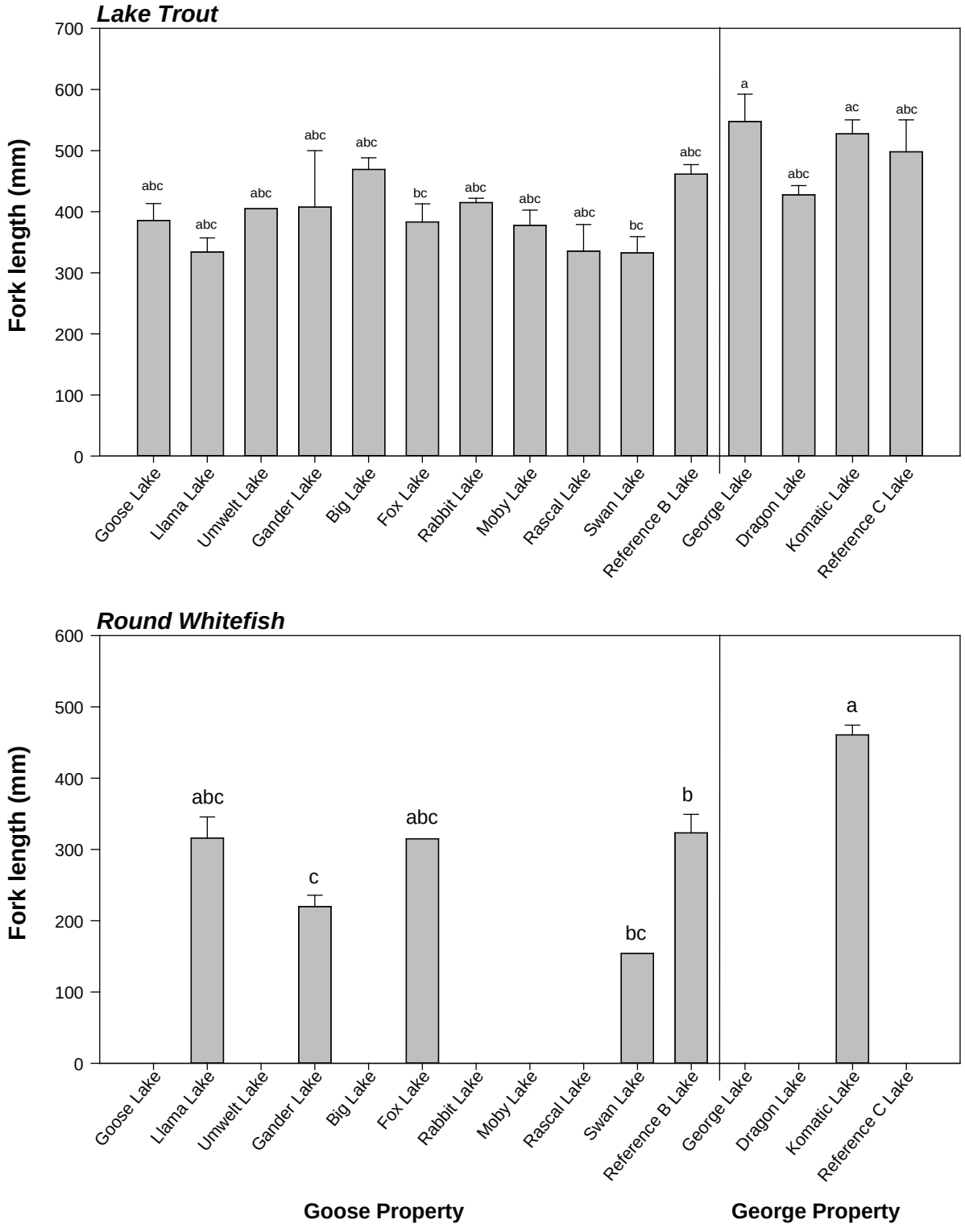
			Standard Weight (g)					Bootstrapped Weight (g)			
Lake	**Species**	**n**	**Mean**	**SD**	**SE**	**Lower CI**	**Upper CI**	**Mean**	**SD**	**Lower CI**	**Upper CI**
Goose Property											
Umwelt Lake	Arctic grayling	2	1.5	0.7	0.5	1.0	2.0	NA	NA	NA	NA
Gander Lake	Arctic grayling	2	35.5	23.3	16.5	19.8	51.2	35.3	9.3	19.0	52.0
	Ninespine stickleback	6	1.3	0.5	0.2	1.0	2.0	NA	NA	NA	NA
	Round whitefish	1	119.0	NA	NA	119.0	119.0	NA	NA	NA	NA
Fox Lake	Round whitefish	2	7.0	1.4	1.0	6.1	8.0	7.0	0.7	6.0	8.0
Rascal Lake	Arctic grayling	6	8.0	5.3	2.2	1.1	13.8	8.0	2.0	4.0	11.7
	Round whitefish	2	1.5	0.7	0.5	1.0	2.0	1.5	0.4	1.0	2.0
George Property											
George Lake	Arctic grayling	2	2.5	0.7	0.5	2.0	3.0	2.5	0.4	2.0	3.0
	Lake trout	2	1.0	0.0	0.0	1.0	1.0	1.0	0.0	1.0	1.0
	Slimy sculpin	1	1.0	NA	NA	1.0	1.0	1.0	0.0	1.0	1.0
Sleigh Lake	Arctic grayling	8	2.5	0.9	0.3	1.2	3.8	2.5	0.3	1.9	3.1
Komatic Lake	Round whitefish	1	2.0	NA	NA	2.0	2.0	2.0	0.0	2.0	2.0
	Slimy sculpin	2	2.0	0.0	0.0	2.0	2.0	2.0	0.0	2.0	2.0

n = sample size (number of fish)
SD = standard deviation
SE = standard error
CI = confidence interval (95%)
NA = not applicable due to low sample size

Lake trout were captured by gillnet in 15 of the 19 lakes sampled (Table 3.3-5). The largest lake trout captured by gillnet came from Komatic Lake and George Lake, while the smallest lake trout were captured in Llama Lake, Rascal Lake, and Swan Lake. There were significant differences in lake trout fork length among the lakes sampled (ANOVA, $F_{14,118} = 3.60$, $P < 0.01$; Figure 3.3-20). Lake trout captured by gillnet were significantly larger in George and Komatic Lakes than lake trout captured in Swan Lake. Lake trout from George Lake were also significantly larger than those from Fox Lake. Lake trout were only captured by beach seine in George Lake (two fish) and Goose Lake (one fish; Table 3.3-6). All of the lake trout captured by beach seine were juveniles with fork lengths less than 133 mm. A length-frequency distribution was plotted for all lake trout captured by gillnet (Figure 3.3-21).

It shows that the majority of fish captured fell into the 440 to 460 mm size class.

Arctic grayling were captured by gillnet in Umwelt and Gander Lakes. In both lakes, the grayling captured by gillnet were adults with mean fork lengths of 255 mm in Umwelt Lake, and 293.5 mm in Gander Lake. Arctic grayling were captured by beach seine in eight of the surveyed lakes. There were significant differences in Arctic grayling fork length among lakes (ANOVA, $F_{7, 49} = 7.63$, $P < 0.01$). Grayling captured by beach seine in Gander Lake and Rascal Lake were significantly longer than those captured in Umwelt Lake (Figure 3.3-22).



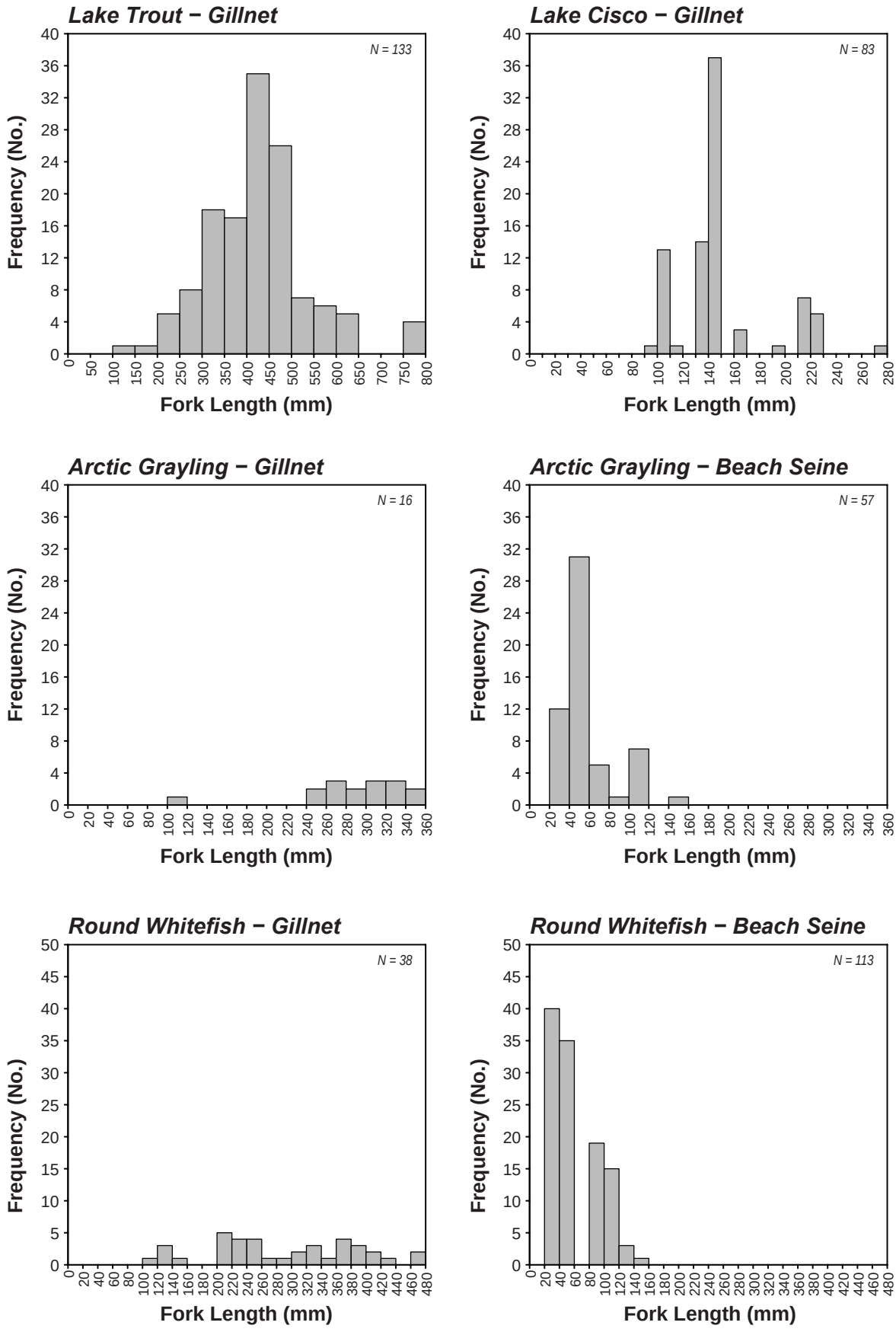
Notes: Letters indicate significant differences among lakes (P < 0.05)
Errors bars indicate 1 standard error of the mean

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Mean Fork Length of Fish Captured by Gillnetting in Surveyed Lakes, 2012

Figure 3.3-20

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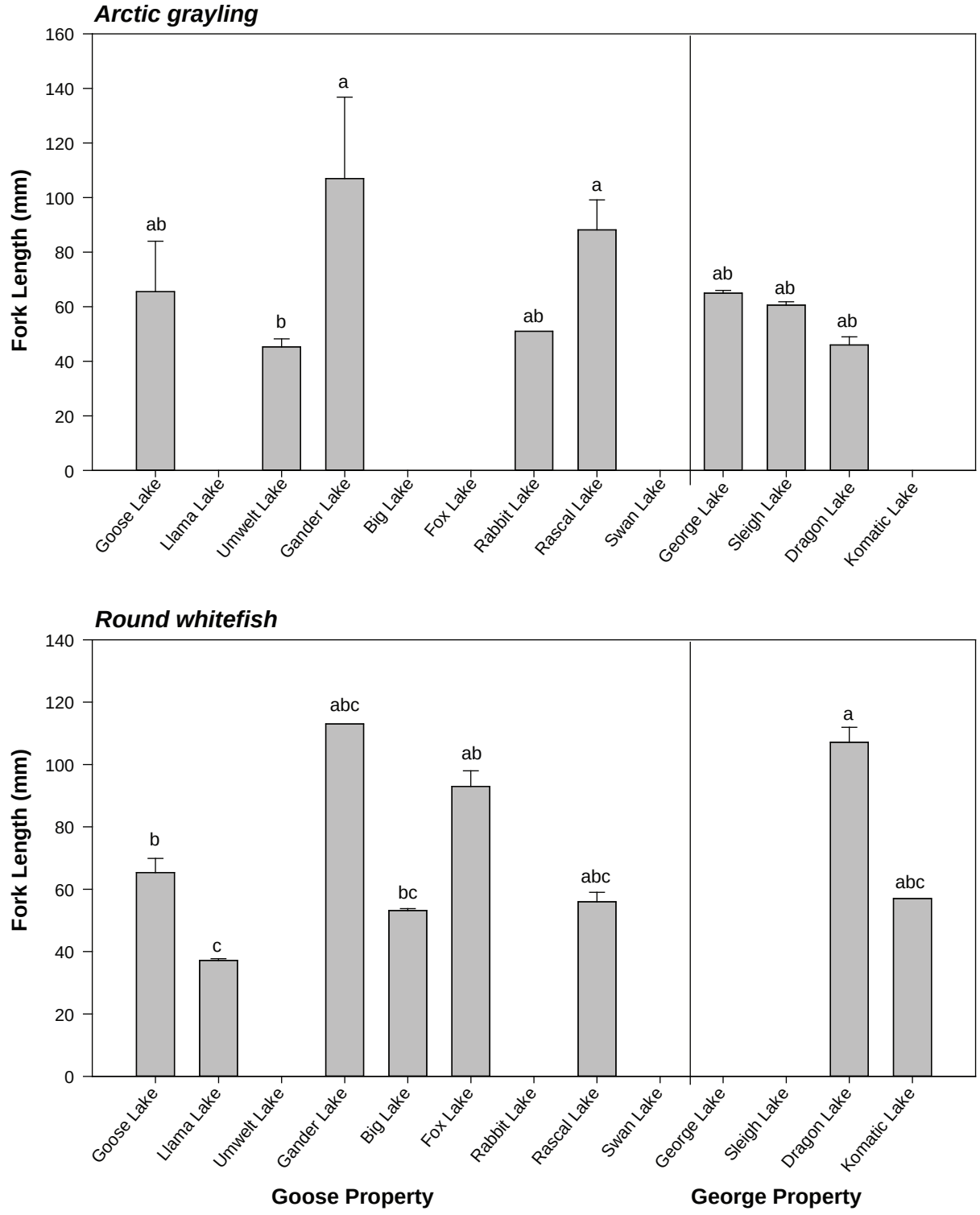


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Length-Frequency Distributions of Fish Species from Surveyed Lakes, 2012

Figure 3.3-21

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Notes: Letters indicate significant differences among lakes (P < 0.05)
Errors bars indicate 1 standard error of the mean

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Mean Fork Length of Fish Captured by Beach Seining in Surveyed Lakes, 2012

Figure 3.3-22

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A length-frequency distribution was prepared for all grayling captured by beach seine and gillnet in surveyed lakes (Figure 3.3-21). The distribution shows that the majority of fish beach seined fell into the 40 to 50 mm size class, while the few fish that were captured by gillnet were larger. Grayling tend to have diverse habitat preferences (Scott and Crossman 1973), and young-of-the-year may spend their first summer rearing in streams, lakes, or rivers. Similarly, adult grayling can also be found in a range of habitats during the summer months.

Round whitefish were captured by gillnet in six of the lakes sampled, with the largest mean fork lengths occurring in Komatic Lake. The smallest round whitefish were captured in Swan Lake. There were significant differences in the mean fork length of round whitefish among the lakes sampled by gillnet (ANOVA; $F_{5,31} = 5.18$, $P < 0.01$). These differences are illustrated in Figure 3.3-20. Round whitefish were captured by beach seine in eight of the surveyed lakes, and there were significant differences in the mean fork length of these fish as well (ANOVA; $F_{7,105} = 14.00$, $P < 0.01$). The largest seined whitefish were captured in Komatic Lake, while the smallest were captured in Swan Lake. The differences in mean fork length among seined lakes are illustrated in Figure 3.3-22.

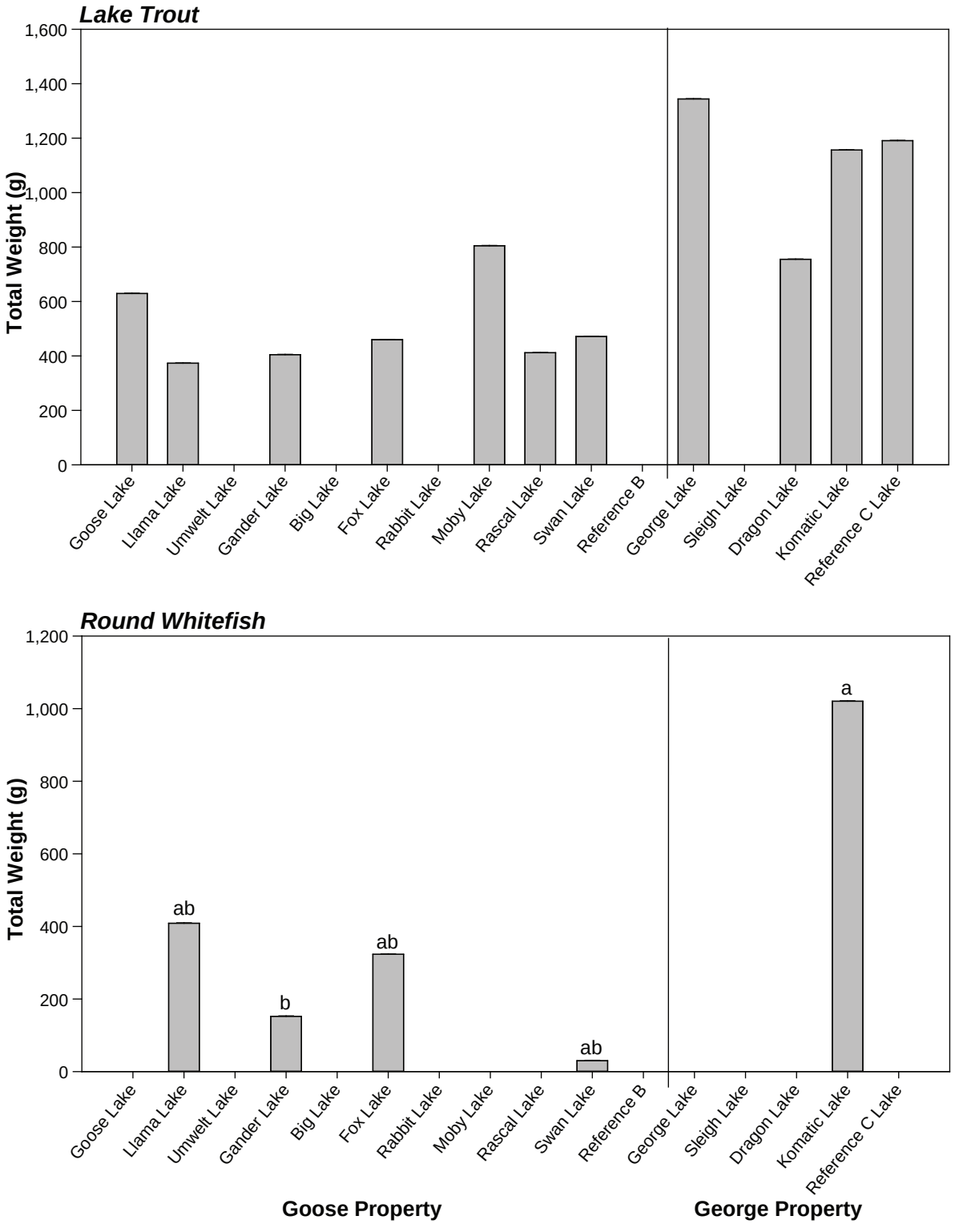
The length-frequency distribution for gillnet-captured round whitefish shows few distinct size classes(Figure 3.3-21). Three faint modes were present at the 120 to 140 mm size class, the 200 to 220 mm size class, and the 360 to 380 mm size class. The length-frequency distribution for beach seined round whitefish shows two distinct modes in the 20 to 40 mm size class and the 80 to 100 mm size class. The majority of fish captured fell into the smallest size class. This pattern is generally typical of fish species in temperate areas where reproduction occurs over a short time period each year. As fish grow, the age classes separate out into distinct size ranges. The decrease in numbers in each cohort represents annual mortality. As fish grow larger and their growth slows, the size classes overlap and become less distinct (Guy and Brown 2007).

Lake cisco were captured mainly in Gander Lake, and had a mean fork length of 152 mm. The length-frequency distribution shows that the majority of captured fish fell into the 140 to 150 mm size range, with relatively strong modes also occurring at 110 to 110 mm and 210 to 220 mm (Figure 3.3-21). Gander Lake may be an important rearing and feeding habitat for ciscoes, which were not caught anywhere else in the Project area.

By weight, the largest lake trout were captured by gillnet in Reference C, Komatic and George Lakes (Table 3.3-7). The smallest lake trout by weight were captured in Gander and Llama Lakes. An analysis of lake trout total weight showed that there were significant differences among lakes (ANOVA, $F_{10,88} = 2.31$, $P < 0.05$); however, post-hoc comparisons between individual lakes did not reveal any significant differences (Figure 3.3-23.

The mean total weight of round whitefish captured by gillnetting was highest in Komatic Lake and lowest in Swan Lake (Table 3.3-7). The mean total weight of whitefish gillnetted from Komatic Lake was significantly higher than Gander and Swan Lakes (ANOVA, $F_{4,22} = 4.42$, $P < 0.01$; Figure 3.3-23). Analyses of round whitefish weight for beach seined fish indicated significant differences among sites (ANOVA; $F_{3,2} = 33.77$, $P < 0.05$); however, post-hoc comparison between individual sites did not reveal any significant differences (Figure 3.3-24).

The mean total weight of Arctic grayling captured by beach seine was highest in Gander Lake, and lowest in George and Sleigh Lakes (Table 3.3-7). There were significant differences in mean total weight among lakes, with fish from Gander Lake being significantly heavier than fish from George, Sleigh and Umwelt Lakes (ANOVA, $F_{4,15} = 6.51$, $P < 0.01$; Figure 3.3-24). The total weight of gillnetted Arctic grayling was not compared due to low sample size.



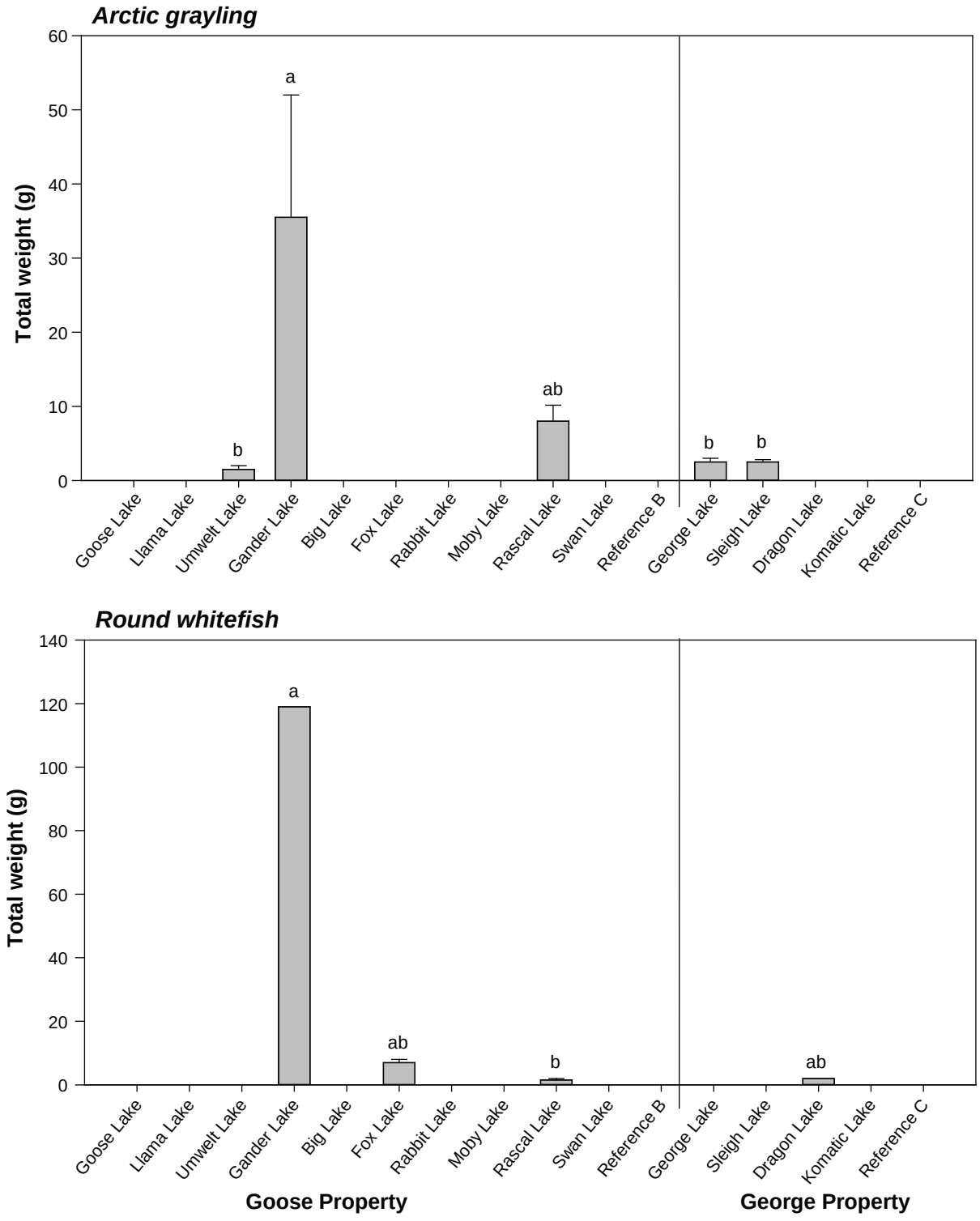
Notes: Letters indicate significant differences among lakes (P < 0.05)
Errors bars indicate 1 standard error of the mean

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Mean Total Weight of Fish Captured by Gillnetting in Surveyed Lakes, 2012

Figure 3.3-23

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Notes: Letters indicate significant differences among lakes (P < 0.05)
Errors bars indicate 1 standard error of the mean

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Mean Total Weight of Fish Captured by Beach Seining in Surveyed Lakes, 2012

Figure 3.3-24

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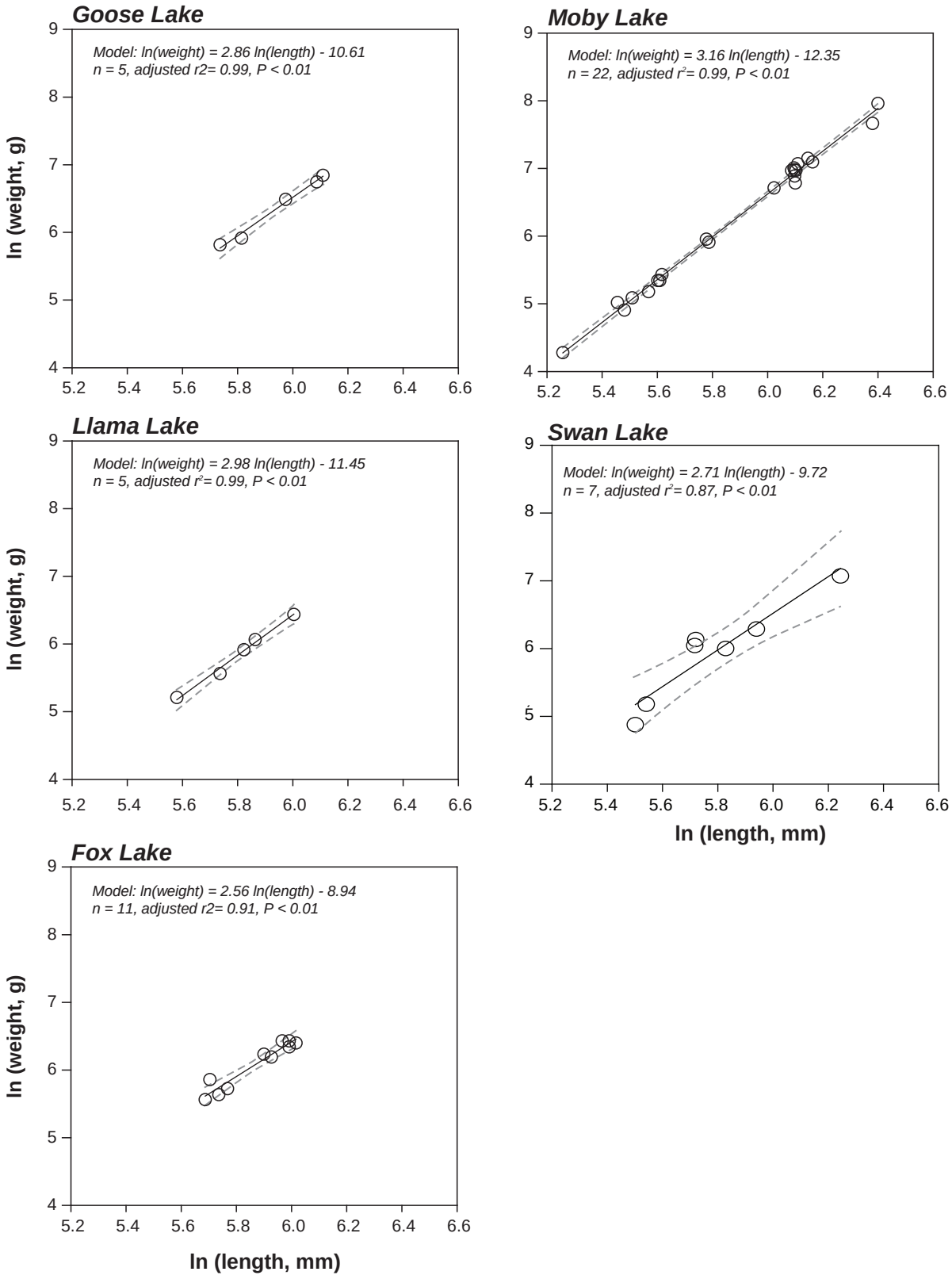
Length-weight regressions were prepared to compare length-at-weight of each species among lakes. For lake trout, significant regressions could be calculated for Dragon, Fox, George, Komatic, Moby, Reference C, Swan, Goose and Llama Lakes (Figures 3.3-25a and 3.3-25b). A general linear model was used to compare the slopes and intercepts of the length-weight regression lines for these lakes. A significant interaction between length and site indicated that the slopes of the regression lines were not equal and the intercepts could not be compared directly among lakes (GLM; $F_{8,88} = 5.28$, $P < 0.01$).

As a substitute for comparing the intercepts of the regression lines, mean condition factor was compared among lakes. Table 3.3-9 presents the standard and bootstrapped mean condition factor for fish species in each lakes in the Project area. The mean condition of lake trout differed significantly among lakes at the Back River Project Area (ANOVA; $F_{10,91} = 4.30$, $P < 0.01$). Figure 3.3-26 illustrates the significant differences among lakes.

Table 3.3-9. Summary of Standard and Bootstrapped Mean Condition Factor of Fish Captured by Gillnet in Lakes, 2012

			Standard Condition (K)					Bootstrapped Condition (K)			
Lake	Species	n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property											
Goose Lake	Lake trout	5	1.043	0.059	0.026	0.986	1.120	1.043	0.023	0.998	1.090
Llama Lake	Lake trout	5	0.948	0.046	0.021	0.879	0.986	0.948	0.019	0.908	0.979
	Round whitefish	9	1.064	0.103	0.034	0.895	1.183	1.064	0.033	0.998	1.126
Umwelt Lake	Arctic grayling	1	1.188	NA	NA	1.188	1.188	NA	NA	NA	NA
Gander Lake	Arctic grayling	12	1.208	0.083	0.024	1.061	1.303	1.207	0.020	1.166	1.244
	Lake cisco	83	1.176	0.112	0.012	1.036	1.384	1.176	0.012	1.152	1.201
	Lake trout	1	1.296	NA	NA	1.296	1.296	1.296	0.000	1.296	1.296
	Longnose sucker	7	1.388	0.127	0.048	1.215	1.557	1.388	0.045	1.302	1.474
	Round whitefish	13	1.219	0.094	0.026	1.050	1.351	1.219	0.024	1.170	1.264
Fox Lake	Lake trout	10	0.993	0.123	0.039	0.874	1.240	0.993	0.035	0.934	1.070
	Round whitefish	1	1.033	NA	NA	1.033	1.033	NA	NA	NA	NA
Moby Lake	Lake trout	22	1.127	0.104	0.022	0.981	1.299	1.127	0.022	1.085	1.170
Rascal Lake	Lake trout	3	1.027	0.166	0.096	0.850	1.127	1.027	0.078	0.836	1.128
Swan Lake	Lake trout	7	1.134	0.300	0.113	0.865	1.599	1.139	0.094	0.968	1.332
	Round whitefish	1	0.821	NA	NA	0.821	0.821	NA	NA	NA	NA
George Property											
George Lake	Lake trout	8	1.019	0.250	0.089	0.536	1.237	1.018	0.079	0.849	1.145
Dragon Lake	Lake trout	22	0.925	0.087	0.019	0.771	1.082	0.925	0.018	0.889	0.961
Komatic Lake	Lake trout	7	0.842	0.076	0.029	0.707	0.912	0.842	0.025	0.788	0.885
	Round whitefish	3	1.047	0.092	0.053	0.988	1.146	1.048	0.043	0.987	1.154
Reference C Lake	Arctic char	6	1.017	0.107	0.044	0.843	1.118	1.018	0.040	0.931	1.085
	Lake trout	10	1.055	0.058	0.018	0.976	1.132	1.055	0.016	1.024	1.084

n = sample size (number of fish)
SD = standard deviation
SE = standard error
CI = confidence interval (95%)
NA = not applicable due to low sample size



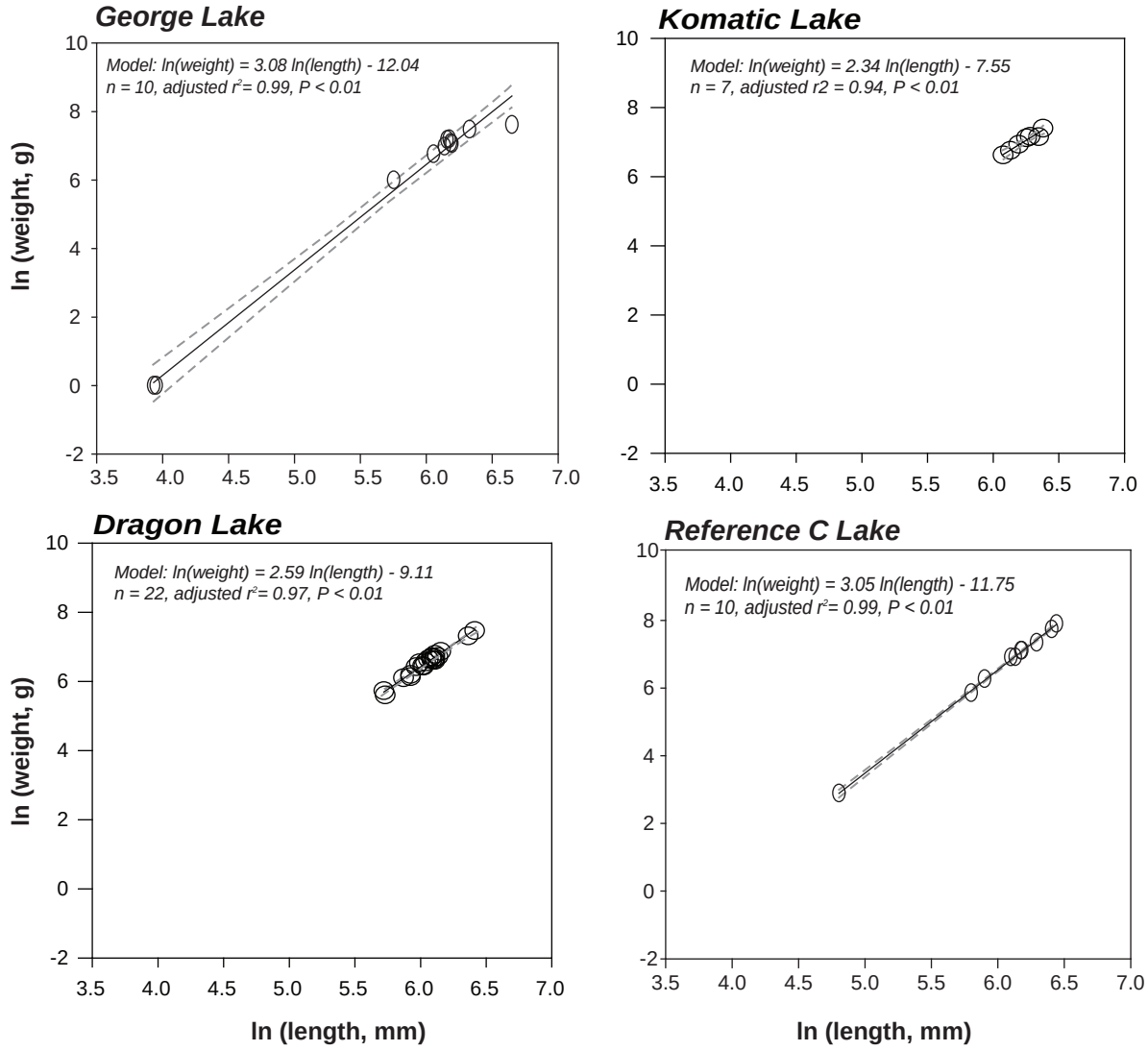
Note: Dashed lines indicate upper and lower 95% confidence intervals

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Length-Weight Regressions for Lake Trout Captured in Surveyed Lakes, Goose Property, 2012

Figure 3.3-25a

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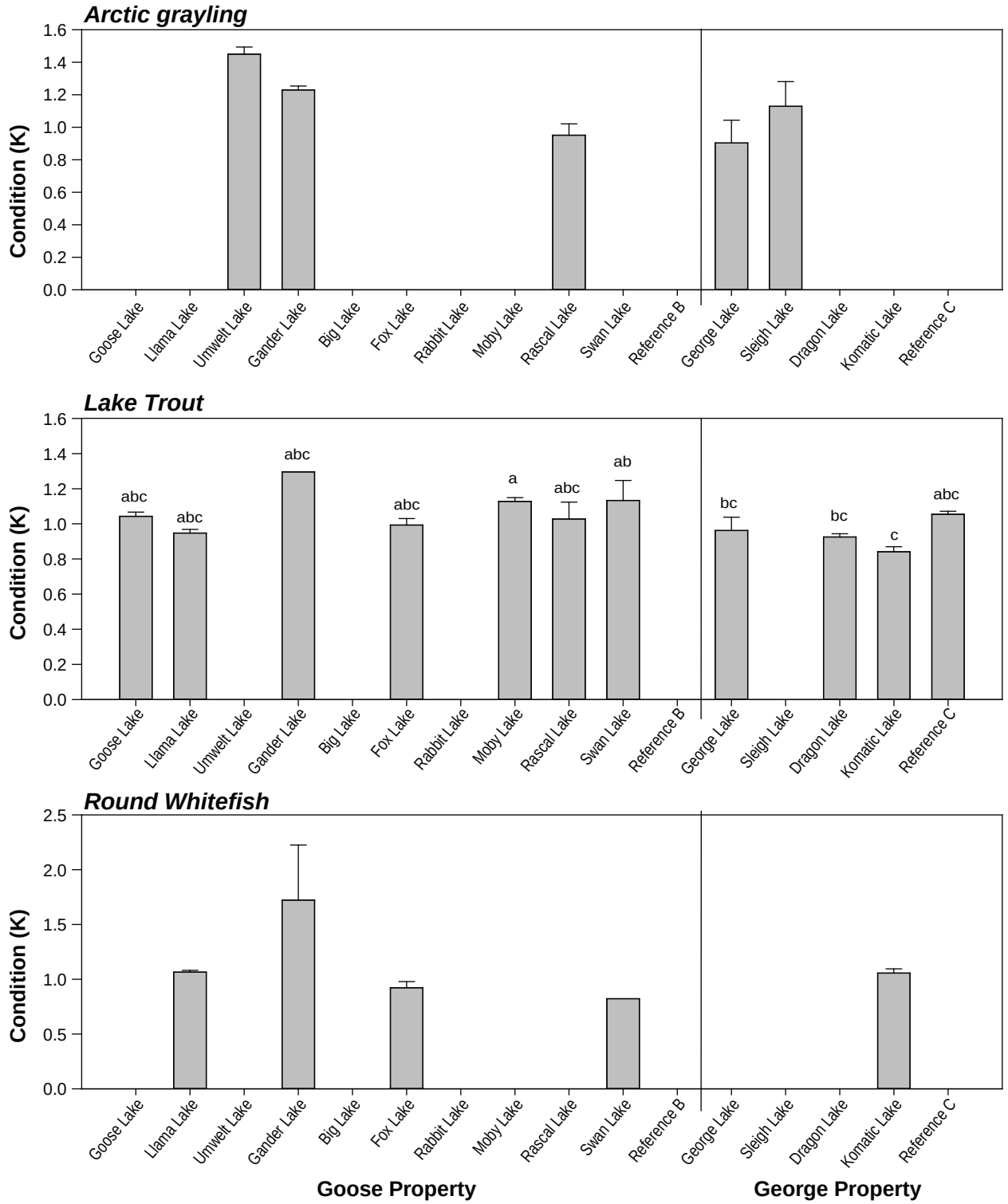
Note: Dashed lines indicate upper and lower 95% confidence intervals

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Length-Weight Regressions for Lake Trout Captured in Surveyed Lakes, George Property, 2012

Figure 3.3-25b

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Notes: Letters indicate significant differences among lakes (P < 0.05)
Errors bars indicate one standard error of the mean

Sabina GOLD & SILVER CORP.

Mean Condition Factor of Fish Captured in Surveyed Lakes, 2012

Figure 3.3-26

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For round whitefish, significant regressions could be calculated for Fox, Gander, Komatic, and Llama Lakes (Figure 3.3-27). A general linear model was used to compared the slopes and intercepts of the length-weight regression lines for these lakes. There was no significant difference in the slopes of the regressions, as indicated by the interaction between site and fork length (GLM; $F_{3,28} = 1.41$, $P = 0.27$). This allowed for a comparison of weight-at-length among sites. There was no significant difference in weight-at-length of round whitefish among lakes (ANCOVA, $F_{3,25} = 1.63$, $P = 0.21$), indicating that fish condition was similar among lakes. This is supported by the finding that there were no significant differences in whitefish condition factor among sites (ANOVA, $F_{3,26} = 1.77$, $P = 0.18$; Figure 3.3-26).

Significant length-weight regressions for Arctic grayling could be calculated for Gander Lake, Rascal Lake, and Umwelt Lake (although only three fish were measured at Umwelt Lake; Figure 3.3-28). Because of the low sample size, weight-at-length was not compared among sites. Rather, condition factor was used as a surrogate for weight-at-length to compare the relative health of grayling among lakes. Although there was a marginally significant effect of site on grayling condition in the Project area (ANOVA, $F_{4,28} = 2.67$, $P = 0.05$), post-hoc comparisons between individual sites did not reveal any significant differences. Figure 3.3-26 shows the mean condition factor of grayling in the Project area.

Relationships between liver weight and total weight of lake trout compared among four of the six lakes where lethal sampling was conducted. No tissue weights were collected at Reference B Lake due to a scale malfunction, and only one lake trout was captured from Umwelt Lake. Due to the low sample size at each lake, a Pearson product-moment correlation analysis was conducted to look for relationships between lake trout total weight and liver weight at each site, and with all sites pooled. Only the relationship for Reference C Lake was significant ($P < 0.01$); however, when all of the sites were pooled together, the relationship was also significant ($P < 0.001$). Figure 3.3-29 shows the relationship between liver weight and total weight, along with a regression line and equation for Reference C Lake.

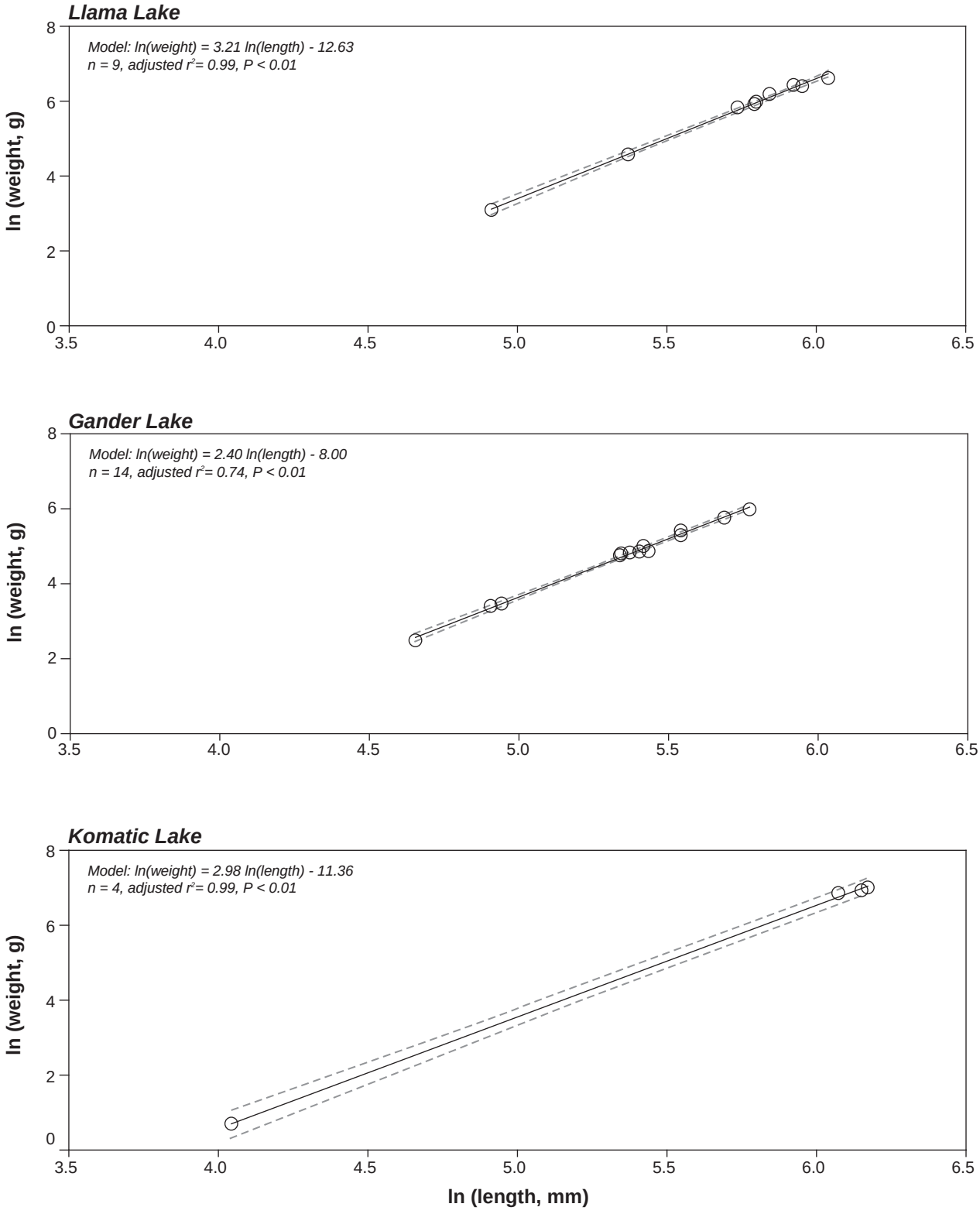
Relationships between liver weight and total weight of round whitefish were compared for fish from Llama Lake. No other lakes could be included due to a scale malfunction that created inaccurate data for Reference B Lake. There was a significant positive correlation between round whitefish total weight and liver weight ($n = 5$, $P < 0.01$) for fish from Llama Lake.

Energy Use

Age-frequency distributions were created for Arctic grayling, lake trout and round whitefish captured in the Back River Project area in 2012 (Figure 3.3-30). Arctic grayling aged in 2012 ranged from 1 to 5 years old, with the majority falling into the 3 and 5-year age classes. Lake trout ranged in age from 1 to 32 years. The age-frequency distribution showed that the majority of fish fall into age classes from 8 to 13 years. This could reflect size selectivity in the fishing gear, since smaller fish are often less easily captured by gillnets, while larger fish are both less numerous and capable of breaking through gillnets. The majority of round whitefish fell into the 1-year age category, with a smaller mode occurring in the 10-year age category. This distribution likely reflects a population with a large number of juveniles that gradually succumb to mortality as they age.

Growth models were prepared to show the age-length relationship of dominant fish species in the Project area. Figures 3.3-31 to 3.3-33 present the growth models for Arctic grayling, lake trout and round whitefish.

A total of 17 Arctic grayling were aged in the Project area in 2012. The ages of the fish ranged from 1 to 5 years. The modified von Bertalanffy model with t_0 fixed at zero was significant for all parameters ($P < 0.05$), and had the highest Akaike weight (0.66) compared to the other models. This model predicted an asymptotic length of 470 mm, with a growth coefficient of 0.24 $years^{-1}$.



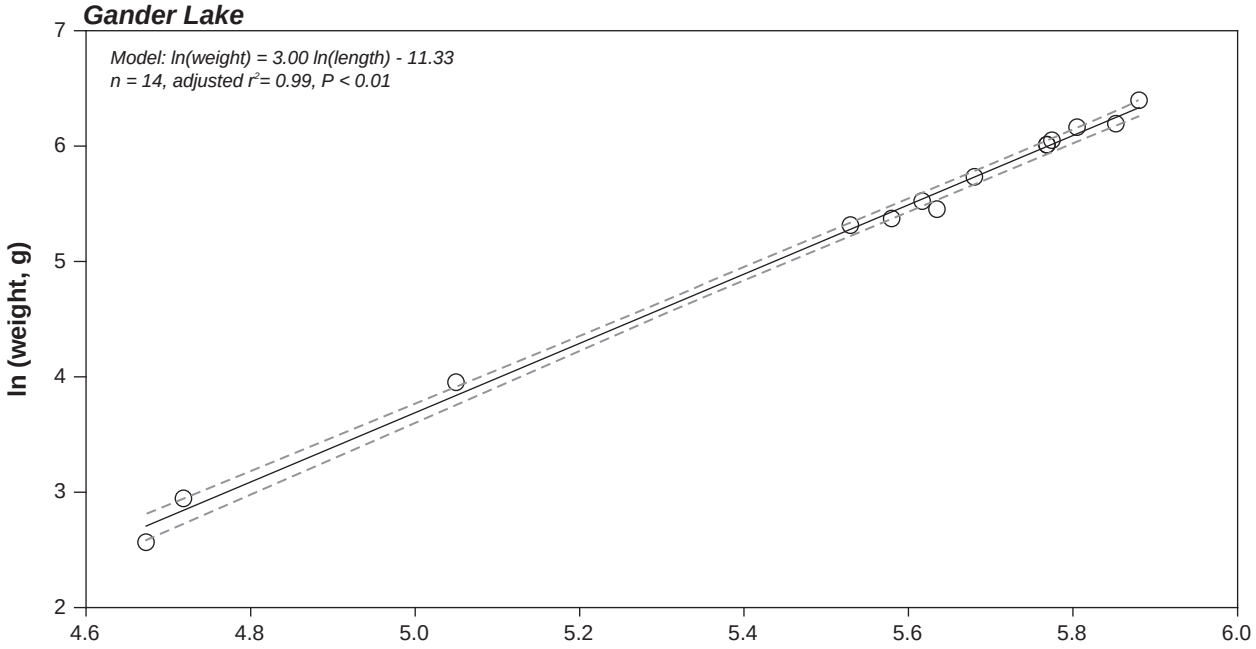
Note: Dashed lines indicate upper and lower 95% confidence intervals

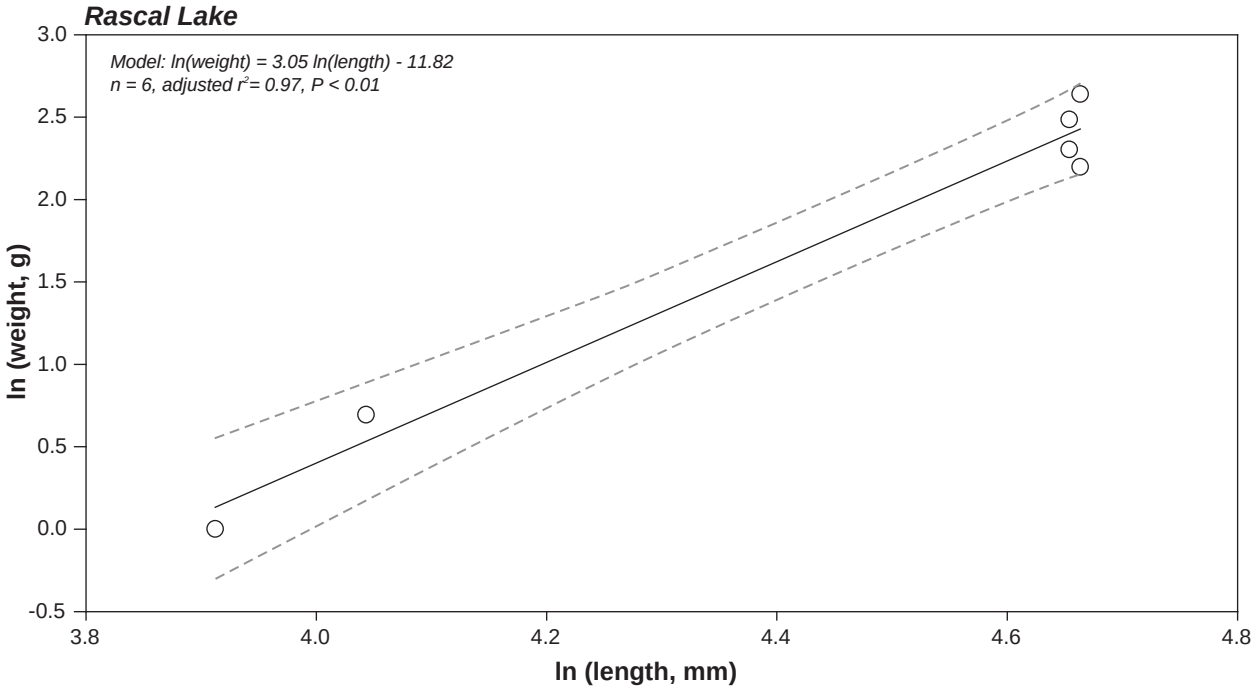
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Length-Weight Regressions for Round Whitefish Captured in Surveyed Lakes, 2012

Figure 3.3-27

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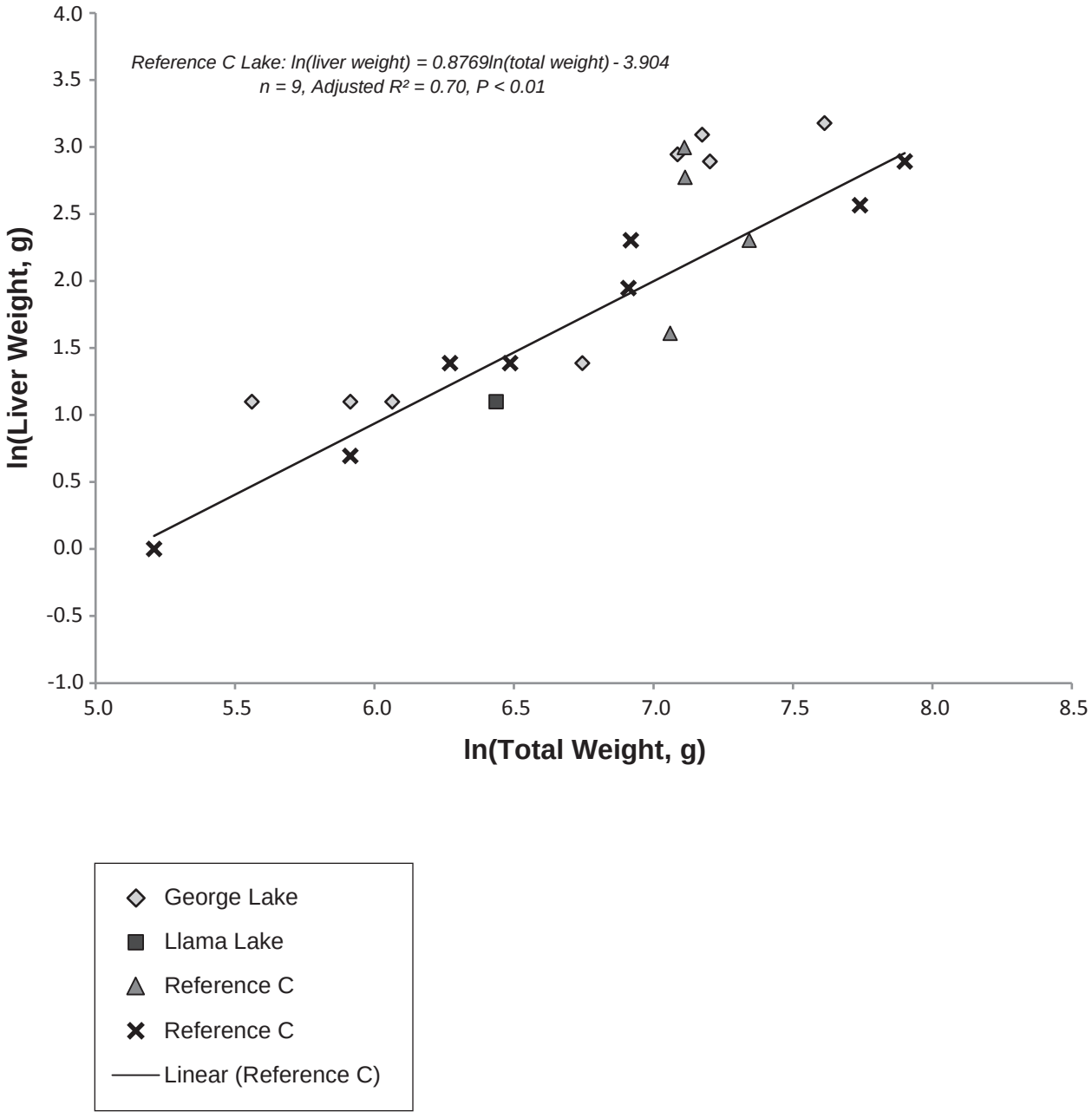
Note: Dashed lines indicate upper and lower 95% confidence intervals

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Length-Weight Regressions for Arctic Grayling Captured in Surveyed Lakes, 2012

Figure 3.3-28

Rescan™ Engineers & Scientists

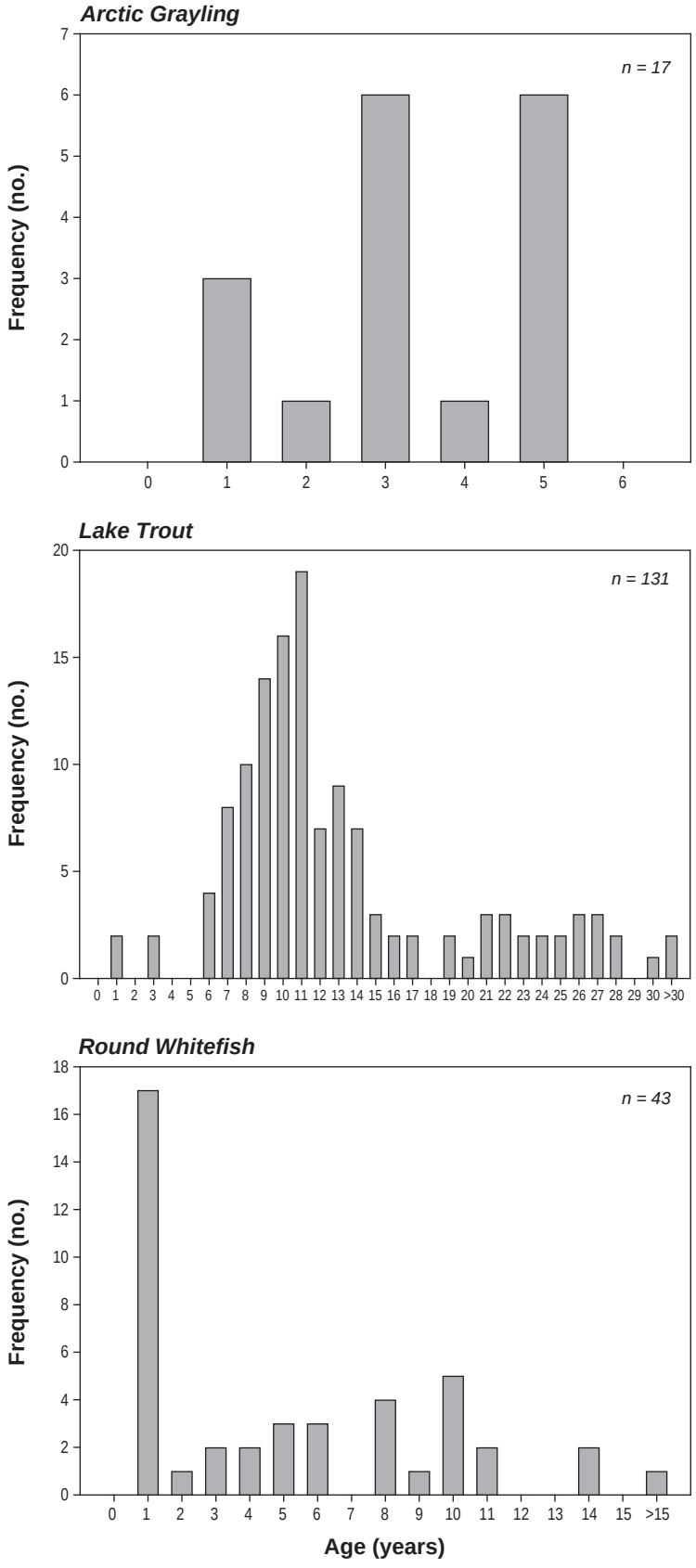


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Liver Weight-Total Weight Regression for Lake Trout from the Back River Project Area, 2012

Figure 3.3-29

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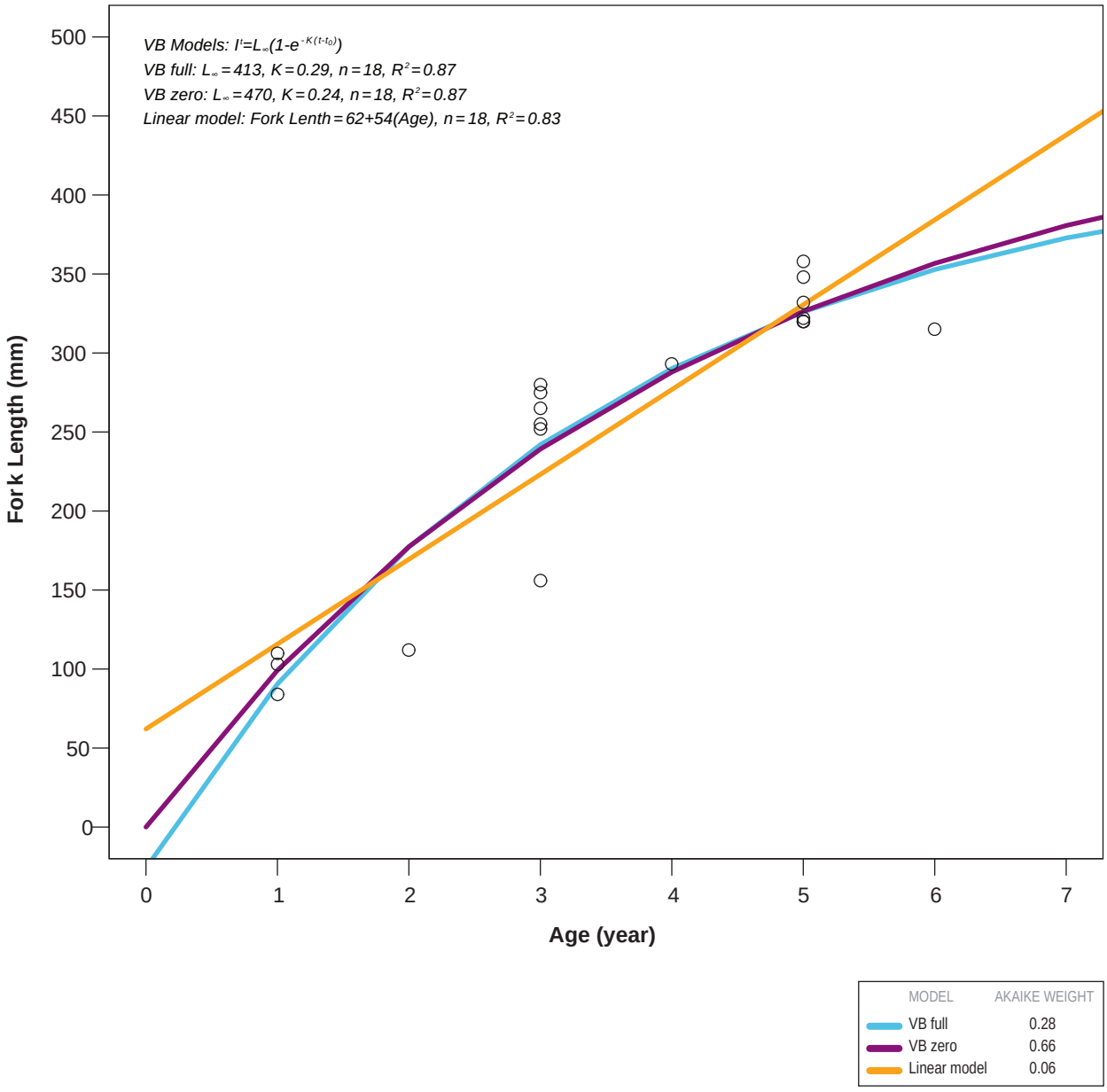


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Age-Frequency Distributions for Fish Captured in Lakes in the Back River Project Area, 2012

Figure 3.3-30

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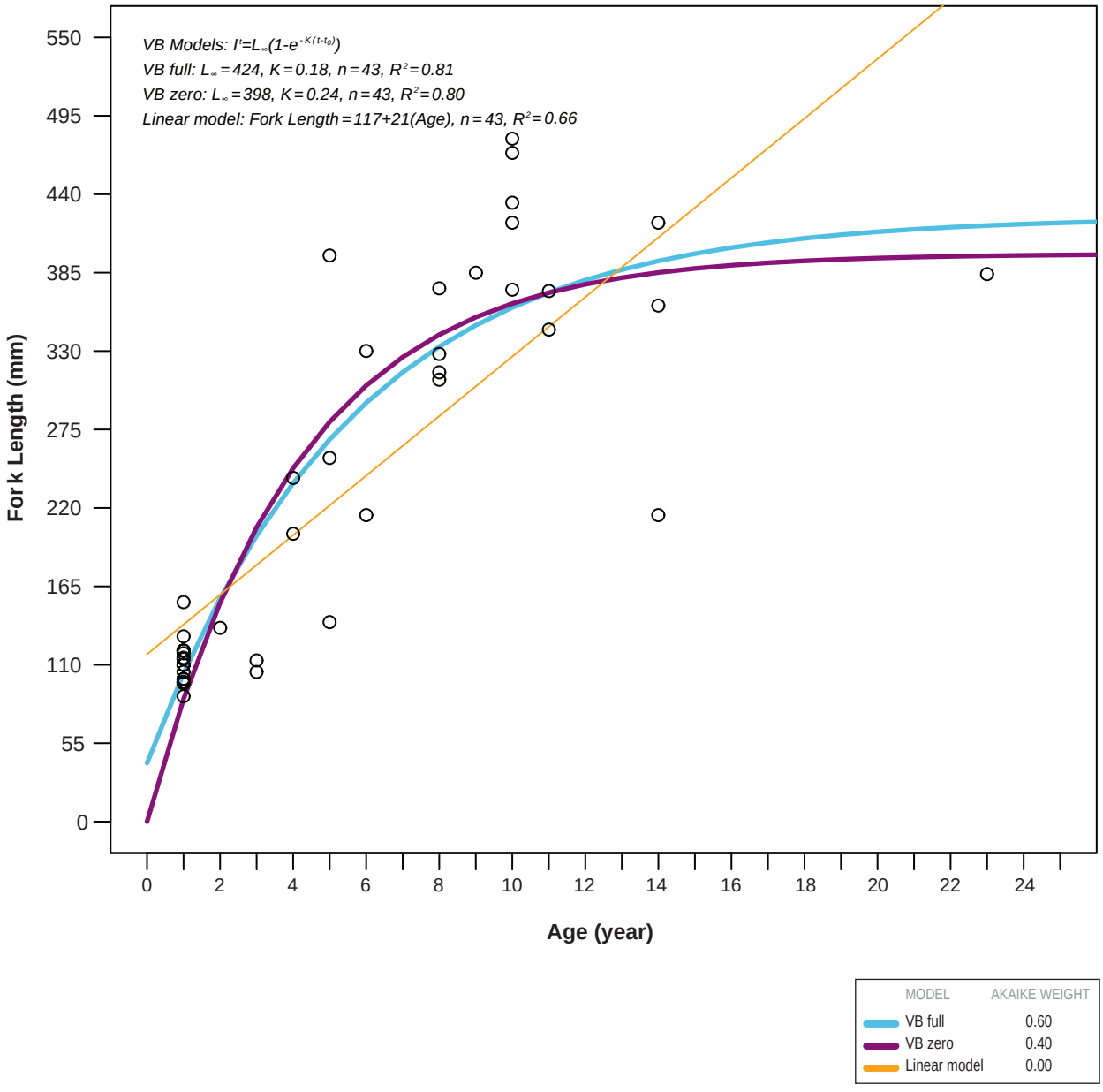


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Von Bertalanffy Growth Model for Arctic Grayling Captured in the Back River Project Area, 2012

Figure 3.3-31

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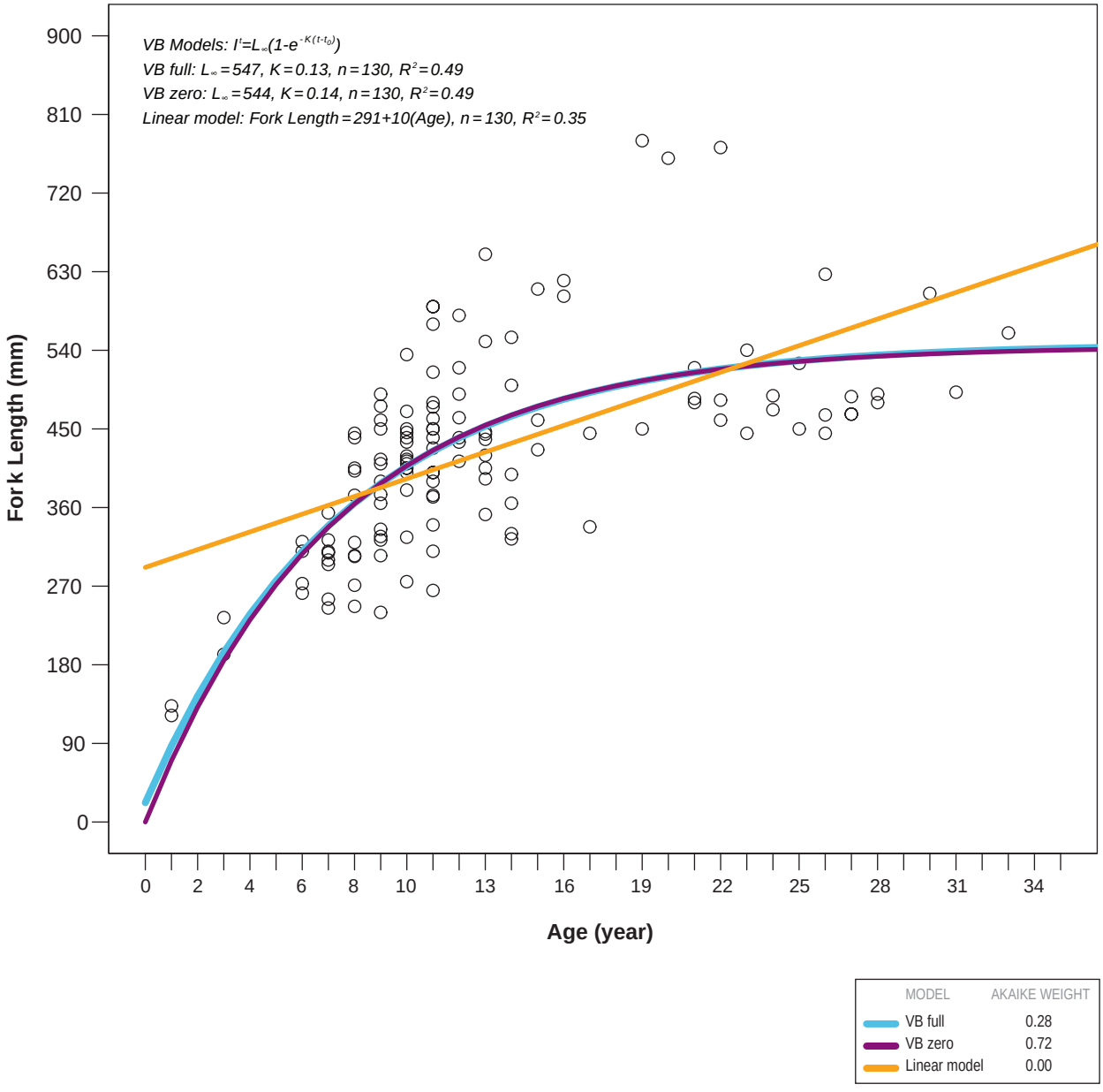


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Von Bertalanffy Growth Model for Round Whitefish in the Back River Project Area, 2012

Figure 3.3-32

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Von Bertalanffy Growth Model for Lake Trout Captured in the Back River Project Area, 2012

Figure 3.3-33

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A total of 130 lake trout ranging in age from 1 to 32 were included in the von Bertalanffy model. The modified equation with t_0 fixed at zero had the highest Akaike weight (0.72) and R^2 value (0.49), and both of the parameters in the equation were highly significant ($P < 0.01$). The model predicted an asymptotic length of 544 mm with a growth coefficient of 0.14 $years^{-1}$.

A total of 43 round whitefish were included in the von Bertalanffy model for the Back River Project area. The full von Bertalanffy model resulted in the best fit based on Akaike weight (0.60) and R^2 value (0.81); however, only two of the three parameters in the model (L_∞ and K) were significant ($P < 0.01$). The model predicted an asymptotic length of 424 mm and a growth coefficient of 0.18 $years^{-1}$. The model estimated t_0 as -0.57 years; however, this was not significant ($P = 0.24$).

A Pearson product-moment correlation analysis was conducted on lake trout data from the Back River Project area. Data for Reference B Lake was not included because of a scale malfunction, and some other fish were excluded from the analysis because they were sexually immature. When each site was examined independently, there was no significant relationship between lake trout total weight and gonad weight. When all of the data was pooled together, there was a slightly significant positive relationship between lake trout total weight and gonad weight for females ($n = 11$, $P < 0.05$), but no significant relationship for males ($n = 5$, $P = 0.76$). Too few mature round whitefish were captured to conduct an analysis of gonad weight and total weight for this species.

Tissue Metals

Results of the tissue metal analyses are presented in Appendix 3.3-4. Replicate and quality control results are presented in Appendices 3.3-5 and 3.3-6. Of the 25 metals included in the tissue quality analysis for lake trout, 13 occurred below the detection limit for the majority of samples from each site. Cobalt and thallium occurred above the detection limit in samples from George Lake, but not in samples from other lakes. Due to errors with the scale used in the field at some lakes, weight data was not accurate for some fish; therefore, length was used as a surrogate for fish size to compare concentrations of tissue metals. Table 3.3-10 presents a summary of the mean tissue metal concentrations for lake trout in surveyed lakes in 2012.

A Pearson product moment correlation analysis indicated that lake trout fork length was significantly correlated with the concentrations of four metals: calcium ($P < 0.01$), magnesium ($P < 0.01$), strontium ($P < 0.01$), and zinc ($P < 0.01$). Further analysis indicated a significant difference in the concentration of calcium across all given lengths (ANCOVA, $F_{4,32} = 2.96$, $P < 0.05$); however, the small sample size may inhibit the power of the analysis. Similarly, zinc concentrations in lake trout tissues differed significantly across all given lengths (ANCOVA, $F_{4,32} = 9.17$, $P < 0.01$). For the remaining metals, a significant interaction between lake and fork length had a significant effect on the concentration of metals in lake trout tissues, indicating that the relationship between fish weight and tissue metal concentrations differed among lakes and could not be compared. Again, low sample numbers from each waterbody may limit the power of these analyses. Table 3.3-11 presents a summary of the statistical results from general linear models, ANOVAs and ANCOVAs conducted on tissue metal data.

Arsenic, selenium, and mercury did not show a significant relationship with fish weight, yet concentrations of these metals in lake trout tissues differed among lakes. Concentrations of arsenic in lake trout tissues were significantly higher in George Lake than in all other lakes, and significantly lower in Reference B Lake than in all other lakes (ANOVA, $F_{4,33} = 37.89$, $P < 0.01$). Concentrations of selenium in lake trout tissues were higher in George Lake than all other lakes, and lower in Reference C Lake than all other lakes (ANOVA, $F_{4,44} = 56.12$, $P < 0.01$).). Mercury concentrations in lake trout tissues were highest in Reference B Lake and Goose Lake, and lowest in George Lake (ANOVA;

Table 3.3-10. Summary of Mean Tissue Metal Concentrations in Lake Trout, 2012

Variable	Units	Detection Limit	George (n = 8)				Goose (n = 4)				Llama (n = 5)			
			Mean	SE	Min	Max	Mean	SE	Min	Max	Mean	SE	Min	Max
Fork Length	mm	1	519	39	426	772	405	19	335	450	334	18	265	405
Moisture	%	0.1	76.0	0.7	72.1	78.8	75.9	0.4	75.0	77.6	76.0	0.2	75.4	76.7
Arsenic	mg/kg wwt	0.010	0.099	0.015	0.031	0.156	0.030	0.001	0.028	0.031	0.042	0.006	0.014	0.057
Barium	mg/kg wwt	0.010	0.027	0.013	0.011	0.114	0.022	0.006	0.005	0.042	0.037	0.008	0.014	0.067
Calcium	mg/kg wwt	2.0	61.6	4.4	43.5	81.5	87.8	4.1	70.8	95.4	242.6	52.8	118.0	434.0
Cobalt	mg/kg wwt	0.020	0.084	0.010	0.055	0.139	<0.020	0.000	<0.020	<0.020	<0.020	0.000	<0.020	<0.020
Copper	mg/kg wwt	0.010*	0.357	0.031	0.248	0.503	0.234	0.022	0.169	0.317	0.234	0.025	0.163	0.352
Lead	mg/kg wwt	0.02	<0.02	0.00	<0.02	0.04	0.05	0.01	<0.02	0.07	<0.02	0.00	<0.02	0.03
Magnesium	mg/kg wwt	1.0	270.0	7.2	240.0	301.0	280.5	6.3	262.0	300.0	285.2	6.4	262.0	312.0
Manganese	mg/kg wwt	0.010	0.126	0.010	0.086	0.173	0.095	0.001	0.091	0.097	0.149	0.019	0.082	0.211
Mercury	mg/kg wwt	0.0050	0.0834	0.0162	0.0319	0.1410	0.2240	0.0153	0.1630	0.2600	0.1682	0.0119	0.1230	0.2080
Selenium	mg/kg wwt	0.20	0.45	0.01	0.38	0.51	0.33	0.01	0.32	0.35	0.35	0.01	0.32	0.41
Strontium	mg/kg wwt	0.010	0.057	0.006	0.025	0.080	0.095	0.008	0.060	0.110	0.298	0.074	0.111	0.566
Thallium	mg/kg wwt	0.010	0.014	0.002	<0.010	0.019	0.007	0.001	<0.010	0.011	<0.010	0.000	<0.010	0.005
Zinc	mg/kg wwt	0.10	3.35	0.09	2.99	3.68	3.45	0.13	3.08	3.98	5.71	0.37	4.14	6.77
Fork Length	mm	1	451	22	324	525	482	35	330	627	405	n/a	405	405
Moisture	%	0.1	78.1	0.5	75.7	79.9	76.4	0.4	74.2	78.0	75.4	n/a	75.4	75.4
Arsenic	mg/kg wwt	0.010	0.007	0.001	<0.010	0.013	0.041	0.008	0.014	0.072	0.025	n/a	0.025	0.025
Barium	mg/kg wwt	0.010	0.031	0.010	<0.010	0.103	0.015	0.005	0.005	0.041	0.011	n/a	0.011	0.011
Calcium	mg/kg wwt	2.0	95.9	14.7	49.0	175.0	83.9	19.8	53.3	230.0	52.1	n/a	52.1	52.1
Cobalt	mg/kg wwt	0.020	0.011	0.001	<0.020	0.021	<0.020	0.000	<0.020	<0.020	<0.020	n/a	<0.020	<0.020
Copper	mg/kg wwt	0.010*	0.241	0.034	0.100	0.419	0.421	0.037	0.265	0.564	0.296	n/a	0.296	0.296
Lead	mg/kg wwt	0.02	0.06	0.03	<0.02	0.31	<0.02	0.00	<0.02	<0.02	0.02	n/a	0.02	0.02
Magnesium	mg/kg wwt	1.0	263.8	5.3	241.0	287.0	286.1	5.6	256.0	305.0	270.0	n/a	270.0	270.0
Manganese	mg/kg wwt	0.010	0.109	0.007	0.088	0.155	0.117	0.009	0.093	0.170	0.114	n/a	0.114	0.114
Mercury	mg/kg wwt	0.0050	0.2269	0.0397	0.1080	0.4560	0.1765	0.0418	0.0478	0.4300	0.1150	n/a	0.1150	0.1150
Selenium	mg/kg wwt	0.20	0.34	0.01	0.29	0.38	0.23	0.01	0.20	0.27	0.32	n/a	0.32	0.32
Strontium	mg/kg wwt	0.010	0.089	0.014	0.030	0.159	0.018	0.003	0.011	0.027	0.060	n/a	0.060	0.060
Thallium	mg/kg wwt	0.010	<0.010	0.000	<0.010	<0.010	<0.010	0.000	<0.010	<0.010	<0.010	n/a	<0.010	<0.010
Zinc	mg/kg wwt	0.10	3.65	0.13	3.17	4.27	3.86	0.22	3.09	5.37	3.67	n/a	3.67	3.67

n = number of samples, SE = standard error of the mean, min = minimum, max = maximum, wwt = wet weight

** Detection limit for one sample in Reference B Lake was raised to 0.2 due to detection of analyte at comparable level in Method Blank.*

Table 3.3-11. Summary of Statistical Results for Lake Trout Tissue Metal Analyses

Variable	Lake	Fork Length	Fork Length x Lake	Result
Arsenic	P<0.01	P=0.29	N/A	Significant difference among lakes
Barium	P=0.26	P=0.18	P=0.15	No significant differences
Calcium	P<0.05	P<0.05	P=0.34	Significant difference in concentration at length
Copper	P=0.84	P=0.14	N/A	No significant differences
Magnesium	P<0.05	P<0.05	P<0.05	Significant interaction. No further analysis possible.
Manganese	P=0.86	P=0.18	N/A	No significant differences
Mercury	P<0.01	P<0.01	P=0.85	Significant difference in concentration at length
Selenium	P<0.01	P=0.27	P=0.28	Significant difference among lakes
Strontium	P<0.01	P=0.36	P<0.01	Significant interaction. No further analysis possible.
Zinc	P<0.01	P<0.05	P=0.19	Significant difference in concentration at length

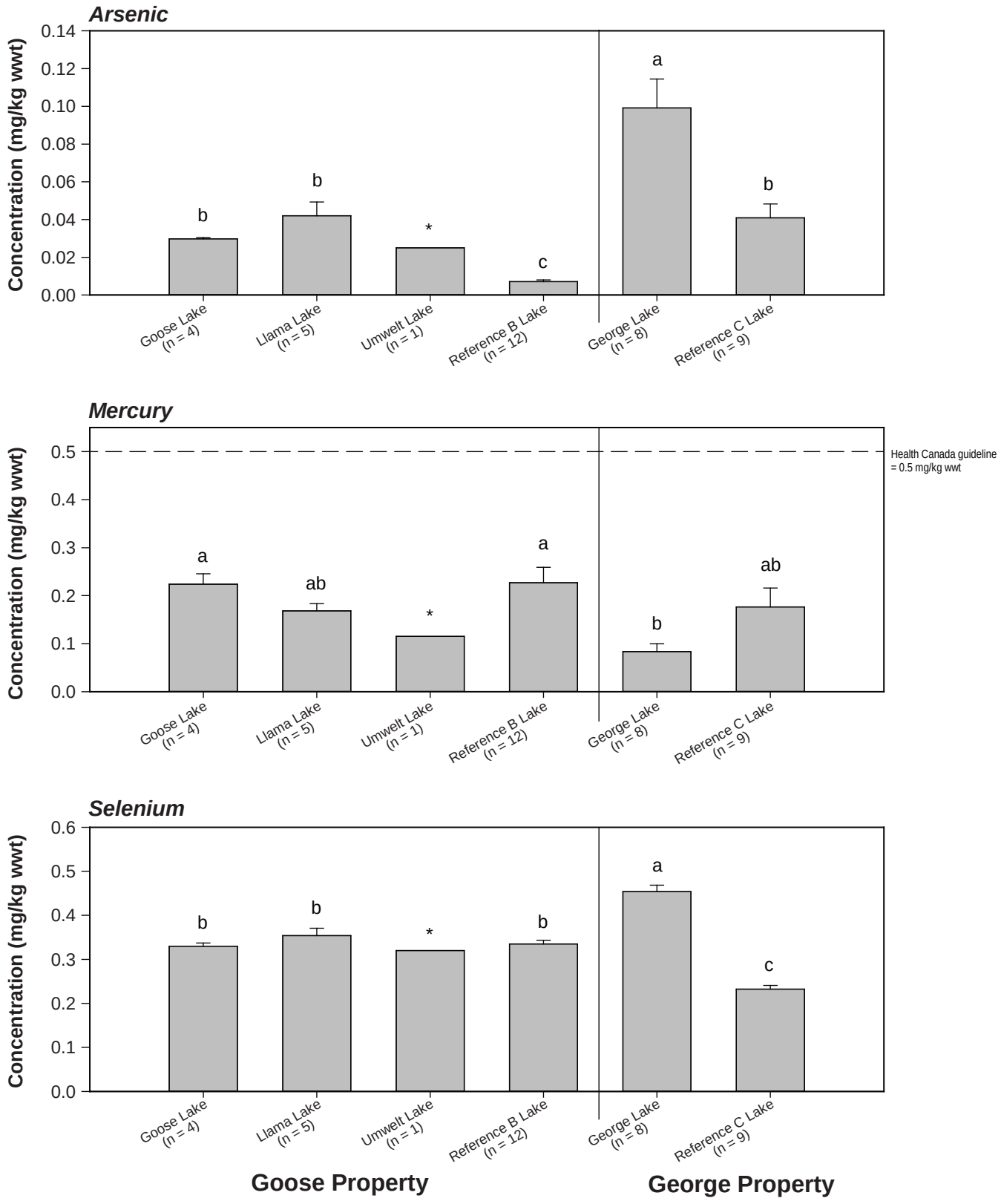
$F_{4,33}$ = 5.55, P < 0.01). Mercury concentrations in lake trout from all lakes were lower than the Health Canada guideline of 0.50 mg/kg wwt for maximum total mercury in fish tissue (CCME 1999; Health Canada 2011). Mercury is the only metal for which Health Canada or CCME guidelines exist for fish tissue (CCME 1999; Health Canada 2011). Figure 3.3-34 illustrates the differences among lakes in arsenic, selenium, and mercury concentrations in lake trout tissue.

Thirteen metals included in the tissue analysis for round whitefish occurred below the method detection limit for the majority of samples from each site. Aluminum and cobalt occurred above the detection limit in fish from Llama Lake, but not in fish from Reference B Lake. Due to errors with the scale used in the field at some lakes, weight data was not accurate for some fish; therefore, length was used as a surrogate for fish size to compare concentrations of tissue metals. Only one round whitefish was captured in Gander Lake, so this lake was not included in statistical analyses. Table 3.3-12 presents a summary of the mean tissue metal concentrations for round whitefish in Project area lakes in 2012.

A Pearson product moment correlation analysis indicated that round whitefish fork length was not significantly correlated with the tissue concentration of any metals. Significant differences in round whitefish tissue metal concentrations occurred for arsenic (ANOVA, $F_{1,13}$ = 24.57, P < 0.01), manganese ($F_{1,13}$ = 7.39, P < 0.05), selenium ($F_{1,13}$ = 5.25, P < 0.05), and barium ($F_{1,13}$ = 4.60, P = 0.05). There were no significant differences in mercury concentrations in round whitefish tissue, and mercury concentrations were below the Health Canada guideline of 0.50 mg/kg wwt in all round whitefish samples tested. Mercury is the only metal for which Health Canada or CCME guidelines exist for fish tissue (CCME 1999; Health Canada 2011). Figure 3.3-35 presents the relative concentrations of these metals in round whitefish tissues from Gander, Llama and Reference B Lakes.

Diet

Appendix 3.3-7 presents the results of the diet analyses for all fish sampled in 2012. Lake trout diet in most lakes was dominated numerically by Chironomid (midge) larvae, which made up between 25% and 87% of the total diet (Figure 3.3-36). Bivalves from the family Veneroida dominated the diet of fish from George Lake (32.5%) and were also present in smaller proportions in the stomachs of lake trout from Goose Lake, Reference C Lake, and Reference B Lake; however, they did not appear in the stomachs of fish from Llama Lake. Zooplankton such as cladocerans were also present in relatively large numbers in most lakes, making up between 4 and 35% of the diet (Plate 3.3-24). Lake trout from Goose Lake and Reference C Lake also ate larger proportions of Trichoptera (caddisflies), while fish from Llama Lake and Reference C Lake ate large numbers of copepods. Fish were present in the diets of lake trout from all of the lakes except George Lake and although they made up a small proportion of the diet numerically, because of their relatively large size they may make up a large proportion of the biomass in the diet.



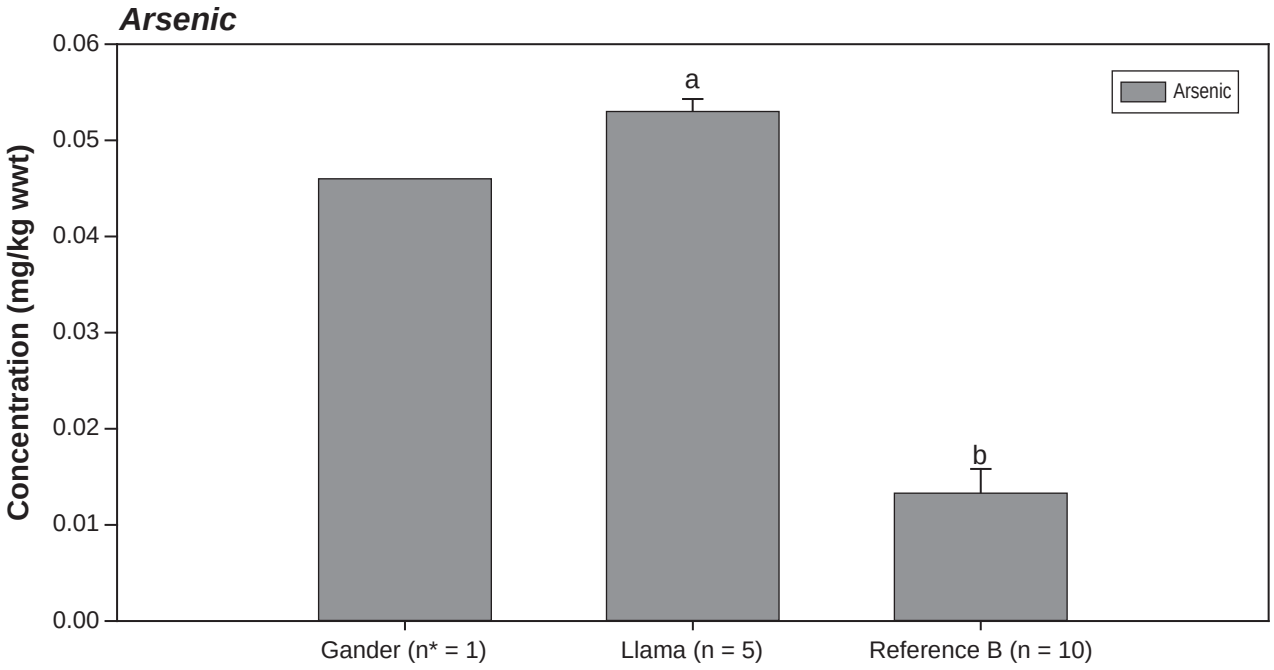
*Notes: *Umwelt Lake was not included in statistical analyses because only one fish was caught.*
Letters indicate significant differences among lakes.

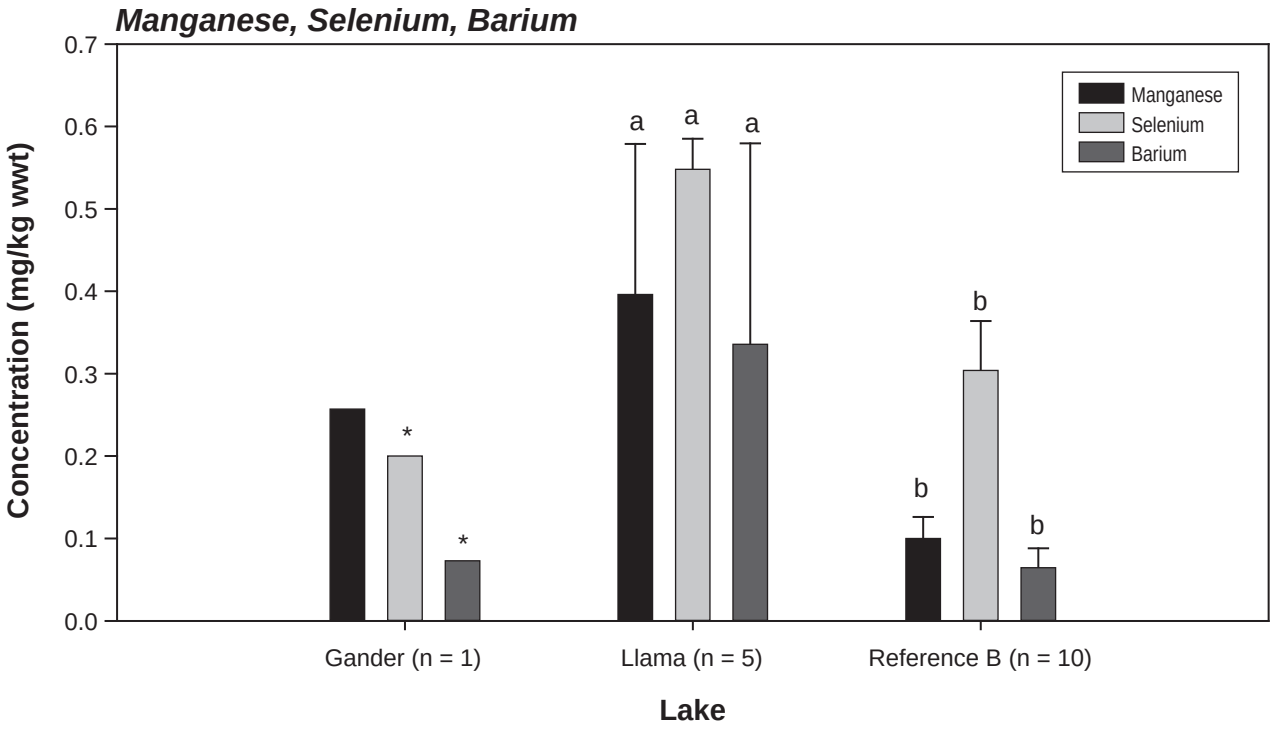
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Mean Tissue Concentrations of Arsenic, Mercury and Selenium in Lake Trout from Select Lakes 2012

Figure 3.3-34

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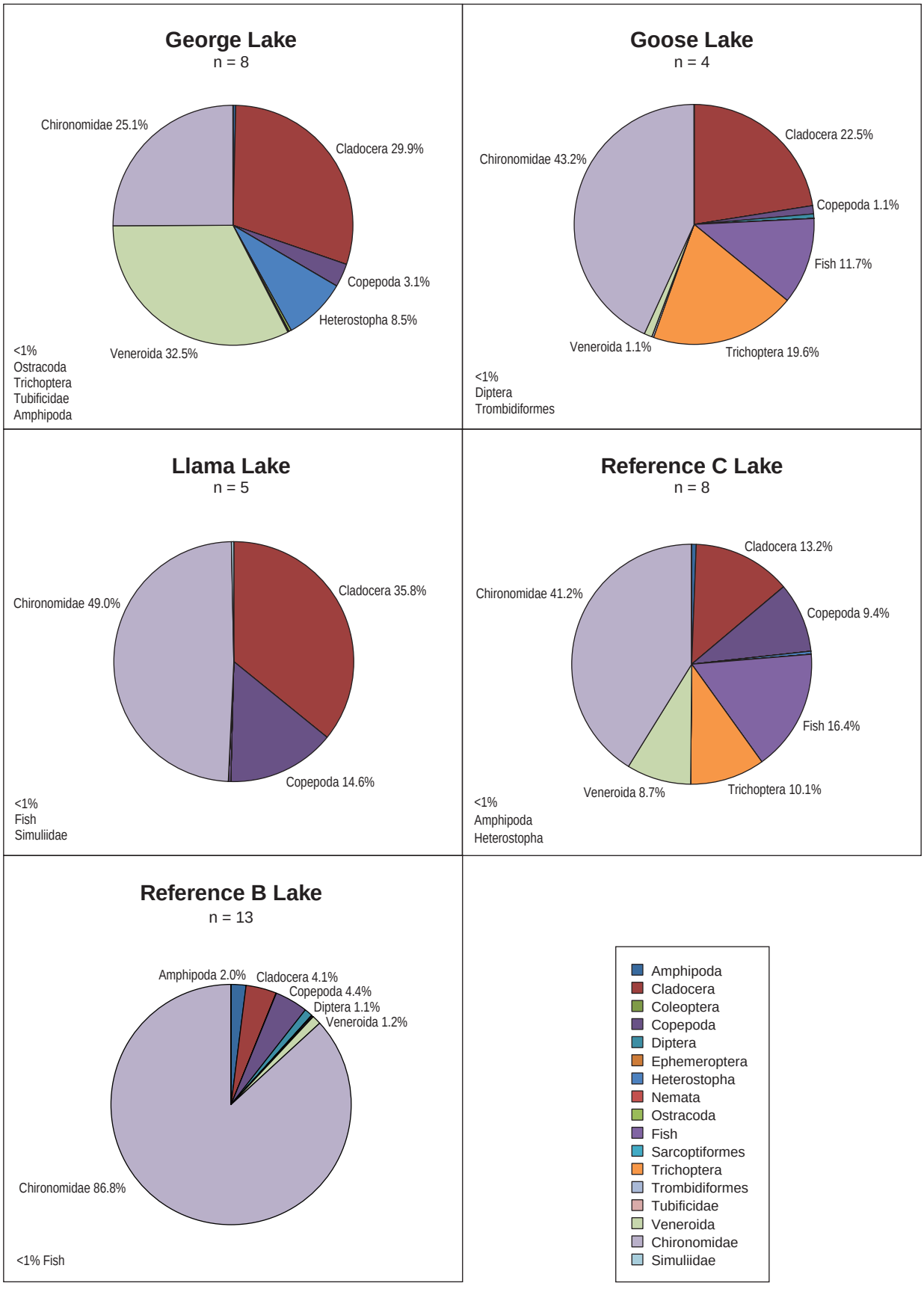
Notes: Error bars indicated standard error of the mean.
** Gander Lake was excluded from statistical analyses because only one fish was analyzed.*
Letters indicate significant differences among lakes.

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Mean Tissue Metal Concentrations in Round Whitefish from Select Lakes, 2012

Figure 3.3-35

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Mean Percent Composition (by Number) of the Stomach Contents of Lake Trout from the Back River Project Area, 2012

Figure 3.3-36

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Table 3.3-12. Summary of Mean Tissue Metal Concentrations in Round Whitefish, 2012

Variable	Units	Detection Limit	Gander (n = 2)				Llama (n = 5)				Reference B (n = 10)			
			Mean	SE	Min	Max	Mean	SE	Min	Max	Mean	SE	Min	Max
Moisture	%	0.10	75.15	0.55	74.60	75.70	74.96	0.18	74.30	75.40	74.85	0.51	72.40	78.30
Aluminum	mg/kg wwt	2.0	7.8	3.2	4.6	10.9	11.1	8.3	2.4	44.3	<2.0	0.0	<2.0	<2.0
Arsenic	mg/kg wwt	0.010	0.044	0.003	0.041	0.046	0.053	0.001	0.049	0.057	0.013	0.003	<0.01	0.026
Barium	mg/kg wwt	0.010	0.114	0.041	0.073	0.155	0.336	0.244	0.057	1.310	0.065	0.024	<0.01	0.257
Calcium	mg/kg wwt	2.0	219.0	92.0	127.0	311.0	258.4	35.7	131.0	312.0	165.4	49.7	19.2	533.0
Cobalt	mg/kg wwt	0.020	0.041	0.008	0.033	0.049	0.029	0.004	0.022	0.046	<0.020	0.000	<0.020	<0.020
Copper	mg/kg wwt	0.010	0.521	0.009	0.512	0.530	0.234	0.012	0.203	0.263	0.206	0.048	0.040	0.421
Magnesium	mg/kg wwt	1.0	322.0	21.0	301.0	343.0	343.0	8.3	326.0	371.0	197.9	45.4	30.3	335.0
Manganese	mg/kg wwt	0.010	0.274	0.017	0.257	0.290	0.396	0.183	0.126	1.120	0.100	0.026	0.013	0.270
Mercury	mg/kg wwt	0.0050	0.0900	0.0211	0.0689	0.1110	0.0556	0.0145	0.0384	0.1130	0.0515	0.0061	0.0326	0.0933
Selenium	mg/kg wwt	0.20	0.24	0.04	0.20	0.27	0.55	0.04	0.43	0.64	0.30	0.06	<0.20	0.53
Strontium	mg/kg wwt	0.010	0.379	0.234	0.145	0.612	0.436	0.078	0.151	0.554	0.300	0.104	0.035	1.140
Zinc	mg/kg wwt	0.10	6.43	0.63	5.80	7.06	4.36	0.21	3.71	5.01	2.77	0.74	0.40	7.56

n = number of samples, SE = standard error of the mean, min = minimum, max = maximum, wwt = wet weight

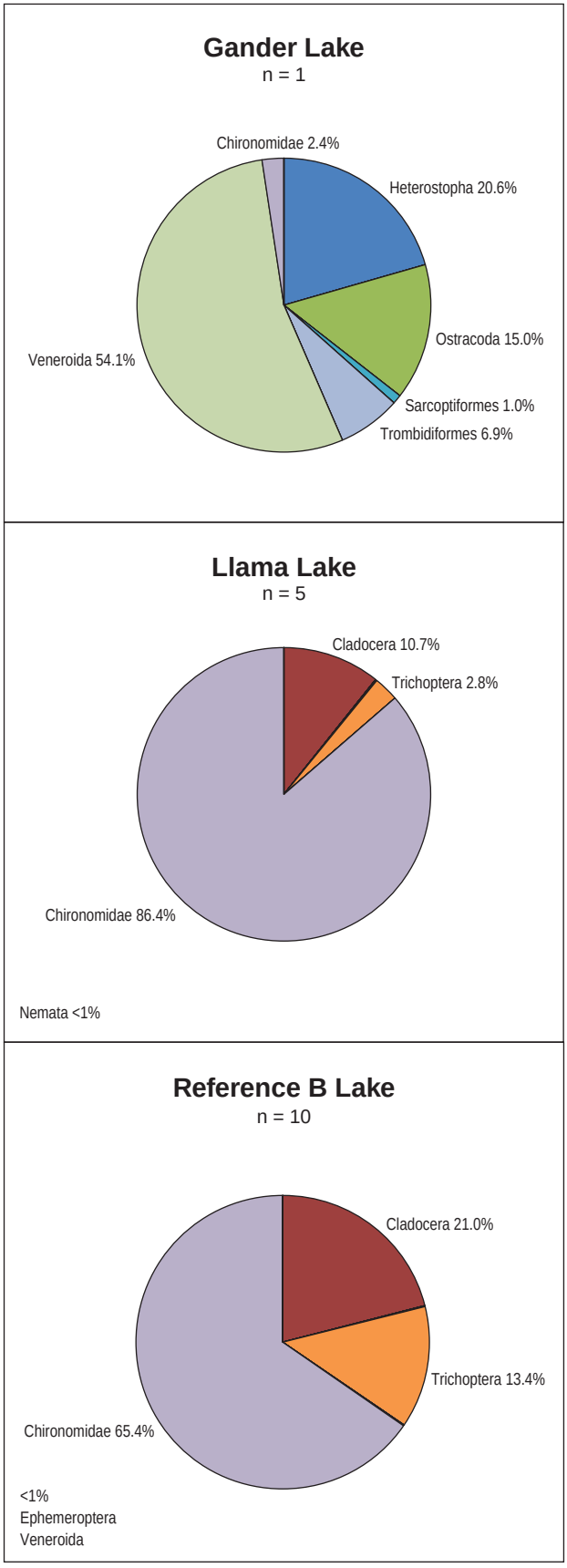


Plate 3.3-24. Zooplankton and bivalves in the stomach contents of an incidental lake trout mortality from Moby Lake.

Round whitefish from Llama Lake and Reference B Lake ate variable diets consisting mainly of Chironomid larvae, cladocerans, and Trichoptera larvae (Figure 3.3-37). Conversely, the single round whitefish captured in Gander Lake had remarkably different stomach contents consisting mainly of bivalves from the family Veneroida and Heterostopha, as well as zooplankton such as ostracods (including individuals from the orders Trombidiformes and Sarcoptiformes). This may indicate that the food chain within Gander Lake is much different from those in Llama and Reference B Lakes; however, it is difficult to know if this is typical due to the single sample.

Parasites

Many of the lake trout and round whitefish sacrificed for tissue metals, as well as fish examined as incidental mortalities, we infected with various types of parasites. Tapeworms were common in the stomach and intestines of fish, particularly lake trout (Plate 3.3-25). Other types of worms and flukes were commonly found in the body cavity outside of the intestinal tract (Plate 3.3-26). Few other indicators of poor fish health were noted. No deformities, lesions or tumours were observed on any fish in the Project area.



Mean Percent Composition (by Number) of the Stomach Contents of Round Whitefish from the Back River Project Area, 2012

Figure 3.3-37

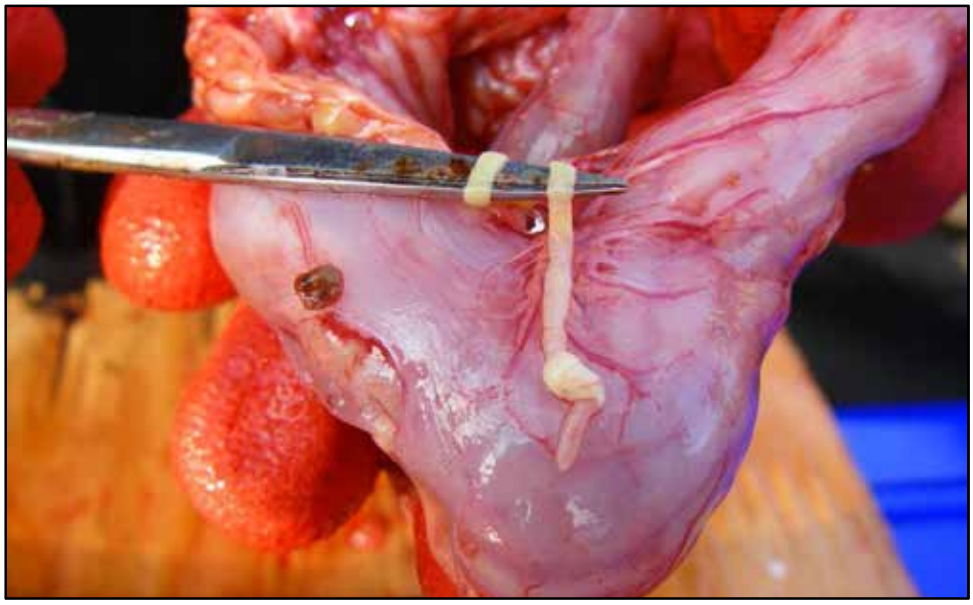


Plate 3.3-25. Tapeworm from the body cavity of a lake trout from George Lake. August 2012.



Plate 3.3-26. Parasites embedded on the stomach wall of a lake trout from Goose Lake. July 2012.

4. Summary

4. Summary

Surveys of stream fish habitat and community composition were conducted at 31 sites along proposed mine roads and receiving environment areas in June and July 2012. Of these, 20 were identified as streams with defined channels and the potential to provide fish habitat. The remaining sites were identified as NCDs with no defined channel and little to no potential to provide fish habitat. The stream sites covered a wide variety of habitat types and stream sizes; however, most of the streams were small, low-gradient drainages with abundant instream cover. Habitat at most of the stream sites was determined to be important, mainly for rearing Arctic grayling and for migration.

Six fish species were captured or observed in Project area streams in 2012: Arctic grayling, lake trout, round whitefish, burbot, ninespine stickleback, and slimy sculpin. Grayling and sculpins were the most commonly captured species in streams. Recently emerged grayling fry were observed in early July in three of the surveyed streams, indicating that these streams are used for spawning and rearing.

A proposed tailings storage area in the Moby Watershed was surveyed in August 2012 using the SHIM. A total of 7.8 km of stream fish habitat was surveyed, 4.1 km of which was on the mainstem of Moby Outflow, while 3.7 km was on tributaries. In total, nine streams or drainages were surveyed. Most of the mainstem of Moby Outflow was characterized as important or critical fish habitat for Arctic grayling, the primary species present. This habitat rating was based on the channel size, abundant cover, and potential for spawning and rearing. Tributaries to Moby Outflow generally had marginal habitat quality due to shallow depths, poorly defined banks, and presence of NCD habitat units. Despite these ratings, juvenile Arctic grayling were observed throughout the streams in the area. The only sections where fish were not observed were the far upper reaches of Moby Outflow and Moby Tributary 2, where cascades and boulder fields block fish passage from downstream areas.

A total of 19 lakes were surveyed for fish habitat and species composition in the Back River Project Area in 2012. At each lake, shoreline substrate and habitat were assessed and a combination of gillnets and beach seines were used to sample for fish. Most of the lakes in the Project area have boulder and cobble-dominated shorelines with sparse aquatic vegetation. The maximum depth of the surveyed lakes ranged from less than 2 m to 16.5 m, but most lakes surveyed had maximum depths of 4 to 6 m.

Based on sampling, visual observations, and connectivity with other lakes, all of the lakes sampled in 2012 were fish-bearing. No fish were captured at Occurrence Lake, Lytle Lake, or Pond 19; however, fish were observed at Pond 19 and have been captured in the past at the other lakes. Of all species, lake trout have the greatest species distribution within the study area. Lake cisco, Arctic char, and longnose sucker were each captured in one lake only. Gander Lake contained the greatest diversity of fish species, with seven species captured. Only one species was captured in Goose Lake, Sleigh Lake and Rascal Lake. Arctic char were only captured at Reference C Lake, which is located approximately 30 km north of the George property, outside of the Project footprint.

References

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Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.

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Appendix 3.1-1
Stream Habitat Data, 2012

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Appendix 3.1-1. Stream Habitat Data, 2012

Stream	Site	Zone	Easting	Northing	Date	Crew	Temp (°C)	pH	Conductivity (uS/cm)	Turbidity	Habitat Number	Habitat Type	Distance from Start	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)	Pool Type	Pool Max Depth (m)
N/A	100	13	432398	7269196	26-Jun-12	KS/QS	10	5.9	43	C	-	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Umwelt Outflow	101	13	431015	7269971	6/26/2012	KS/QS	9.1	6.5	74	C	1	P	0	14	0	1.4	-	8.4	-	5	0	0	80	15	D	1.4
Umwelt Outflow	101	13	431015	7269971	6/26/2012	KS/QS	9.1	6.5	74	C	2	R	14	10	1.5	0.5	-	10.3	-	0	0	0	100	0	-	-
Umwelt Outflow	101	13	431015	7269971	6/26/2012	KS/QS	9.1	6.5	74	C	3	P	24	29	0	1.5	-	16.4	-	0	0	0	40	60	D	1.5
Umwelt Outflow	101	13	431015	7269971	6/26/2012	KS/QS	9.1	6.5	74	C	4	R	53	53	2	0.4	-	10	-	0	0	0	25	75	-	-
Fox Outflow	102	13	430059	7269546	6/26/2012	KS/QS	16.6	7	10	C	1	R	0	9.3	2	0.2	0.4	1.5	1.6	0	0	10	90	0	-	-
Fox Outflow	102	13	430059	7269546	6/26/2012	KS/QS	16.6	7	10	C	2	P	9.3	9	0	0.6	0.65	2.8	3	40	50	10	0	0	S	0.6
Fox Outflow	102	13	430059	7269546	6/26/2012	KS/QS	16.6	7	10	C	3	R	18.3	4	2	0.3	0.5	1.8	2.2	50	0	0	50	0	-	-
Fox Outflow	102	13	430059	7269546	6/26/2012	KS/QS	16.6	7	10	C	4	P	22.3	6.8	0	0.6	0.7	3.3	3.8	50	0	10	40	0	S	0.68
Fox Outflow	102	13	430059	7269546	6/26/2012	KS/QS	16.6	7	10	C	5	R	29.1	15.6	2	0.2	0.35	3.1	4.2	30	0	10	60	0	-	-
Fox Outflow	102	13	430059	7269546	6/26/2012	KS/QS	16.6	7	10	C	6	G	44.7	5.5	0	0.4	0.6	3.7	4.1	75	0	0	25	0	-	-
Fox Outflow	102	13	430059	7269546	6/26/2012	KS/QS	16.6	7	10	C	7	R	50.2	15.5	2.5	0.2	0.35	2.9	2.9	0	10	60	30	0	-	-
Llama Outflow	103	13	428829	7277464	6/27/2012	KS/QS	8.2	6.8	81	C	1	R	0	25.7	2	0.15	0.2	3.8	4.4	0	60	35	5	0	-	-
Llama Outflow	103	13	428829	7277464	6/27/2012	KS/QS	8.2	6.8	81	C	2	G	25.7	48.5	1	0.25	0.35	2.9	2.9	0	30	40	30	0	-	-
Llama Outflow	103	13	428829	7277464	6/27/2012	KS/QS	8.2	6.8	81	C	3	R	74.2	8.4	2	0.15	0.25	7	7	60	0	35	5	0	-	-
Llama Outflow	103	13	428829	7277464	6/27/2012	KS/QS	8.2	6.8	81	C	4	G	82.6	4.4	0	0.3	0.4	7.3	7.3	60	10	20	10	0	-	-
Llama Outflow	103	13	428829	7277464	6/27/2012	KS/QS	8.2	6.8	81	C	5	R	87	23.4	1	0.2	0.3	2.9	2.9	0	5	65	30	0	-	-
Fox Outflow	104	13	431023	7268053	6/26/2012	KS/QS	10.1	7.1	8	C	1	P	0	4.5	0	0.4	0.5	3.7	3.7	10	10	0	50	30	S	0.55
Fox Outflow	104	13	431023	7268053	6/26/2012	KS/QS	10.1	7.1	8	C	2	C	4.5	7	10	0.15	0.2	7	7.4	0	0	0	100	0	-	-
Fox Outflow	104	13	431023	7268053	6/26/2012	KS/QS	10.1	7.1	8	C	3	R	11.5	12	3	0.2	0.4	13	13	0	0	0	100	0	-	-
Fox Outflow	104	13	431023	7268053	6/26/2012	KS/QS	10.1	7.1	8	C	4	G	23.5	14	0	0.3	0.5	18.5	20.3	0	0	0	100	0	-	-
Fox Outflow	104	13	431023	7268053	6/26/2012	KS/QS	10.1	7.1	8	C	5	R	37.5	24	1.5	0.15	0.25	12.8	12.8	0	0	10	90	0	-	-
Fox Outflow	104	13	431023	7268053	6/26/2012	KS/QS	10.1	7.1	8	C	6	C	61.5	13.5	10	0.2	0.35	6.8	9.5	0	0	0	100	0	-	-
Fox Outflow	104	13	431023	7268053	6/26/2012	KS/QS	10.1	7.1	8	C	7	G	75	7	0	0.3	0.4	12.3	12.3	0	0	0	100	0	-	-
Fox Outflow	104	13	431023	7268053	6/26/2012	KS/QS	10.1	7.1	8	C	8	R	82	12.5	2	0.2	0.3	6.1	6.9	0	0	10	90	0	-	-
Fox Outflow	104	13	431023	7268053	6/26/2012	KS/QS	10.1	7.1	8	C	9	G	94.5	8.5	1	0.3	0.4	7.1	7.1	10	0	0	90	0	-	-
N/A	105	-	-	-	-	-	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N/A	106	13	429600	7267000	6/27/2012	KS/QS	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N/A	107	13	429834	7267528	6/27/2012	KS/QS	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N/A	108	13	428069	7266592	6/28/2012	KS/QS	11	6.9	12	C	1	G	0	6.4	1	0.25	0.3	5	7	90	0	0	10	0	-	-
N/A	108	13	428069	7266592	6/28/2012	KS/QS	11	6.9	12	C	2	R	6.4	11	2	0.25	0.3	1.3	1.3	0	20	0	80	0	-	-
N/A	108	13	428069	7266592	6/28/2012	KS/QS	11	6.9	12	C	3	G	17.4	25	0	0.2	0.25	3.5	5	85	10	0	5	0	-	-
N/A	108	13	428069	7266592	6/28/2012	KS/QS	11	6.9	12	C	4	R	42.4	13.5	2	0.3	0.35	0.8	1.1	95	0	0	5	0	-	-
N/A	108	13	428069	7266592	6/28/2012	KS/QS	11	6.9	12	C	5	BG	55.9	12	3	0	0	0	0	0	0	0	100	0	-	-
N/A	108	13	428069	7266592	6/28/2012	KS/QS	11	6.9	12	C	6	P	67.9	6.5	0	0.3	0.4	2.6	4	95	0	0	5	0	D	0.4
N/A	108	13	428069	7266592	6/28/2012	KS/QS	11	6.9	12	C	7	R	74.4	8.3	2	0.1	0.15	0.6	0.6	90	0	0	10	0	-	-
N/A	108	13	428069	7266592	6/28/2012	KS/QS	11	6.9	12	C	8	G	82.7	13.5	0	0.1	0.15	1	0.9	0	0	0	100	0	-	-
N/A	108	13	428069	7266592	6/28/2012	KS/QS	11	6.9	12	C	9	P	96.2	8.5	0	0.8	0.6	4	4.3	20	0	0	80	0	D	0.8
N/A	108	13	428069	7266592	6/28/2012	KS/QS	11	6.9	12	C	10	BG	104.7	24	2	0	0	0	0	0	0	0	100	0	-	-
N/A	109	13	426453	7266125	6/28/2012	KS/QS	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N/A	110	13	425750	7265441	6/28/2012	KS/QS	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N/A	111	13	425063	7265478	6/28/2012	KS/QS	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N/A	112	13	424660	7265705	6/28/2012	KS/QS	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose Inflow	113	13	434345	7269776	6/29/2012	KS/QS	11.6	7.1	7	C	1	R	0	35	1	0.3	0.5	9.8	9.8	0	10	30	60	0	-	-
Goose Inflow	113	13	434345	7269776	6/29/2012	KS/QS	11.6	7.1	7	C	2	C	35	30	4	0.25	0.4	3.2	3.2	0	20	10	70	0	-	-

Appendix 3.1-1. Stream Habitat Data, 2012

Stream	Site	Zone	Easting	Northing	Date	Crew	Temp (°C)	pH	Conductivity (uS/cm)	Turbidity	Habitat Number	Habitat Type	Distance from Start	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)	Pool Type	Pool Max Depth (m)
Goose Inflow	113	13	434345	7269776	6/29/2012	KS/QS	11.6	7.1	7	C	3	G	65	18	0	0.4	0.5	2.4	2.3	0	60	20	20	0	-	-
Goose Inflow	113	13	434345	7269776	6/29/2012	KS/QS	11.6	7.1	7	C	4	R	83	13.5	1	0.25	0.4	3.2	3	5	0	0	95	0	-	-
Goose Inflow	113	13	434345	7269776	6/29/2012	KS/QS	11.6	7.1	7	C	5	G	96.5	20	0	0.6	0.7	4.3	4.3	75	0	0	25	0	-	-
Goose Inflow	113	13	434345	7269776	6/29/2012	KS/QS	11.6	7.1	7	C	6	R	116.5	12	1	0.3	0.4	2.9	2.9	0	0	0	100	0	-	-
Gander River	114	13	424323	7266180	6/29/2012	KS/QS	11.2	7	10	C	1	R	0	120	2	0.3	0.5	17	25.5	0	0	30	70	0	-	-
Gander River	114	13	424323	7266180	6/29/2012	KS/QS	11.2	7	10	C	2	G	120	11.6	0	0.5	0.7	21.5	27	0	10	30	60	0	-	-
Gander River	114	13	424323	7266180	6/29/2012	KS/QS	11.2	7	10	C	3	R	131.6	56	1.5	0.3	0.5	42	50	0	0	30	70	0	-	-
Gander River	114	13	424323	7266180	6/29/2012	KS/QS	11.2	7	10	C	4	G	187.6	79	0	0.6	0.7	20	25	0	0	10	90	0	-	-
Gander River	114	13	424323	7266180	6/29/2012	KS/QS	11.2	7	10	C	5	R	266.6	30	2	0.4	0.5	19	24	0	0	0	100	0	-	-
Gander River	114	13	424323	7266180	6/29/2012	KS/QS	11.2	7	10	C	6	G	296.6	74	0	0.6	0.7	17.3	24.5	0	20	30	50	0	-	-
Gander River	115	13	423420	7264549	6/29/2012	KS/QS	11.1	7	10	C	1	G	0	200	0	0.7	1	50	50	95	0	0	5	0	-	-
Moby Creek	117	13	420271	7266861	6/29/2012	KS/QS	10.2	6.6	20	C	1	PD	0	42	0	1	1.3	21	23	70	0	0	20	10	-	-
Moby Creek	117	13	420271	7266861	6/29/2012	KS/QS	10.2	6.6	20	C	2	C	42	9	5	0.15	0.35	4.5	6	0	5	20	75	0	-	-
Moby Creek	117	13	420271	7266861	6/29/2012	KS/QS	10.2	6.6	20	C	3	P	51	7.7	0	0.4	0.6	7	7.3	0	0	30	60	10	S	0.5
Moby Creek	117	13	420271	7266861	6/29/2012	KS/QS	10.2	6.6	20	C	4	R	58.7	7.7	2	0.15	0.35	13	13.4	0	0	10	90	0	-	-
Moby Creek	117	13	420271	7266861	6/29/2012	KS/QS	10.2	6.6	20	C	5	G	66.4	8.5	0	0.3	0.5	9.7	11.5	0	0	25	70	5	-	-
Moby Creek	117	13	420271	7266861	6/29/2012	KS/QS	10.2	6.6	20	C	6	R	74.9	12	2	0.2	0.4	7.9	12.5	0	0	20	80	0	-	-
Moby Creek	117	13	420271	7266861	6/29/2012	KS/QS	10.2	6.6	20	C	7	C	86.9	20.7	6	0.2	0.5	3.1	9	0	0	0	50	50	-	-
Moby Creek	117	13	420271	7266861	6/29/2012	KS/QS	10.2	6.6	20	C	8	R	107.6	18	1	0.15	0.35	3.7	4	0	0	20	80	0	-	-
Moby Creek	117	13	420271	7266861	6/29/2012	KS/QS	10.2	6.6	20	C	9	P	125.6	3	0	0.5	0.7	2.2	3.7	0	0	0	50	50	S	0.7
Moby Creek	117	13	420271	7266861	6/29/2012	KS/QS	10.2	6.6	20	C	10	C	128.6	12	11	0.2	0.4	1.6	2	0	0	0	10	90	-	-
Moby Creek	117	13	420271	7266861	6/29/2012	KS/QS	10.2	6.6	20	C	11	R	140.6	29	0	0.3	0.4	10.7	14	5	0	5	50	40	-	-
Moby Creek	118	13	422082	7266114	6/30/2012	KS/QS	10.6	6.6	18	C	1	R	0	30	3	0.25	0.4	3.1	2.5	0	0	10	90	0	-	-
Moby Creek	118	13	422082	7266114	6/30/2012	KS/QS	10.6	6.6	18	C	2	G	30	54	0	0.4	0.7	3.9	4	50	0	0	50	0	-	-
Moby Creek	118	13	422082	7266114	6/30/2012	KS/QS	10.6	6.6	18	C	3	P	84	40	0	1	1.3	11	11	100	0	0	0	0	S	1.4
Moby Creek	118	13	422082	7266114	6/30/2012	KS/QS	10.6	6.6	18	C	4	P	124	15	0	0.7	0.9	13	16	100	0	0	0	0	S	1.3
Moby Creek	118	13	422082	7266114	6/30/2012	KS/QS	10.6	6.6	18	C	5	G	139	20	0	0.4	0.5	6.7	6.7	100	0	0	0	0	-	-
Moby Creek	118	13	422082	7266114	6/30/2012	KS/QS	10.6	6.6	18	C	6	P	159	16	0	0.8	1	5	7	90	10	0	0	0	S	0.9
Moby Creek	118	13	422082	7266114	6/30/2012	KS/QS	10.6	6.6	18	C	7	P	175	12	0	1	1.2	7.7	9.5	100	0	0	0	0	S	1.5
Moby Creek	118	13	422082	7266114	6/30/2012	KS/QS	10.6	6.6	18	C	8	G	187	11	0	0.4	0.6	5.5	7.5	95	0	0	5	0	-	-
Moby Creek	118	13	422082	7266114	6/30/2012	KS/QS	10.6	6.6	18	C	9	P	198	18	0	1.2	1.4	7	8	60	5	0	5	30	S	1.5
Moby Creek	118	13	422082	7266114	6/30/2012	KS/QS	10.6	6.6	18	C	10	R	216	10	1	0.45	0.55	2	2.9	90	0	0	10	0	-	-
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	1	G	0	2.5	0	0.5	0.6	0.9	1.9	100	0	0	0	0	-	-
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	2	P	2.5	2.9	0	0.8	0.9	0.8	1.5	100	0	0	0	0	S	0.95
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	3	P	5.4	11	0	1.1	1.2	2	2.4	100	0	0	0	0	S	1.2
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	4	G	16.4	7.5	0	0.8	0.9	1	0.9	100	0	0	0	0	-	-
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	5	G	23.9	14.5	0	0.9	1	1.1	1.4	100	0	0	0	0	-	-
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	6	P	38.4	5	0	0.8	0.9	4.5	5.5	100	0	0	0	0	S	0.9
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	7	G	43.4	4.6	0	0.7	0.9	0.4	0.9	100	0	0	0	0	-	-
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	8	P	48	4.6	0	0.9	1.1	2	4	95	5	0	0	0	S	1.1
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	9	G	52.6	22.5	0	0.7	0.9	4.6	6.8	100	0	0	0	0	-	-
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	10	C	75.1	5.2	10	0.4	0.6	0.5	0.5	100	0	0	0	0	-	-
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	11	G	80.3	8	0	0.3	0.5	1	1.6	100	0	0	0	0	-	-
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	12	P	88.3	3.3	0	0.5	0.7	1.5	2	100	0	0	0	0	S	0.65
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	13	G	91.6	9.2	0	0.25	0.45	1.3	1.7	100	0	0	0	0	-	-
Moby Inflow	119	13	419186	7267943	6/30/2012	KS/QS	12.7	6.2	21	C	14	P	100.8	8	0	0.6	0.8	1.4	2.8	100	0	0	0	0	S	1.1

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Stream	Site	Zone	Easting	Northing	Date	Crew	Temp (°C)	pH	Conductivity (uS/cm)	Turbidity	Habitat Number	Habitat Type	Distance from Start	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)	Pool Type	Pool Max Depth (m)
Moby Tributary 2	120	13	421610	7266544	6/30/2012	KS/QS	13.7	6.6	20	C	1	G	0	14	0	0.35	0.55	2.4	2.4	0	5	90	5	0	-	-
Moby Tributary 2	120	13	421610	7266544	6/30/2012	KS/QS	13.7	6.6	20	C	2	R	14	14.5	2	0.2	0.4	2.7	2.7	0	5	90	5	0	-	-
Moby Tributary 2	120	13	421610	7266544	6/30/2012	KS/QS	13.7	6.6	20	C	3	G	28.5	19	0	0.4	0.6	1.7	2.2	0	10	60	30	0	-	-
Moby Tributary 2	120	13	421610	7266544	6/30/2012	KS/QS	13.7	6.6	20	C	4	R	47.5	5	1	0.1	0.3	2.2	2.2	0	0	90	10	0	-	-
Moby Tributary 2	120	13	421610	7266544	6/30/2012	KS/QS	13.7	6.6	20	C	5	G	52.5	5	0	0.2	0.4	2.3	2.3	0	10	70	20	0	-	-
Moby Tributary 2	120	13	421610	7266544	6/30/2012	KS/QS	13.7	6.6	20	C	6	R	57.5	4.7	1	0.2	0.4	1.5	2	0	0	10	90	0	-	-
Moby Tributary 2	120	13	421610	7266544	6/30/2012	KS/QS	13.7	6.6	20	C	7	G	62.2	16.8	0	0.4	0.6	2.5	2.5	60	25	5	10	0	-	-
Moby Tributary 2	120	13	421610	7266544	6/30/2012	KS/QS	13.7	6.6	20	C	8	P	79	4	0	0.4	0.6	2	2.2	30	30	20	20	0	S	0.6
George Outflow	122	13	386707	7314503	7/12/2012	KS/DQ	14.2	-	37	C	1	G	0	50.8	1	0.3	0.6	20.7	35	0	0	0	100	0	-	-
George Outflow	122	13	386707	7314503	7/12/2012	KS/DQ	14.2	-	37	C	2	R	50.8	33	1.5	0.2	0.5	23.5	35	0	0	0	100	0	-	-
George Outflow	122	13	386707	7314503	7/12/2012	KS/DQ	14.2	-	37	C	3	G	83.8	7.7	1	0.4	0.9	19.7	28	0	0	0	100	0	-	-
George Outflow	122	13	386707	7314503	7/12/2012	KS/DQ	14.2	-	37	C	4	R	91.5	82	2.5	0.2	0.4	7.5	11.4	0	0	0	100	0	-	-
George Outflow	122	13	386707	7314503	7/12/2012	KS/DQ	14.2	-	37	C	5	P	173.5	11	0	0.6	0.8	7	7	20	0	0	80	0	S	0.8
George Inflow	123	13	385805	7315637	7/2/2012	KS/DQ	-	-	-	C	1	G	0	23.7	0	0.4	0.5	3.8	3.8	100	0	0	0	0	-	-
George Inflow	123	13	385805	7315637	7/3/2012	KS/DQ	-	-	-	C	2	P	23.7	5.5	0	0.7	0.8	4.8	4.8	100	0	0	0	0	S	0.8
George Inflow	123	13	385805	7315637	7/4/2012	KS/DQ	-	-	-	C	3	G	29.2	30	0	0.5	0.6	5	5	100	0	0	0	0	-	-
George Inflow	123	13	385805	7315637	7/5/2012	KS/DQ	-	-	-	C	4	G	59.2	13	0	0.4	0.5	5.4	5.4	80	0	20	0	0	-	-
George Inflow	123	13	385805	7315637	7/6/2012	KS/DQ	-	-	-	C	5	R	72.2	11.5	1.5	0.2	0.3	6.4	7	55	10	30	5	0	-	-
George Inflow	123	13	385805	7315637	7/7/2012	KS/DQ	-	-	-	C	6	G	83.7	6	0	0.4	0.5	2.3	3.6	60	10	10	20	0	-	-
George Inflow	123	13	385805	7315637	7/8/2012	KS/DQ	-	-	-	C	7	R	89.7	9	1.5	0.2	0.3	0.9	1.2	0	10	60	30	0	-	-
George Inflow	123	13	385805	7315637	7/9/2012	KS/DQ	-	-	-	C	8	P	98.7	5.4	0	0.4	0.5	2.3	1.8	90	0	5	5	0	S	0.45
George Inflow	123	13	385805	7315637	7/10/2012	KS/DQ	-	-	-	C	9	G	104.1	17.5	0	0.3	0.4	3.7	4	90	0	0	10	0	-	-
George Inflow	123	13	385805	7315637	7/11/2012	KS/DQ	-	-	-	C	10	R	121.6	30	1.5	0.2	0.3	1.8	2	0	0	20	80	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	1	G	0	7.5	0	0.3	0.4	2.5	2.5	40	0	0	60	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	2	R	7.5	1.2	1	0.1	0.15	1.5	2	0	90	10	0	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	3	G	8.7	5	0	0.3	0.4	3.5	5.5	80	0	0	20	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	4	R	13.7	2.4	1	0.3	0.4	3.5	4.1	40	0	0	60	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	5	G	16.1	18	0	0.3	0.4	8.2	8.2	35	10	5	50	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	6	R	34.1	6	1	0.1	0.2	1	1	90	0	0	10	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	7	G	40.1	3.5	0	0.2	0.3	1	1	40	0	0	60	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	8	R	43.6	17.5	2	0.4	0.6	0.5	0.5	80	0	0	20	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	9	G	61.1	6	0	0.4	0.5	7.7	7.7	80	0	0	20	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	10	R	67.1	8	2	0.2	0.3	1	1	70	0	0	30	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	11	G	75.1	5.6	0	0.3	0.4	1.3	1.3	20	0	0	80	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	12	R	80.7	2.5	2	0.1	0.2	1.8	3	50	0	0	50	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	13	G	83.2	9.5	0.5	0.4	0.6	0.6	0.7	20	0	0	80	0	-	-
George Inflow 2	124	13	387336	7315627	7/1/2012	KS/DQ	17.2	4.4	54	C	14	P	92.7	2.7	0	0.5	0.7	5.9	5.9	60	0	0	40	0	S	0.6
Ref B Outflow	125	13	424475	7257901	7/2/2012	KS/AB	15.1	7	9	C	1	R	0	20.3	1	0.2	0.3	1.1	1.1	0	0	10	90	0	-	-
Ref B Outflow	125	13	424475	7257901	7/2/2012	KS/AB	15.1	7	9	C	2	G	20.3	18	0	0.2	0.3	1	1.1	40	30	0	30	0	-	-
Ref B Outflow	125	13	424475	7257901	7/2/2012	KS/AB	15.1	7	9	C	3	P	38.3	9	0	0.4	0.5	2	2.1	45	50	0	5	0	S	0.45
Ref B Outflow	125	13	424475	7257901	7/2/2012	KS/AB	15.1	7	9	C	4	G	47.3	9	0	0.15	0.2	4	4.5	100	0	0	0	0	-	-
Ref B Outflow	125	13	424475	7257901	7/2/2012	KS/AB	15.1	7	9	C	5	R	56.3	7	1	0.25	0.35	-	-	0	0	0	100	0	-	-
Ref B Outflow	125	13	424475	7257901	7/2/2012	KS/AB	15.1	7	9	C	6	G	63.3	21	0	0.2	0.25	2	2.2	75	0	0	25	0	-	-
Ref B Outflow	125	13	424475	7257901	7/2/2012	KS/AB	15.1	7	9	C	7	R	84.3	13	1	0.1	0.2	1	1	80	10	0	10	0	-	-
Ref B Outflow	125	13	424475	7257901	7/2/2012	KS/AB	15.1	7	9	C	8	G	97.3	11	0	0.2	0.25	1.1	1.1	50	30	10	10	0	-	-
Ref B Outflow	125	13	424475	7257901	7/2/2012	KS/AB	15.1	7	9	C	9	R	108.3	12	1	0.15	0.25	1.5	1.6	10	20	10	60	0	-	-
Ref B Outflow	125	13	424475	7257901	7/2/2012	KS/AB	15.1	7	9	C	10	G	120.3	40.5	0	0.25	0.3	2.2	2.2	95	0	5	0	0	-	-

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Stream	Site	Zone	Easting	Northing	Date	Crew	Temp (°C)	pH	Conductivity (uS/cm)	Turbidity	Habitat Number	Habitat Type	Distance from Start	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)	Pool Type	Pool Max Depth (m)
Rascal Outflow	126	13	433891	7268373	7/2/2012	KS/AB	17.4	6.7	7	C	1	G	0	50	0	0.3	0.5	37	45	0	0	0	100	0	-	-
Rascal Outflow	126	13	433891	7268373	7/2/2012	KS/AB	17.4	6.7	7	C	2	R	50	60	2.5	0.3	0.4	6	9	0	0	30	70	0	-	-
Rascal Outflow	126	13	433891	7268373	7/2/2012	KS/AB	17.4	6.7	7	C	3	G	110	100	0	0.7	0.9	22	24	0	0	0	80	20	-	-
Rascal Outflow	126	13	433891	7268373	7/2/2012	KS/AB	17.4	6.7	7	C	4	C	210	20	5	0.2	0.3	7	10	0	0	0	60	40	-	-
Rabbit Outflow	127	13	431327	7266244	7/2/2012	KS/AB	21.7	7.2	11	C	1	G	0	10	0	0.1	0.2	4.7	4.7	50	5	10	35	0	-	-
Rabbit Outflow	127	13	431327	7266244	7/2/2012	KS/AB	21.7	7.2	11	C	2	R	10	5.4	2	0.1	0.2	3	3	20	5	20	55	0	-	-
Rabbit Outflow	127	13	431327	7266244	7/2/2012	KS/AB	21.7	7.2	11	C	3	G	15.4	8.5	0	0.3	0.4	1.9	2.2	10	20	40	30	0	-	-
Rabbit Outflow	127	13	431327	7266244	7/2/2012	KS/AB	21.7	7.2	11	C	4	R	23.9	4.5	2	0.15	0.25	3.3	5	40	10	20	30	0	-	-
Rabbit Outflow	127	13	431327	7266244	7/2/2012	KS/AB	21.7	7.2	11	C	5	G	28.4	22	0	0.2	0.3	2.5	10.5	90	5	5	0	0	-	-
Slave Outflow	128	13	390583	7309494	7/3/2012	KS/DQ	15.9	7.4	37	C	1	P	0	11.5	0	0.9	0.9	3.4	3.4	100	0	0	0	0	S	1
Slave Outflow	128	13	390583	7309494	7/3/2012	KS/DQ	15.9	7.4	37	C	2	P	11.5	29	0	1.5	1.6	4	4	95	0	0	5	0	S	1.6
Slave Outflow	128	13	390583	7309494	7/3/2012	KS/DQ	15.9	7.4	37	C	3	G	40.5	13	0	0.6	0.7	4	6.5	60	0	0	40	0	-	-
Slave Outflow	128	13	390583	7309494	7/3/2012	KS/DQ	15.9	7.4	37	C	4	P	53.5	10	0	0.7	0.8	2.5	2.5	95	0	5	0	0	S	1.1
Slave Outflow	128	13	390583	7309494	7/3/2012	KS/DQ	15.9	7.4	37	C	5	G	63.5	12	0	0.7	0.9	3	2.8	90	0	10	0	0	-	-
Slave Outflow	128	13	390583	7309494	7/3/2012	KS/DQ	15.9	7.4	37	C	6	P	75.5	5.5	0	0.8	0.9	2.4	2.4	95	0	0	5	0	S	1.1
Slave Outflow	128	13	390583	7309494	7/3/2012	KS/DQ	15.9	7.4	37	C	7	G	81	13	0	1	1.1	2.5	2.5	100	0	0	0	0	-	-
Slave Outflow	128	13	390583	7309494	7/3/2012	KS/DQ	15.9	7.4	37	C	8	P	94	13	0	0.8	0.9	3.4	3.4	100	0	0	0	0	S	1.2
Slave Outflow	128	13	390583	7309494	7/3/2012	KS/DQ	15.9	7.4	37	C	9	G	107	8	0	0.7	0.8	2.9	3.3	100	0	0	0	0	-	-
Dragon Inflow	129	13	390285	7312418	7/3/2012	KS/DQ	16.8	6.3	39	C	1	C	0	6.4	10	0.2	0.4	2.1	2.1	0	0	0	100	0	-	-
Dragon Inflow	129	13	390285	7312418	7/3/2012	KS/DQ	16.8	6.3	39	C	2	G	6.4	10.5	0	0.3	0.5	2.2	2.7	90	0	0	10	0	-	-
Dragon Inflow	129	13	390285	7312418	7/3/2012	KS/DQ	16.8	6.3	39	C	3	R	16.9	4.5	1.5	0.15	0.35	1.8	4	0	20	30	50	0	-	-
Dragon Inflow	129	13	390285	7312418	7/3/2012	KS/DQ	16.8	6.3	39	C	4	G	21.4	7	0	0.35	0.45	1.5	1.7	100	0	0	0	0	-	-
Dragon Inflow	129	13	390285	7312418	7/3/2012	KS/DQ	16.8	6.3	39	C	5	R	28.4	14.5	2	0.15	0.25	2	2	0	0	80	20	0	-	-
Dragon Inflow	129	13	390285	7312418	7/3/2012	KS/DQ	16.8	6.3	39	C	6	C	42.9	19.5	5	0.3	0.4	0.8	0.8	80	0	0	20	0	-	-
Dragon Inflow	129	13	390285	7312418	7/3/2012	KS/DQ	16.8	6.3	39	C	7	P	62.4	6.5	0	0.3	0.5	0.7	0.7	90	0	10	0	0	S	0.5
Dragon Inflow	129	13	390285	7312418	7/3/2012	KS/DQ	16.8	6.3	39	C	8	C	68.9	23.5	4	0.3	0.5	0.5	0.3	20	0	60	20	0	-	-
Dragon Inflow	129	13	390285	7312418	7/3/2012	KS/DQ	16.8	6.3	39	C	9	P	92.4	9	0	0.7	0.8	2.6	2.6	100	0	0	0	0	S	0.8
Dragon Inflow	129	13	390285	7312418	7/3/2012	KS/DQ	16.8	6.3	39	C	10	R	101.4	12	1.5	0.4	0.5	0.4	0.5	40	0	60	0	0	-	-
Dragon Inflow	129	13	390285	7312418	7/3/2012	KS/DQ	16.8	6.3	39	C	11	P	113.4	2.5	0	0.4	0.5	0.6	0.6	80	0	0	20	0	S	0.45

N/A = not applicable; LB = left bank; RB = right bank; - = not collected

Habitat type
P = pool
G = glide
R = riffle
C = cascade
NCD = non-classified drainage
PD = pond

Pool type
S = scour
D = dam

Barrier type
F = falls
BF = boulder field
V = velocity barrier
CH = chute
NC = no channel
P = permanent
T = temporary

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Stream	Pool Crest Depth (m)	Barrier Type	T/P	LB Height (m)	RB Height (m)	LB Stability	RB Stability	Pool Cover (%)	Boulder Cover (%)	Instream Veg Cover(%)	Overhang Veg Cover(%)	Undercut Bank Cover (%)	Bankfull Area (m^2)	Wetted Area (m^2)	Proportional Length (%)	Proportional Bankfull Area (%)	Proportional Wetted Area (%)	Comments
N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Seepage with small pond. No continous habitat
Umwelt Outflow	0.7	BF	T	-	-	-	-	0	80	0	0	0	-	117.6	0.1	-	0.1	No defined banks - boulder field
Umwelt Outflow	-	-	-	-	-	-	-	40	0	0	0	0	-	103.0	0.1	-	0.1	No defined banks - boulder field
Umwelt Outflow	0.3	BF	T	-	-	-	-	0	30	0	0	0	-	475.6	0.3	-	0.4	No defined banks - boulder field
Umwelt Outflow	-	-	-	-	-	-	-	0	40	0	0	0	-	530.0	0.5	-	0.4	No defined banks - boulder field
Fox Outflow	-	-	-	0.4	0.5	0.5	0.5	0	10	0	0	0	14.9	14.0	0.1	0.1	0.1	
Fox Outflow	0.2	-	-	0.3	0.1	0.5	0.5	0	0	0	0	10	27.0	25.2	0.1	0.1	0.1	
Fox Outflow	-	-	-	0.3	0.2	0.5	0.5	0	30	0	0	0	8.8	7.2	0.1	0.0	0.0	
Fox Outflow	0.3	-	-	0.3	0.1	0.5	0.5	0	10	0	0	10	25.8	22.4	0.1	0.1	0.1	
Fox Outflow	-	-	-	0.15	0.2	0.5	0.5	0	0	0	20	5	65.5	48.4	0.2	0.3	0.3	
Fox Outflow	-	-	-	0.3	0.1	0.5	0.5	0	5	0	5	0	22.6	20.4	0.1	0.1	0.1	
Fox Outflow	-	-	-	0.4	0.2	0.5	0.5	0	5	0	0	20	45.0	45.0	0.2	0.2	0.2	
Llama Outflow	-	-	-	0.1	0.1	0.5	0.5	0	5	0	0	5	113.1	97.7	0.2	0.3	0.2	
Llama Outflow	-	-	-	0.1	0.1	0.5	0.5	0	5	5	0	5	140.7	140.7	0.4	0.3	0.4	
Llama Outflow	-	-	-	0.2	0.3	0.5	0.5	0	0	40	0	0	58.8	58.8	0.1	0.1	0.1	
Llama Outflow	-	-	-	0.2	0.1	0.5	0.5	0	5	40	0	0	32.1	32.1	0.0	0.1	0.1	
Llama Outflow	-	-	-	0.2	0.2	0.5	0.5	0	10	20	0	0	67.9	67.9	0.2	0.2	0.2	
Fox Outflow	0.2	-	-	0.1	0.25	0.5	0.5	0	20	0	0	5	16.7	16.7	0.0	0.0	0.0	
Fox Outflow	-	-	-	0.1	0.3	0.5	0.5	0	40	0	5	0	51.8	49.0	0.1	0.0	0.0	4 channels
Fox Outflow	-	-	-	0.25	0.3	0.5	0.5	0	60	0	0	0	156.0	156.0	0.1	0.1	0.1	4 channels
Fox Outflow	-	-	-	0.3	0.3	0.5	0.5	0	60	0	0	10	284.2	259.0	0.1	0.2	0.2	
Fox Outflow	-	-	-	0.2	0.2	0.5	0.5	0	60	0	0	5	307.2	307.2	0.2	0.3	0.3	
Fox Outflow	-	-	-	0.3	0.2	0.5	0.5	0	70	0	0	0	128.3	91.8	0.1	0.1	0.1	
Fox Outflow	-	-	-	0.3	0.25	0.5	0.5	0	70	0	0	0	86.1	86.1	0.1	0.1	0.1	
Fox Outflow	-	-	-	0.2	0.3	0.5	0.5	0	40	0	0	0	86.3	76.3	0.1	0.1	0.1	
Fox Outflow	-	-	-	0.1	0.2	0.5	0.5	0	50	0	0	0	60.4	60.4	0.1	0.1	0.1	
N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NCD - flew over only
N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NCD
N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NCD
N/A	-	-	-	0.4	0.2	0.5	0.5	0	0	10	0	0	44.8	32.0	0.0	0.2	0.1	
N/A	-	-	-	0.2	0.2	0.5	0.5	0	20	0	0	10	14.3	14.3	0.1	0.1	0.1	
N/A	-	-	-	0.1	0.1	0.5	0.5	0	5	5	0	5	125.0	87.5	0.2	0.4	0.4	
N/A	-	-	-	0.1	0.1	0.5	0.5	0	5	0	0	0	14.9	10.8	0.1	0.1	0.1	
N/A	-	BF	T	-	-	-	-	-	-	-	-	-	-	-	0.1	-	-	
N/A	0.15	-	-	0.1	0.3	0.5	0.5	0	5	60	0	0	26.0	16.9	0.1	0.1	0.1	Ephemeral side channel
N/A	-	NC	T	0.1	0.2	0.5	0.5	0	0	40	0	10	5.0	5.0	0.1	0.0	0.0	Ephemeral side channel
N/A	-	-	-	0.2	0.2	0.5	0.5	0	50	0	0	20	12.2	13.5	0.1	0.0	0.1	ARGR
N/A	0.25	-	-	0.4	0.2	0.5	0.5	0	60	0	0	10	36.6	34.0	0.1	0.1	0.2	
N/A	-	BF	T	-	-	-	-	-	-	-	-	-	-	-	0.2	-	-	
N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Drainage from small pond
N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Small, muddy channel. Likely ephemeral. No alluvium, no fish hab.
N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NCD with occasional muddy channel, ponds.
N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Seepage draining lake.
Goose Inflow	-	-	-	0.2	0.2	0.5	0.5	0	20	0	0	5	343.0	343.0	0.3	0.5	0.5	
Goose Inflow	-	-	-	0.2	0.2	0.5	0.5	0	5	0	0	5	96.0	96.0	0.2	0.1	0.1	

Appendix 3.1-1. Stream Habitat Data, 2012

Stream	Pool Crest Depth (m)	Barrier Type	T/P	LB Height (m)	RB Height (m)	LB Stability	RB Stability	Pool Cover (%)	Boulder Cover (%)	Instream Veg Cover(%)	Overhang Veg Cover(%)	Undercut Bank Cover (%)	Bankfull Area (m^2)	Wetted Area (m^2)	Proportional Length (%)	Proportional Bankfull Area (%)	Proportional Wetted Area (%)	Comments
Goose Inflow	-	-	-	0.1	0.1	0.5	0.5	0	0	0	0	5	41.4	43.2	0.1	0.1	0.1	
Goose Inflow	-	-	-	0.2	0.2	0.5	0.5	0	10	0	0	5	40.5	43.2	0.1	0.1	0.1	
Goose Inflow	-	-	-	0.1	0.1	0.5	0.5	0	10	0	0	5	86.0	86.0	0.2	0.1	0.1	
Goose Inflow	-	-	-	0.2	0.1	0.5	0.5	0	30	0	0	0	34.8	34.8	0.1	0.1	0.1	
Gander River	-	-	-	0.2	0.2	0.5	0.5	0	50	5	0	0	3,060.0	2,040.0	0.3	0.3	0.3	
Gander River	-	-	-	0.2	0.3	0.5	0.5	0	30	0	0	0	313.2	249.4	0.0	0.0	0.0	
Gander River	-	-	-	0.2	0.3	0.5	0.5	0	40	20	0	0	2,800.0	2,352.0	0.2	0.3	0.3	
Gander River	-	-	-	0.3	0.3	0.5	0.5	0	30	0	0	5	1,975.0	1,580.0	0.2	0.2	0.2	
Gander River	-	-	-	0.1	0.2	0.5	0.5	0	60	0	0	0	720.0	570.0	0.1	0.1	0.1	
Gander River	-	-	-	0.1	0.1	0.5	0.5	0	10	0	0	0	1,813.0	1,280.2	0.2	0.2	0.2	
Gander River	-	-	-	0.4	0.5	0.5	0.5	0	5	0	0	0	10,000.0	10,000.0	1	1	1	Large river at Gander Lake inflow - all glide
Moby Creek	-	-	-	0.5	0.5	1	0.5	60	0	0	0	0	966.0	882.0	0.2	0.5	0.5	
Moby Creek	-	-	-	0.3	0.3	0.5	1	0	50	0	0	0	54.0	40.5	0.1	0.0	0.0	Bedrock chute
Moby Creek	0.2	-	-	0.4	0.5	1	1	0	20	0	0	0	56.2	53.9	0.0	0.0	0.0	
Moby Creek	-	-	-	0.4	0.2	1	1	0	70	0	0	0	103.2	100.1	0.0	0.0	0.1	
Moby Creek	-	-	-	0.3	0.2	0.5	0.5	0	40	0	0	0	97.8	82.5	0.1	0.0	0.0	
Moby Creek	-	-	-	0.3	0.3	0.5	0.5	0	60	0	0	0	150.0	94.8	0.1	0.1	0.1	
Moby Creek	-	-	-	0.2	0.2	1	1	0	40	0	0	0	186.3	64.2	0.1	0.1	0.0	
Moby Creek	-	-	-	0.1	0.5	0.5	0.5	0	30	0	5	0	72.0	66.6	0.1	0.0	0.0	
Moby Creek	0.2	-	-	0.4	0.5	1	1	60	20	0	0	0	11.1	6.6	0.0	0.0	0.0	
Moby Creek	-	CH	P	0.4	0.4	1	1	0	30	0	0	0	24.0	19.2	0.1	0.0	0.0	
Moby Creek	-	-	-	0.3	0.3	0.5	0.5	0	30	0	10	0	406.0	310.3	0.2	0.2	0.2	
Moby Creek	-	-	-	0.3	0.2	0.5	0.5	0	40	0	0	10	75.0	93.0	0.1	0.0	0.1	
Moby Creek	-	-	-	0.4	0.3	0.5	0.5	0	20	0	0	20	216.0	210.6	0.2	0.1	0.1	
Moby Creek	0.5	-	-	0.2	0.3	0.5	0.5	30	0	0	0	5	440.0	440.0	0.2	0.3	0.3	
Moby Creek	0.5	-	-	0.1	0.2	0.5	0.5	50	0	0	0	0	240.0	195.0	0.1	0.2	0.1	
Moby Creek	-	-	-	0.1	0.1	0.5	0.5	0	0	0	0	0	134.0	134.0	0.1	0.1	0.1	
Moby Creek	0.4	-	-	0.1	0.3	0.5	0	30	0	0	0	5	112.0	80.0	0.1	0.1	0.1	
Moby Creek	0.5	-	-	0.1	0.2	0.5	0.5	30	0	0	0	0	114.0	92.4	0.1	0.1	0.1	
Moby Creek	-	-	-	0.1	0.1	0.5	0.5	0	0	0	0	0	82.5	60.5	0.0	0.1	0.0	
Moby Creek	0.4	-	-	0.1	0.2	0.5	0.5	60	0	0	0	5	144.0	126.0	0.1	0.1	0.1	
Moby Creek	-	-	-	0.1	0.1	0.5	0.5	0	0	0	0	20	29.0	20.0	0.0	0.0	0.0	
Moby Inflow	-	-	-	0.1	0.1	0.5	0.5	0	0	0	0	10	4.8	2.3	0.0	0.0	0.0	
Moby Inflow	0.4	-	-	0.1	0.1	0.5	0.5	0	0	0	0	50	4.4	2.3	0.0	0.0	0.0	
Moby Inflow	0.5	-	-	0.1	0.1	0.5	0.5	50	0	0	0	40	26.4	22.0	0.1	0.1	0.1	
Moby Inflow	-	-	-	0.1	0.1	0.5	0.5	0	0	0	0	80	6.8	7.5	0.1	0.0	0.0	Subsurface channelized flow
Moby Inflow	-	-	-	0.1	0.2	0.5	0.5	0	0	0	0	80	20.3	16.0	0.1	0.1	0.1	
Moby Inflow	0.3	-	-	0.2	0.2	0.5	0.5	0	0	0	0	40	27.5	22.5	0.0	0.1	0.1	
Moby Inflow	-	-	-	0.3	0.2	0.5	0.5	0	0	0	0	90	4.1	1.8	0.0	0.0	0.0	
Moby Inflow	0.5	-	-	0.3	0.3	0.5	0.5	20	0	0	0	20	18.4	9.2	0.0	0.1	0.0	
Moby Inflow	-	-	-	0.2	0.2	0	0.5	0	0	0	0	10	153.0	103.5	0.2	0.5	0.5	
Moby Inflow	-	V	T	0.2	0.2	0.5	0.5	0	0	0	0	20	2.6	2.6	0.0	0.0	0.0	Possible barrier
Moby Inflow	-	-	-	0.3	0.1	0.5	0.5	0	0	0	0	20	12.8	8.0	0.1	0.0	0.0	
Moby Inflow	0.25	-	-	0.1	0.1	0.5	0.5	0	0	0	0	30	6.6	5.0	0.0	0.0	0.0	
Moby Inflow	-	-	-	0.2	0.1	0.5	0.5	0	0	0	0	5	15.6	12.0	0.1	0.0	0.1	
Moby Inflow	0.4	-	-	0.1	0.1	0.5	0	0	0	0	0	0	22.4	11.2	0.1	0.1	0.0	

Appendix 3.1-1. Stream Habitat Data, 2012

Stream	Pool Crest Depth (m)	Barrier Type	T/P	LB Height (m)	RB Height (m)	LB Stability	RB Stability	Pool Cover (%)	Boulder Cover (%)	Instream Veg Cover(%)	Overhang Veg Cover(%)	Undercut Bank Cover (%)	Bankfull Area (m^2)	Wetted Area (m^2)	Proportional Length (%)	Proportional Bankfull Area (%)	Proportional Wetted Area (%)	Comments
Moby Tributary 2	-	-	-	0.2	0.3	0.5	0.5	0	0	0	0	0	33.6	33.6	0.2	0.2	0.2	
Moby Tributary 2	-	-	-	0.3	0.3	0.5	0.5	0	0	0	0	0	39.2	39.2	0.2	0.2	0.2	
Moby Tributary 2	-	-	-	0.1	0.2	0.5	0.5	0	0	0	0	20	41.8	32.3	0.2	0.2	0.2	
Moby Tributary 2	-	-	-	0.2	0.2	0.5	0.5	0	0	0	0	0	11.0	11.0	0.1	0.1	0.1	
Moby Tributary 2	-	-	-	0.3	0.3	0.5	0.5	0	0	0	0	5	11.5	11.5	0.1	0.1	0.1	
Moby Tributary 2	-	-	-	0.1	0.4	0.5	0.5	0	20	0	0	0	9.4	7.1	0.1	0.0	0.0	
Moby Tributary 2	-	-	-	0.1	0.1	0.5	0.5	0	5	0	0	5	42.0	42.0	0.2	0.2	0.2	
Moby Tributary 2	0.3	-	-	0.2	0.2	0.5	0.5	0	0	0	0	30	8.8	8.0	0.0	0.0	0.0	
George Outflow	-	-	-	1.5	0.5	0	0.5	0	50	0	0	0	1,778.0	1,051.6	0.3	0.4	0.4	
George Outflow	-	BF	T	1.5	0.3	0	0	0	50	0	0	0	1,155.0	775.5	0.2	0.3	0.3	
George Outflow	-	-	-	1.5	0.5	0	0	0	50	0	0	0	215.6	151.7	0.0	0.1	0.1	
George Outflow	-	-	-	2	0.3	0.5	0.5	0	30	0	0	0	934.8	615.0	0.4	0.2	0.2	
George Outflow	0.3	-	-	2.5	0.2	1	0.5	0	30	0	5	0	77.0	77.0	0.1	0.0	0.0	
George Inflow	-	-	-	0.1	0.1	0.5	0.5	0	0	20	0	0	90.1	90.1	0.2	0.2	0.2	
George Inflow	0.25	-	-	0.1	0.1	0.5	0.5	0	0	5	0	0	26.4	26.4	0.0	0.0	0.0	
George Inflow	-	-	-	0.1	0.1	0.5	0.5	0	0	5	0	0	150.0	150.0	0.2	0.3	0.3	
George Inflow	-	-	-	0.1	0.1	0.5	0.5	0	0	5	0	0	70.2	70.2	0.1	0.1	0.1	
George Inflow	-	-	-	0.2	0.1	0.5	0.5	0	0	30	0	5	80.5	73.6	0.1	0.1	0.1	
George Inflow	-	-	-	0.1	0.1	0.5	0.5	0	10	20	0	0	21.6	13.8	0.0	0.0	0.0	
George Inflow	-	-	-	0.1	0.1	0.5	0.5	0	10	10	0	10	10.8	8.1	0.1	0.0	0.0	
George Inflow	0.2	-	-	0.1	0.1	0.5	0.5	0	0	10	0	30	9.7	12.4	0.0	0.0	0.0	
George Inflow	-	-	-	0.1	0.1	0.5	0.5	0	0	20	0	5	70.0	64.8	0.1	0.1	0.1	
George Inflow	-	-	-	0.2	0.2	0.5	0.5	0	30	0	0	0	60.0	54.0	0.2	0.1	0.1	
George Inflow 2	-	-	-	0.1	0.1	0	0.5	0	10	10	0	0	18.8	18.8	0.1	0.1	0.1	EF conditions fair - some difficult boulder hab
George Inflow 2	-	-	-	0.1	0.1	0.5	0.5	0	0	5	0	0	2.4	1.8	0.0	0.0	0.0	
George Inflow 2	-	-	-	0.1	0.1	0.5	0.5	0	5	0	0	0	27.5	17.5	0.1	0.1	0.1	
George Inflow 2	-	-	-	0.2	0.1	0.5	0.5	0	30	5	0	0	9.8	8.4	0.0	0.0	0.0	
George Inflow 2	-	-	-	0.1	0.1	0.5	0.5	0	10	0	0	0	147.6	147.6	0.2	0.5	0.5	
George Inflow 2	-	-	-	0.2	0.2	0.5	0.5	0	0	40	0	0	6.0	6.0	0.1	0.0	0.0	
George Inflow 2	-	-	-	0.2	0.2	0.5	0.5	0	10	10	0	0	3.5	3.5	0.0	0.0	0.0	
George Inflow 2	-	-	-	0.2	0.2	0.5	0.5	0	5	10	0	30	8.8	8.8	0.2	0.0	0.0	
George Inflow 2	-	-	-	0.2	0.1	0.5	0.5	0	20	10	0	0	46.2	46.2	0.1	0.1	0.2	
George Inflow 2	-	-	-	0.2	0.1	0.5	0.5	0	10	5	0	0	8.0	8.0	0.1	0.0	0.0	
George Inflow 2	-	-	-	0.2	0.1	0.5	0	0	30	0	0	0	7.3	7.3	0.1	0.0	0.0	
George Inflow 2	-	-	-	0.2	0.1	0.5	0.5	0	30	10	0	0	7.5	4.5	0.0	0.0	0.0	
George Inflow 2	-	-	-	0.2	0.1	0.5	0.5	0	40	0	0	0	6.7	5.7	0.1	0.0	0.0	
George Inflow 2	0.15	-	-	0.2	0.2	0.5	0.5	0	30	10	0	0	15.9	15.9	0.0	0.1	0.1	
Ref B outflow	-	-	-	0.1	0.1	0.5	0.5	0	20	10	0	0	22.3	22.3	0.1	0.1	0.1	
Ref B outflow	-	-	-	0.1	0.2	0.5	0.5	0	5	0	0	0	19.8	18.0	0.1	0.1	0.1	Antler in stream
Ref B outflow	0.2	-	-	0.1	0.1	0.5	0.5	0	0	0	0	5	18.9	18.0	0.1	0.1	0.1	Splits in 3 channels
Ref B outflow	-	-	-	0.1	0.1	0.5	0.5	0	0	0	0	0	40.5	36.0	0.1	0.1	0.1	No cover
Ref B outflow	-	BF	T	-	-	-	-	-	-	-	-	-	-	-	0.0	-	-	
Ref B outflow	-	-	-	0.25	0.25	0.5	0.5	0	60	0	0	0	46.2	42.0	0.1	0.2	0.2	
Ref B outflow	-	-	-	0.15	0.1	0.5	0.5	0	20	0	0	0	13.0	13.0	0.1	0.0	0.0	Middle channel
Ref B outflow	-	-	-	0.15	0.2	0.5	0.5	0	5	0	0	5	12.1	12.1	0.1	0.0	0.0	
Ref B outflow	-	-	-	0.1	0.2	0.5	0.5	0	30	0	0	0	19.2	18.0	0.1	0.1	0.1	
Ref B outflow	-	-	-	0.15	0.15	0.5	0.5	0	0	0	0	0	89.1	89.1	0.3	0.3	0.3	No cover

Appendix 3.1-1. Stream Habitat Data, 2012

Stream	Pool Crest Depth (m)	Barrier Type	T/P	LB Height (m)	RB Height (m)	LB Stability	RB Stability	Pool Cover (%)	Boulder Cover (%)	Instream Veg Cover(%)	Overhang Veg Cover(%)	Undercut Bank Cover (%)	Bankfull Area (m^2)	Wetted Area (m^2)	Proportional Length (%)	Proportional Bankfull Area (%)	Proportional Wetted Area (%)	Comments
Rascal Outflow	-	BF	T	0.3	0.4	0.5	0.5	0	90	0	0	0	2,250.0	1,850.0	0.2	0.4	0.4	Rascal Outflow - lots of ARGR YOY, esp in boulder field
Rascal Outflow	-	-	-	1.3	0.5	0.5	0.5	0	20	0	0	0	540.0	360.0	0.3	0.1	0.1	Sunny, hot - 25°
Rascal Outflow	-	-	-	0.3	0.3	0.5	0.5	0	10	0	0	0	2,400.0	2,200.0	0.4	0.4	0.5	
Rascal Outflow	-	-	-	0.6	0.1	1	0.5	0	40	0	0	0	200.0	140.0	0.1	0.0	0.0	
Rabbit Outflow	-	-	-	0.1	0.1	0.5	0.5	0	10	10	0	5	47.0	47.0	0.2	0.1	0.3	Hot, sunny - 25°C
Rabbit Outflow	-	-	-	0.1	0.1	0.5	0.5	0	10	20	0	0	16.2	16.2	0.1	0.0	0.1	
Rabbit Outflow	-	-	-	0.1	0.1	0.5	0.5	0	5	10	0	5	18.7	16.2	0.2	0.1	0.1	
Rabbit Outflow	-	-	-	0.1	0.1	0.5	0.5	0	0	10	0	0	22.5	14.9	0.1	0.1	0.1	
Rabbit Outflow	-	-	-	0.1	0.1	0.5	0.5	0	0	10	0	0	231.0	55.0	0.4	0.7	0.4	
Slave Outflow	0.6	-	-	0.1	0.3	0.5	0.5	20	0	10	0	0	39.1	39.1	0.1	0.1	0.1	Meandering stream w/ deep box channel, deep pools
Slave Outflow	0.7	-	-	0.3	0.1	0.5	0.5	40	0	0	0	5	116.0	116.0	0.3	0.3	0.3	
Slave Outflow	-	-	-	0.1	0.1	0.5	0.5	0	10	5	0	5	84.5	52.0	0.1	0.2	0.1	
Slave Outflow	0.5	-	-	0.3	0.2	0.5	0.5	10	0	10	0	10	25.0	25.0	0.1	0.1	0.1	
Slave Outflow	-	-	-	0.2	0.2	0.5	0.5	0	0	20	0	10	33.6	36.0	0.1	0.1	0.1	
Slave Outflow	0.5	-	-	0.2	0.1	0.5	0.5	30	5	0	0	5	13.2	13.2	0.0	0.0	0.0	
Slave Outflow	-	-	-	0.2	0.3	0.5	0.5	0	0	10	0	5	32.5	32.5	0.1	0.1	0.1	
Slave Outflow	0.7	-	-	0.1	0.1	0.5	0.5	40	0	0	0	5	44.2	44.2	0.1	0.1	0.1	
Slave Outflow	-	-	-	0.1	0.1	0.5	0.5	0	0	10	0	10	26.4	23.2	0.1	0.1	0.1	
Dragon Inflow	-	-	-	0.3	0.4	0.5	0.5	0	50	0	0	0	13.4	13.4	0.1	0.1	0.1	Nice small stream
Dragon Inflow	-	-	-	0.2	0.2	0.5	0.5	0	5	0	0	0	28.4	23.1	0.1	0.2	0.2	
Dragon Inflow	-	-	-	0.2	0.1	0.5	0.5	0	20	0	0	0	18.0	8.1	0.0	0.1	0.1	
Dragon Inflow	-	-	-	0.1	0.1	0.5	0.5	0	0	0	0	0	11.9	10.5	0.1	0.1	0.1	
Dragon Inflow	-	-	-	0.1	0.2	0.5	0.5	0	5	40	0	0	29.0	29.0	0.1	0.2	0.2	
Dragon Inflow	-	-	-	0.2	0.2	0.5	0.5	0	10	10	20	40	15.6	15.6	0.2	0.1	0.1	
Dragon Inflow	0.1	-	-	0.2	0.2	0.5	0.5	0	0	20	0	30	4.6	4.6	0.1	0.0	0.0	
Dragon Inflow	-	-	-	0.1	0.1	0.5	0.5	0	0	0	20	50	7.1	11.8	0.2	0.0	0.1	
Dragon Inflow	0.4	-	-	0.1	0.1	0.5	0.5	20	0	0	5	10	23.4	23.4	0.1	0.1	0.2	
Dragon Inflow	-	-	-	0.1	0.1	0.5	0.5	0	0	10	0	50	6.0	4.8	0.1	0.0	0.0	
Dragon Inflow	0.2	-	-	0.3	0.2	0.5	0.5	0	0	10	0	20	1.5	1.5	0.0	0.0	0.0	

N/A = not applicable; LB = left bank; RB = right bank; - = not collected

Habitat type
P = pool
G = glide
R = riffle
C = cascade
NCD = non-classified drainage
PD = pond

Pool type
S = scour
D = dam

Barrier type
F = falls
BF = boulder field
V = velocity barrier
CH = chute
NC = no channel
P = permanent
T = temporary

Appendix 3.1-2

Stream Sampling Summary, 2012

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Appendix 3.1-2. Stream Sampling Summary, 2012

Local Name	Site #	Sampling Method	Method Number	Temperature (°C)	Conductivity (µS/cm)	Turbidity	Haul or Pass	EF Seconds	Length (m)	Width (m)	Enclosure	Voltage	Frequency	Pulse	Make	Model	Species Code	Stage	Total Number	Min Length (mm)	Max Length (mm)	Fish Activity	Comments
Umwelt Outflow	101	EF	1	9.1	74	C	1	466	75	10	O	450	30	2.4	Smith-root	LR 24	-	-	-	-	-	-	No fish caught or seen in good conditions and excellent visibility
Fox Outflow	102	EF	1	16.6	9	C	1	641	150	4	O	490	30	4	Smith-root	LR 24	-	-	-	-	-	-	NFC
Llama Outflow	103	EF	1	9.3	-	C	1	923	120	5	O	400	50	4	Smith-root	LR 24	ARGR	juvenile	3	118	123	rearing	
Llama Outflow	103	EF	1	9.3	-	C	1	923	120	5	O	400	50	4	Smith-root	LR 24	ARGR	fry	8	67	76	rearing	
Llama Outflow	103	EF	1	9.3	-	C	1	923	120	5	O	400	50	4	Smith-root	LR 24	RDWH	fry	1	67	-	rearing	
Llama Outflow	103	EF	1	9.3	-	C	1	923	120	5	O	400	50	4	Smith-root	LR 24	SLSC	adult	6	50	78	rearing	
Fox Outflow	104	EF	1	-	-	C	1	1000	150	3	O	400	50	4	Smith-root	LR 24	-	-	-	-	-	-	NFC
n/a	108	EF	1	11.1	10	C	1	363	100	1	O	500	30	4	Smith-root	LR 24	-	-	-	-	-	-	NFC
n/a	108	VO	1	11.1	10	C	1	-	-	-	-	-	-	-	-	-	ARGR	adult	5	170	350	rearing	May be stuck after spawning
Goose Inflow	113	EF	1	-	7	C	1	1133	120	5	O	730	30	4	Smith-root	LR 24	SLSC	-	15	30	67	rearing	
Goose Inflow	113	EF	1	-	7	C	1	1133	120	5	O	730	30	4	Smith-root	LR 24	NNSB	-	8	31	60	rearing	
Gander River	114	EF	1	11.1	10	C	1	993	300	2	O	620	30	4	Smith-root	LR 24	-	-	-	-	-	-	NFC
Moby Creek	117	EF	1	10.2	20	C	1	443	100	2	O	700	30	4	Smith-root	LR 24	-	-	-	-	-	-	NFC
Moby Creek	118	EF	1	10.8	18	C	1	604	300	2	O	600	30	4	Smith-root	LR 24	-	-	-	-	-	-	NFC in excellent habitat, no barriers
Moby Inflow	119	EF	1	-	-	-	1	531	100	1	O	400	30	4	Smith-root	LR 24	LKTR	adult	1	275	-	-	
Moby Inflow	119	EF	1	-	-	-	1	531	100	1	O	400	30	4	Smith-root	LR 24	SLSC	adult	4	53	63	rearing	
n/a	120	EF	1	-	-	C	1	656	120	2	O	550	30	4	Smith-root	LR 24	-	-	-	-	-	-	NFC
George Outflow	122	EF	1	14.2	37	C	1	608	150	4	O	450	30	4	Smith-root	LR 24	LKTR	juvenile	1	166	-	rearing	
George Outflow	122	VO	1	14.2	37	C	1	-	-	-	-	-	-	-	-	-	LKTR	juvenile	2	150	-	rearing	
George Inflow	123	EF	1	-	-	-	1	604	120	1.5	O	550	30	4	Smith-root	LR 24	LKTR	juvenile	8	121	162	rearing	Missed ~ 5
George Inflow	123	EF	1	-	-	-	1	604	120	1.5	O	550	30	4	Smith-root	LR 24	LKTR	adult	1	125	-	-	
George Inflow 2	124	EF	1	-	-	-	1	430	100	1	O	500	30	4	Smith-root	LR 24	-	-	-	-	-	-	NFC
Ref B Outflow	125	EF	1	-	-	C	1	570	120	1.5	O	600	30	4	Smith-root	LR 24	ARGR	juvenile	1	86	-	rearing	
Ref B Outflow	125	EF	1	-	-	C	1	570	120	1.5	O	600	30	4	Smith-root	LR 24	BB	juvenile	1	90	-	rearing	
Rabbit Outflow	127	EF	1	21.7	11	C	1	731	100	4	O	375	30	4	Smith-root	LR 24	ARGR	juvenile	2	-	-	-	
Dragon Inflow	129	EF	1	16.8	39	C	1	637	120	1	O	450	30	4	Smith-root	LR 24	ARGR	juvenile	4	65	171	rearing	Missed ~ five more
Dragon Inflow	129	EF	1	16.8	39	C	2	637	120	1	O	450	30	4	Smith-root	LR 24	LKTR	juvenile	1	91	-	rearing	

Sample method
EF = electrofishing
VO = visual observation

NFC = No fish caught
- = not collected

Turbidity
C = clear

Enclosure
O = open

Species Code
ARGR = Arctic grayling
LKTR = Lake trout
SLSC = Slimy sculpin
NNSB = Ninespine stickleback
BB = Burbot
RDWH = Round whitefish

Appendix 3.1-3

Individual Fish Data — Streams, 2012

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Appendix 3.1-3. Individual Fish Data — Streams, 2012

Local Name	Site #	Method	Method Number	Haul or Pass	Species Code	Length (mm)	Weight (g)	Condition (g/mm^3)	Comments
Llama Outflow	103	EF	1	1	ARGR	118	15	0.91	
Llama Outflow	103	EF	1	1	ARGR	123	20	1.07	
Llama Outflow	103	EF	1	1	ARGR	76	5	1.14	
Llama Outflow	103	EF	1	1	ARGR	123	21	1.13	
Llama Outflow	103	EF	1	1	ARGR	67	2	0.66	
Llama Outflow	103	EF	1	1	ARGR	74	4	0.99	
Llama Outflow	103	EF	1	1	ARGR	73	4	1.03	
Llama Outflow	103	EF	1	1	ARGR	80	6	1.17	
Llama Outflow	103	EF	1	1	ARGR	68	3	0.95	
Llama Outflow	103	EF	1	1	ARGR	70	4	1.17	
Llama Outflow	103	EF	1	1	ARGR	67	3	1.00	
Llama Outflow	103	EF	1	1	RDWH	67	3	1.00	
Llama Outflow	103	EF	1	1	SLSC	70	4	1.17	
Llama Outflow	103	EF	1	1	SLSC	78	4	0.84	
Llama Outflow	103	EF	1	1	SLSC	50	2	1.60	
Llama Outflow	103	EF	1	1	SLSC	60	3	1.39	
Llama Outflow	103	EF	1	1	SLSC	52	2	1.42	
Llama Outflow	103	EF	1	1	SLSC	56	2	1.14	
Fox Outflow	104	EF	1	1	ARGR	135	23	0.93	
Fox Outflow	104	EF	1	1	ARGR	137	21	0.82	
Fox Outflow	104	EF	1	1	ARGR	128	23	1.10	
Fox Outflow	104	EF	1	1	ARGR	130	24	1.09	
Fox Outflow	104	EF	1	1	SLSC	64	2	0.76	
Goose Inflow	113	EF	1	1	SLSC	57	1	0.54	
Goose Inflow	113	EF	1	1	SLSC	52	1	0.71	
Goose Inflow	113	EF	1	1	SLSC	47	1	0.96	
Goose Inflow	113	EF	1	1	SLSC	67	2	0.66	
Goose Inflow	113	EF	1	1	SLSC	60	2	0.93	
Goose Inflow	113	EF	1	1	SLSC	49	1	0.85	
Goose Inflow	113	EF	1	1	SLSC	54	1	0.64	
Goose Inflow	113	EF	1	1	SLSC	52	1	0.71	
Goose Inflow	113	EF	1	1	SLSC	48	1	0.90	
Goose Inflow	113	EF	1	1	SLSC	55	1	0.60	

Appendix 3.1-3. Individual Fish Data — Streams, 2012

Local Name	Site #	Method	Method Number	Haul or Pass	Species Code	Length (mm)	Weight (g)	Condition (g/mm^3)	Comments
Goose Inflow	113	EF	1	1	SLSC	44	<1		
Goose Inflow	113	EF	1	1	SLSC	40	<1		
Goose Inflow	113	EF	1	1	SLSC	31	<1		
Goose Inflow	113	EF	1	1	SLSC	30	<1		
Goose Inflow	113	EF	1	1	NSSB	47	<1		
Goose Inflow	113	EF	1	1	NSSB	60	1	0.46	
Goose Inflow	113	EF	1	1	NSSB	31	<1		
Goose Inflow	113	EF	1	1	NSSB	39	<1		
Goose Inflow	113	EF	1	1	NSSB	30	<1		
Goose Inflow	113	EF	1	1	NSSB	43	<1		
Goose Inflow	113	EF	1	1	NSSB	38	<1		
Goose Inflow	113	EF	1	1	NSSB	36	<1		
Goose Inflow	113	EF	1	1	SLSC	31	<1		Missed lots of SLSC and NSB - possibly two salmonids
Moby Inflow	119	EF	1	1	LKTR	275	216	1.04	
Moby Inflow	119	EF	1	1	SLSC	58	2	1.03	
Moby Inflow	119	EF	1	1	SLSC	62	2	0.84	
Moby Inflow	119	EF	1	1	SLSC	53	1	0.67	
Moby Inflow	119	EF	1	1	SLSC	63	2	0.80	
George Outflow	122	EF	1	1	LKTR	166	42	0.92	Missed two LKTR, all caught and seen at George outlet top of site
George Inflow	123	EF	1	1	LKTR	154	34	0.93	
George Inflow	123	EF	1	1	LKTR	127	17	0.83	
George Inflow	123	EF	1	1	LKTR	162	39	0.92	
George Inflow	123	EF	1	1	LKTR	162	40	0.94	
George Inflow	123	EF	1	1	LKTR	153	34	0.95	
George Inflow	123	EF	1	1	LKTR	156	32	0.84	
George Inflow	123	EF	1	1	LKTR	123	11	0.59	
George Inflow	123	EF	1	1	LKTR	121	14	0.79	
George Inflow	123	EF	1	1	SLSC	125	13	0.67	
Ref B Outflow	125	EF	1	1	ARGR	86	7	1.10	
Ref B Outflow	125	EF	1	1	BB	90	5	0.69	
Rabbit Outlow	127	EF	1	1	SLSC	52	1	0.71	Missed ~ two SLSC
Dragon Inflow	129	EF	1	1	ARGR	171	54	1.08	
Dragon Inflow	129	EF	1	1	ARGR	129	24	1.12	

Appendix 3.1-3. Individual Fish Data — Streams, 2012

Local Name	Site #	Method	Method Number	Haul or Pass	Species Code	Length (mm)	Weight (g)	Condition (g/mm^3)	Comments
Dragon Inflow	129	EF	1	1	ARGR	170	52	1.06	
Dragon Inflow	129	EF	1	1	ARGR	65	3	1.09	
Dragon Inflow	129	EF	1	1	LKTR	91	7	0.93	
Dragon Inflow	129	EF	1	1	SLSC	67	2	0.66	
Dragon Inflow	129	EF	1	1	SLSC	75	4	0.95	
Dragon Inflow	129	EF	1	1	SLSC	74	3	0.74	
Dragon Inflow	129	EF	1	1	SLSC	70	3	0.87	
Dragon Inflow	129	EF	1	1	SLSC	68	2	0.64	
Dragon Inflow	129	EF	1	1	SLSC	65	2	0.73	
Dragon Inflow	129	EF	1	1	SLSC	54	1	0.64	
Dragon Inflow	129	EF	1	1	SLSC	62	2	0.84	
Dragon Inflow	129	EF	1	1	SLSC	50	2	1.60	
Dragon Inflow	129	EF	1	1	SLSC	61	1	0.44	

Method

EF = electrofishing

Species

ARGR = Arctic grayling
LKTR = Lake trout
SLSC = Slimy sculpin
NNSB = Ninespine stickleback
BB = Burbot
RDWH = Round whitefish

Appendix 3.2-1

Sensitive Habitat Inventory Methodology Data, Moby Outflow, 2012

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Appendix 3.2-1. Sensitive Habitat Inventory Methodology Data, Moby Outflow, 2012

Stream Name	Reach #	Longitude	Latitude	Date	Time	Crew	Stage	Comments	Photo #	Reach Length (m)	Secondary Classification	Channel Morphology	Comment - Classification
Moby Outflow	1	-106.6581917	65.50091119	8/28/2012	8:32:40 AM	KS RM	moderate	Start just downstream of tailings dam	745	706.1		Run	Deep narrow glide with beaded pools
Moby Outflow	2	-106.6650945	65.50407588	8/28/2012	10:26:10 AM	KS RM	low	Reach 2	750	229.8		Riffle/Pool	Slightly narrower, steeper reach
Moby Outflow	3	-106.6670296	65.50573239	8/28/2012	12:07:55 PM	KS RM	low	Reach 3	751	630.0		Run	Back to deep glide habitat
Moby Outflow	4	-106.675358	65.50858143	8/28/2012	1:51:17 PM	KS RM	low	Wide shallow sandy glides	755	260.0		Run	
Moby Outflow	5	-106.6797657	65.50817012	8/28/2012	2:53:40 PM	KS RM	low		759	297.4		Riffle/Pool	
Moby Outflow	6	-106.6842239	65.50798098	8/29/2012	2:56:40 PM	KS RM	low	Riffle, then wide shallow glide	761	247.6		Run	
Moby Outflow	7	-106.6886656	65.50813043	8/29/2012	3:08:40 PM	KS RM	low	Narrower RP section	763	129.7		Riffle/Pool	
Moby Outflow	8	-106.689932	65.50873363	8/29/2012	3:26:34 PM	KS RM	low	Wide, shallow run	765	278.6		Run	
Moby Outflow	9	-106.6925412	65.5104782	8/29/2012	4:18:11 PM	KS RM	low	Gravel/cobble reach	768	253.4		Riffle/Pool	
Moby Outflow	10	-106.6955264	65.51195401	8/30/2012	2:37:25 PM	KS DE	low	Upstream main tributary	773	240.5		Riffle/Pool	
Moby Outflow	11	-106.6998579	65.5122457	8/30/2012	3:44:20 PM	KS DE	low	Cascade pool section	778	77.9		Cascade/Pool	
Moby Outflow	12	-106.7036099	65.51256436	8/31/2012	9:39:49 AM	KS DE	low	Boulder field reach	794	442.3	Non-channelized	Boulder Garden	Very little open water. Undefined boulder garden - no FHAP
Moby Outflow	13	-106.7107585	65.51416876	8/31/2012	10:01:28 AM	KS DE	low	Defined channel at edge of TMF	796	258.2	Intermittent	Riffle/Pool	Mostly dewatered
Moby Trib 1	1	-106.6998419	65.512232	8/31/2012	8:43:27 AM	KS DE	low	Small tributary furthest upstream before barriers	789	263.0		Riffle/Pool	Riffles mostly overland flow
Moby Trib 2	1	-106.6955258	65.51197316	8/31/2012	11:29:00 AM	KS DE	low	Main tributary to Moby from northwest pond	799	247.5		Riffle/Pool	At site 120 from June
Moby Trib 2	2	-106.6974141	65.51358112	8/31/2012	12:48:32 PM	KS DE	low	Reach 2 Moby Tributary	803	57.9		Cascade/Pool	Slightly higher gradient, more side channels
Moby Trib 2	2.1	-106.6974817	65.5138374	8/31/2012	1:27:26 PM	KS DE	low	Side channel of Moby Tributary 2	805	31.6	Side channel	Riffle/Pool	Box channel - no FHAP
Moby Trib 2	2.2	-106.6974092	65.51358952	8/31/2012	1:34:05 PM	KS DE	low	Side channel with good depth but little flow. Deep at bottom, NCD at top	806	44.6	Side channel	Riffle/Pool	Riffles very shallow, mostly overland flow - no FHAP
Moby Trib 2	3	-106.6977566	65.51412088	8/31/2012	2:17:19 PM	KS DE	low	Upstream of pond	809	149.1		Run	Glide habitat with clean gravel
Moby Trib 2	4	-106.6999825	65.51460337	8/31/2012	3:06:07 PM	KS DE	dry	Boulder field - no FHAP	810	175.1	Non-channelized	Boulder Garden	Sections of channel ~ 10% of length, mostly boulder field - no FHAP
Moby Trib 2	4	-106.7016995	65.51562617	8/31/2012	3:25:25 PM	KS DE	dry	Dry boulder field - no FHAP		403.1	Non-channelized	Boulder Garden	
Moby Trib 2-1	1	-106.699976	65.51455849	9/1/2012	8:52:15 AM	KS DE	low	No defined channel at confluence	820	444.6	Intermittent	Riffle/Pool	Riffle pool stream with NCD segments
Moby Trib 2-1	2	-106.7076321	65.51468025	9/1/2012	9:52:05 AM	KS DE	dry	Boulder field	825	51.6	Non-channelized	Boulder Garden	Dry boulder field
Moby Trib 3	1	-106.692911	65.50828699	9/1/2012	12:17:38 PM	KS DE	low	FHAP 3004	831	316.3		Run	Slow glide
Moby Trib 3	2	-106.6923859	65.50730907	9/2/2012	8:47:32 AM	KS DE	low	Marginally channelized NCD	863	440.2	Non-channelized	Other	NCD
Moby Trib 3	3	-106.6995674	65.50830549	9/2/2012	9:06:00 AM	KS DE	low	Higher gradient NCD section. Still no defined banks	867	99.2	Non-channelized	Other	NCD
Moby Trib 3	4	-106.701377	65.50847891	9/2/2012	9:14:16 AM	KS DE	low	Channelized stream section	869	136.6	Braided	Riffle/Pool	Section of reasonably well defined channel, sometimes braided
Moby Trib 4	1	-106.6841708	65.50796977	9/1/2012	1:34:17 PM	KS DE	low	Small tributary coming from seepage [same area as trib 3]	840	50.9	Intermittent	Riffle/Pool	
Moby Trib 5	1	-106.6766703	65.50854821	9/1/2012	2:16:30 PM	KS DE	low	Poorly defined channel draining small, shallow pond	843	225.9	Non-channelized	Other	NCD with marginal channel
Moby Trib 5	2	-106.6790614	65.50992324	9/1/2012	2:28:11 PM	KS DE	low	Stream flowing into seepage pond	846	327.7		Riffle/Pool	
Moby Trib 5	3	-106.6814516	65.51231918	9/1/2012	3:22:06 PM	KS DE	low	Reach 3	851	171.0		Riffle/Pool	
Moby Trib 6	1	-106.6744829	65.50862928	9/2/2012	10:55:23 AM	KS DE	low	NCD trib to Moby Outflow	872	152.8	Non-channelized	Other	NCD

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Appendix 3.2-1. Sensitive Habitat Inventory Methodology Data, Moby Outflow, 2012

Stream Name	Reach #	Gradient	Spawning Habitat	Over-winter Habitat	Rearing Habitat	Overall Habitat	Bars	Comment Site Characteristics	Wetted Width (m)	Bankfull Width (m)	Wetted Depth (m)	Bankfull Depth (m)	Comment - Channel
Moby Outflow	1	0	Poor	Fair	Good	Important	Point/Lateral	Very few bars, but occasional side bars	5	5.2	1.5	1.6	Deep glide with beaded pools. One small riffle
Moby Outflow	2	1	Fair	Poor	Good	Important	None	Micropatches of SP gravel	1.9	1.5	0.8	1	
Moby Outflow	3	0	Poor	Poor	Good	Important	None	Hundreds of ARGR 60 - 300 mm	3	3.5	0.8	1	
Moby Outflow	4	0	Poor	Poor	Fair	Marginal	Point/Lateral	Bars at tributary confluence	5.5	6	0.4	0.6	Pools up to 16 m wide
Moby Outflow	5	0	Fair	Poor	Good	Important	None	Few patches of gravel	1.5	2	0.5	0.7	
Moby Outflow	6	1	Fair	Poor	Fair	Important	None		5	5.5	0.5	0.7	
Moby Outflow	7	1	Poor	Fair	Good	Important	None		2	2.5	0.6	0.8	
Moby Outflow	8	0	Fair	Poor	Fair	Important	None	Micropatches of small gravel in shallow areas	4	4.5	0.5	0.6	
Moby Outflow	9	1	Good	None	Poor	Critical	Medial		2.5	2.8	0.5	0.7	
Moby Outflow	10	1	Fair	None	Fair	Important	None		1.5	1.7	0.4	0.5	
Moby Outflow	11	7	Poor	None	Poor	Marginal	None	Probable ARGR EFU	2	2.5	0.2	0.5	
Moby Outflow	12	2	None	None	None	None	None	No defined channel	0	0	0	0	
Moby Outflow	13	2	Poor	None	Poor	Marginal	None	Ephemeral channel at upstream edge of boulder field	1.4	2.5	0.1	0.4	Almost dry, isolated pools
Moby Trib 1	1	3	None	None	Poor	Marginal	None	No fish habitat beyond lower 5 m	0.5	0.8	0.3	0.4	
Moby Trib 2	1	1	Good	Poor	Good	Important	None	Good rearing, lots of juvenile ARGR	1.8	2	0.4	0.6	One really nice pool 1.1 m deep
Moby Trib 2	2	2	Poor	None	Good	Important	None	Gravel cobble covered in moss and algae	0.8	1	0.2	0.4	
Moby Trib 2	2.1	0	Poor	None	Good	Important	None	Micropatches of spawning gravel	0.5	0.6	0.3	0.5	
Moby Trib 2	2.2	2	None	None	Fair	Marginal	None	Mostly disjointed pools, juvenile ARGR in lower ones	0.8	1	0.4	0.6	
Moby Trib 2	3	0	Fair	Poor	Good	Important	None	Potentially critical if spawning occurs here	2	2.5	0.4	0.5	Narrow at start, then wide
Moby Trib 2	4	2	None	None	Poor	Marginal	None	Fish trapped in isolated pools, isolated channel segments	3	5	0.3	0.4	Only in isolated areas
Moby Trib 2	4	0							0	0	0	0	
Moby Trib 2-1	1	1	Poor	None	Fair	Marginal	None	Good rearing, but no connection to main channel. Fish trapped at low water	0.6	1.5	0.4	0.5	Wide flooding over banks in spring
Moby Trib 2-1	2	4	None	None	None	None	None	No fish habitat	0	0	0	0	No defined channel
Moby Trib 3	1	0	None	None	Poor	Marginal	None		0.6	1.4	0.1	0.2	Poorly defined banks
Moby Trib 3	2	1	None	None	Poor	Marginal	None	Shallow flowing seepage, low cover, no pools	4	0	0.1	0	No defined banks
Moby Trib 3	3	3	None	None	Fair	Marginal	None	Slightly deeper, more pools	3	0	0.2	0	No defined banks
Moby Trib 3	4	2	None	None	Fair	Marginal	None	~ 20 ARGR in first pool	1	1.4	0.2	0.3	
Moby Trib 4	1	2	Poor	None	Poor	Marginal	None		1.4	2	0.1	0.2	
Moby Trib 5	1	3	None	None	Poor	Marginal	None	Juvenile ARGR in lower channel area	1.5	0	0.2	0	No defined banks
Moby Trib 5	2	1	Fair	None	Good	Important	Point/Lateral	Some pea gravel and clean sand for spawning, especially further upstream	0.6	1.3	0.3	0.4	Few pools
Moby Trib 5	3	2	Poor	None	Good	Marginal	None		0.7	1	0.2	0.3	
Moby Trib 6	1	1	None	None	None	None	None		0	0	0	0	

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Appendix 3.2-1. Sensitive Habitat Inventory Methodology Data, Moby Outflow, 2012

Stream Name	Reach #	Substrate Organic	Substrate Fines	Substrate Gravel	Substrate Cobble	Substrate Boulder	Substrate Bedrock	Compaction	Comment - Substrate	Riparian Classification	Riparian Stage	Bank Stability	Bank Material	Bank - Comment
Moby Outflow	1	8	90	0	0	2	0	Medium	Mud bottom	Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	Some undercut, little sloughing
Moby Outflow	2	0	85	15	0	0	0	Low		Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	Some sloughing, but mostly stable
Moby Outflow	3	0	75	15	0	10	0	Low		Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	
Moby Outflow	4	0	100	0	0	0	0	Medium		Herbs/grasses	low shrubs <2m	Stable - no undercut	Fines	
Moby Outflow	5	0	80	20	0	0	0	Low		Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	
Moby Outflow	6	0	90	0	0	10	0	Low		Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	Slight undercut
Moby Outflow	7	40	60	0	0	0	0	Medium	Organic blocks and sand	Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	Mostly stable with some collapsed blocks
Moby Outflow	8	20	65	10	5	0	0	Low		Herbs/grasses	low shrubs <2m	Stable - no undercut	Fines	
Moby Outflow	9	0	0	60	10	30	0	Low		Herbs/grasses	low shrubs <2m	Stable - no undercut	Fines	Small to no undercut banks
Moby Outflow	10	0	20	60	20	0	0	Low		Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	Slight undercut
Moby Outflow	11	0	0	0	20	50	30	High		Shrubs	low shrubs <2m	Stable - no undercut	Bedrock	Bedrock chute, then b/c banks above
Moby Outflow	12	0	0	0	0	100	0	Low		Herbs/grasses	low shrubs <2m			No defined banks
Moby Outflow	13	0	0	10	30	60	0	Low		Shrubs	low shrubs <2m	Stable - no undercut	Boulder	
Moby Trib 1	1	0	90	0	0	10	0	Medium		Herbs/grasses	low shrubs <2m	Stable - no undercut	Fines	Clay banks. Undercut at bottom, but not after 10 m
Moby Trib 2	1	0	10	30	40	20	0	Low	Loose, round gravel, but algae covered	Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	
Moby Trib 2	2	0	0	10	80	10	0	Low		Herbs/grasses	low shrubs <2m	Stable - no undercut	Fines	
Moby Trib 2	2.1	0	20	0	60	20	0	Low	Algae covered substrate	Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	
Moby Trib 2	2.2	0	40	0	40	20	0	Low		Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	
Moby Trib 2	3	0	40	20	30	10	0	Low	Some good spawning gravel in first glide	Herbs/grasses	low shrubs <2m	Eroding	Fines	Some block erosion
Moby Trib 2	4	0	10	0	0	90	0	Low	Fines in some isolated pools	Herbs/grasses	low shrubs <2m			No defined banks
Moby Trib 2	4	0	0	0	0	0	0							
Moby Trib 2-1	1	0	90	10	0	0	0	Low		Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	Areas of surface erosion on banks
Moby Trib 2-1	2	0	0	0	0	100	0	Medium		Shrubs	low shrubs <2m			No banks
Moby Trib 3	1	100	0	0	0	0	0	Low		Herbs/grasses	low shrubs <2m		Fines	
Moby Trib 3	2	100	0	0	0	0	0	Low		Natural wetland	low shrubs <2m			No defined banks
Moby Trib 3	3	95	0	0	5	0	0	Low	Some cobble in scoured areas	Herbs/grasses	low shrubs <2m			No defined banks
Moby Trib 3	4	90	0	0	0	10	0	Low	Mostly fines	Herbs/grasses	low shrubs <2m	Eroding	Fines	Lots of weak banks, but also some stable
Moby Trib 4	1	0	30	0	50	10	10	High		Herbs/grasses	low shrubs <2m	Stable - no undercut	Fines	
Moby Trib 5	1	100	0	0	0	0	0	Low		Herbs/grasses	low shrubs <2m		Fines	No defined banks
Moby Trib 5	2	0	70	25	5	0	0	Low	Fines dominate for 50 m near pond, but gravel dominates further upstream. Good spawning substrate	Herbs/grasses	low shrubs <2m	Eroding	Fines	Some erosion on corners
Moby Trib 5	3	0	100	0	0	0	0	Low		Herbs/grasses	low shrubs <2m	Stable - undercut	Fines	
Moby Trib 6	1	0	0	0	0	0	0							

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Appendix 3.2-1. Sensitive Habitat Inventory Methodology Data, Moby Outflow, 2012

Stream Name	Reach #	% Riffle	% Pool	% Run	% Cascade	% Boulder Garden	% Total Cover	Boulder	Deep Pool	Instream Vegetation	Overhanging Vegetation	Undercut Bank
Moby Outflow	1	0	25	75	0	0	40	0	20	20	0	0
Moby Outflow	2	30	30	40	0	0	40	0	5	15	0	20
Moby Outflow	3	0	35	60	5	0	60	10	10	10	0	30
Moby Outflow	4	0	50	50	0	0	10	0	0	10	0	0
Moby Outflow	5	10	50	40	0	0	50	0	0	30	0	20
Moby Outflow	6	10	30	60	0	0	15	5	0	5	0	5
Moby Outflow	7	10	40	50	0	0	50	0	20	0	0	30
Moby Outflow	8	0	25	75	0	0	5	0	0	5	0	0
Moby Outflow	9	20	30	40	10	0	5	0	0	0	0	5
Moby Outflow	10	30	30	40	0	0	10	0	0	0	0	10
Moby Outflow	11	30	30	10	30	0	20	20	0	0	0	0
Moby Outflow	12	0	0	0	0	100	0	0	0	0	0	0
Moby Outflow	13	30	0	70	0	0	15	10	0	0	5	0
Moby Trib 1	1	30	50	20	0	0	20	0	0	15	0	5
Moby Trib 2	1	30	50	20	0	0	20	5	5	0	0	10
Moby Trib 2	2	40	0	50	20	0	10	5	0	0	0	5
Moby Trib 2	2.1	30	30	40	0	0	40	5	0	0	5	30
Moby Trib 2	2.2	20	70	10	0	0	50	20	0	0	0	30
Moby Trib 2	3	0	30	70	0	0	15	0	5	0	0	10
Moby Trib 2	4	10	10	10	0	70	0	30	0	0	0	0
Moby Trib 2	4	0	0	0	0	0	0	0	0	0	0	0
Moby Trib 2-1	1	20	30	50	0	0	20	0	0	5	0	15
Moby Trib 2-1	2	0	0	0	0	100	0	0	0	0	0	0
Moby Trib 3	1	40	0	60	0	0	20	0	0	20	0	0
Moby Trib 3	2	10	0	90	0	0	20	0	0	20	0	0
Moby Trib 3	3	30	30	40	0	0	40	0	0	20	0	20
Moby Trib 3	4	20	30	50	0	0	10	0	0	5	0	5
Moby Trib 4	1	50	10	40	0	0	20	5	0	15	0	0
Moby Trib 5	1	50	0	40	10	0	30	0	0	30	0	0
Moby Trib 5	2	40	20	40	0	0	5	0	0	0	0	0
Moby Trib 5	3	30	5	65	0	0	20	0	0	0	0	20
Moby Trib 6	1	0	0	0	0	0	0	0	0	0	0	0

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Appendix 3.2-2

Fish Habitat Assessment Procedure Data, Moby Outflow, 2012

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Appendix 3.2-2. Fish Habitat Assessment Procedure Data, Moby Outflow, 2012

Site	Stream	Reach	Zone	Easting	Northing	Date	Crew	Temp	pH	Conductivity	Turbidity	Habitat #	Habitat Type	Distance from Start	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)
1000	Moby	1	13	423151	7265382	8/28/2012	KS/RM	8.5	7.1	50	C	1	P	0	17	0	1.3	1.5	3.1	3.1	100	0	0	0	0
1000	Moby	1	13	423151	7265382	8/28/2012	KS/RM	8.5	7.1	50	C	2	G	17	15.8	0	0.9	1.1	1.6	2.2	100	0	0	0	0
1000	Moby	1	13	423151	7265382	8/28/2012	KS/RM	8.5	7.1	50	C	3	P	32.8	7.8	0	1.5	1.6	3	3.6	100	0	0	0	0
1000	Moby	1	13	423151	7265382	8/28/2012	KS/RM	8.5	7.1	50	C	4	G	40.6	12.8	0.5	0.8	1	1.4	1.5	100	0	0	0	0
1000	Moby	1	13	423151	7265382	8/28/2012	KS/RM	8.5	7.1	50	C	5	R	53.4	1.7	1	0.5	0.6	0.9	1.7	100	0	0	0	0
1001	Moby	2	13	422971	7265658	8/28/2012	KS/RM	8.1	6.8	53	C	1	R	0	8.5	1	0.7	0.8	0.9	1.4	100	0	0	0	0
1001	Moby	2	13	422971	7265658	8/28/2012	KS/RM	8.1	6.8	53	C	2	G	8.5	4.3	0	0.7	0.9	1.8	1.8	90	10	0	0	0
1001	Moby	2	13	422971	7265658	8/28/2012	KS/RM	8.1	6.8	53	C	3	R	12.8	16.5	1	0.5	0.7	1.2	1.8	60	40	0	0	0
1001	Moby	2	13	422971	7265658	8/28/2012	KS/RM	8.1	6.8	53	C	4	G	29.3	30	0	0.6	0.7	0.9	2	80	20	0	0	0
1001	Moby	2	13	422971	7265658	8/28/2012	KS/RM	8.1	6.8	53	C	5	P	59.3	10	0	1	1.1	3.2	4.8	90	10	0	0	0
1001	Moby	2	13	422971	7265658	8/28/2012	KS/RM	8.1	6.8	53	C	6	G	69.3	16.7	0	0.7	0.9	1.7	1.9	70	30	0	0	0
1001	Moby	2	13	422971	7265658	8/28/2012	KS/RM	8.1	6.8	53	C	7	P	86	30	0	1.9	2	11	12	95	0	0	5	0
1002	Moby	3	13	422885	7265840	8/28/2012	KS/RM	8.5	7.1	50	C	1	G	0	19.7	0	0.6	0.8	1.5	1.9	90	10	0	0	0
1002	Moby	3	13	422885	7265840	8/28/2012	KS/RM	8.5	7.1	50	C	2	P	19.7	24	0	0.8	1	7	8	100	0	0	0	0
1002	Moby	3	13	422885	7265840	8/28/2012	KS/RM	8.5	7.1	50	C	3	G	43.7	8.5	0	0.4	0.6	1.7	1.7	90	10	0	0	0
1002	Moby	3	13	422885	7265840	8/28/2012	KS/RM	8.5	7.1	50	C	4	P	52.2	13.4	0	0.8	1	4	5	80	20	0	0	0
1002	Moby	3	13	422885	7265840	8/28/2012	KS/RM	8.5	7.1	50	C	5	P	65.6	21	0	1.6	1.7	11	11.2	100	0	0	0	0
1002	Moby	3	13	422885	7265840	8/28/2012	KS/RM	8.5	7.1	50	C	6	R	86.6	2	1	0.3	0.5	1	2	30	70	0	0	0
1002	Moby	3	13	422885	7265840	8/28/2012	KS/RM	8.5	7.1	50	C	7	G	88.6	32	0	0.8	1	2.2	3	90	10	0	0	0
1002	Moby	3	13	422885	7265840	8/28/2012	KS/RM	8.5	7.1	50	C	8	P	120.6	25.7	0	1.6	1.8	14.8	16.3	50	0	10	40	0
1002	Moby	3	13	422885	7265840	8/28/2012	KS/RM	8.5	7.1	50	C	9	C	146.3	17.4	4	0.5	0.6	2.5	2.7	10	0	10	80	0
1003	Moby	4	13	422508	7266168	8/28/2012	KS/RM	11.6	6.8	53	C	1	G	0	27.5	0	0.2	0.4	1.9	1.9	100	0	0	0	0
1003	Moby	4	13	422508	7266168	8/28/2012	KS/RM	11.6	6.8	53	C	2	G	27.5	30	0	0.3	0.5	12	16	100	0	0	0	0
1003	Moby	4	13	422508	7266168	8/28/2012	KS/RM	11.6	6.8	53	C	3	G	57.5	38	0	0.5	0.8	3.5	4.3	100	0	0	0	0
1003	Moby	4	13	422508	7266168	8/28/2012	KS/RM	11.6	6.8	53	C	4	P	95.5	28.5	0	0.8	1	15	16	95	5	0	0	0
1003	Moby	4	13	422508	7266168	8/28/2012	KS/RM	11.6	6.8	53	C	5	G	124	22.5	0	0.4	0.6	3.6	3.6	100	0	0	0	0
1003	Moby	4	13	422508	7266168	8/28/2012	KS/RM	11.6	6.8	53	C	6	P	146.5	22	0	1	1.2	7.5	7.5	100	0	0	0	0
1004	Moby	5	13	422302	7266129	8/28/2012	KS/RM	11.6	6.8	53	C	1	R	0	9.5	1	0.2	0.4	1.1	1.2	20	70	10	0	0
1004	Moby	5	13	422302	7266129	8/28/2012	KS/RM	11.6	6.8	53	C	2	G	9.5	24	0	0.6	0.8	1.5	2	75	20	5	0	0
1004	Moby	5	13	422302	7266129	8/28/2012	KS/RM	11.6	6.8	53	C	3	P	33.5	26.5	0	1.2	1.5	5	6	100	0	0	0	0
1004	Moby	5	13	422302	7266129	8/28/2012	KS/RM	11.6	6.8	53	C	4	R	60	3.5	0	0.4	0.6	1.4	1.3	80	20	0	0	0
1004	Moby	5	13	422302	7266129	8/28/2012	KS/RM	11.6	6.8	53	C	5	P	63.5	19.5	0	1.1	1.2	9	10	100	0	0	0	0
1004	Moby	5	13	422302	7266129	8/28/2012	KS/RM	11.6	6.8	53	C	6	R	83	30	2	0.5	0.7	1.1	1.5	100	0	0	0	0
1005	Moby	6	13	422097	7266113	8/29/2012	KS/RM	7.1	7.1	50	C	1	R	0	47	3	0.2	0.4	3.3	3	10	0	10	80	0
1005	Moby	6	13	422097	7266113	8/29/2012	KS/RM	7.1	7.1	50	C	2	G	47	40	0	0.5	0.6	4.7	4.5	80	0	0	20	0
1005	Moby	6	13	422097	7266113	8/29/2012	KS/RM	7.1	7.1	50	C	3	P	87	28	0	0.8	1	9.5	9	95	0	0	5	0
1005	Moby	6	13	422097	7266113	8/29/2012	KS/RM	7.1	7.1	50	C	4	G	115	17	0	0.7	0.9	7	7	95	0	0	5	0
1005	Moby	6	13	422097	7266113	8/29/2012	KS/RM	7.1	7.1	50	C	5	P	132	17.5	0	0.9	1	9.5	10	95	0	0	5	0
1006	Moby	7	13	421891	7266134	8/29/2012	KS/RM	7.1	7.1	50	C	1	G	0	15.5	0	0.7	0.9	2.1	2.5	100	0	0	0	0
1006	Moby	7	13	421891	7266134	8/29/2012	KS/RM	7.1	7.1	50	C	2	R	15.5	2.4	1	0.5	0.6	1	1.7	100	0	0	0	0
1006	Moby	7	13	421891	7266134	8/29/2012	KS/RM	7.1	7.1	50	C	3	P	17.9	5.1	0	0.6	0.7	1.6	2	100	0	0	0	0
1006	Moby	7	13	421891	7266134	8/29/2012	KS/RM	7.1	7.1	50	C	4	R	23	2	1	0.5	0.6	1.7	2.1	100	0	0	0	0
1006	Moby	7	13	421891	7266134	8/29/2012	KS/RM	7.1	7.1	50	C	5	P	25	4.3	0	1.1	1.2	1.7	2	100	0	0	0	0
1006	Moby	7	13	421891	7266134	8/29/2012	KS/RM	7.1	7.1	50	C	6	R	29.3	1.7	0	0.15	0.3	1.6	2.1	100	0	0	0	0
1006	Moby	7	13	421891	7266134	8/29/2012	KS/RM	7.1	7.1	50	C	7	P	31	12.2	0	1	1.2	9	11	95	5	0	0	0
1006	Moby	7	13	421891	7266134	8/29/2012	KS/RM	7.1	7.1	50	C	8	R	43.2	1.7	2	0.1	0.4	1	1.8	100	0	0	0	0
1006	Moby	7	13	421891	7266134	8/29/2012	KS/RM	7.1	7.1	50	C	9	G	44.9	19.5	0	0.5	0.6	2.6	2.9	95	0	0	5	0
1006	Moby	7	13	421891	7266134	8/29/2012	KS/RM	7.1	7.1	50	C	10	R	64.4	6	1	0.4	0.6	1.4	1	5	0	0	95	0
1007	Moby	8	13	421835	7266203	8/29/2012	KS/RM	7.1	7.1	50	C	1	P	0	10.7	0	0.8	1	4	4	80	20	0	0	0
1007	Moby	8	13	421835	7266203	8/29/2012	KS/RM	7.1	7.1	50	C	2	G	10.7	51.9	0	0.5	0.7	4.5	4.5	100	0	0	0	0
1007	Moby	8	13	421835	7266203	8/29/2012	KS/RM	7.1	7.1	50	C	3	G	62.6	20.5	0	0.2	0.4	2.5	2.4	70	30	0	0	0

Appendix 3.2-2. Fish Habitat Assessment Procedure Data, Moby Outflow, 2012

Site	Stream	Reach	Zone	Easting	Northing	Date	Crew	Temp	pH	Conductivity	Turbidity	Habitat #	Habitat Type	Distance from Start	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)
1007	Moby	8	13	421835	7266203	8/29/2012	KS/RM	7.1	7.1	50	C	4	G	83.1	4.2	0	0.6	0.8	1.5	1.8	75	20	5	0	0
1007	Moby	8	13	421835	7266203	8/29/2012	KS/RM	7.1	7.1	50	C	5	R	87.3	5	1	0.3	0.4	1.1	1.7	80	20	0	0	0
1007	Moby	8	13	421835	7266203	8/29/2012	KS/RM	7.1	7.1	50	C	6	G	92.3	58	0	0.7	0.9	7	7.5	100	0	0	0	0
1008	Moby	9	13	421719	7266401	8/29/2012	KS/RM	7.1	7.1	50	C	1	G	0	26.5	0	0.3	0.4	2.2	2.8	30	40	25	5	0
1008	Moby	9	13	421719	7266401	8/29/2012	KS/RM	7.1	7.1	50	C	2	P	26.5	25.3	0	0.7	0.9	11.5	12	80	0	0	20	0
1008	Moby	9	13	421719	7266401	8/29/2012	KS/RM	7.1	7.1	50	C	3	G	51.8	23	0	0.5	0.7	4.6	5	60	30	10	0	0
1008	Moby	9	13	421719	7266401	8/29/2012	KS/RM	7.1	7.1	50	C	4	G	74.8	18.5	0	0.3	0.5	0.7	1.1	30	70	0	0	0
1008	Moby	9	13	421719	7266401	8/29/2012	KS/RM	7.1	7.1	50	C	5	P	93.3	9.5	0	0.8	0.9	5.8	6.3	45	50	5	0	0
1008	Moby	9	13	421719	7266401	8/29/2012	KS/RM	7.1	7.1	50	C	6	R	102.8	4.4	2	0.1	0.3	5.6	5.9	0	80	20	0	0
1008	Moby	9	13	421719	7266401	8/29/2012	KS/RM	7.1	7.1	50	C	7	G	107.2	12	0	0.4	0.6	1.7	1.4	0	40	30	30	0
1008	Moby	9	13	421719	7266401	8/29/2012	KS/RM	7.1	7.1	50	C	8	C	119.2	9	4	0.1	0.3	2.7	2.7	0	10	40	50	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	1	G	0	7.5	0	0.3	0.4	1.2	1.2	10	60	30	0	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	2	R	7.5	5.5	2	0.2	0.4	0.5	0.5	80	20	0	0	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	3	G	13	4.5	0	0.2	0.3	1.1	1.2	40	50	10	0	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	4	P	17.5	3.1	0	0.3	0.4	0.9	0.9	0	50	50	0	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	5	R	20.6	3	2	0.2	0.3	0.3	0.4	0	70	30	0	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	6	G	23.6	4	0	0.3	0.4	0.8	1	40	40	20	0	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	7	P	27.6	3.4	0	0.4	0.5	0.6	0.7	90	10	0	0	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	8	R	31	6.2	1	0.3	0.4	0.6	0.7	40	40	20	0	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	9	G	37.2	9	0	0.4	0.5	0.8	1	20	60	20	0	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	10	P	46.2	12.5	0	0.5	0.6	3.6	4.6	80	0	20	0	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	11	G	58.7	10	0	0.3	0.4	1	1.7	10	30	60	0	0
1009	Moby	10	13	421586	7266569	8/30/2012	KS/DE	7.4	6.6	57	C	12	R	68.7	17.5	2	0.2	0.4	1.2	1.5	10	40	30	20	0
1010	Moby	11	13	421386	7266607	8/30/2012	KS/DE	7.4	6.6	57	C	1	C	0	4	4	0.2	0.4	2.3	2.5	0	0	0	100	0
1010	Moby	11	13	421386	7266607	8/30/2012	KS/DE	7.4	6.6	57	C	2	P	4	2.5	0	0.5	0.7	1.4	1.4	0	0	0	80	20
1010	Moby	11	13	421386	7266607	8/30/2012	KS/DE	7.4	6.6	57	C	3	C	6.5	4.5	4	0.1	0.4	0.9	1.8	0	0	20	70	10
1010	Moby	11	13	421386	7266607	8/30/2012	KS/DE	7.4	6.6	57	C	4	R	11	5.6	2	0.2	0.5	0.9	1.8	0	0	0	40	60
1010	Moby	11	13	421386	7266607	8/30/2012	KS/DE	7.4	6.6	57	C	5	C	16.6	6	20	0.1	0.4	0.5	1.5	0	0	0	40	60
1010	Moby	11	13	421386	7266607	8/30/2012	KS/DE	7.4	6.6	57	C	6	P	22.6	5.7	0	0.5	0.7	2.4	2.9	10	0	0	40	50
1010	Moby	11	13	421386	7266607	8/30/2012	KS/DE	7.4	6.6	57	C	7	R	28.3	5.8	3	0.1	0.3	1	1.2	0	0	50	50	0
1010	Moby	11	13	421386	7266607	8/30/2012	KS/DE	7.4	6.6	57	C	8	G	34.1	6.5	0	0.4	0.6	2.3	2.5	20	0	40	40	0
1014	Moby	13	13	420888	7266835	8/31/2012	KS/DE	6.9	6.5	61	C	1	G	0	14	0	0.2	0.4	2.5	3	0	0	40	60	0
1014	Moby	13	13	420888	7266835	8/31/2012	KS/DE	6.9	6.5	61	C	2	R	14	3.9	2	0.05	0.3	1	3.2	0	0	50	50	0
1014	Moby	13	13	420888	7266835	8/31/2012	KS/DE	6.9	6.5	61	C	3	G	17.9	11.4	0	0.3	0.5	2.1	2.8	0	0	30	50	20
1014	Moby	13	13	420888	7266835	8/31/2012	KS/DE	6.9	6.5	61	C	4	R	29.3	14	2	0.1	0.5	1.4	3.3	0	20	40	40	0
1014	Moby	13	13	420888	7266835	8/31/2012	KS/DE	6.9	6.5	61	C	5	G	43.3	4	0	0.1	0.3	1.4	2.4	0	0	40	60	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	1	G	0	2.3	0	0.2	0.5	0.7	0.4	100	0	0	0	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	2	R	2.3	1.6	3	0.1	0.5	0.3	0.5	0	0	10	90	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	3	P	3.9	1.2	0	0.3	0.5	0.8	0.8	0	0	0	100	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	4	C	5.1	1.6	80	0.1	0.3	0.1	0.4	50	0	0	50	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	5	P	6.7	1.3	0	0.2	0.3	0.5	0.7	100	0	0	0	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	6	P	8	1.5	0	0.3	0.4	0.3	0.3	100	0	0	0	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	7	R	9.5	3.1	2	0.05	0.2	0.4	0.5	100	0	0	0	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	8	P	12.6	5.2	0	0.4	0.5	0.7	0.8	90	0	0	10	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	9	R	17.8	1.7	3	0.05	0.2	0.1	0.6	100	0	0	0	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	10	P	19.5	4.6	0	0.5	0.6	0.6	1.5	100	0	0	0	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	11	R	24.1	2	2	0.05	0.2	0.3	0.8	100	0	0	0	0
2000	Trib 1	1	13	421387	7266605	8/31/2012	KS/DE	2.9	5.6	142	C	12	G	26.1	3	0	0.1	0.2	0.4	1.2	100	0	0	0	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	1	G	0	8	0	0.2	0.3	1.6	1.8	0	30	70	0	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	2	R	8	3.1	2	0.1	0.3	2.2	2.4	0	40	60	0	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	3	G	11.1	7.2	0	0.2	0.4	2	2.3	0	20	80	0	0

Appendix 3.2-2. Fish Habitat Assessment Procedure Data, Moby Outflow, 2012

Site	Stream	Reach	Zone	Easting	Northing	Date	Crew	Temp	pH	Conductivity	Turbidity	Habitat #	Habitat Type	Distance from Start	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	4	R	18.3	5	3	0.1	0.3	1.6	1.9	0	0	70	30	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	5	G	23.3	7.1	0	0.3	0.4	0.9	0.9	0	20	60	20	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	6	G	30.4	13	0	0.4	0.5	2.3	2.1	60	25	5	0	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	7	R	43.4	2	1	0.2	0.3	0.9	2.4	40	50	10	0	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	8	P	45.4	2.7	0	0.4	0.5	3.1	4.3	90	10	0	0	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	9	P	48.1	3.5	0	0.5	0.6	1.9	7.8	100	0	0	0	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	10	P	51.6	7.3	0	0.6	0.7	1.9	5	70	10	10	10	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	11	R	58.9	9.5	1	0.3	0.5	1.2	2	90	0	10	0	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	12	G	68.4	4	0	0.4	0.6	2.3	2.3	50	0	30	20	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	13	R	72.4	3.8	1	0.3	0.5	0.7	1	0	0	20	80	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	14	P	76.2	6.7	0	1	1.2	3.4	3.9	0	50	0	30	20
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	15	R	82.9	2.5	1	0.2	0.5	1.1	1.1	0	0	0	100	0
2001	Trib 2	1	13	421586	7266571	8/31/2012	KS/DE	7.3	6.5	66	C	16	G	85.4	5.5	0	0.4	0.6	2	1.8	0	0	10	90	0
2002	Trib 2	2	13	421504	7266752	8/31/2012	KS/DE	7.3	6.5	66	C	1	C	0	10.6	4	0.1	0.3	2	2.5	0	0	30	70	0
2002	Trib 2	2	13	421504	7266752	8/31/2012	KS/DE	7.3	6.5	66	C	2	R	10.6	6	2	0.3	0.4	2.1	2.8	0	0	10	90	0
2002	Trib 2	2	13	421504	7266752	8/31/2012	KS/DE	7.3	6.5	66	C	3	G	16.6	4	0	0.3	0.4	3.7	4.2	0	0	40	60	0
2002	Trib 2	2	13	421504	7266752	8/31/2012	KS/DE	7.3	6.5	66	C	4	R	20.6	2.8	3	0.1	0.3	1.9	2.3	0	0	50	50	0
2002	Trib 2	2	13	421504	7266752	8/31/2012	KS/DE	7.3	6.5	66	C	5	G	23.4	11	0	0.3	0.5	1.7	2	0	0	80	20	0
2002	Trib 2	2	13	421504	7266752	8/31/2012	KS/DE	7.3	6.5	66	C	6	R	34.4	1.4	2	0.05	0.2	0.8	1.1	0	40	60	0	0
2002	Trib 2	2	13	421504	7266752	8/31/2012	KS/DE	7.3	6.5	66	C	7	G	35.8	5.7	0	0.1	0.3	0.8	0.9	0	20	80	0	0
2002	Trib 2	2	13	421504	7266752	8/31/2012	KS/DE	7.3	6.5	66	C	8	R	41.5	9.3	1	0.1	0.3	0.6	0.6	0	0	90	10	0
2003	Trib 2	3	13	421490	7266813	8/31/2012	KS/DE	7.3	6.5	66	C	1	G	0	15.4	0	0.4	0.5	1.2	1.2	40	20	30	10	0
2003	Trib 2	3	13	421490	7266813	8/31/2012	KS/DE	7.3	6.5	66	C	2	P	15.4	10	0	0.7	0.9	6.3	7	100	0	0	0	0
2003	Trib 2	3	13	421490	7266813	8/31/2012	KS/DE	7.3	6.5	66	C	3	G	25.4	11.5	0	0.5	0.6	1.3	2	60	30	10	0	0
2003	Trib 2	3	13	421490	7266813	8/31/2012	KS/DE	7.3	6.5	66	C	4	P	36.9	7.5	0	1	1.1	1.7	2.1	90	10	0	0	0
2003	Trib 2	3	13	421490	7266813	8/31/2012	KS/DE	7.3	6.5	66	C	5	G	44.4	13.5	0	0.4	0.5	1.5	2	100	0	0	0	0
2003	Trib 2	3	13	421490	7266813	8/31/2012	KS/DE	7.3	6.5	66	C	6	P	57.9	9.4	0	0.7	0.8	5.5	5.7	100	0	0	0	0
2003	Trib 2	3	13	421490	7266813	8/31/2012	KS/DE	7.3	6.5	66	C	7	G	67.3	10.3	0	0.4	0.5	3	3.5	100	0	0	0	0
2003	Trib 2	3	13	421490	7266813	8/31/2012	KS/DE	7.3	6.5	66	C	8	P	77.6	30	0	0.7	0.8	17	18	90	0	0	10	0
2003	Trib 2	3	13	421490	7266813	8/31/2012	KS/DE	7.3	6.5	66	C	9	G	107.6	21.8	0	0.4	0.5	4	4.5	50	0	0	50	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	1	P	0	4.5	0	0.5	0.6	1.7	2.4	80	0	20	0	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	2	G	4.5	11.3	0	0.2	0.3	1.1	1.5	90	0	10	0	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	3	R	15.8	1.5	2	0.1	0.2	1	1.4	100	0	0	0	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	4	G	17.3	1.7	0	0.2	0.3	0.7	1	30	10	60	0	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	5	R	19	2.5	2	0.1	0.2	0.7	2.4	100	0	0	0	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	6	P	21.5	2	0	0.2	0.3	0.9	1.6	80	0	20	0	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	7	R	23.5	4.5	2	0.1	0.2	0.5	1.1	90	0	0	10	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	8	G	28	3.7	0	0.2	0.3	0.7	0.9	95	0	0	5	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	9	P	31.7	1.7	0	0.3	0.4	0.9	1.2	10	0	0	90	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	10	P	33.4	1.6	0	0.3	0.4	0.7	1.4	100	0	0	0	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	11	G	35	3.7	0	0.2	0.3	0.7	1.4	100	0	0	0	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	12	G	38.7	3	0	0.1	0.2	2	3.7	95	0	5	0	0
2006	Trib 3-1	2	13	421305	7266189	9/2/2012	KS/DE	6.4	6.2	59	C	13	R	41.7	12.3	2	0.05	0.1	1.5	2.6	70	0	0	30	0
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	1	P	0	2.9	0	0.5	0.6	1.3	3.1	80	20	0	0	0
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	2	R	2.9	4.3	2	0.1	0.2	0.4	1.2	40	60	0	0	0
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	3	G	7.2	9.8	0	0.3	0.4	0.8	1.7	100	0	0	0	0
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	4	P	17	2.7	0	0.4	0.5	0.8	2.5	70	30	0	0	0
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	5	G	19.7	4.5	0	0.3	0.4	0.7	1.2	95	5	0	0	0
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	6	P	24.2	7.6	0	0.4	0.5	1.5	2.7	100	0	0	0	0
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	7	R	31.8	0.9	3	0.05	0.2	0.2	0.6	100	0	0	0	0
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	8	P	32.7	1.1	0	0.4	0.5	0.4	0.8	70	30	0	0	0

Appendix 3.2-2. Fish Habitat Assessment Procedure Data, Moby Outflow, 2012

Site	Stream	Reach	Zone	Easting	Northing	Date	Crew	Temp	pH	Conductivity	Turbidity	Habitat #	Habitat Type	Distance from Start	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)	Bedrock (%)
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	9	G	33.8	5.2	0	0.3	0.4	0.6	1.7	95	5	0	0	0
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	10	G	39	4.1	0	0.4	0.5	0.8	1	100	0	0	0	0
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	11	P	43.1	3.4	0	0.3	0.4	1.1	1.4	80	20	0	0	0
3000	Trib 2-1	1	13	421319	7266863	9/1/2012	KS/DE	6.7	7.3	71	C	12	R	46.5	2.3	2	0.1	0.2	0.8	2	100	0	0	0	0
3004	Trib 3-1	1	13	421695	7266157	9/1/2012	KS/DE	11.8	6.5	53	C	1	G	0	11.7	0	0.1	0.2	1.7	2.5	100	0	0	0	0
3004	Trib 3-1	1	13	421695	7266157	9/1/2012	KS/DE	11.8	6.5	53	C	2	R	11.7	5	1	0.05	0.1	0.7	2	100	0	0	0	0
3004	Trib 3-1	1	13	421695	7266157	9/1/2012	KS/DE	11.8	6.5	53	C	3	G	16.7	10.6	0	0.1	0.2	1	1.7	100	0	0	0	0
3004	Trib 3-1	1	13	421695	7266157	9/1/2012	KS/DE	11.8	6.5	53	C	4	R	27.3	5	1	0.1	0.2	0.6	1.4	100	0	0	0	0
3004	Trib 3-1	1	13	421695	7266157	9/1/2012	KS/DE	11.8	6.5	53	C	5	U	32.3	22	0	0.1		2.7		100	0	0	0	0
3004	Trib 3-1	1	13	421695	7266157	9/1/2012	KS/DE	11.8	6.5	53	C	6	G	54.3	5.4	0	0.1	0.2	0.9	1.7	100	0	0	0	0
3004	Trib 3-1	1	13	421695	7266157	9/1/2012	KS/DE	11.8	6.5	53	C	7	R	59.7	17.8	1	0.1	0.2	0.8	2.6	100	0	0	0	0
3004	Trib 3-1	1	13	421695	7266157	9/1/2012	KS/DE	11.8	6.5	53	C	8	G	77.5	3.6	0	0.1	0.2	2	3.3	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	1	P	0	3.9	0	0.3	0.4	1	1.4	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	2	R	3.9	2.5	2	0.1	0.2	0.4	0.8	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	3	G	6.4	3.5	0	0.1	0.2	0.6	0.8	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	4	P	9.9	2.6	0	0.3	0.4	0.9	1.3	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	5	G	12.5	6.7	0	0.15	0.25	0.9	1.3	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	6	P	19.2	2.8	0	0.4	0.5	0.8	1.2	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	7	G	22	4.3	0	0.4	0.5	0.6	0.9	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	8	P	26.3	3	0	0.5	0.6	1.2	1.6	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	9	R	29.3	3.1	2	0.1	0.2	0.6	1.4	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	10	G	32.4	3	0	0.15	0.25	0.7	1.2	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	11	R	35.4	4.4	2	0.1	0.2	0.6	1.2	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	12	G	39.8	3.6	0	0.1	0.2	0.6	1.3	100	0	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	13	R	43.4	4.2	1	0.1	0.2	1.4	2.2	90	10	0	0	0
3005	Trib 5	2	13	422099	7266111	9/1/2012	KS/DE	9.3	6.6	80	C	14	P	47.6	3.3	0	0.3	0.4	1.4	1.8	100	0	0	0	0
3006	Trib 5	3	13	422238	7266592	9/1/2012	KS/DE	7	6.1	34	C	1	R	0	2.7	1	0.2	0.3	0.3	0.7	100	0	0	0	0
3006	Trib 5	3	13	422238	7266592	9/1/2012	KS/DE	7	6.1	34	C	2	G	2.7	2.3	0	0.2	0.3	0.6	0.9	100	0	0	0	0
3006	Trib 5	3	13	422238	7266592	9/1/2012	KS/DE	7	6.1	34	C	3	R	5	10	2	0.2	0.3	0.3	0.8	95	5	0	0	0
3006	Trib 5	3	13	422238	7266592	9/1/2012	KS/DE	7	6.1	34	C	4	G	15	11.5	0	0.3	0.4	0.9	1.3	100	0	0	0	0
3006	Trib 5	3	13	422238	7266592	9/1/2012	KS/DE	7	6.1	34	C	5	R	26.5	2.8	1	0.2	0.3	0.4	0.7	100	0	0	0	0
3006	Trib 5	3	13	422238	7266592	9/1/2012	KS/DE	7	6.1	34	C	6	G	29.3	7.1	0	0.3	0.4	0.7	1.2	100	0	0	0	0
3006	Trib 5	3	13	422238	7266592	9/1/2012	KS/DE	7	6.1	34	C	7	R	36.4	2.8	1	0.2	0.3	0.4	1.1	100	0	0	0	0
3006	Trib 5	3	13	422238	7266592	9/1/2012	KS/DE	7	6.1	34	C	8	G	39.2	5.7	0	0.2	0.3	0.6	0.9	100	0	0	0	0
3006	Trib 5	3	13	422238	7266592	9/1/2012	KS/DE	7	6.1	34	C	9	P	44.9	2.3	0	0.3	0.4	0.8	1.6	100	0	0	0	0
3006	Trib 5	3	13	422238	7266592	9/1/2012	KS/DE	7	6.1	34	C	10	G	47.2	9	0	0.1	0.2	0.7	1.1	100	0	0	0	0
3050	Trib 4	1	13	422341	7266322	9/1/2012	KS/DE	7	6.1	34	C	1	R	0	7.3	2	0.1	0.2	1.2	2.1	10	0	60	30	0
3050	Trib 4	1	13	422341	7266322	9/1/2012	KS/DE	7	6.1	34	C	2	P	7.3	5	0	0.2	0.3	3.9	4.2	0	0	40	60	0
3050	Trib 4	1	13	422341	7266322	9/1/2012	KS/DE	7	6.1	34	C	3	C	12.3	10	4	0.05	0.2	1	1.9	0	0	30	30	40
3050	Trib 4	1	13	422341	7266322	9/1/2012	KS/DE	7	6.1	34	C	4	G	22.3	24.3	0	0.2	0.3	1.5	2.2	45	0	50	5	0

N/A = not applicable; LB = left bank; RB = right bank; - = not collected

Habitat type
P = pool
G = glide
R = riffle
C = cascade
NCD = non-classified drainage
PD = pond
U = undefined section (no banks)

Pool type
S = scour
D = dam

Turbidity
C = clear

Barrier type
F = falls
BF = boulder field
V = velocity barrier
CH = chute
NC = no channel
P = permanent
T = temporary

Appendix 3.2-2. Fish Habitat Assessment Procedure Data, Moby Outflow, 2012

Site	Stream	Reach	Pool Type	Pool Max Depth (m)	Pool Crest Depth (m)	Barrier Type	T/P	LB Height (m)	RB Height (m)	LB Stability	RB Stability	Pool Cover (%)	Boulder Cover (%)	Instream Veg Cover(%)	Overhang Veg Cover(%)	Undercut Bank Cover (%)	Bankfull Area (m^2)	Wetted Area (m^2)	Proportional Length (%)	Proportional Bankfull Area (%)	Proportional Wetted Area (%)
1000	Moby	1	S	1.6	0.5			0.5	0.5	0.5	0.5	30	0	20	0	0	52.7	52.7	0.3	0.4	0.4
1000	Moby	1						0.4	0.5	0.5	0.5	0	0	20	0	5	34.8	25.3	0.3	0.3	0.2
1000	Moby	1	S	1.5	0.7			0.3	0.3	0.5	0.5	40	0	20	0	0	28.1	23.4	0.1	0.2	0.2
1000	Moby	1						0.1	0.3	0.5	0.5	0	0	10	0	30	19.2	17.9	0.2	0.1	0.1
1000	Moby	1						0.1	0.2	0.5	0.5	0	0	20	0	0	2.9	1.5	0.0	0.0	0.0
1001	Moby	2						0.5	0.5	0.5	0	0	0	10	0	50	11.9	7.7	0.1	0.0	0.0
1001	Moby	2	S	1	0.7			0.4	0.2	0.5	0.5	0	0	0	0	40	7.7	7.7	0.0	0.0	0.0
1001	Moby	2						0.2	0.2	0.5	0.5	0	0	0	0	40	29.7	19.8	0.1	0.1	0.0
1001	Moby	2						0.2	0.2	0.5	0.5	0	0	0	0	0	60.0	27.0	0.3	0.1	0.1
1001	Moby	2	S	1	0.5			0.2	0.2	0.5	0.5	0	0	20	0	10	48.0	32.0	0.1	0.1	0.1
1001	Moby	2						0.3	0.2	0.5	0.5	0	0	30	0	10	31.7	28.4	0.1	0.1	0.1
1001	Moby	2	S	1.9	0.7			0.7	0.4	0	0.5	50	0	5	0	0	360.0	330.0	0.3	0.7	0.7
1002	Moby	3						0.2	0.3	0.5	0.5	0	0	40	0	10	37.4	29.6	0.1	0.0	0.0
1002	Moby	3	S	1	0.4			0.3	0.4	0.5	0.5	0	0	60	0	0	192.0	168.0	0.1	0.2	0.2
1002	Moby	3						0.4	0.3	0.5	0.5	0	0	50	0	10	14.5	14.5	0.1	0.0	0.0
1002	Moby	3	S	0.8	0.4			0.4	0.3	0.5	0.5	0	0	30	0	0	67.0	53.6	0.1	0.1	0.1
1002	Moby	3	S	1.6	0.8			0.2	0.3	0.5	0.5	40	0	10	0	0	235.2	231.0	0.1	0.2	0.2
1002	Moby	3						0.3	0.3	0.5	0.5	0	0	40	0	20	4.0	2.0	0.0	0.0	0.0
1002	Moby	3						0.2	0.5	0.5	0.5	0	0	50	0	10	96.0	70.4	0.2	0.1	0.1
1002	Moby	3	S	1.6	0.5			0.5	0.4	0.5	0.5	20	30	10	0	0	418.9	380.4	0.2	0.4	0.4
1002	Moby	3						0.2	0.3	0.5	0.5	0	70	0	0	10	47.0	43.5	0.1	0.0	0.0
1003	Moby	4						0.1	0.2	0.5	0.5	0	0	5	0	0	52.3	52.3	0.2	0.0	0.0
1003	Moby	4						0.2	0.4	0.5	0.5	0	0	30	0	0	480.0	360.0	0.2	0.3	0.3
1003	Moby	4						0.3	0.2	0.5	0.5	0	0	5	0	0	163.4	133.0	0.2	0.1	0.1
1003	Moby	4	S	0.8	0.2			0.2	0.1	0.5	0.5	0	0	0	0	0	456.0	427.5	0.2	0.3	0.4
1003	Moby	4						0.3	0.3	0.5	0.5	0	0	10	0	0	81.0	81.0	0.1	0.1	0.1
1003	Moby	4	S	1.1	0.5			0.2	0.2	0.5	0.5	0	0	0	0	0	165.0	165.0	0.1	0.1	0.1
1004	Moby	5						0.3	0.2	0.5	0.5	0	0	10	0	10	11.4	10.5	0.1	0.0	0.0
1004	Moby	5						0.3	0.1	0.5	0.5	0	0	20	0	30	48.0	36.0	0.2	0.1	0.1
1004	Moby	5	S	1.3	0.2			0.2	0.2	0.5	0.5	20	0	10	0	0	159.0	132.5	0.2	0.3	0.3
1004	Moby	5						0.2	0.4	0.5	0.5	0	0	20	0	20	4.6	4.9	0.0	0.0	0.0
1004	Moby	5	S	1.2	0.2			0.1	0.1	0.5	0.5	20	0	30	0	0	195.0	175.5	0.2	0.4	0.4
1004	Moby	5						0.1	0.2	0.5	0.5	0	0	20	0	30	45.0	33.0	0.3	0.1	0.1
1005	Moby	6						0.4	0.3	0.5	0.5	0	30	0	0	5	141.0	155.1	0.3	0.2	0.2
1005	Moby	6						0.3	0.2	0.5	0.5	0	10	5	0	5	180.0	188.0	0.3	0.2	0.2
1005	Moby	6	S	0.8	0.4			0.3	0.1	0.5	0.5	0	0	5	0	5	252.0	266.0	0.2	0.3	0.3
1005	Moby	6						0.2	0.1	0.5	0.5	0	5	0	0	5	119.0	119.0	0.1	0.1	0.1
1005	Moby	6	S	0.9	0.6			0.1	0.1	0.5	0.5	0	0	5	0	0	175.0	166.3	0.1	0.2	0.2
1006	Moby	7						0.1	0.1	0.5	0.5	0	0	0	0	20	38.8	32.6	0.2	0.1	0.1
1006	Moby	7						0.1	0.1	0.5	0.5	0	0	0	0	40	4.1	2.4	0.0	0.0	0.0
1006	Moby	7	S	0.65	0.2			0.2	0.2	0.5	0.5	0	0	0	0	20	10.2	8.2	0.1	0.0	0.0
1006	Moby	7						0.1	0.2	0.5	0.5	0	0	0	0	10	4.2	3.4	0.0	0.0	0.0
1006	Moby	7	S	1.1	0.2			0.2	0.2	0.5	0.5	50	0	0	0	20	8.6	7.3	0.1	0.0	0.0
1006	Moby	7						0.4	0.2	0.5	0.5	0	0	0	0	0	3.6	2.7	0.0	0.0	0.0
1006	Moby	7	S	1.1	0.1			0.1	0.2	0.5	0.5	10	0	5	0	5	134.2	109.8	0.2	0.5	0.5
1006	Moby	7						0.4	0.1	0.5	0.5	0	0	0	0	0	3.1	1.7	0.0	0.0	0.0
1006	Moby	7						0.4	0.2	0	0.5	0	0	0	0	10	56.6	50.7	0.3	0.2	0.2
1006	Moby	7						0.5	0.3	0.5	0.5	0	20	0	0	30	6.0	8.4	0.1	0.0	0.0
1007	Moby	8	S	0.9	0.4			0.2	0.2	0.5	0.5	30	0	0	0	0	42.8	42.8	0.1	0.1	0.1
1007	Moby	8						0.4	0.4	0.5	0.5	0	0	5	0	0	233.6	233.6	0.3	0.3	0.3
1007	Moby	8						0.1	0.2	0.5	0.5	0	0	60	0	0	49.2	51.3	0.1	0.1	0.1

Appendix 3.2-2. Fish Habitat Assessment Procedure Data, Moby Outflow, 2012

Site	Stream	Reach	Pool Type	Pool Max Depth (m)	Pool Crest Depth (m)	Barrier Type	T/P	LB Height (m)	RB Height (m)	LB Stability	RB Stability	Pool Cover (%)	Boulder Cover (%)	Instream Veg Cover(%)	Overhang Veg Cover(%)	Undercut Bank Cover (%)	Bankfull Area (m^2)	Wetted Area (m^2)	Proportional Length (%)	Proportional Bankfull Area (%)	Proportional Wetted Area (%)
1007	Moby	8						0.1	0.1	0.5	0.5	0	0	5	0	20	7.6	6.3	0.0	0.0	0.0
1007	Moby	8						0.2	0.1	0.5	0.5	0	0	30	0	10	8.5	5.5	0.0	0.0	0.0
1007	Moby	8						0.1	0.3	0.5	0.5	0	0	0	0	0	435.0	406.0	0.4	0.6	0.5
1008	Moby	9						0.1	0.2	0.5	0.5	0	5	0	0	0	74.2	58.3	0.2	0.1	0.1
1008	Moby	9	S	0.9	0.4			0.2	0.2	0.5	0.5	0	0	0	0	0	303.6	291.0	0.2	0.5	0.5
1008	Moby	9						0.2	0.2	0.5	0.5	0	0	0	0	0	115.0	105.8	0.2	0.2	0.2
1008	Moby	9						0.2	0.2	0.5	0.5	0	0	5	0	5	20.4	13.0	0.1	0.0	0.0
1008	Moby	9	S	0.9	0.4			0.2	0.3	0.5	0.5	0	0	0	0	10	59.9	55.1	0.1	0.1	0.1
1008	Moby	9						0.2	0.3	0.5	0.5	0	0	0	0	0	26.0	24.6	0.0	0.0	0.0
1008	Moby	9						0.2	0.3	0.5	0.5	0	10	0	0	10	16.8	20.4	0.1	0.0	0.0
1008	Moby	9						0.3	0.3	0.5	0.5	0	40	0	0	5	24.3	24.3	0.1	0.0	0.0
1009	Moby	10						0.1	0.2	0.5	0.5	0	0	0	0	10	9.0	9.0	0.1	0.1	0.1
1009	Moby	10						0.3	0.3	0.5	0.5	0	0	0	0	20	2.8	2.8	0.1	0.0	0.0
1009	Moby	10						0.3	0.2	0.5	0.5	0	0	5	0	10	5.4	5.0	0.1	0.0	0.0
1009	Moby	10	S	0.4	0.1			0.1	0.2	0.5	0.5	0	0	0	0	30	2.8	2.8	0.0	0.0	0.0
1009	Moby	10						0.1	0.1	0.5	0.5	0	0	0	0	10	1.2	0.9	0.0	0.0	0.0
1009	Moby	10						0.1	0.1	0.5	0.5	0	0	0	0	0	4.0	3.2	0.0	0.0	0.0
1009	Moby	10	S	0.6	0.2			0.2	0.1	0.5	0.5	0	0	0	0	10	2.4	2.0	0.0	0.0	0.0
1009	Moby	10						0.3	0.1	0.5	0.5	0	0	0	0	20	4.3	3.7	0.1	0.0	0.0
1009	Moby	10						0.2	0.1	0.5	0.5	0	0	0	0	10	9.0	7.2	0.1	0.1	0.1
1009	Moby	10	S	0.6	0.3			0.2	0.1	0.5	0.5	0	0	0	0	0	57.5	45.0	0.1	0.4	0.4
1009	Moby	10						0.2	0.2	0.5	0.5	0	0	0	0	5	17.0	10.0	0.1	0.1	0.1
1009	Moby	10						0.2	0.4	0.5	0.5	0	5	0	0	5	26.3	21.0	0.2	0.2	0.2
1010	Moby	11						1.1	1.1	1	1	0	30	0	0	0	10.0	9.2	0.1	0.1	0.2
1010	Moby	11	D	0.6	0.1			1.1	1.5	1	1	0	40	0	0	0	3.5	3.5	0.1	0.0	0.1
1010	Moby	11						0.7	1	1	1	0	20	0	0	0	8.1	4.1	0.1	0.1	0.1
1010	Moby	11						0.6	1	1	1	0	10	0	0	0	10.1	5.0	0.1	0.1	0.1
1010	Moby	11				V	P	0.5	0.5	1	1	0	20	0	0	0	9.0	3.0	0.1	0.1	0.1
1010	Moby	11	S	0.8	0.2			0.3	0.5	0	0.5	0	10	0	0	10	16.5	13.7	0.1	0.2	0.2
1010	Moby	11						0.4	0.3	0.5	0.5	0	30	0	0	0	7.0	5.8	0.1	0.1	0.1
1010	Moby	11						0.3	0.5	0.5	0.5	0	20	0	0	0	16.3	15.0	0.2	0.2	0.3
1014	Moby	13						0.2	0.2	0.5	0.5	0	30	0	0	0	42.0	35.0	0.3	0.3	0.4
1014	Moby	13						0.2	0.2	0.5	0.5	0	40	0	0	0	12.5	3.9	0.1	0.1	0.0
1014	Moby	13						0.3	0.3	0.5	1	0	40	0	5	0	31.9	23.9	0.2	0.2	0.3
1014	Moby	13						0.5	0.3	0.5	0.5	0	20	0	0	0	46.2	19.6	0.3	0.3	0.2
1014	Moby	13						0.5	0.4	0.5	0.5	0	10	0	20	0	9.6	5.6	0.1	0.1	0.1
2000	Trib 1	1						0.5	0.5	0.5	0.5	0	0	0	0	90	0.9	1.6	0.1	0.0	0.1
2000	Trib 1	1						0.4	0.4	0.5	0.5	0	60	0	0	0	0.8	0.5	0.1	0.0	0.0
2000	Trib 1	1	D	0.3	0.1			0.4	0.3	0.5	0.5	0	20	0	0	10	1.0	1.0	0.0	0.0	0.1
2000	Trib 1	1				F	P	0.1	0.1	0.5	0.5	0	20	0	0	10	0.6	0.2	0.1	0.0	0.0
2000	Trib 1	1	S	0.3	0.05			0.1	0.1	0.5	0.5	0	0	0	0	5	0.9	0.7	0.0	0.0	0.0
2000	Trib 1	1	S	0.4	0.05			0.2	0.1	0.5	0.5	0	0	0	0	30	0.5	0.5	0.1	0.0	0.0
2000	Trib 1	1						0.1	0.1	0.5	0.5	0	0	5	0	0	1.6	1.2	0.1	0.1	0.1
2000	Trib 1	1	S	0.5	0.05			0.2	0.1	0.5	0.5	0	0	0	0	20	4.2	3.6	0.2	0.2	0.3
2000	Trib 1	1						0.1	0.1	0.5	0.5	0	0	20	0	0	1.0	0.2	0.1	0.0	0.0
2000	Trib 1	1	S	0.6	0.1			0.2	0.1	0.5	0.5	0	0	0	0	10	6.9	2.8	0.2	0.3	0.2
2000	Trib 1	1						0.1	0.1	0.5	0.5	0	0	20	0	0	1.6	0.6	0.1	0.1	0.0
2000	Trib 1	1						0.1	0.1	0.5	0.5	0	0	10	0	0	3.6	1.2	0.1	0.2	0.1
2001	Trib 2	1						0.2	0.3	0.5	0.5	0	0	0	0	5	14.4	12.8	0.1	0.1	0.1
2001	Trib 2	1						0.3	0.2	0.5	0.5	0	0	0	0	5	7.4	6.8	0.0	0.0	0.0
2001	Trib 2	1						0.4	0.3	0.5	0.5	0	0	0	0	5	16.6	14.4	0.1	0.1	0.1

Appendix 3.2-2. Fish Habitat Assessment Procedure Data, Moby Outflow, 2012

Site	Stream	Reach	Pool Type	Pool Max Depth (m)	Pool Crest Depth (m)	Barrier Type	T/P	LB Height (m)	RB Height (m)	LB Stability	RB Stability	Pool Cover (%)	Boulder Cover (%)	Instream Veg Cover(%)	Overhang Veg Cover(%)	Undercut Bank Cover (%)	Bankfull Area (m^2)	Wetted Area (m^2)	Proportional Length (%)	Proportional Bankfull Area (%)	Proportional Wetted Area (%)
2001	Trib 2	1						0.2	0.4	0.5	0.5	0	20	0	0	0	9.5	8.0	0.1	0.0	0.0
2001	Trib 2	1						0.3	0.3	0.5	0.5	0	5	0	0	20	6.4	6.4	0.1	0.0	0.0
2001	Trib 2	1						0.2	0.2	0.5	0.5	0	0	0	0	5	27.3	29.9	0.1	0.1	0.2
2001	Trib 2	1						0.1	0.1	0.5	0.5	0	0	0	0	20	4.8	1.8	0.0	0.0	0.0
2001	Trib 2	1	S	0.5	0.2			0.1	0.1	0.5	0.5	0	0	0	0	10	11.6	8.4	0.0	0.0	0.0
2001	Trib 2	1	S	0.7	0.3			0.1	0.1	0.5	0.5	0	0	0	0	10	27.3	6.7	0.0	0.1	0.0
2001	Trib 2	1	S	0.7	0.4			0.1	0.1	0.5	0.5	0	0	10	0	10	36.5	13.9	0.1	0.2	0.1
2001	Trib 2	1						0.1	0.2	0.5	0.5	0	0	10	0	30	19.0	11.4	0.1	0.1	0.1
2001	Trib 2	1						0.2	0.3	0.5	0.5	0	5	0	0	20	9.2	9.2	0.0	0.0	0.1
2001	Trib 2	1						0.3	0.3	0.5	0.5	0	20	0	0	20	3.8	2.7	0.0	0.0	0.0
2001	Trib 2	1	S	1.1	0.3			0.1	0.3	0.5	0.5	30	20	0	0	0	26.1	22.8	0.1	0.1	0.1
2001	Trib 2	1						0.3	0.2	0.5	0.5	0	10	0	0	10	2.8	2.8	0.0	0.0	0.0
2001	Trib 2	1						0.4	0.3	0.5	0.5	0	20	0	0	10	9.9	11.0	0.1	0.0	0.1
2002	Trib 2	2						0.4	0.2	0.5	0.5	0	30	0	0	0	26.5	21.2	0.2	0.3	0.3
2002	Trib 2	2						0.3	0.3	0.5	0.5	0	40	0	0	0	16.8	12.6	0.1	0.2	0.2
2002	Trib 2	2						0.3	0.3	0.5	0.5	0	20	0	0	10	16.8	14.8	0.1	0.2	0.2
2002	Trib 2	2						0.3	0.3	0.5	0.5	0	20	0	0	0	6.4	5.3	0.1	0.1	0.1
2002	Trib 2	2						0.3	0.3	0.5	0.5	0	5	0	0	5	22.0	18.7	0.2	0.2	0.2
2002	Trib 2	2						0.3	0.3	0.5	0.5	0	0	0	0	0	1.5	1.1	0.0	0.0	0.0
2002	Trib 2	2						0.3	0.3	0.5	0.5	0	0	0	0	5	5.1	4.6	0.1	0.1	0.1
2002	Trib 2	2						0.4	0.4	0.5	0.5	0	5	0	10	0	5.6	5.6	0.2	0.1	0.1
2003	Trib 2	3						0.2	0.2	0.5	0.5	0	0	0	0	20	18.5	18.5	0.1	0.0	0.0
2003	Trib 2	3	S	1.1	0.4			0.3	0.3	0	0.5	10	0	0	0	5	70.0	63.0	0.1	0.1	0.1
2003	Trib 2	3						0.2	0.1	0.5	0.5	0	0	0	0	5	23.0	15.0	0.1	0.0	0.0
2003	Trib 2	3	S	1.1	0.4			0.1	0.2	0.5	0.5	0	0	0	0	5	15.8	12.8	0.1	0.0	0.0
2003	Trib 2	3						0.2	0.1	0.5	0.5	0	0	0	0	5	23.0	15.0	0.1	0.0	0.0
2003	Trib 2	3						0.3	0.1	0.5	0.5	0	0	0	0	5	27.0	20.3	0.1	0.0	0.0
2003	Trib 2	3	S	1	0.4			0.3	0.2	0.5	0.5	0	0	5	0	5	53.6	51.7	0.1	0.1	0.1
2003	Trib 2	3						0.3	0.2	0.5	0.5	0	0	0	0	0	36.1	30.9	0.1	0.0	0.0
2003	Trib 2	3	S	0.8	0.4			0.2	0.1	0.5	0.5	0	5	5	0	0	540.0	510.0	0.2	0.6	0.6
2003	Trib 2	3						0.3	0.3	0.5	0.5	0	40	40	0	0	98.1	87.2	0.2	0.1	0.1
2006	Trib 3-1	2	S	0.7	0.2			0.1	0.1	0	0.5	0	0	0	0	10	10.8	7.7	0.1	0.1	0.1
2006	Trib 3-1	2						0.1	0.1	0.5	0.5	0	0	5	0	0	17.0	12.4	0.2	0.2	0.2
2006	Trib 3-1	2						0.2	0.2	0.5	0.5	0	0	5	0	0	2.1	1.5	0.0	0.0	0.0
2006	Trib 3-1	2						0.3	0.1	0.5	0.5	0	0	0	0	5	1.7	1.2	0.0	0.0	0.0
2006	Trib 3-1	2						0.1	0.1	0	0	0	0	30	0	0	6.0	1.8	0.0	0.1	0.0
2006	Trib 3-1	2	S	0.3	0.1			0.1	0.2	0	0	0	0	0	0	0	3.2	1.8	0.0	0.0	0.0
2006	Trib 3-1	2						0.1	0.2	0	0.5	0	5	5	0	0	5.0	2.3	0.1	0.0	0.0
2006	Trib 3-1	2						0.2	0.2	0.5	0.5	0	5	5	0	0	3.3	2.6	0.1	0.0	0.0
2006	Trib 3-1	2	D	0.4	0.1			0.1	0.3	0	0.5	0	30	10	0	0	2.0	1.5	0.0	0.0	0.0
2006	Trib 3-1	2	D	0.4	0.2			0.1	0.1	0.5	0.5	0	0	20	0	0	2.2	1.1	0.0	0.0	0.0
2006	Trib 3-1	2						0.1	0.1	0.5	0	0	0	20	0	0	5.2	2.6	0.1	0.1	0.0
2006	Trib 3-1	2						0.1	0.1	0	0	0	0	0	0	10	11.1	6.0	0.1	0.1	0.1
2006	Trib 3-1	2						0.1	0.2	0	0.5	0	20	10	0	0	32.0	18.5	0.2	0.3	0.3
3000	Trib 2-1	1	S	0.6	0.1			0.1	0.1	0.5	0.5	0	0	0	0	20	9.0	3.8	0.1	0.1	0.1
3000	Trib 2-1	1						0.2	0.1	0.5	0.5	0	0	0	0	10	5.2	1.7	0.1	0.1	0.0
3000	Trib 2-1	1						0.2	0.1	0.5	0	0	0	5	0	20	16.7	7.8	0.2	0.2	0.2
3000	Trib 2-1	1	S	0.4	0.2			0.2	0.1	0.5	0.5	0	0	0	0	30	6.8	2.2	0.1	0.1	0.1
3000	Trib 2-1	1						0.2	0.1	0.5	0.5	0	0	0	0	0	5.4	3.2	0.1	0.1	0.1
3000	Trib 2-1	1	S	0.4	0.05			0.1	0.2	0	0.5	0	0	0	0	5	20.5	11.4	0.2	0.2	0.3
3000	Trib 2-1	1						0.1	0.2	0.5	0.5	0	0	10	0	0	0.5	0.2	0.0	0.0	0.0
3000	Trib 2-1	1	S	0.5	0.05			0.1	0.2	0.5	0.5	0	0	10	0	40	0.9	0.4	0.0	0.0	0.0

Appendix 3.2-2. Fish Habitat Assessment Procedure Data, Moby Outflow, 2012

Site	Stream	Reach	Pool Type	Pool Max Depth (m)	Pool Crest Depth (m)	Barrier Type	T/P	LB Height (m)	RB Height (m)	LB Stability	RB Stability	Pool Cover (%)	Boulder Cover (%)	Instream Veg Cover(%)	Overhang Veg Cover(%)	Undercut Bank Cover (%)	Bankfull Area (m^2)	Wetted Area (m^2)	Proportional Length (%)	Proportional Bankfull Area (%)	Proportional Wetted Area (%)
3000	Trib 2-1	1						0.1	0.1	0.5	0.5	0	0	0	0	5	8.8	3.1	0.1	0.1	0.1
3000	Trib 2-1	1						0.2	0.2	0.5	0.5	0	0	0	0	10	4.1	3.3	0.1	0.0	0.1
3000	Trib 2-1	1	S	0.4	0.2			0.2	0.1	0.5	0.5	0	0	0	0	10	4.8	3.7	0.1	0.1	0.1
3000	Trib 2-1	1						0.1	0.1	0.5	0	0	0	40	0	0	4.6	1.8	0.0	0.1	0.0
3004	Trib 3-1	1						0.1	0.1	0	0	0	0	5	0	0	29.3	19.9	0.1	0.2	0.2
3004	Trib 3-1	1						0.1	0.1	0.5	0	0	0	10	0	0	10.0	3.5	0.1	0.1	0.0
3004	Trib 3-1	1						0.1	0.1	0	0	0	0	30	0	0	18.0	10.6	0.1	0.1	0.1
3004	Trib 3-1	1						0.1	0.1	0.5	0	0	0	50	0	0	7.0	3.0	0.1	0.1	0.0
3004	Trib 3-1	1										0	0	60	0	0	0.0	59.4	0.3	0.0	0.5
3004	Trib 3-1	1						0.1	0.1	0	0	0	0	20	0	0	9.2	4.9	0.1	0.1	0.0
3004	Trib 3-1	1						0.1	0.1	0	0	0	0	60	0	0	46.3	14.2	0.2	0.4	0.1
3004	Trib 3-1	1						0.1	0.1	0	0	0	0	20	0	0	11.9	7.2	0.0	0.1	0.1
3005	Trib 5	2	S	0.4	0.05			0.1	0.1	0.5	0.5	0	0	0	0	5	5.5	3.9	0.1	0.1	0.1
3005	Trib 5	2						0.2	0.1	0.5	0.5	0	0	0	0	5	2.0	1.0	0.0	0.0	0.0
3005	Trib 5	2						0.2	0.1	0.5	0.5	0	0	0	0	0	2.8	2.1	0.1	0.0	0.0
3005	Trib 5	2	S	0.4	0.1			0.1	0.1	0	0.5	0	0	0	0	0	3.4	2.3	0.1	0.1	0.1
3005	Trib 5	2						0.1	0.1	0	0.5	0	0	0	0	0	8.7	6.0	0.1	0.1	0.1
3005	Trib 5	2	S	0.5	0.1			0.1	0.1	0.5	0.5	0	0	0	0	20	3.4	2.2	0.1	0.0	0.1
3005	Trib 5	2						0.1	0.1	0.5	0.5	0	0	0	0	10	3.9	2.6	0.1	0.1	0.1
3005	Trib 5	2	S	0.6	0.3			0.1	0.1	0.5	0.5	0	0	0	0	10	4.8	3.6	0.1	0.1	0.1
3005	Trib 5	2						0.1	0.2	0	0.5	0	0	0	0	0	4.3	1.9	0.1	0.1	0.0
3005	Trib 5	2						0.2	0.2	0.5	0.5	0	0	0	0	10	3.6	2.1	0.1	0.1	0.0
3005	Trib 5	2						0.2	0.1	0.5	0	0	0	0	0	10	5.3	2.6	0.1	0.1	0.1
3005	Trib 5	2						0.2	0.1	0.5	0	0	0	0	0	0	4.7	2.2	0.1	0.1	0.1
3005	Trib 5	2						0.2	0.1	0	0.5	0	0	0	0	0	9.2	5.9	0.1	0.1	0.1
3005	Trib 5	2						0.2	0.1	0.5	0	0	0	0	0	0	4.7	2.2	0.1	0.1	0.1
3005	Trib 5	2						0.2	0.1	0	0.5	0	0	0	0	0	9.2	5.9	0.1	0.1	0.1
3005	Trib 5	2	S	0.4	0.1			0.2	0.1	0	0.5	0	0	0	0	0	5.9	4.6	0.1	0.1	0.1
3006	Trib 5	3						0.2	0.2	0.5	0.5	0	0	0	0	30	1.9	0.8	0.0	0.0	0.0
3006	Trib 5	3						0.2	0.1	0.5	0.5	0	0	0	0	5	2.1	1.4	0.0	0.0	0.0
3006	Trib 5	3						0.1	0.1	0.5	0.5	0	0	0	0	20	8.0	3.0	0.2	0.1	0.1
3006	Trib 5	3						0.1	0.1	0	0.5	0	0	0	0	20	15.0	10.4	0.2	0.3	0.3
3006	Trib 5	3						0.2	0.2	0.5	0.5	0	0	0	0	30	2.0	1.1	0.0	0.0	0.0
3006	Trib 5	3						0.1	0.1	0	0.5	0	0	0	0	10	8.5	5.0	0.1	0.1	0.1
3006	Trib 5	3						0.1	0.1	0	0	0	0	0	0	30	3.1	1.1	0.0	0.1	0.0
3006	Trib 5	3						0.1	0.1	0.5	0.5	0	0	0	0	5	5.1	3.4	0.1	0.1	0.1
3006	Trib 5	3	S	0.5	0.2			0.2	0.1	0.5	0	0	0	0	0	10	3.7	1.8	0.0	0.1	0.1
3006	Trib 5	3						0.1	0.2	0	0.5	0	0	0	0	0	9.9	6.3	0.2	0.2	0.2
3050	Trib 4	1						0.1	0.1	0	0	0	10	10	0	0	15.3	8.8	0.2	0.1	0.1
3050	Trib 4	1	D	0.3	0.05			0.2	0.2	0.5	0.5	0	5	10	0	0	21.0	19.5	0.1	0.2	0.3
3050	Trib 4	1				BF	T	0.5	0.5	0.5	0.5	0	30	0	0	0	19.0	10.0	0.2	0.2	0.1
3050	Trib 4	1						0.3	0.2	0.5	0.5	0	0	20	0	0	53.5	36.5	0.5	0.5	0.5

N/A = not applicable; LB = left bank; RB = right bank; - = not collected

Habitat type
P = pool
G = glide
R = riffle
C = cascade
NCD = non-classified drainage
PD = pond
U = undefined section (no banks)

Pool type
S = scour
D = dam

Turbidity
C = clear

Barrier type
F = falls
BF = boulder field
V = velocity barrier
CH = chute
NC = no channel
P = permanent
T = temporary

Appendix 3.3-1
Lake Substrate Zone Data, 2012

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Appendix 3.3-1. Lake Substrate Zone Data, 2012

Lake	Date	Crew	Weather	Water Temp	Substrate Zone	Fines	Gravel	Cobble	Boulder	Bedrock	Vegetation Abundance	Vegetation Type
Big	7-Aug	LT/TS	sunny, warm	15	1	35	35	25	5	0	n	n
Big	7-Aug	LT/TS	sunny, warm	15	2	15	60	20	5	0	n	n
Big	7-Aug	LT/TS	sunny, warm	15	3	20	20	50	10	0	s	m
Big	7-Aug	LT/TS	sunny, warm	15	4	20	20	35	20	5	n	n
Big	7-Aug	LT/TS	sunny, warm	15	5	0	0	0	10	90	n	n
Big	7-Aug	LT/TS	sunny, warm	15	6	60	10	15	15	0	n	n
Big	7-Aug	LT/TS	sunny, warm	15	7	40	15	40	5	0	n	n
Big	7-Aug	LT/TS	sunny, warm	15	8	10	10	40	40	0	n	n
Big	7-Aug	LT/TS	sunny, warm	15	9	5	20	25	35	15	s	v
Big	7-Aug	LT/TS	sunny, warm	15	10	15	45	35	5	0	s	m
Big	7-Aug	LT/TS	sunny, warm	15	11	5	10	30	55	0	n	n
Big	7-Aug	LT/TS	sunny, warm	15	12	45	35	15	5	0	n	n
Big	7-Aug	LT/TS	sunny, warm	15	13	50	40	5	5	0	n	n
Big	7-Aug	LT/TS	sunny, warm	15	14	10	10	40	40	0	n	n
Big	7-Aug	LT/TS	sunny, warm	15	15	0	0	0	0	100	n	n
Big	7-Aug	LT/TS	sunny, warm	15	16	0	0	10	30	60	n	n
Big	7-Aug	LT/TS	sunny, warm	15	17	5	5	40	40	5	n	n
Fox	22-Jul	LT/QS	windy		1	0	0	0	0	100	n	n
Fox	22-Jul	LT/QS	windy		2	0	0	20	20	60	n	n
Fox	22-Jul	LT/QS	windy		3	0	0	20	40	40	n	n
Fox	22-Jul	LT/QS	windy		4	50	0	20	30	0	n	n
Fox	22-Jul	LT/QS	windy		5	20	0	10	20	50	n	n
Fox	22-Jul	LT/QS	windy		6	10	0	10	60	20	n	n
Fox	22-Jul	LT/QS	windy		7	0	0	20	40	40	n	n
Fox	22-Jul	LT/QS	windy		8	20	0	10	60	10	n	n
Fox	22-Jul	LT/QS	windy		9	0	0	20	80	0	n	n
Fox	22-Jul	LT/QS	windy		10	0	0	20	60	20	n	n
Fox	22-Jul	LT/QS	windy		11	10	0	60	30	0	n	n
Fox	22-Jul	LT/QS	windy		12	10	10	0	60	20	s	m
Fox	22-Jul	LT/QS	windy		13	30	20	40	10	0	n	n
Fox	22-Jul	LT/QS	windy		14	20	0	40	30	10	n	n
Gander	26-Jul	KS/FT	overcast		1	0	20	30	50	0	n	n
Gander	26-Jul	KS/FT	overcast		2	0	0	0	100	0	n	n
Gander	26-Jul	KS/FT	overcast		3	0	0	60	40	0	n	n
Gander	26-Jul	KS/FT	overcast		4	10	60	30	0	0	n	n
Gander	26-Jul	KS/FT	overcast		5	90	10	0	0	0	s	v
Gander	26-Jul	KS/FT	overcast		6	80	0	0	20	0	n	n
Gander	26-Jul	KS/FT	overcast		7	20	0	0	80	0	n	n
Gander	26-Jul	KS/FT	overcast		8	30	0	0	70	0	n	n
Gander	26-Jul	KS/FT	overcast		9	0	0	10	90	0	n	n
Gander	26-Jul	KS/FT	overcast		10	100	0	0	0	0	n	n
George	11-Aug	LT/TS	fog, rain	14	1	5	5	10	50	30	n	n
George	11-Aug	LT/TS	fog, rain	14	2	0	0	0	30	70	n	n
George	11-Aug	LT/TS	fog, rain	14	3	5	5	20	30	40	n	n
George	11-Aug	LT/TS	fog, rain	14	4	5	45	40	10	0	n	n
George	11-Aug	LT/TS	fog, rain	14	5	20	20	30	30	0	s	m
George	11-Aug	LT/TS	fog, rain	14	6	20	40	30	10	0	n	n
George	11-Aug	LT/TS	fog, rain	14	7	5	5	70	20	0	n	n
George	11-Aug	LT/TS	fog, rain	14	8	10	10	40	40	0	n	n
George	11-Aug	LT/TS	fog, rain	14	9	70	10	10	10	0	n	n
George	11-Aug	LT/TS	fog, rain	14	10	5	5	60	20	10	n	n
George	11-Aug	LT/TS	fog, rain	14	11	10	25	40	15	10	s	m
George	11-Aug	LT/TS	fog, rain	14	12	30	20	30	20	0	s	m

Appendix 3.3-1. Lake Substrate Zone Data, 2012

Lake	Date	Crew	Weather	Water Temp	Substrate Zone	Fines	Gravel	Cobble	Boulder	Bedrock	Vegetation Abundance	Vegetation Type
George	11-Aug	LT/TS	fog, rain	14	13	30	60	10	0	0	n	n
George	11-Aug	LT/TS	fog, rain	14	14	30	20	10	40	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		1	0	5	5	90	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		2	10	0	0	90	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		3	5	10	5	80	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		4	0	0	30	70	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		5	10	0	20	70	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		6	30	0	30	40	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		7	0	0	0	100	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		8	0	0	0	0	100	n	n
Goose	22-Jul	KS/LT	sunny, warm		9	0	0	0	20	80	n	n
Goose	22-Jul	KS/LT	sunny, warm		10	30	60	0	5	5	n	n
Goose	22-Jul	KS/LT	sunny, warm		11	0	70	30	0	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		12	50	0	0	0	50	n	n
Goose	22-Jul	KS/LT	sunny, warm		13	20	0	0	80	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		14	10	30	60	0	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		15	30	10	10	30	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		16	10	0	0	90	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		17	30	0	0	70	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		18	60	0	0	40	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		19	30	0	10	60	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		20	30	10	30	30	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		21	10	10	60	20	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		22	5	10	80	5	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		23	0	5	95	0	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		24	25	5	10	60	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		25	60	20	0	20	0	n	n
Goose	22-Jul	KS/LT	sunny, warm		26	90	0	5	5	0	n	n
Komatic	15-Aug	JC/JW	cloudy, rainy	12	1	20	0	20	60	0	n	n
Komatic	15-Aug	JC/JW	cloudy, rainy	12	2	90	0	10	0	0	n	n
Komatic	15-Aug	JC/JW	cloudy, rainy	12	3	100	0	0	0	0	n	n
Komatic	15-Aug	JC/JW	cloudy, rainy	12	4	0	0	30	70	0	n	n
Komatic	15-Aug	JC/JW	cloudy, rainy	12	5	70	0	30	0	0	n	n
Llama	26-Jul	LT/QS	sunny, warm		1	50	10	30	10	0	n	n
Llama	26-Jul	LT/QS	sunny, warm		2	0	0	30	70	0	n	n
Llama	26-Jul	LT/QS	sunny, warm		3	0	0	30	40	30	n	n
Llama	26-Jul	LT/QS	sunny, warm		4	5	5	20	70	0	n	n
Llama	26-Jul	LT/QS	sunny, warm		5	0	0	30	50	20	n	n
Llama	26-Jul	LT/QS	sunny, warm		6	50	30	20	0	0	n	n
Llama	26-Jul	LT/QS	sunny, warm		7	70	0	10	20	0	s	m
Llama	26-Jul	LT/QS	sunny, warm		8	5	45	40	10	0	n	n
Llama	26-Jul	LT/QS	sunny, warm		9	0	20	40	30	10	n	n
Llama	26-Jul	LT/QS	sunny, warm		10	25	30	30	15	0	n	n
Llama	26-Jul	LT/QS	sunny, warm		11	0	0	10	30	60	n	n
Llama	26-Jul	LT/QS	sunny, warm		12	25	50	20	5	0	n	n
Llama	26-Jul	LT/QS	sunny, warm		13	45	30	20	5	0	n	n
Llama	26-Jul	LT/QS	sunny, warm		14	10	10	60	20	0	n	n
Llama	26-Jul	LT/QS	sunny, warm		15	35	30	20	15	0	n	n
Llama	26-Jul	LT/QS	sunny, warm		16	10	0	25	65	0	n	n
Lytle	15-Aug	JC/JW	p. cloudy	10	1	0	0	80	20	0	n	n
Lytle	15-Aug	JC/JW	p. cloudy	10	2	0	0	40	60	0	n	n
Lytle	15-Aug	JC/JW	p. cloudy	10	3	70	0	30	0	0	s	s

Appendix 3.3-1. Lake Substrate Zone Data, 2012

Lake	Date	Crew	Weather	Water Temp	Substrate Zone	Fines	Gravel	Cobble	Boulder	Bedrock	Vegetation Abundance	Vegetation Type
Moby	24-Jul	KS/FT	sunny, warm		1	100	0	0	0	0	n	n
Moby	24-Jul	KS/FT	sunny, warm		2	10	0	30	60	0	n	n
Moby	24-Jul	KS/FT	sunny, warm		3	20	0	0	80	0	n	n
Moby	24-Jul	KS/FT	sunny, warm		4	0	0	0	100	0	n	n
Occurrence	13-Aug	LT/TS	partly cloudy	12	1	0	0	5	5	90	n	n
Occurrence	13-Aug	LT/TS	partly cloudy	12	2	0	0	10	30	60	n	n
Occurrence	13-Aug	LT/TS	partly cloudy	12	3	0	5	45	50	0	n	n
Occurrence	13-Aug	LT/TS	partly cloudy	12	4	5	15	40	40	0	n	n
Occurrence	13-Aug	LT/TS	partly cloudy	12	5	10	10	30	50	0	s	v
Occurrence	13-Aug	LT/TS	partly cloudy	12	6	0	0	40	40	20	n	n
Occurrence	13-Aug	LT/TS	partly cloudy	12	7	30	30	30	10	0	n	n
Occurrence	13-Aug	LT/TS	partly cloudy	12	8	75	15	5	5	0	s	m
Pond 19	7-Aug	JC/JW	partly cloudy	13	1	0	0	0	100	0	n	n
Pond 19	7-Aug	JC/JW	partly cloudy	13	2	0	0	50	50	0	n	n
Pond 19	7-Aug	JC/JW	partly cloudy	13	3	20	0	30	50	0	n	n
Rabbit	8-Aug	LT/TS	sunny, warm	15	1	5	5	20	60	10	s	m
Rabbit	8-Aug	LT/TS	sunny, warm	15	2	5	5	20	30	40	s	m
Rabbit	8-Aug	LT/TS	sunny, warm	15	3	0	0	30	40	30	s	m
Rabbit	8-Aug	LT/TS	sunny, warm	15	4	0	0	0	0	100	s	m
Rabbit	8-Aug	LT/TS	sunny, warm	15	5	10	15	30	35	10	s	m
Rascal	10-Aug	JC/JW	cloudy, rainy	15	1	20	0	20	60	0	n	n
Rascal	10-Aug	JC/JW	cloudy, rainy	15	2	0	0	10	90	0	n	n
Rascal	10-Aug	JC/JW	cloudy, rainy	15	3	30	0	10	40	0	n	n
Rascal	10-Aug	JC/JW	cloudy, rainy	15	4	0	0	0	100	0	n	n
Reference B	29-Jul	LT/QS	overcast		1	5	0	30	60	5	s	m
Reference B	29-Jul	LT/QS	overcast		2	5	5	30	60	0	s	v
Reference B	29-Jul	LT/QS	overcast		3	10	10	15	65	10	n	n
Reference B	29-Jul	LT/QS	overcast		4	20	5	35	40	0	n	n
Reference B	29-Jul	LT/QS	overcast		5	5	30	0	55	10	n	n
Reference B	29-Jul	LT/QS	overcast		6	10	5	35	50	0	n	n
Reference B	29-Jul	LT/QS	overcast		7	15	5	20	55	5	n	n
Reference B	29-Jul	LT/QS	overcast		8	45	25	15	5	0	n	n
Reference B	29-Jul	LT/QS	overcast		9	30	15	45	10	0	n	n
Reference B	29-Jul	LT/QS	overcast		10	5	5	35	50	5	n	n
Reference C	14-Aug	LT/TS	windy	12	1	10	10	35	45	0	s	m
Reference C	14-Aug	LT/TS	windy	12	2	5	5	30	60	0	n	n
Reference C	14-Aug	LT/TS	windy	12	3	15	35	40	10	0	s	m
Reference C	14-Aug	LT/TS	windy	12	4	20	20	30	30	0	n	n
Reference C	14-Aug	LT/TS	windy	12	5	10	10	10	20	50	n	n
Reference C	14-Aug	LT/TS	windy	12	6	0	0	0	10	90	n	n
Reference C	14-Aug	LT/TS	windy	12	7	10	20	60	10	0	n	n
Reference C	14-Aug	LT/TS	windy	12	8	5	5	20	70	0	n	n
Reference C	14-Aug	LT/TS	windy	12	9	5	5	20	60	10	n	n
Sleigh	11-Aug	JC/JW	partly cloudy	12	1	0	0	40	60	0	n	n
Sleigh	11-Aug	JC/JW	partly cloudy	12	2	70	0	30	0	0	n	n
Sleigh	11-Aug	JC/JW	partly cloudy	12	3	0	40	40	20	0	n	n
Sleigh	11-Aug	JC/JW	partly cloudy	12	4	50	50	0	0	0	n	n
Sleigh	11-Aug	JC/JW	partly cloudy	12	5	70	0	0	30	0	n	n
Sleigh	11-Aug	JC/JW	partly cloudy	12	6	80	0	0	20	0	s	s
Sleigh	11-Aug	JC/JW	partly cloudy	12	7	40	0	20	40	0	s	s
Swan	9-Aug	JC/JW	sunny, warm	15	1	0	0	20	80	0	n	n
Swan	9-Aug	JC/JW	sunny, warm	15	2	20	0	20	60	0	n	n
Swan	9-Aug	JC/JW	sunny, warm	15	3	0	0	0	100	0	n	n

Appendix 3.3-1. Lake Substrate Zone Data, 2012

Lake	Date	Crew	Weather	Water Temp	Substrate Zone	Fines	Gravel	Cobble	Boulder	Bedrock	Vegetation Abundance	Vegetation Type
Swan	9-Aug	JC/JW	sunny, warm	15	4	0	0	0	50	50	n	n
Swan	9-Aug	JC/JW	sunny, warm	15	5	50	0	20	30	0	n	n
Umwelt	27-Jul	LT/QS	sunny, warm		1	30	30	30	10	0	s	v
Umwelt	27-Jul	LT/QS	sunny, warm		2	5	5	30	60	0	n	n
Umwelt	27-Jul	LT/QS	sunny, warm		3	5	30	50	15	0	n	n
Umwelt	27-Jul	LT/QS	sunny, warm		4	25	10	30	35	0	n	n
Umwelt	27-Jul	LT/QS	sunny, warm		5	10	10	40	40	0	n	n
Umwelt	27-Jul	LT/QS	sunny, warm		6	5	5	40	50	0	n	n
Umwelt	27-Jul	LT/QS	sunny, warm		7	10	20	60	10	0	n	n
Umwelt	27-Jul	LT/QS	sunny, warm		8	20	30	40	10	0	n	n
Umwelt	27-Jul	LT/QS	sunny, warm		9	15	15	30	40	0	n	n
Umwelt	27-Jul	LT/QS	sunny, warm		10	20	20	40	20	0	n	n
Umwelt	27-Jul	LT/QS	sunny, warm		11	15	15	30	40	0	n	n
Umwelt	27-Jul	LT/QS	sunny, warm		12	20	20	40	20	0	n	n

KS = Kirsten Seymour
LT = Lora Tryon
QS = Quinn Sheppard
FT = Fraser Tindall
JC = Jason Clarke
JW = Jarvis Williams
TS = Tamara Skubovius

Vegetation Abundance
n = none
s = sparse
a = abundant

Vegetation Type
n = none
m = moss
v = vascular
s = sedge

Appendix 3.3-2a

Lake Sampling Effort and Species Summary — Gillnets, 2012

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Appendix 3.3-2a. Lake Sampling Effort and Species Summary — Gillnets, 2012

Date	Lake	Crew	Method	Net/Trap #	Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1 (m)	Easting 1	Northing 1
7/21/2012	Goose Lake	KS, LT	GN	1	8:48	9:55	1:07	1.12	4.5	433889	7270952
7/21/2012	Goose Lake	KS, LT	GN	2	10:00	11:05	1:05	1.08	10	433171	7271198
7/21/2012	Goose Lake	KS, LT	GN	3	12:20	13:25	1:05	1.08	2.7	434293	7269977
7/21/2012	Goose Lake	KS, LT	GN	4	13:40	14:40	1:00	1.00	4.1	433472	7270792
7/21/2012	Goose Lake	KS, LT	GN	5	15:10	16:05	0:55	0.92	5.1	433962	7271371
7/21/2012	Goose Lake	KS, LT	GN	6	16:25	17:25	1:00	1.00	1.4	433273	7271292
7/22/2012	Gander Lake	KS, LT	GN	1	10:15	11:15	1:00	1.00	1.8	North end of lake	
7/22/2012	Gander Lake	KS, LT	GN	2	11:40	12:20	0:40	0.67	1.8	423858	7261441
7/22/2012	Gander Lake	KS, LT	GN	3	13:20	14:00	0:40	0.67	2.1	424877	7261138
7/22/2012	Gander Lake	KS, LT	GN	4	14:30	15:40	1:10	1.17	2.1	424808	7260592
7/23/2012	Fox Lake	LT, QS	GN	1	10:56	12:00	1:04	1.07	5.4	430842	7266540
7/24/2012	Fox Lake	LT, QS	GN	2	9:00	9:45	0:45	0.75	4.2	930975	7266550
7/24/2012	Fox Lake	LT, QS	GN	3	10:15	11:15	1:00	1.00	4.6	431228	726690
7/24/2012	Fox Lake	LT, QS	GN	4	11:45	13:00	1:15	1.25	2.9	431215	7267385
7/24/2012	Moby Lake	KS, LT	GN	1	9:30	10:20	0:50	0.83	7.6	419455	7267123
7/24/2012	Moby Lake	KS, LT	GN	2	10:35	11:20	0:45	0.75	8.2	419735	7267072
7/24/2012	Moby Lake	KS, LT	GN	3	11:25	12:20	0:55	0.92	4.3	419804	7267202
7/24/2012	Moby Lake	KS, LT	GN	4	12:30	13:25	0:55	0.92	2.7	419916	7266912
7/24/2012	Moby Lake	KS, LT	GN	5	13:25	14:30	1:05	1.08	12.5	419715	7267123
7/24/2012	Moby Lake	KS, LT	GN	6	14:45	15:50	1:05	1.08	2.4	419506	7266943
7/25/2012	Llama Lake	LT, QS	GN	1	9:15	10:15	1:00	1.00	4.3	428472	7272053
7/25/2012	Llama Lake	LT, QS	GN	2	11:00	12:45	1:45	1.75	4.3	428707	7272155
7/25/2012	Llama Lake	LT, QS	GN	3	13:10	14:30	1:20	1.33	16	428562	7272595
7/25/2012	Llama Lake	LT, QS	GN	4	15:00	16:00	1:00	1.00	5.4	428728	7272489
7/26/2012	Umwelt Lake	KS, FT	GN	1	9:20	10:20	1:00	1.00	2.1	428940	7270947
7/26/2012	Umwelt Lake	KS, FT	GN	2	10:30	11:40	1:10	1.17	2.1	-	-
7/26/2012	Umwelt Lake	KS, FT	GN	3	11:50	13:10	1:20	1.33	1.8	-	-
7/26/2012	Umwelt Lake	KS, FT	GN	4	13:30	14:35	1:05	1.08	1.8	-	-
7/27/2012	Umwelt Lake	LT, QS	GN	1	9:40	11:01	1:21	1.35	2.3	428677	7271219
7/27/2012	Umwelt Lake	LT, QS	GN	2	11:20	12:50	1:30	1.50	3	428854	7271043
7/28/2012	Reference B Lake	LT, QS	GN	1	10:00	11:20	1:20	1.33	3.2	441740	7259176
7/28/2012	Reference B Lake	LT, QS	GN	2	11:50	14:00	2:10	2.17	4.9	441832	7258851
7/28/2012	Reference B Lake	LT, QS	GN	3	14:20	15:35	1:15	1.25	4.1	441979	7258652

Appendix 3.3-2a. Lake Sampling Effort and Species Summary — Gillnets, 2012

Date	Lake	Crew	Method	Net/Trap #	Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1 (m)	Easting 1	Northing 1
7/28/2012	Reference B Lake	LT, QS	GN	4	9:20	10:20	1:00	1.00	4.2	442036	7258756
7/28/2012	Reference B Lake	LT, QS	GN	5	10:35	12:00	1:25	1.42	3.5	441908	7259920
8/7/2012	Big Lake	LT, TS	GN	1	9:07	10:10	1:03	1.05	3.2	425658	7268517
8/7/2012	Big Lake	LT, TS	GN	2	10:39	12:20	1:41	1.68	4.2	425593	7268980
8/7/2012	Big Lake	LT, TS	GN	3	13:10	14:40	1:30	1.50	6.2	425289	7269158
8/8/2012	Rabbit Lake	LT, TS	GN	1	15:18	16:15	0:57	0.95	2.5	431464	7265729
8/8/2012	Rabbit Lake	LT, TS	GN	2	8:37	9:45	1:08	1.13	2.5	432016	7265437
8/8/2012	Rabbit Lake	LT, TS	GN	3	10:02	11:05	1:03	1.05	2.8	432102	7265426
8/8/2012	Rabbit Lake	LT, TS	GN	4	11:28	12:35	1:07	1.12	3	431421	7265639
8/8/2012	Swan Lake	JC, JW	GN	1	9:20	10:20	1:00	1.00	5	422580	7272833
8/8/2012	Swan Lake	JC, JW	GN	2	10:58	12:00	1:02	1.03	5	422389	7273120
8/8/2012	Swan Lake	JC, JW	GN	3	12:30	13:30	1:00	1.00	6	422271	7273310
8/8/2012	Swan Lake	JC, JW	GN	4	13:45	14:45	1:00	1.00	6	422090	7273442
8/9/2012	Rascal Lake	JC, JW	GN	1	14:35	15:30	0:55	0.92	4	434060	7267737
8/9/2012	Rascal Lake	JC, JW	GN	2	15:40	16:30	0:50	0.83	4	434086	7267400
8/10/2012	Gander Lake	LT, TS	GN	1	10:20	11:20	1:00	1.00	2.2	424710	7261802
8/10/2012	Gander Lake	LT, TS	GN	2	11:33	13:00	1:27	1.45	2	424370	7262027
8/10/2012	Gander Lake	LT, TS	GN	3	13:12	13:30	0:18	0.30	2	424442	7262216
8/10/2012	Rascal Lake	JC, JW	GN	3	8:30	9:30	1:00	1.00	4	434107	7267352
8/10/2012	Rascal Lake	JC, JW	GN	4	9:45	10:45	1:00	1.00	4	434077	7261476
8/10/2012	Rascal Lake	JC, JW	GN	5	11:00	12:00	1:00	1.00	4	434106	7267371
8/10/2012	Rascal Lake	JC, JW	GN	6	12:10	13:10	1:00	1.00	4	434232	7267188
8/10/2012	Rascal Lake	JC, JW	GN	7	13:20	14:30	1:10	1.17	4	434045	7267498
8/11/2012	George Lake	LT, TS	GN	1	11:33	12:36	1:03	1.05	6.3	387932	7314158
8/11/2012	George Lake	LT, TS	GN	2	13:00	14:10	1:10	1.17	3.4	387457	7315314
8/11/2012	George Lake	LT, TS	GN	3	14:25	15:40	1:15	1.25	4.2	387210	7314776
8/11/2012	George Lake	LT, TS	GN	4	15:50	16:45	0:55	0.92			
8/12/2012	Dragon Lake	JC, JW	GN	1	15:10	16:10	1:00	1.00	3	390052	7310625
8/12/2012	George Lake	LT, TS	GN	5	8:40	9:32	0:52	0.87	8.9	387932	7314375
8/12/2012	George Lake	LT, TS	GN	6	9:40	11:15	1:35	1.58	7.3	388292	7313588
8/13/2012	Dragon Lake	JC, JW	GN	2	8:08	9:10	1:02	1.03	4	390618	7310842
8/13/2012	Dragon Lake	JC, JW	GN	3	9:30	10:30	1:00	1.00	4	390467	7311056
8/13/2012	Dragon Lake	JC, JW	GN	4	10:43	11:30	0:47	0.78	3	390289	7311178

Appendix 3.3-2a. Lake Sampling Effort and Species Summary — Gillnets, 2012

Date	Lake	Crew	Method	Net/Trap #	Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1 (m)	Easting 1	Northing 1
8/13/2012	Dragon Lake	JC, JW	GN	5	11:49	12:30	0:41	0.68	4	390270	7311328
8/13/2012	Occurrence Lake	LT, TS	GN	1	8:40	9:45	1:05	1.08	1.5	387373	7313253
8/13/2012	Occurrence Lake	LT, TS	GN	2	9:53	11:00	1:07	1.12	1.5	387289	7313365
8/13/2012	Occurrence Lake	LT, TS	GN	3	11:10	12:25	1:15	1.25	1.6	387414	7313104
8/13/2012	Occurrence Lake	LT, TS	GN	4	12:34	13:45	1:11	1.18	1.7	387667	7313050
8/13/2012	Occurrence Lake	LT, TS	GN	5	13:57	15:15	1:18	1.30	1.6	387738	7313070
8/13/2012	Occurrence Lake	LT, TS	GN	6	15:25	16:30	1:05	1.08	1.6	387739	7313176
8/14/2012	Komatic Lake	JC, JW	GN	1	11:45	12:48	1:03	1.05	4	391406	7308734
8/14/2012	Komatic Lake	JC, JW	GN	2	13:05	14:07	1:02	1.03	5	391601	7308486
8/14/2012	Komatic Lake	JC, JW	GN	3	14:20	15:20	1:00	1.00	4	391813	7308263
8/14/2012	Komatic Lake	JC, JW	GN	4	15:32	16:34	1:02	1.03	4	391757	7308461
8/14/2012	Reference C Lake	LT, TS	GN	1	11:40	12:50	1:10	1.17	3.8	395115	7336232
8/14/2012	Reference C Lake	LT, TS	GN	2	13:05	14:15	1:10	1.17	8.9	395035	7336327
8/14/2012	Reference C Lake	LT, TS	GN	3	14:30	15:50	1:20	1.33	5.1	394816	7336568
8/14/2012	Reference C Lake	LT, TS	GN	4	8:49	9:45	0:56	0.93	8.1	394872	7337681
8/14/2012	Reference C Lake	LT, TS	GN	5	10:00	11:20	1:20	1.33	6.9	394802	7337639
8/14/2012	Reference C Lake	LT, TS	GN	6	11:30	12:50	1:20	1.33	4.7	394637	7337322
8/14/2012	Reference C Lake	LT, TS	GN	7	13:20	15:00	1:40	1.67	3.1	396107	7335889
8/15/2012	Gander Lake	LT, TS	GN	4	9:30	11:00	1:30	1.50	1.8	424190	7262314
8/15/2012	Gander Lake	LT, TS	GN	5	11:15	12:45	1:30	1.50	1.5	424794	7262170
8/15/2012	Gander Lake	LT, TS	GN	6	13:30	15:00	1:30	1.50	1.9	423823	7262134
8/15/2012	Gander Lake	LT, TS	GN	7	15:10	16:10	1:00	1.00	1.8	424165	7262326
8/15/2012	Komatic Lake	JC, JW	GN	5	8:58	10:00	1:02	1.03	4	391537	7308518

KS = Kirsten Seymour
LT = Lora Tryon
QS = Quinn Sheppard
FT = Fraser Tindall
JC = Jason Clarke
JW = Jarvis Williams
TS = Tamara Skubovius

Method
GN = gillnet
NFC = No fish caught

Species
ARGR = Arctic grayling
LKTR = Lake trout
SLSC = Slimy sculpin
NNSB = Ninespine stickleback
BB = Burbot
RDWH = Round whitefish
LKCS = Lake cisco
LNSU = Longnose sucker

Appendix 3.3-2a. Lake Sampling Effort and Species Summary — Gillnets, 2012

Date	Lake	Depth 2 (m)	Easting 2	Northing 2	ARCH	ARGR	LKCS	LKTR	LNSU	RDWH	Total	Comment
7/21/2012	Goose Lake	4.7	433978	7270956	0	0	0	1	0	0	1	
7/21/2012	Goose Lake	1.2	433258	7271182	0	0	0	1	0	0	1	
7/21/2012	Goose Lake	2.9	434344	7270061	0	0	0	2	0	0	2	
7/21/2012	Goose Lake	4.6	433559	7270823	0	0	0	0	0	0	0	
7/21/2012	Goose Lake	6.3	433193	7271273	0	0	0	0	0	0	0	
7/21/2012	Goose Lake	1.3	433194	7271230	0	0	0	1	0	0	1	
7/22/2012	Gander Lake	1.8	-	-	0	3	9	1	6	9	28	
7/22/2012	Gander Lake	1.8	423885	7261550	0	0	1	0	1	2	4	
7/22/2012	Gander Lake	2.1	424802	7261052	0	0	49	0	0	0	49	
7/22/2012	Gander Lake	1.8	424850	7260686	0	0	22	0	0	1	23	
7/23/2012	Fox Lake	18	430957	7266482	0	1	0	4	0	0	5	
7/24/2012	Fox Lake	3.9	431076	7266545	0	0	0	0	0	0	0	
7/24/2012	Fox Lake	4.7	431263	7267033	0	0	0	1	0	0	1	
7/24/2012	Fox Lake	3.2	431261	7267482	0	0	0	5	0	0	5	
7/24/2012	Moby Lake	3.4	419377	7267218	0	0	0	7	0	0	7	
7/24/2012	Moby Lake	5.5	419640	7267087	0	0	0	1	0	0	1	
7/24/2012	Moby Lake	10.7	419769	7267117	0	0	0	4	0	0	4	Lost 1 LKTR
7/24/2012	Moby Lake	4	419827	7266973	0	0	0	5	0	0	5	
7/24/2012	Moby Lake	3.4	419797	7267204	0	0	0	3	0	0	3	
7/24/2012	Moby Lake	2.7	419612	7266995	0	0	0	3	0	0	3	
7/25/2012	Llama Lake	4.9	428603	7272111	0	0	0	0	0	5	5	Part of GN over 2.5 m
7/25/2012	Llama Lake	5	428715	7272304	0	0	0	0	0	1	1	
7/25/2012	Llama Lake	9.5	428604	7272428	0	0	0	2	0	0	2	
7/25/2012	Llama Lake	2.8	428797	7272347	0	0	0	2	0	3	5	
7/26/2012	Umwelt Lake	2.1	428903	7271041	0	0	0	0	0	0	0	
7/26/2012	Umwelt Lake	1.5	-	-	0	0	0	0	0	0	0	
7/26/2012	Umwelt Lake	1.8	-	-	0	0	0	0	0	0	0	
7/26/2012	Umwelt Lake	2.1	-	-	0	1	0	0	0	0	1	
7/27/2012	Umwelt Lake	2.5	428784	7271103	0	0	0	0	0	0	0	
7/27/2012	Umwelt Lake	2.7	428935	7270935	0	0	0	1	0	0	1	
7/28/2012	Reference B Lake	3.3	441812	7259007	0	0	0	1	0	2	3	
7/28/2012	Reference B Lake	5.4	441907	7258675	0	0	0	8	0	1	9	
7/28/2012	Reference B Lake	5.4	442025	7258464	0	0	0	4	0	0	4	

Appendix 3.3-2a. Lake Sampling Effort and Species Summary — Gillnets, 2012

Date	Lake	Depth 2 (m)	Easting 2	Northing 2	ARCH	ARGR	LKCS	LKTR	LNSU	RDWH	Total	Comment
7/28/2012	Reference B Lake	3.6	442182	7258623	0	0	0	2	0	3	5	
7/28/2012	Reference B Lake	3.8	442032	7258818	0	0	0	0	0	4	4	
8/7/2012	Big Lake	2.9	425762	7268509	0	0	0	2	0	0	2	
8/7/2012	Big Lake	4.4	425690	7268962	0	0	0	5	0	0	5	
8/7/2012	Big Lake	5.8	425382	7269144	0	0	0	1	0	0	1	
8/8/2012	Rabbit Lake	1.5	431549	7265675	0	0	0	1	0	0	1	
8/8/2012	Rabbit Lake	2.7	432046	7265525	0	0	0	1	0	0	1	
8/8/2012	Rabbit Lake	2.5	432049	7265507	0	0	0	1	0	0	1	
8/8/2012	Rabbit Lake	2.5	431466	7265727	0	0	0	1	0	0	1	
8/8/2012	Swan Lake	3	422706	7272916	0	0	0	1	0	3	4	
8/8/2012	Swan Lake	5	422526	7273161	0	0	0	3	0	0	3	
8/8/2012	Swan Lake	6	422398	7273347	0	0	0	1	0	0	1	
8/8/2012	Swan Lake	6	422243	7273456	0	0	0	4	0	0	4	
8/9/2012	Rascal Lake	4	434064	7267591	0	0	0	0	0	0	0	NFC
8/9/2012	Rascal Lake	4	434113	7267271	0	0	0	0	0	0	0	NFC
8/10/2012	Gander Lake	2.5	424671	7261702	0	0	1	1	0	0	2	
8/10/2012	Gander Lake	2.1	424320	7261942	0	2	1	0	0	0	3	
8/10/2012	Gander Lake	2	424374	7262148	0	1	0	0	0	0	1	
8/10/2012	Rascal Lake	4	434063	7267161	0	0	0	1	0	0	1	
8/10/2012	Rascal Lake	4	434077	7267349	0	0	0	1	0	0	1	
8/10/2012	Rascal Lake	4	434147	7267237	0	0	0	0	0	0	0	NFC
8/10/2012	Rascal Lake	4	434209	7267058	0	0	0	0	0	0	0	NFC
8/10/2012	Rascal Lake	3	434027	7267381	0	0	0	1	0	0	1	
8/11/2012	George Lake	8.9	388081	7314035	0	0	0	0	0	0	0	
8/11/2012	George Lake	6.2	387485	7315223	0	0	0	0	0	0	0	
8/11/2012	George Lake	3.2	387314	7314698	0	0	0	0	0	0	0	
8/11/2012	George Lake				0	0	0	9	0	0	9	
8/12/2012	Dragon Lake	3	390922	7310508	0	0	0	0	0	0	0	
8/12/2012	George Lake	8.9	387256	7314699	0	0	0	0	0	0	0	
8/12/2012	George Lake	3.8	388357	7313496	0	0	0	2	0	0	2	
8/13/2012	Dragon Lake	4	390701	7310745	0	0	0	9	0	0	9	
8/13/2012	Dragon Lake	4	390580	7311011	0	0	0	5	0	0	5	
8/13/2012	Dragon Lake	4	390400	7311145	0	0	0	1	0	0	1	

Appendix 3.3-2a. Lake Sampling Effort and Species Summary — Gillnets, 2012

Date	Lake	Depth 2 (m)	Easting 2	Northing 2	ARCH	ARGR	LKCS	LKTR	LNSU	RDWH	Total	Comment
8/13/2012	Dragon Lake	4	390361	7311238	0	0	0	7	0	0	7	
8/13/2012	Occurrence Lake	1.5	387458	7313293	0	0	0	0	0	0	0	
8/13/2012	Occurrence Lake	1.5	387389	7313401	0	0	0	0	0	0	0	
8/13/2012	Occurrence Lake	1.5	387471	7313182	0	0	0	0	0	0	0	
8/13/2012	Occurrence Lake	1.3	387606	7313155	0	0	0	0	0	0	0	
8/13/2012	Occurrence Lake	1.6	387710	7313169	0	0	0	0	0	0	0	
8/13/2012	Occurrence Lake	1.5	387650	7313254	0	0	0	0	0	0	0	
8/14/2012	Komatic Lake	5	391464	7308606	0	0	0	2	0	0	2	
8/14/2012	Komatic Lake	3	391648	7308382	0	0	0	1	0	0	1	
8/14/2012	Komatic Lake	4	391899	7308792	0	0	0	0	0	0	0	
8/14/2012	Komatic Lake	4	391831	7308381	0	0	0	3	0	0	3	
8/14/2012	Reference C Lake	1.8	395209	7336214	0	0	0	2	0	0	2	
8/14/2012	Reference C Lake	4.3	395125	7336262	2	0	0	1	0	0	3	
8/14/2012	Reference C Lake	5.5	395886	7336294	0	0	0	2	0	0	2	
8/14/2012	Reference C Lake	5.4	394954	7337618	2	0	0	0	0	0	2	
8/14/2012	Reference C Lake	3.8	395768	7337739	2	0	0	4	0	0	6	
8/14/2012	Reference C Lake	5.1	394688	7337241	0	0	0	1	0	0	1	
8/14/2012	Reference C Lake	-	396357	7335662	0	0	0	2	0	0	2	
8/15/2012	Gander Lake	2.1	424152	7262225	0	2	2	0	0	0	4	
8/15/2012	Gander Lake	1.5	424843	7262082	0	3	0	0	0	0	3	
8/15/2012	Gander Lake	2.2	423819	7262037	0	1	0	0	0	0	1	
8/15/2012	Gander Lake	2.1	424184	7262219	0	3	0	0	0	0	3	
8/15/2012	Komatic Lake	3	391608	7308425	0	0	0	2	0	3	5	

KS = Kirsten Seymour
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NFC = No fish caught

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ARGR = Arctic grayling
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Appendix 3.3-2b

Lake Sampling Effort and Species Summary — Beach Seine, 2012

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Appendix 3.3-2b. Lake Sampling Effort and Species Summary — Beach Seine, 2012

Date	Lake	Set #	Time	Samplers	Easting	Northing	Seined Area (m^2)	ARGR	LKTR	SLSC	NNSB	RDWH	Total	Comments
8/8/2012	Big Lake	1	8:44	LT, TS	425247	7269439	39					4	4	
8/8/2012	Big Lake	2	8:55	LT, TS	425151	7269444	39					3	3	
8/8/2012	Big Lake	3	11:35	LT, TS	727005	7268543	65					4	4	
8/8/2012	Big Lake	4	11:50	LT, TS	427036	7268542	65					1	1	
8/8/2012	Big Lake	5	12:00	LT, TS	427071	7268545	39						0	
8/8/2012	Big Lake	6	12:15	LT, TS	427235	7268622	78						0	
8/12/2012	Dragon Lake	1	-	JC, JW	391519	7309992	200	1				14	15	
8/12/2012	Dragon Lake	2	-	JC, JW	391572	7309954	200	1				1	2	
8/12/2012	Dragon Lake	3	-	JC, JW	391590	7309938	200	1					1	NFC
7/24/2012	Fox Lake	3	12:15	LT, QS	431051	7267219	100		1			2	3	Photo 1066
7/24/2012	Fox Lake	4	15:15	LT, QS	431273	7266792	100						0	
7/23/2012	Gander Lake	1	8:55	KS, FT	424709	7262151	100						0	Substrate: 100% fine with abundant veg (moss)
7/23/2012	Gander Lake	2	9:30	KS, FT	424710	7262117	100						0	Substrate: 100% fine with abundant veg (moss)
7/23/2012	Gander Lake	3	9:50	KS, FT	-	-	225						0	Substrate: 80% F 20% G no veg. exposed
7/23/2012	Gander Lake	4	10:15	KS, FT	-	-	225						0	Substrate: 80% F 20% G no veg. exposed
7/23/2012	Gander Lake	5	11:30	KS, FT	424052	7263135	225						0	Substrate: 80% F 20% G sparse veg.
7/23/2012	Gander Lake	6	11:40	KS, FT	423986	7263220	225						0	Substrate: 80% F 20% G sparse veg.
7/23/2012	Gander Lake	7	13:39	KS, FT	423940	7263344	225						0	Substrate: 90% F 10% G sparse veg
7/23/2012	Gander Lake	8	13:15	KS, FT	424720	7260263	225						0	Substrate: 40% B 60% F no veg.
7/23/2012	Gander Lake	9	13:30	KS, FT	424793	7260225	225						0	Substrate: 40% B 60% F no veg.
7/23/2012	Gander Lake	10	13:50	KS, FT	424943	7260082	225						0	-
8/10/2012	Gander Lake	1	-	LT, TS	424645	7262706	225	1			4		5	BS as had to wait for helo for missing gear in am. GN for rest of day
8/11/2012	George Lake	1	14:50	LT, TS	386963	7314859	104						0	Photo 1185
8/11/2012	George Lake	2	14:58	LT, TS	386968	7314844	130						0	
8/11/2012	George Lake	3	15:05	LT, TS	386972	7314834	78			1			1	
8/11/2012	George Lake	4	15:15	LT, TS	387026	7314767	90						0	Photo 1184
8/12/2012	George Lake	5	9:15	LT, TS	387648	7314422	130						0	Photo 1196
8/12/2012	George Lake	6	9:20	LT, TS	387633	7314420	130						0	Photo 1196
8/12/2012	George Lake	7	13:50	LT, TS	386859	7315471	65						0	Photo 1200
8/12/2012	George Lake	8	14:00	LT, TS	386788	7315505	65						0	
8/12/2012	George Lake	9	14:40	LT, TS	386459	7315370	130			1			1	Photo 1202 greater at inflow
8/12/2012	George Lake	10	14:50	LT, TS	386462	7315344	175						0	
7/22/2012	Goose Lake	4	11:40	LT, QS	433618	7272301	200			1	1	1	3	
7/22/2012	Goose Lake	5	11:40	LT, QS	433664	7272312	200							
7/22/2012	Goose Lake	6	14:45	LT, QS	434759	7271155	200	1			1		2	
7/22/2012	Goose Lake	7	14:45	LT, QS	434759	7271155	200							
7/22/2012	Goose Lake	8	16:20	LT, QS	434629	7269980	150					14	14	Photo 1018 and 1017 on sand with scattered B01

Appendix 3.3-2b. Lake Sampling Effort and Species Summary — Beach Seine, 2012

Date	Lake	Set #	Time	Samplers	Easting	Northing	Seined Area (m^2)	ARGR	LKTR	SLSC	NNSB	RDWH	Total	Comments
7/22/2012	Goose Lake	9	16:20	LT, QS	434629	7269980	150							
7/22/2012	Goose Lake	10	16:50	LT, QS	434722	7269986	400				2		2	Inflow
7/22/2012	Goose Lake	11	16:50	LT, QS	434689	7269990	400							
7/22/2012	Goose Lake	12	17:00	LT, QS	-	-	400	1			1	3	5	Behind sand bar at inflow, water depth 2-3 m (seined from shallows on either side). Photo 1022
7/22/2012	Goose Lake	1	10:15	LT, QS	433551	7272269	200					1	1	BS along gravel/sand beach at 1.2 m depth. Deeper end over mud bottom. Each seine use white long net 17 m. Photo 1002- view east along shore where BS's 1
7/22/2012	Goose Lake	2	10:15	LT, QS	433537	7272267	200					8	8	
7/22/2012	Goose Lake	3	10:15	LT, QS	433514	7272247	200					2	2	
7/22/2012	Goose Lake	4	11:40	LT, QS	433473	7272243	200				1	14	15	Photo 1003 (inflow BS%) and 1004 (BS$ pond at inflow)
7/22/2012	Goose Lake	5	11:40	LT, QS	433502	7272238	200							
7/26/2012	Llama Lake	1	9:30	LT, QS	428904	7272340	150						0	
7/26/2012	Llama Lake	2	9:35	LT, QS	428904	7272340	150			1			1	
7/26/2012	Llama Lake	3	9:40	LT, QS	428904	7272340	150						0	
7/26/2012	Llama Lake	4	12:00	LT, QS	428546	7272762	150						0	0.4 on sandy beach
7/26/2012	Llama Lake	5	12:05	LT, QS	428546	7272762	150						0	0.4 on sandy beach
7/26/2012	Llama Lake	6	13:45	LT, QS	428474	7272622	120						0	1.2 gravels and boulders
7/26/2012	Llama Lake	7	13:50	LT, QS	428474	7272622	120					1	1	
7/26/2012	Llama Lake	8	14:40	LT, QS	428400	7272019	100			1			1	
7/26/2012	Llama Lake	9	14:45	LT, QS	428400	7272019	100					8	8	
8/16/2012	Lytle	1	-	JC, JW	386962	7314181	200						0	NFC
8/16/2012	Lytle	2	-	JC, JW	386950	7314193	200						0	NFC
8/16/2012	Lytle	3	-	JC, JW	386917	7314208	200						0	NFC
8/16/2012	Lytle	4	-	JC, JW	386807	7314223	200						0	NFC
8/16/2012	Lytle	5	-	JC, JW	386954	7314185	200						0	NFC
8/16/2012	Lytle	6	-	JC, JW	386948	7314201	200						0	NFC
8/16/2012	Lytle	7	-	JC, JW	386947	7314203	200						0	NFC
8/16/2012	Lytle	8	-	JC, JW	386924	7314207	200						0	NFC
8/16/2012	Lytle	9	-	JC, JW	386962	7313691	200						0	NFC
8/16/2012	Lytle	10	-	JC, JW	386933	7313698	200						0	NFC
8/16/2012	Lytle	11	-	JC, JW	386953	7314187	200						0	NFC
8/16/2012	Lytle	12	-	JC, JW	386948	7314198	200						0	NFC
7/25/2012	Moby Lake	1	8:45	KS, FT	419327	7266912	200						0	Depth 0.3 Substrate 100% sand
7/25/2012	Moby Lake	2	9:00	KS, FT	419320	7267123	200						0	Depth 0.3 Substrate 100% sand
7/25/2012	Moby Lake	3	9:30	KS, FT	419194	7266943	200						0	Depth 0.3 Substrate 100% sand
8/13/2012	Occurrence	1	10:50	LT, TS	387200	7313450	104						0	NFC

Appendix 3.3-2b. Lake Sampling Effort and Species Summary — Beach Seine, 2012

Date	Lake	Set #	Time	Samplers	Easting	Northing	Seined Area (m^2)	ARGR	LKTR	SLSC	NNSB	RDWH	Total	Comments
8/13/2012	Occurrence	2	12:00	LT, TS	387362	7313069	130						0	NFC
8/13/2012	Occurrence	3	14:15	LT, TS	387798	7313016	130						0	0.7 photo 1216
8/13/2012	Occurrence	4	15:40	LT, TS	387780	7313212	130						0	Photo 1215
8/7/2012	Pond 19	1	-	JC, JW	430255	7265708	200						0	NFC. Pond quite rocky for beach seine. Not many good locations for net placement. Fish-bearing: a few small minnow sized fish were seen.
8/7/2012	Pond 19	2	-	JC, JW	430375	7265872	200						0	NFC
8/7/2012	Pond 19	3	-	JC, JW	430361	7265864	200						0	NFC
8/7/2012	Pond 19	4	-	JC, JW	430426	7265871	200						0	NFC
8/9/2012	Rabbit Lake	1	15:00	LT, TS	431778	7264895	65						0	
8/9/2012	Rabbit Lake	2	15:10	LT, TS	431780	7264907	65	1			3		4	
8/9/2012	Rabbit Lake	3	15:25	LT, TS	431776	7264914	65				2		2	
8/10/2012	Rascal Lake	1	-	JC, JN	434121	7267839	60						0	NFC
8/10/2012	Rascal Lake	2	-	JC, JN	434114	7267853	200						0	NFC
8/10/2012	Rascal Lake	3	-	JC, JN	434115	7267864	200		5				5	
8/10/2012	Rascal Lake	4	-	JC, JN	434693	7267909	200		2				2	
8/10/2012	Rascal Lake	5	-	JC, JN	434076	7267964	200		1				1	
7/29/2012	Reference B	1	10:35	LT, QS	441988	7258208	200						0	Zero fish. Photo 1136 very poor for BS too many rocks
7/29/2012	Reference B	2	15:20	LT, QS	442029	7258210	200						0	Zero fish. Photo 1136 very poor for BS too many rocks
7/29/2012	Reference B	3	15:30	LT, QS	442038	7258218	200						0	Zero fish. Photo 1136 very poor for BS too many rocks
7/29/2012	Reference B	4	15:40	LT, QS	441816	7258492	200						0	Zero fish. Photo 1136 very poor for BS too many rocks
8/15/2012	Reference C	1	12:20	LT, TS	394688	7337241	78						0	
8/15/2012	Reference C	2	12:30	LT, TS	394688	7337260	150						0	
8/15/2012	Reference C	3	15:35	LT, TS	395980	7335703	52						0	
8/15/2012	Reference C	4	15:45	LT, TS	395978	7335699	26						0	
8/14/2012	Komatic Lake	1	-	JC, JW	391115	7308837	200						0	NFC
8/14/2012	Komatic Lake	2	-	JC, JW	391371	7308954	200			1		1	2	
8/14/2012	Komatic Lake	3	-	JC, JW	391282	7308974	200						0	NFC
8/14/2012	Komatic Lake	4	-	JC, JW	391290	7308967	200			1		1	2	
8/14/2012	Komatic Lake	5	-	JC, JW	391265	7308939	200			2			2	
8/14/2012	Komatic Lake	6	-	JC, JW	291247	7309000	200						0	NFC
8/11/2012	Sleigh Lake	1	-	JC, JN	388100	7312440	200	4					4	
8/11/2012	Sleigh Lake	2	-	JC, JN	388120	7312438	200						0	NFC
8/11/2012	Sleigh Lake	3	-	JC, JN	388122	7312433	200						0	NFC
8/11/2012	Sleigh Lake	4	-	JC, JN	388126	7312430	200	2					2	
8/11/2012	Sleigh Lake	5	-	JC, JN	388139	7312456	200	1					1	
8/11/2012	Sleigh Lake	6	-	JC, JN	388160	7312528	200						0	NFC
8/11/2012	Sleigh Lake	7	-	JC, JN	388168	7312541	200						0	NFC

Appendix 3.3-2b. Lake Sampling Effort and Species Summary — Beach Seine, 2012

Date	Lake	Set #	Time	Samplers	Easting	Northing	Seined Area (m^2)	ARGR	LKTR	SLSC	NNSB	RDWH	Total	Comments
8/11/2012	Sleigh Lake	8	-	JC, JN	388172	7312549	200						0	NFC
8/11/2012	Sleigh Lake	9	-	JC, JN	388140	7312454	200						0	NFC
8/11/2012	Sleigh Lake	10	-	JC, JN	388111	7312435	200						0	NFC
8/11/2012	Sleigh Lake	11	-	JC, JN	387757	7312780	200						0	NFC
8/11/2012	Sleigh Lake	12	-	JC, JN	387778	7312732	200						0	NFC
8/7/2012	Swan Lake	1	-	JC, JN	422853	7272362	120						0	NFC Photo of Swan Lake 358-360
8/7/2012	Swan Lake	2	-	JC, JN	422839	7272401	120						0	NFC
8/7/2012	Swan Lake	3	-	JC, JN	422819	7272391	120						0	NFC
8/7/2012	Swan Lake	4	-	JC, JN	422861	7272439	120		1				1	
8/7/2012	Swan Lake	5	-	JC, JN	422857	7272494	120						0	NFC
8/7/2012	Swan Lake	6	-	JC, JN	422843	7272239	120						0	NFC
8/7/2012	Swan Lake	7	-	JC, JN	422829	7272238	120						0	NFC
8/7/2012	Swan Lake	8	-	JC, JN	422853	7272363	120						0	NFC
7/27/2012	Umwelt Lake	1	2:35	LT, QS	-	-	120	2					2	
7/27/2012	Umwelt Lake	2	2:45	LT, QS	-	-	420	31					31	

KS = Kirsten Seymour
LT = Lora Tryon
QS = Quinn Sheppard
FT = Fraser Tindall
JC = Jason Clarke
JW = Jarvis Williams
TS = Tamara Skubovius

NFC = no fish caught

Species
ARGR = Arctic grayling
LKTR = Lake trout
SLSC = Slimy sculpin
NNSB = Ninespine stickleback
BB = Burbot
RDWH = Round whitefish
LKCS = Lake cisco
LNSU = Longnose sucker

Appendix 3.3-3

Individual Fish Data — Lakes, 2012

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Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
8/8/2012	Big Lake	LT/TS	BS	3,4	-	RDWH	48	-	-	U	0	-	-	-	-	-	-
8/8/2012	Big Lake	LT/TS	BS	3,4	-	RDWH	51	-	-	U	0	-	-	-	-	-	-
8/8/2012	Big Lake	LT/TS	BS	1	-	RDWH	52	-	-	U	0	-	-	-	-	-	-
8/8/2012	Big Lake	LT/TS	BS	1	-	RDWH	53	-	-	U	0	-	-	-	-	-	-
8/8/2012	Big Lake	LT/TS	BS	2	-	RDWH	53	-	-	U	0	-	-	-	-	-	-
8/8/2012	Big Lake	LT/TS	BS	1	-	RDWH	54	-	-	U	0	-	-	-	-	-	-
8/8/2012	Big Lake	LT/TS	BS	1	-	RDWH	54	-	-	U	0	-	-	-	-	-	-
8/8/2012	Big Lake	LT/TS	BS	2	-	RDWH	54	-	-	U	0	-	-	-	-	-	-
8/8/2012	Big Lake	LT/TS	BS	2	-	RDWH	54	-	-	U	0	-	-	-	-	-	-
8/8/2012	Big Lake	LT/TS	BS	3,4	-	RDWH	54	-	-	U	0	-	-	-	-	-	-
8/8/2012	Big Lake	LT/TS	BS	3,4	-	RDWH	54	-	-	U	0	S,F	-	-	-	-	Mort
8/8/2012	Big Lake	LT/TS	BS	1	-	RDWH	57	-	-	U	0	-	-	-	-	-	-
8/7/2012	Big Lake	LT/TS	GN	1	1	LKTR	462	-	-	U	0	-	11	-	-	-	-
8/7/2012	Big Lake	LT/TS	GN	1	2	LKTR	490	-	-	U	0	-	12	-	-	-	Mort
8/7/2012	Big Lake	LT/TS	GN	2	3	LKTR	550	-	-	U	0	-	13	-	-	-	-
8/7/2012	Big Lake	LT/TS	GN	2	4	LKTR	465	-	-	U	0	-	ua	-	-	-	-
8/7/2012	Big Lake	LT/TS	GN	2	5	LKTR	500	-	-	U	0	-	14	-	-	-	-
8/7/2012	Big Lake	LT/TS	GN	2	6	LKTR	402	-	-	U	0	-	8	-	-	-	Mort
8/7/2012	Big Lake	LT/TS	GN	2	7	LKTR	415	-	-	U	0	-	9	-	-	-	Mort
8/12/2012	Dragon Lake	JC/JW	BS	1	1	RDWH	105	-	-	U	1	F	1	-	-	-	Forgot Scale for 1-15 Photo 399
8/12/2012	Dragon Lake	JC/JW	BS	1	2	RDWH	120	-	-	U	1	F	1	-	-	-	Photo 400
8/12/2012	Dragon Lake	JC/JW	BS	1	3	RDWH	118	-	-	U	1	F	1	-	-	-	Photo 401
8/12/2012	Dragon Lake	JC/JW	BS	1	4	RDWH	120	-	-	U	1	F	1	-	-	-	Photo 402
8/12/2012	Dragon Lake	JC/JW	BS	1	5	RDWH	115	-	-	U	1	F	1	-	-	-	Photo 404
8/12/2012	Dragon Lake	JC/JW	BS	1	6	RDWH	110	-	-	U	1	F	1	-	-	-	Photo 405
8/12/2012	Dragon Lake	JC/JW	BS	1	7	RDWH	100	-	-	U	1	F	1	-	-	-	Photo 407
8/12/2012	Dragon Lake	JC/JW	BS	1	8	RDWH	114	-	-	U	1	F	1	-	-	-	Photo 408
8/12/2012	Dragon Lake	JC/JW	BS	1	9	RDWH	98	-	-	U	1	F	1	-	-	-	Photo 409
8/12/2012	Dragon Lake	JC/JW	BS	1	10	RDWH	100	-	-	U	1	F	1	-	-	-	Photo 413
8/12/2012	Dragon Lake	JC/JW	BS	1	11	RDWH	97	-	-	U	1	F	1	-	-	-	Photo 414
8/12/2012	Dragon Lake	JC/JW	BS	1	12	RDWH	110	-	-	U	1	F	1	-	-	-	Photo 415
8/12/2012	Dragon Lake	JC/JW	BS	1	13	RDWH	120	-	-	U	1	F	1	-	-	-	Photo 416
8/12/2012	Dragon Lake	JC/JW	BS	1	14	RDWH	130	-	-	U	1	F	1	-	-	-	Photo 417
8/12/2012	Dragon Lake	JC/JW	BS	1	-	ARGR	43	-	-	U	0	F	-	-	-	-	Photo 419
8/12/2012	Dragon Lake	JC/JW	BS	2	-	ARGR	49	-	-	U	0	-	-	-	-	-	Photo 421
8/12/2012	Dragon Lake	JC/JW	BS	2	-	RDWH	50	-	-	U	1	F	-	-	-	-	Photo 420
8/13/2012	Dragon Lake	JC/JW	GN	2	15	LKTR	470	961	0.9256138	U	0	F	10	-	-	-	Photo 422
8/13/2012	Dragon Lake	JC/JW	GN	2	16	LKTR	450	738	0.8098765	U	0	F	11	-	-	-	Photo 423
8/13/2012	Dragon Lake	JC/JW	GN	2	17	LKTR	438	804	0.9568277	U	0	F	13	-	-	-	Photo 424
8/13/2012	Dragon Lake	JC/JW	GN	2	18	LKTR	308	272	0.9309294	U	0	F	7	-	-	-	Photo 425
8/13/2012	Dragon Lake	JC/JW	GN	2	19	LKTR	440	755	0.8863167	U	0	F	11	-	-	-	Photo 426
8/13/2012	Dragon Lake	JC/JW	GN	2	20	LKTR	410	635	0.9213447	U	0	F	9	-	-	-	Photo 427
8/13/2012	Dragon Lake	JC/JW	GN	2	21	LKTR	390	615	1.0367673	U	0	F	9	-	-	-	Photo 428
8/13/2012	Dragon Lake	JC/JW	GN	2	22	LKTR	460	826	0.8486069	U	0	F	15	-	-	-	Photo 429
8/13/2012	Dragon Lake	JC/JW	GN	2	23	LKTR	413	628	0.8914757	U	0	F	10	-	-	-	Photo 430
8/13/2012	Dragon Lake	JC/JW	GN	3	24	LKTR	450	881	0.9668038	U	0	F	11	-	-	-	Photo 431
8/13/2012	Dragon Lake	JC/JW	GN	3	25	LKTR	419	709	0.9638383	U	0	F	10	-	-	-	Photo 432

Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
8/13/2012	Dragon Lake	JC/JW	GN	3	26	LKTR	440	821	0.963796	U	0	F	8	-	-	-	Photo 433
8/13/2012	Dragon Lake	JC/JW	GN	3	27	LKTR	400	690	1.078125	U	0	F	11	-	-	-	Photo 434
8/13/2012	Dragon Lake	JC/JW	GN	3	28	LKTR	305	308	1.0855534	U	0	F	8	-	-	-	Photo 435
8/13/2012	Dragon Lake	JC/JW	GN	4	29	LKTR	354	448	1.0098764	U	0	F	7	-	-	-	Photo 436
8/13/2012	Dragon Lake	JC/JW	GN	5	30	LKTR	610	1753	0.7723113	U	0	F	15	-	-	-	Photo 437
8/13/2012	Dragon Lake	JC/JW	GN	5	31	LKTR	580	1503	0.7703268	U	0	F	12	-	-	-	Photo 438
8/13/2012	Dragon Lake	JC/JW	GN	5	32	LKTR	450	796	0.8735254	U	0	F	10	-	-	-	Photo 439
8/13/2012	Dragon Lake	JC/JW	GN	5	33	LKTR	374	463	0.8850467	U	0	F	8	-	-	-	Photo 440
8/13/2012	Dragon Lake	JC/JW	GN	5	34	LKTR	445	745	0.8454272	U	0	F	8	-	-	-	Photo 441
8/13/2012	Dragon Lake	JC/JW	GN	5	35	LKTR	374	492	0.9404816	U	0	F	11	-	-	-	Photo 442
8/13/2012	Dragon Lake	JC/JW	GN	5	36	LKTR	428	773	0.9859348	U	0	F	11	-	-	-	Photo 443
7/24/2012	Fox Lake	LT/QS	-	-	9	LKTR	650	-	-	U	0	F	13	-	-	-	-
7/24/2012	Fox Lake	LT/QS	BS	3	7	RDWH	98	8	0.849986	U	0	F	1	-	-	-	Photo 1064
7/24/2012	Fox Lake	LT/QS	BS	3	8	RDWH	88	6	0.880447	U	0	F	1	-	-	-	Photo 1065
7/23/2012	Fox Lake	LT/QS	GN	1	1	LKTR	390	620	1.0451963	U	0	F	11	-	-	-	Photo 082
7/23/2012	Fox Lake	LT/QS	GN	1	2	LKTR	300	350	1.2962963	U	0	F	7	-	-	-	Photo 083
7/23/2012	Fox Lake	LT/QS	GN	1	3	LKTR	410	600	0.8705619	U	0	F	10	-	-	-	Photo 084
7/23/2012	Fox Lake	LT/QS	GN	1	4	LKTR	295	260	1.0127618	U	0	F	7	-	-	-	-
7/23/2012	Fox Lake	LT/QS	GN	1	5	RDWH	315	323	1.0334057	U	0	F	8	-	-	-	Photo 085
7/24/2012	Fox Lake	LT/QS	GN	3	6	LKTR	320	306	0.9338379	U	0	F	8	-	-	-	Photo 1062
7/24/2012	Fox Lake	LT/QS	GN	4	10	LKTR	375	489	0.9272889	U	0	F	9	-	-	-	Photo 1070
7/24/2012	Fox Lake	LT/QS	GN	4	11	LKTR	400	620	0.96875	U	0	F	10	-	-	-	-
7/24/2012	Fox Lake	LT/QS	GN	4	12	LKTR	365	509	1.0467409	U	0	F	9	-	-	-	-
7/24/2012	Fox Lake	LT/QS	GN	4	13	LKTR	400	568	0.8875	U	0	F	11	-	-	-	-
7/24/2012	Fox Lake	LT/QS	GN	4	14	LKTR	310	280	0.9398812	U	0	F	7	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	105	NSSB	16	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	106	NSSB	16	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	107	NSSB	21	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	108	NSSB	19	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	109	NSSB	18	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	110	NSSB	19	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	111	NSSB	19	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	112	NSSB	17	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	113	NSSB	19	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	114	NSSB	20	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	115	NSSB	19	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	116	NSSB	18	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	117	NSSB	14	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	118	NSSB	16	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	119	NSSB	18	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	120	NSSB	57	1	0.5399772	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	121	NSSB	59	2	0.9738094	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	122	NSSB	19	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	123	NSSB	58	1	0.5125261	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	124	NSSB	51	1	0.7538579	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	125	NSSB	17	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	126	SLSC	42	-	-	U	0	-	-	-	-	-	-

Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
7/23/2012	Gander Lake	KS/FT	BS	1	127	NSSB	38	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	128	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
7/23/2012	Gander Lake	KS/FT	BS	1	128	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
7/23/2012	Gander Lake	KS/FT	BS	1	129	ARGR	156	52	1.3697129	U	0	F	3	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	129	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
7/23/2012	Gander Lake	KS/FT	BS	1	130	ARGR	112	19	1.3523825	U	0	F	2	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	130	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
7/23/2012	Gander Lake	KS/FT	BS	1	131	RDWH	113	119	8.2472969	U	0	F	3	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	131	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
7/23/2012	Gander Lake	KS/FT	BS	1	132	NSSB	-	-	-	U	0	-	-	-	-	-	5 YOY NSSB
7/23/2012	Gander Lake	KS/FT	BS	1	132	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
7/23/2012	Gander Lake	KS/FT	BS	1	133	NSSB	56	2	1.1388484	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	133	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
7/23/2012	Gander Lake	KS/FT	BS	1	134	NSSB	62	1	0.4195898	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	134	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
7/23/2012	Gander Lake	KS/FT	BS	1	135	NSSB	44	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	135	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
7/23/2012	Gander Lake	KS/FT	BS	1	136	NSSB	50	-	-	U	0	-	-	-	-	-	-
7/23/2012	Gander Lake	KS/FT	BS	1	136	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
7/23/2012	Gander Lake	KS/FT	BS	1	137	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
7/23/2012	Gander Lake	KS/FT	BS	1	138	NSSB	-	-	-	U	0	-	-	-	-	-	YOY
8/10/2012	Gander Lake	LT/TS	BS	1	-	ARGR	53	-	-	U	0	-	-	-	-	-	Photo 1178
8/10/2012	Gander Lake	LT/TS	BS	1	-	NSSB	32	-	-	U	0	-	-	-	-	-	-
8/10/2012	Gander Lake	LT/TS	BS	1	-	NSSB	51	-	-	U	0	-	-	-	-	-	-
8/10/2012	Gander Lake	LT/TS	BS	1	-	NSSB	61	-	-	U	0	-	-	-	-	-	Photo 1176
8/10/2012	Gander Lake	LT/TS	BS	1	-	NSSB	61	-	-	F	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	1	LNSU	337	587	1.5337282	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	2	LNSU	279	339	1.5609432	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	3	LNSU	324	451	1.3259939	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	4	LNSU	353	615	1.3981411	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	5	LNSU	273	283	1.3909083	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	6	LNSU	302	361	1.3106489	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	7	RDWH	255	198	1.1941109	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	8	RDWH	255	225	1.3569442	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	9	RDWH	225	149	1.3080933	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	10	RDWH	209	122	1.3363523	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	11	RDWH	208	116	1.2890447	U	0	-	-	-	-	-	-
8/10/2012	Gander Lake	LT/TS	GN	1	12	LKTR	500	-	-	U	0	F	14	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	12	RDWH	215	125	1.2577509	U	0	-	-	-	-	-	-
8/10/2012	Gander Lake	LT/TS	GN	1	13	RDWH	261	-	-	F	0	F,S	15	9	23	-	Photo 1180
7/22/2012	Gander Lake	KS/FT	GN	1	13	RDWH	135	30	1.2193263	U	0	-	-	-	-	-	-
8/10/2012	Gander Lake	LT/TS	GN	2	14	ARGR	298	-	-	U	3	F	-	-	-	-	Photo 1181
7/22/2012	Gander Lake	KS/FT	GN	1	14	RDWH	140	32	1.1661808	U	0	-	5	-	-	-	-
8/10/2012	Gander Lake	LT/TS	GN	2	15	ARGR	305	-	-	U	0	F	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	15	RDWH	105	12	1.0366051	U	0	-	3	-	-	-	-
8/10/2012	Gander Lake	LT/TS	GN	2	16	LKCS	196	78	1.0359204	U	0	F,S	7	1	1	-	Photo 1182
7/22/2012	Gander Lake	KS/FT	GN	1	16	LKCS	110	15	1.1269722	U	0	-	-	-	-	-	-

Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
7/22/2012	Gander Lake	KS/FT	GN	1	17	LKCS	100	11	1.1	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	18	LKCS	105	14	1.2093726	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	19	LKCS	105	14	1.2093726	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	20	LKCS	108	14	1.1113651	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	21	LKCS	138	29	1.1034705	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	22	LKCS	108	14	1.1113651	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	23	LKCS	102	11	1.0365546	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	24	ARGR	107	13	1.0611872	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	25	ARGR	348	489	1.1603022	M	2	S,F	5	-	-	-	Stomach parasites. Eating fish and bugs.
7/22/2012	Gander Lake	KS/FT	GN	1	26	ARGR	322	424	1.269984	U	0	S,F	5	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	27	LKTR	315	405	1.2957564	U	0	S,F	6	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	1	28	RDWH	321	397	1.2002602	U	0	-	6	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	2	29	RDWH	222	128	1.1699062	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	2	30	RDWH	229	130	1.0825224	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	2	31	LNSU	210	111	1.1985747	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	2	32	LKCS	279	333	1.5333158	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	33	LKCS	137	33	1.2833711	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	34	LKCS	143	36	1.231103	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	35	LKCS	142	35	1.2223709	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	36	LKCS	147	40	1.2592385	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	37	LKCS	143	37	1.2653003	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	38	LKCS	149	39	1.1789783	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	39	LKCS	164	60	1.360253	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	40	LKCS	140	35	1.2755102	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	41	LKCS	107	12	0.9795575	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	42	LKCS	104	13	1.1556953	U	0	-	-	-	-	-	-
8/16/2012	Gander Lake	LT/TS	GN	4	43	ARGR	332	475	1.2980139	U	0	F	5	-	-	-	Photo 1236
7/22/2012	Gander Lake	KS/FT	GN	3	43	LKCS	165	55	1.2243649	U	0	-	-	-	-	-	-
8/16/2012	Gander Lake	LT/TS	GN	4	44	ARGR	252	203	1.2685115	U	0	F	3	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	44	LKCS	144	33	1.1051633	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	45	LKCS	142	36	1.2572958	U	0	-	-	-	-	-	-
8/16/2012	Gander Lake	LT/TS	GN	4	45	LKCS	212	125	1.3119051	U	0	F	4	-	-	-	Photo 1237
7/22/2012	Gander Lake	KS/FT	GN	3	46	LKCS	142	36	1.2572958	U	0	-	-	-	-	-	-
8/16/2012	Gander Lake	LT/TS	GN	4	46	LKCS	215	108	1.0866968	U	0	F	4	-	-	-	Photo 1238
8/16/2012	Gander Lake	LT/TS	GN	5	47	ARGR	293	308	1.2244692	U	0	F	4	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	47	LKCS	144	32	1.0716735	U	0	-	-	-	-	-	-
8/16/2012	Gander Lake	LT/TS	GN	5	48	ARGR	320	408	1.2451172	U	0	F	5	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	48	LKCS	147	36	1.1333146	U	0	-	-	-	-	-	-
8/16/2012	Gander Lake	LT/TS	GN	5	49	ARGR	320	407	1.2420654	U	0	F	5	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	49	LKCS	137	27	1.0500309	U	0	-	-	-	-	-	-
8/16/2012	Gander Lake	LT/TS	GN	6	50	ARGR	275	250	1.2021037	U	0	F	3	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	50	LKCS	135	33	1.341259	U	0	-	-	-	-	-	-
8/16/2012	Gander Lake	LT/TS	GN	7	51	ARGR	280	233	1.0614067	U	0	F	3	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	51	LKCS	145	34	1.1152569	U	0	-	-	-	-	-	-
8/16/2012	Gander Lake	LT/TS	GN	7	52	ARGR	265	215	1.1553161	U	0	F	3	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	52	LKCS	150	37	1.0962963	U	0	-	-	-	-	-	-
8/16/2012	Gander Lake	LT/TS	GN	7	53	ARGR	358	599	1.3055026	U	0	F	5	-	-	-	-

Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
7/22/2012	Gander Lake	KS/FT	GN	3	53	LKCS	146	35	1.1246295	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	54	LKCS	147	39	1.2277575	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	55	LKCS	144	36	1.2056327	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	56	LKCS	145	35	1.1480586	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	57	LKCS	146	35	1.1246295	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	58	LKCS	143	33	1.1285111	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	59	LKCS	140	34	1.2390671	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	60	LKCS	143	35	1.1969057	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	61	LKCS	143	36	1.231103	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	62	LKCS	145	33	1.0824552	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	63	LKCS	145	34	1.1152569	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	64	LKCS	143	34	1.1627084	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	65	LKCS	143	33	1.1285111	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	66	LKCS	104	14	1.2445949	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	67	LKCS	143	34	1.1627084	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	68	LKCS	144	35	1.1721429	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	69	LKCS	140	35	1.2755102	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	70	LKCS	143	33	1.1285111	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	71	LKCS	170	54	1.0991248	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	72	LKCS	138	33	1.2556734	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	73	LKCS	146	35	1.1246295	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	74	LKCS	148	34	1.0488026	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	75	LKCS	148	34	1.0488026	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	76	LKCS	142	31	1.0826714	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	77	LKCS	140	30	1.0932945	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	78	LKCS	145	35	1.1480586	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	79	LKCS	138	31	1.1795719	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	80	LKCS	148	36	1.1104969	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	3	81	LKCS	145	35	1.1480586	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	82	LKCS	106	16	1.3433909	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	83	LKCS	110	16	1.2021037	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	84	LKCS	142	32	1.1175963	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	85	LKCS	145	33	1.0824552	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	86	LKCS	138	31	1.1795719	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	87	LKCS	215	118	1.1873168	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	88	LKCS	227	134	1.1455848	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	89	LKCS	217	121	1.1841485	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	90	LKCS	216	117	1.1609797	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	91	LKCS	140	38	1.3848397	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	92	LKCS	103	18	1.647255	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	93	LKCS	222	129	1.1790461	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	94	LKCS	140	36	1.3119534	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	95	LKCS	144	32	1.0716735	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	96	LKCS	213	110	1.1382925	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	97	LKCS	222	131	1.1973259	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	98	LKCS	220	122	1.1457551	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	99	LKCS	221	124	1.1488012	U	0	-	-	-	-	-	-

Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
7/22/2012	Gander Lake	KS/FT	GN	4	100	LKCS	137	33	1.2833711	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	101	LKCS	223	136	1.2263779	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	102	LKCS	117	13	0.8116817	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	103	LKCS	108	15	1.1907484	U	0	-	-	-	-	-	-
7/22/2012	Gander Lake	KS/FT	GN	4	104	RDWH	295	317	1.2347903	U	0	-	-	-	-	-	-
8/10/2012	Gander Lake	LT/TS	GN	3	-	ARGR	327	-	-	U	0	-	-	-	-	-	Released from boat - time factor
8/11/2012	George Lake	LT/TS	BS	10	-	ARGR	64	2	0.7629395	-	-	S,F	-	-	-	-	-
8/11/2012	George Lake	LT/TS	BS	10	-	ARGR	66	3	1.0434928	-	-	S,F	-	-	-	-	Photo 1203
8/11/2012	George Lake	LT/TS	BS	10	-	LKTR	51	1	0.7538579	-	-	S,F	-	-	-	-	Photo 1204
8/11/2012	George Lake	LT/TS	BS	10	-	LKTR	52	1	0.7111971	-	-	S,F	-	-	-	-	Photo 1205
8/11/2012	George Lake	LT/TS	BS	9	-	SLSC	46	1	1.0273691	-	-	S,F	-	-	-	-	-
8/11/2012	George Lake	LT/TS	BS	3	-	SLSC	62	-	-	-	-	-	-	-	-	-	Photo 1188
8/11/2012	George Lake	LT/TS	GN	4	17	LKTR	780	-	-	-	-	-	19	-	-	-	-
8/11/2012	George Lake	LT/TS	GN	4	18	LKTR	485	1196	1.0483492	F	3	S,F	21	19	147	-	Photo of Gonads 1191
8/11/2012	George Lake	LT/TS	GN	4	19	LKTR	480	1343	1.2143736	F	3	S,F	21	18	158	-	Photo of Gonads 1190
8/11/2012	George Lake	LT/TS	GN	4	20	LKTR	472	1306	1.2419874	F	3	S,F	24	22	154	-	Photo of Gonads 1192
8/11/2012	George Lake	LT/TS	GN	4	21	LKTR	490	1165	0.9902337	M	3	S,F	28	5	26	-	-
8/11/2012	George Lake	LT/TS	GN	4	22	LKTR	463	1080	1.08813	M	5	S,F	12	8	-	-	-
8/11/2012	George Lake	LT/TS	GN	4	23	LKTR	426	863	1.1163028	M	2	S,F	15	8	-	-	-
8/11/2012	George Lake	LT/TS	GN	6	24	LKTR	560	1778	1.0124362	M	2	S,F	33	8	2	-	Photo 1199
8/11/2012	George Lake	LT/TS	GN	6	25	LKTR	772	2025	0.440122	F	2	S,F	22	24	22	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	4	ARGR	84	-	-	U	0	F	1	-	-	-	Photo 1022
7/22/2012	Goose Lake	LT/QS	BS	12	5	NSSB	45	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	5	NSSB	47	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	5	NSSB	48	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	5	NSSB	50	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	5	NSSB	55	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	5	RDWH	39	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	5	RDWH	42	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	5	RDWH	43	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	5	RDWH	95	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	5	RDWH	130	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	5	RDWH	145	-	-	U	0	F	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	6	LKTR	133	-	-	U	0	F	1	-	-	-	Photo 1023
7/22/2012	Goose Lake	LT/QS	BS	12	6	SLSC	52	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	6	SLSC	55	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	6	SLSC	60	-	-	U	0	-	-	-	-	-	Photo 472
7/22/2012	Goose Lake	LT/QS	BS	6,7	-	ARGR	47	-	-	U	0	-	-	-	-	-	Over small cobbles, shallow
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	NSSB	37	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	NSSB	44	-	-	U	0	-	-	-	-	-	Photo 1007
7/22/2012	Goose Lake	LT/QS	BS	12	-	NSSB	49	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	30	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	30	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	30	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	31	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	10,11	-	RDWH	34	-	-	U	0	-	-	-	-	-	Plus 2 STBK
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	35	-	-	U	0	-	-	-	-	-	-

Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	35	-	-	U	0	-	-	-	-	-	Photo 1001 fish set 3
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	36	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	36	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	6,7	-	RDWH	37	-	-	U	0	-	-	-	-	-	Set (~0.20-0.30 m) Photo 1015 and 1016
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	37	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	38	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	38	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	38	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	38	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	39	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	41	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	42	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	42	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	45	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	8,9	-	RDWH	47	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	48	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	48	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	49	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	54	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	54	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	57	-	-	U	0	-	-	-	-	-	Photo of B54:1010
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	85	-	-	U	0	F	-	-	-	-	Photo 1000 3 sets : fish set 1
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	85	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	85	-	-	U	0	F	-	-	-	-	Photo 1000 3 sets : fish set 1
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	85	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	85	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	-	RDWH	88	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	90	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	91	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	92	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	92	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	94	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	96	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	99	-	-	U	0	-	-	-	-	-	25x-8m
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	99	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	12	-	RDWH	103	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	103	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	RDWH	103	-	-	U	0	-	-	-	-	-	BS4+5 = ~200m^2
7/22/2012	Goose Lake	LT/QS	BS	12	-	RDWH	105	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	105	-	-	U	0	-	-	-	-	-	-
7/22/2012	Goose Lake	LT/QS	BS	1,2,3	-	RDWH	135	-	-	U	0	F	-	-	-	-	Fish set 2 fish set 2
7/22/2012	Goose Lake	LT/QS	BS	4,5	-	SLSC	34	-	-	U	0	-	-	-	-	-	Photo 1009
7/21/2012	Goose Lake	KS/LT	GN	1	1	LKTR	393	656	1.0807523	U	1	S,F	13	4	-	y	Tapeworms
7/21/2012	Goose Lake	KS/LT	GN	2	2	LKTR	440	850	0.99784	F	2	S,F	12	4	7	-	-
7/21/2012	Goose Lake	KS/LT	GN	3	3	LKTR	310	335	1.1245007	U	0	F	6	-	-	-	Not sampled
7/21/2012	Goose Lake	KS/LT	GN	3	4	LKTR	335	370	0.9841636	F	1	S,F	9	3	too small	y	Stomach and intestine with worms and eggs?
7/21/2012	Goose Lake	KS/LT	GN	6	5	LKTR	450	937	1.0282579	M	2	S,F	19	6	17	y	Stomach parasites and tapeworms

Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
8/14/2012	Komatic Lake	JC/JW	BS	2	-	RDWH	57	2	1.0799544	U	0	-	-	-	-	-	Photo 449
8/15/2012	Komatic Lake	JC/JW	BS	4	-	RDWH	57	-	-	U	0	-	-	-	-	-	Photo 463
8/15/2012	Komatic Lake	JC/JW	BS	4	-	SLSC	43	-	-	U	0	-	-	-	-	-	Photo 462
8/14/2012	Komatic Lake	JC/JW	BS	2	-	SLSC	53	-	-	U	0	-	-	-	-	-	Photo 448
8/15/2012	Komatic Lake	JC/JW	BS	5	-	SLSC	57	2	1.0799544	U	0	-	-	-	-	-	Photo 464
8/15/2012	Komatic Lake	JC/JW	BS	5	-	SLSC	59	2	0.9738094	U	0	-	-	-	-	-	Photo 465
8/14/2012	Komatic Lake	JC/JW	GN	1	1	LKTR	460	861	0.8845648	U	0	F	9	-	-	-	Photo 444
8/14/2012	Komatic Lake	JC/JW	GN	1	2	LKTR	520	1237	0.8797508	U	0	F	12	-	-	-	Photo 445
8/14/2012	Komatic Lake	JC/JW	GN	2	3	LKTR	435	755	0.917232	U	0	F	10	-	-	-	Photo 446
8/14/2012	Komatic Lake	JC/JW	GN	4	4	LKTR	570	1279	0.6906309	U	0	F	11	-	-	-	Photo 450
8/14/2012	Komatic Lake	JC/JW	GN	4	5	LKTR	535	1294	0.8450316	U	0	F	10	-	-	-	Photo 451
8/14/2012	Komatic Lake	JC/JW	GN	4	6	LKTR	590	1639	0.7980368	U	0	F	11	-	-	-	Photo 452
8/15/2012	Komatic Lake	JC/JW	GN	5	7	RDWH	434	943	1.1535662	U	0	F	10	-	-	-	Photo 453
8/15/2012	Komatic Lake	JC/JW	GN	5	8	RDWH	469	1018	0.9868002	U	0	F	10	-	-	-	Photo 454
8/15/2012	Komatic Lake	JC/JW	GN	5	9	RDWH	479	1100	1.0008895	U	0	F	10	-	-	-	Photo 455
8/15/2012	Komatic Lake	JC/JW	GN	5	10	LKTR	490	1030	0.8754856	U	0	F	9	-	-	-	Photo 456
8/15/2012	Komatic Lake	JC/JW	GN	5	11	LKTR	620	>6000	-	U	0	F	16	-	-	-	Photo 457
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	31	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	33	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	33	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	33	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	35	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	35	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	35	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	36	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	36	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	36	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	9	-	RDWH	36	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	9	-	RDWH	36	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	37	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	37	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	37	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	6	-	RDWH	37	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	9	-	RDWH	37	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	9	-	RDWH	37	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	9	-	RDWH	37	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	38	-	-	U	0	-	-	-	-	-	Photo 1098
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	38	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	38	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	38	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	39	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	42	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	9	-	RDWH	42	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	9	-	RDWH	42	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	9	-	RDWH	42	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	4,5	-	RDWH	43	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	8	-	SLSC	58	-	-	U	0	-	-	-	-	-	-
7/26/2012	Llama Lake	LT/QS	BS	1,3	-	SLSC	65	-	-	U	0	-	-	-	-	-	In BS2

Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
7/25/2012	Llama Lake	LT/QS	GN	1	1	RDWH	310	341	1.144641	F	2	S,F	8	2	3	-	Photo 1077
7/25/2012	Llama Lake	LT/QS	GN	1	2	RDWH	215	97	0.9760147	U	0	S,F	6	1	<1	-	Only 1 odolith measured
7/25/2012	Llama Lake	LT/QS	GN	1	3	RDWH	328	372	1.0541961	M	2	S,F	8	2	4	-	-
7/25/2012	Llama Lake	LT/QS	GN	1	4	RDWH	345	486	1.1835292	M	0	S,F	11	3	7	-	-
7/25/2012	Llama Lake	LT/QS	GN	1	5	RDWH	385	600	1.0514026	M	2	S,F	9	3	8	-	Photo 1078
7/25/2012	Llama Lake	LT/QS	GN	2	6	RDWH	420	744	1.0042112	U	0	F	10	-	-	-	-
7/25/2012	Llama Lake	LT/QS	GN	2	7	LKTR	338	370	0.95819	U	0	S,F	17	2	-	y	Photo 1080 parasites
7/25/2012	Llama Lake	LT/QS	GN	3	8	LKTR	310	260	0.8727468	F	1	S,F	11	3	2	y	Photo 1081 parasites 1082
7/25/2012	Llama Lake	LT/QS	GN	3	9	LKTR	352	430	0.9859172	F	1	S,F	13	3	1	y	Parasites
7/25/2012	Llama Lake	LT/QS	GN	4	10	RDWH	330	397	1.104711	U	0	F	6	-	-	-	-
7/25/2012	Llama Lake	LT/QS	GN	4	11	RDWH	374	619	1.1832482	U	0	F	8	-	-	-	-
7/25/2012	Llama Lake	LT/QS	GN	4	12	RDWH	136	22	0.8745929	U	0	F	2	-	-	-	-
7/25/2012	Llama Lake	LT/QS	GN	4	13	LKTR	405	624	0.9393329	F	2	S,F	13	3	2	-	Photo 1083
7/25/2012	Llama Lake	LT/QS	GN	4	14	LKTR	265	183	0.9833621	U	0	S,F	11	1	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	1	24	SLSC	54	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	1	25	SLSC	55	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	1	26	SLSC	57	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	1	27	SLSC	49	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	1	28	SLSC	61	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	1	29	SLSC	37	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	1	30	SLSC	60	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	2	31	SLSC	45	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	3	32	SLSC	53	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	3	33	SLSC	52	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	3	34	SLSC	45	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	3	35	SLSC	46	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	3	36	SLSC	56	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	3	37	SLSC	54	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	3	38	SLSC	47	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	3	39	SLSC	42	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	3	40	SLSC	37	-	-	U	0	-	-	-	-	-	-
7/25/2012	Moby Lake	KS/FT	EF	3	41	SLSC	46	-	-	U	0	-	-	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	1	1	LKTR	444	1103	1.2601626	U	0	F	13	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	1	2	LKTR	475	1204	1.1234291	U	0	F	11	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	1	3	LKTR	262	177	0.9841683	U	0	F	6	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	1	4	LKTR	413	821	1.1654483	U	0	F	12	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	1	5	LKTR	271	209	1.0501188	U	1	F,S	8	-	-	y	Few parasites
7/24/2012	Moby Lake	KS/FT	GN	1	6	LKTR	323	385	1.142492	U	0	F	7	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	1	7	LKTR	275	228	1.0963186	U	1	F,S	10	-	-	y	Stomach parasites
7/24/2012	Moby Lake	KS/FT	GN	2	8	LKTR	440	1062	1.246713	U	0	F	10	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	3	9	LKTR	590	2130	1.037107	U	0	F	11	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	3	10	LKTR	450	1174	1.2883402	U	0	F	9	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	3	11	LKTR	326	368	1.0621724	U	0	F	10	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	4	12	LKTR	247	162	1.0750388	U	0	F	8	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	4	13	LKTR	192	72	1.0172526	U	0	F	3	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	4	14	LKTR	234	151	1.1784994	U	0	F	3	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	4	15	LKTR	446	882	0.9941777	U	0	F	10	-	-	-	-

Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
7/24/2012	Moby Lake	KS/FT	GN	4	16	LKTR	240	135	0.9765625	U	1	F,S	9	-	-	-	Stomach parasites (eat zooplankton)
7/24/2012	Moby Lake	KS/FT	GN	5	17	LKTR	273	209	1.0272079	U	0	F	6	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	5	18	LKTR	445	1073	1.2176422	M	2	F,S	23	-	-	-	Stomach parasites (eat zooplankton)
7/24/2012	Moby Lake	KS/FT	GN	5	19	LKTR	467	1271	1.2479435	M	3	F,S	27	-	-	-	Stomach parasites (eat zooplankton, fish, insects)
7/24/2012	Moby Lake	KS/FT	GN	6	20	LKTR	447	1062	1.189055	U	0	F	13	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	6	21	LKTR	602	2858	1.3100044	U	0	F	16	-	-	-	-
7/24/2012	Moby Lake	KS/FT	GN	6	22	LKTR	445	980	1.1121056	M	3	F,S	17	-	-	-	Stomach parasites. Empty stomach (some fish)
8/8/2012	Rabbit Lake	LT/QS	BS	2	-	ARGR	51	-	-	U	0	-	-	-	-	-	Photo 1175
8/8/2012	Rabbit Lake	LT/QS	BS	2	-	NSSB	32	-	-	U	0	-	-	-	-	-	-
8/8/2012	Rabbit Lake	LT/QS	BS	3	-	NSSB	32	-	-	U	0	-	-	-	-	-	-
8/8/2012	Rabbit Lake	LT/QS	BS	2	-	NSSB	35	-	-	U	0	-	-	-	-	-	-
8/8/2012	Rabbit Lake	LT/QS	BS	3	-	NSSB	35	-	-	U	0	-	-	-	-	-	-
8/8/2012	Rabbit Lake	LT/QS	BS	2	-	NSSB	54	-	-	U	0	-	-	-	-	-	-
8/8/2012	Rabbit Lake	LT/QS	GN	1	8	LKTR	405	-	-	U	1	F	8	-	-	-	Mort
8/8/2012	Rabbit Lake	LT/QS	GN	2	9	LKTR	435	-	-	U	2	F	12	-	-	-	Mort
8/8/2012	Rabbit Lake	LT/QS	GN	3	10	LKTR	405	-	-	U	3	F	10	-	-	-	-
8/8/2012	Rabbit Lake	LT/QS	GN	4	11	LKTR	415	-	-	U	4	-	10	-	-	-	-
8/10/2012	Rascal Lake	JC/JW	BS	3	3	ARGR	105	12	1.0366051	U	2	F	-	-	-	-	-
8/10/2012	Rascal Lake	JC/JW	BS	3	4	ARGR	106	14	1.175467	U	2	F	-	-	-	-	Photo 375
8/10/2012	Rascal Lake	JC/JW	BS	3	5	ARGR	105	10	0.8638376	U	2	F	-	-	-	-	Photo 377
8/10/2012	Rascal Lake	JC/JW	BS	3	6	ARGR	106	9	0.7556574	U	2	-	-	-	-	-	Photo 378
8/10/2012	Rascal Lake	JC/JW	BS	3	7	RDWH	53	1	0.6716954	U	1	F	-	-	-	-	Photo 379
8/10/2012	Rascal Lake	JC/JW	BS	4	-	ARGR	50	1	0.8	U	0	-	-	-	-	-	Photo 383
8/10/2012	Rascal Lake	JC/JW	BS	4	-	ARGR	57	2	1.0799544	U	0	-	-	-	-	-	Photo 382
8/10/2012	Rascal Lake	JC/JW	BS	5	-	RDWH	59	2	0.9738094	U	1	-	-	-	-	-	Photo 385
8/10/2012	Rascal Lake	JC/JW	Gn	3	1	LKTR	379	455	0.8357834	U	0	F	-	-	-	-	Photo 373
8/10/2012	Rascal Lake	JC/JW	GN	4	2	LKTR	379	609	1.118664	U	0	F	-	-	-	-	Photo 374
8/10/2012	Rascal Lake	JC/JW	GN	7	8	LKTR	248	172	1.1276476	U	0	-	-	-	-	-	Photo 380 and 381
7/28/2012	Reference B	LT/QS	GN	1	1	RDWH	255	-	-	F	5	S,F	5	6	4	-	Photo 1122
7/28/2012	Reference B	LT/QS	GN	1	2	LKTR	372	-	-	M	3	S,F	11	13	37	-	Photo 1123
7/28/2012	Reference B	LT/QS	GN	1	3	RDWH	373	-	-	M	3	S,F	10	17	19	-	Photo 1124
7/28/2012	Reference B	LT/QS	GN	2	4	LKTR	525	-	-	F	3	S,F	25	17	44	-	Photo 1125
7/28/2012	Reference B	LT/QS	GN	2	5	LKTR	492	-	-	M	5	S,F	31	23	10	-	Photo 1126
7/28/2012	Reference B	LT/QS	GN	2	6	LKTR	487	-	-	F	5	S,F	27	9	38	-	-
7/28/2012	Reference B	LT/QS	GN	2	7	LKTR	467	-	-	M	3	S,F	27	17	43	-	-
7/28/2012	Reference B	LT/QS	GN	2	8	LKTR	488	-	-	M	3	S,F	24	24	95	-	-
7/28/2012	Reference B	LT/QS	GN	2	9	LKTR	450	-	-	M	3	S,F	25	28	48	-	-
7/28/2012	Reference B	LT/QS	GN	2	10	LKTR	466	-	-	M	3	S,F	26	17	73	-	-
7/28/2012	Reference B	LT/QS	GN	2	11	LKTR	324	-	-	U	1	S,F	14	3	-	-	-
7/28/2012	Reference B	LT/QS	GN	2	12	RDWH	420	-	-	M	3	S,F	14	18	67	-	-
7/28/2012	Reference B	LT/QS	GN	3	13	LKTR	476	-	-	U	0	F	9	-	-	-	-
7/28/2012	Reference B	LT/QS	GN	3	14	LKTR	420	-	-	M	3	S,F	13	16	75	-	-
7/28/2012	Reference B	LT/QS	GN	3	15	LKTR	398	-	-	F	3	S,F	14	18	30	-	-
7/28/2012	Reference B	LT/QS	GN	3	16	LKTR	520	-	-	M	2	S,F	21	31	30	-	-
7/29/2012	Reference B	LT/QS	GN	4	17	LKTR	480	-	-	U	0	F	11	-	-	-	-
7/29/2012	Reference B	LT/QS	GN	4	18	LKTR	555	-	-	U	0	F	14	-	-	-	Photo 1130
7/29/2012	Reference B	LT/QS	GN	4	19	RDWH	202	-	-	F	1	S,F	4	3	-	-	Photo 1132

Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
7/29/2012	Reference B	LT/QS	GN	4	20	RDWH	397	-	-	U	1	S,F	5	2	-	-	-
7/29/2012	Reference B	LT/QS	GN	4	21	RDWH	226	-	-	F	1	S,F	ua	2	-	-	-
7/29/2012	Reference B	LT/QS	GN	5	22	RDWH	241	-	-	F	2	S,F	4	3	1	-	-
7/29/2012	Reference B	LT/QS	GN	5	23	RDWH	372	-	-	F	3	S,F	11	11	30	-	Parasites - Photo 1134
7/29/2012	Reference B	LT/QS	GN	5	24	RDWH	384	-	-	M	3	S,F	23	15	35	-	-
7/29/2012	Reference B	LT/QS	GN	5	25	RDWH	362	-	-	M	3	S,F	14	11	37	-	-
8/14/2012	Reference C	LT/TS	GN	1	26	LKTR	122	18	0.9912724	U	0	F	1	-	-	-	Photo 1218
8/14/2012	Reference C	LT/TS	GN	1	27	LKTR	605	2300	1.038632	M	3	S,F	30	13	38	-	Photo 1219
8/14/2012	Reference C	LT/TS	GN	2	28	ARCH	413	751	1.06608	U	0	F	5	-	-	-	Photo 1223
8/14/2012	Reference C	LT/TS	GN	2	29	ARCH	385	640	1.1214961	U	0	F	4	-	-	-	Photo 1222
8/14/2012	Reference C	LT/TS	GN	2	30	LKTR	445	1003	1.1382061	M	3	S,F	26	7	26	-	-
8/14/2012	Reference C	LT/TS	GN	3	31	LKTR	627	2700	1.0953708	U	5	S,F	26	18	-	-	Spent? Photo 1226
8/14/2012	Reference C	LT/TS	GN	3	32	LKTR	365	529	1.0878702	M	1	S,F	14	4	-	-	-
8/15/2012	Reference C	LT/TS	GN	4	33	ARCH	440	860	1.0095793	M	2	S,F	8	-	-	-	Photo 1229
8/15/2012	Reference C	LT/TS	GN	4	34	ARCH	420	608	0.8206457	U	0	F	4	-	-	-	-
8/15/2012	Reference C	LT/TS	GN	5	35	LKTR	760	>5k	-	U	0	F	ua	-	-	-	-
8/15/2012	Reference C	LT/TS	GN	5	36	LKTR	760	>5k	-	U	0	F	20	-	-	-	-
8/15/2012	Reference C	LT/TS	GN	5	37	ARCH	303	277	0.9957536	U	0	F	4	-	-	-	Photo 1233
8/15/2012	Reference C	LT/TS	GN	5	38	ARCH	398	687	1.0897014	U	0	F	4	-	-	-	-
8/15/2012	Reference C	LT/TS	GN	5	39	LKTR	483	1229	1.090713	F	3	S,F	22	16	84	-	-
8/15/2012	Reference C	LT/TS	GN	5	40	LKTR	460	1012	1.0396975	M	1	S,O	22	10	-	-	-
8/15/2012	Reference C	LT/TS	GN	6	41	LKTR	480	1226	1.1085793	F	3	S,F	28	20	111	-	-
8/15/2012	Reference C	LT/TS	GN	7	42	LKTR	330	350	0.9739266	U	0	S,F	14	3	-	-	-
8/15/2012	Reference C	LT/TS	GN	7	43	LKTR	540	1546	0.9818117	F	2	S,O	23	10	9	-	-
8/11/2012	Sleigh Lake	JC/JW	BS	1	-	ARGR	55	3	1.8031555	U	0	-	-	-	-	-	Photo 386
8/11/2012	Sleigh Lake	JC/JW	BS	5	-	ARGR	58	2	1.0250523	U	0	-	-	-	-	-	Photo 393
8/11/2012	Sleigh Lake	JC/JW	BS	2	-	ARGR	59	2	0.9738094	U	0	-	-	-	-	-	Photo 388
8/11/2012	Sleigh Lake	JC/JW	BS	2	-	ARGR	60	3	1.3888889	U	0	-	-	-	-	-	Photo 387
8/11/2012	Sleigh Lake	JC/JW	BS	6	-	ARGR	60	1	0.462963	U	0	-	-	-	-	-	Photo 394
8/11/2012	Sleigh Lake	JC/JW	BS	2	-	ARGR	64	4	1.5258789	U	0	-	-	-	-	-	Photo 390
8/11/2012	Sleigh Lake	JC/JW	BS	5	-	ARGR	64	2	0.7629395	U	0	-	-	-	-	-	Photo 391
8/11/2012	Sleigh Lake	JC/JW	BS	2	-	ARGR	65	3	1.0923987	U	0	-	-	-	-	-	Photo 389
8/7/2012	Swan Lake	JC/JW	BS	4	1	NSSB	22	-	-	-	1	-	-	-	-	-	Photo 361
8/8/2012	Swan Lake	JC/JW	GN	1	1	LKTR	515	1175	0.8602332	-	0	F	11	-	-	-	Photo 362
8/8/2012	Swan Lake	JC/JW	GN	1	2	RDWH	154	30	0.8214083	-	0	F	1	-	-	-	Photo 363
8/8/2012	Swan Lake	JC/JW	GN	2	3	LKTR	327	-	-	F	0	F	9	-	-	-	Photo 365
8/8/2012	Swan Lake	JC/JW	GN	2	4	LKTR	323	-	-	M	0	F	9	-	-	-	Photo 366
8/8/2012	Swan Lake	JC/JW	GN	2	5	LKTR	304	420	1.4949564	M	0	F	8	-	-	-	Photo 367
8/8/2012	Swan Lake	JC/JW	GN	3	6	LKTR	305	459	1.6177566	F	0	F	9	-	-	-	Photo 368
8/8/2012	Swan Lake	JC/JW	GN	4	7	LKTR	255	177	1.0674627	U	0	F	7	-	-	-	Photo 369
8/8/2012	Swan Lake	JC/JW	GN	4	8	LKTR	245	131	0.8907853	U	0	F	7	-	-	-	Photo 370
8/8/2012	Swan Lake	JC/JW	GN	4	9	LKTR	340	403	1.0253409	U	0	F	11	-	-	-	Photo 371
8/8/2012	Swan Lake	JC/JW	GN	4	10	LKTR	380	537	0.9786412	U	0	F	10	-	-	-	Photo 372
7/27/2012	Umwelt Lake	LT/QS	BS	1	1	ARGR	30	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	2	ARGR	110	-	-	U	0	F	1	-	-	-	Photo 1116
7/27/2012	Umwelt Lake	LT/QS	BS	2	3	ARGR	103	-	-	U	0	F	1	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	34	-	-	U	0	-	-	-	-	-	-

Appendix 3.3-3. Individual Fish Data — Lakes, 2012

Date	Site	Crew	Sample Method	HP #	Sample #	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm^3)	Sex	Repr. Status	Age Taken (S/F/O)	Age	Liver Weight (g)	Gonad Weight (g)	Parasites	Comments
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	34	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	34	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	34	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	34	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	36	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	37	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	38	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	39	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	-	-	ARGR	40	1	1.5625	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	40	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	41	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	41	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	42	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	43	-	-	U	0	-	-	-	-	-	Photo 118
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	43	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	43	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	43	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	44	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	44	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	44	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	44	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	45	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	46	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	46	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	47	-	-	U	0	-	-	-	-	-	Photo 1117
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	47	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	48	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	48	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	50	-	-	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	BS	2	-	ARGR	50	2	1.6	U	0	-	-	-	-	-	-
7/27/2012	Umwelt Lake	LT/QS	GN	2	1	LKTR	405	-	-	F	2	S,F	10	37	5	-	Photo 1114
7/26/2012	Umwelt Lake	KS/FT	GN	4	1	ARGR	255	197	1.18808	U	0	F	3	-	-	-	-

KS = Kirsten Seymour
LT = Lora Tryon
QS = Quinn Sheppard
FT = Fraser Tindall
JC = Jason Clarke
JW = Jarvis Williams
TS = Tamara Skubovius

Species
ARGR = Arctic grayling
LKTR = Lake trout
SLSC = Slimy sculpin
NNSB = Ninespine stickleback
BB = Burbot
RDWH = Round whitefish
LKCS = Lake cisco
LNSU = Longnose sucker

Method
GN = gillnet
BS = beach seine

Sex
M = male
F = female
U = unknown

Reproductive Status
0 = unknown
1 = green
2 = maturing
3 = ripe
4 = running
5 = spent

Age Taken
S = scale
F = fin ray
O = otolith

- = not collected
Y = yes

Appendix 3.3-4

Tissue Metal Analysis — Raw Data, 2012

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Appendix 3.3-4a. Tissue Metal Analysis — Raw Data, 2012

Project	833-002-04
Report To	Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No.	L1187074
Date Received	31-Jul-12 15:50
Date	30-Aug-12

RESULTS OF ANALYSIS

Sample ID	REF B LKTR 8	REF B LKTR 9	REF B LKTR 15	REF B LKTR 16	REF B LKTR 14	REF B LKTR 5	REF B LKTR 10
Date Sampled	28-JUL-12	28-JUL-12	28-JUL-12	28-JUL-12	28-JUL-12	28-JUL-12	28-JUL-12
Time Sampled	13:00	13:00	13:00	13:00	13:00	13:00	13:00
ALS Sample ID	L1187074-1	L1187074-2	L1187074-3	L1187074-4	L1187074-5	L1187074-6	L1187074-7
Matrix	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue	Tissue
Physical Tests							
% Moisture	77.0	79.4	76.1	77.8	77.5	79.0	79.9
Metals							
Aluminum (Al)-Total	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Antimony (Sb)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	<0.010	<0.010	0.010	<0.010	<0.010	0.012	<0.010
Barium (Ba)-Total	<0.010	0.023	0.043	0.029	0.058	0.028	0.014
Beryllium (Be)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total	66.7	74.2	66.3	79.8	76.8	123	64.9
Chromium (Cr)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Copper (Cu)-Total	0.219	0.191	0.419	0.323	0.272	<0.20	0.206
Lead (Pb)-Total	<0.020	0.036	0.046	<0.020	<0.020	0.141	<0.020
Lithium (Li)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	272	241	286	258	274	256	253
Manganese (Mn)-Total	0.102	0.094	0.116	0.091	0.115	0.122	0.090
Mercury (Hg)-Total	0.221	0.249	0.108	0.283	0.151	0.456	0.201
Molybdenum (Mo)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel (Ni)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	0.35	0.32	0.36	0.34	0.30	0.35	0.34
Strontium (Sr)-Total	0.054	0.086	0.076	0.074	0.074	0.116	0.045
Thallium (Tl)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Tin (Sn)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total	3.42	3.53	4.27	4.23	3.57	3.17	3.51

Appendix 3.3-4a. Tissue Metal Analysis — Raw Data, 2012

Project	833-002-04
Report To	Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No.	L1187074
Date Received	31-Jul-12 15:50
Date	30-Aug-12

RESULTS OF ANALYSIS							
Sample ID	**REF B LKTR 11**	**REF B LKTR 6**	**REF B LKTR 4**	**REF B LKTR 2**	**REF B LKTR 7**	**REF B RDWH 1**	**REF B RDWH 3**
Date Sampled	**28-JUL-12**	**28-JUL-12**	**28-JUL-12**	**28-JUL-12**	**28-JUL-12**	**28-JUL-12**	**28-JUL-12**
Time Sampled	**13:00**	**13:00**	**13:00**	**13:00**	**13:00**	**13:00**	**13:00**
ALS Sample ID	**L1187074-8**	**L1187074-9**	**L1187074-10**	**L1187074-11**	**L1187074-12**	**L1187074-13**	**L1187074-14**
Matrix	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**
Physical Tests							
% Moisture	77.3	79.6	79.0	75.7	78.5	76.3	78.3
Metals							
Aluminum (Al)-Total	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Antimony (Sb)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	<0.010	<0.010	0.013	0.010	<0.010	0.021	0.012
Barium (Ba)-Total	0.019	0.021	<0.010	0.025	0.103	0.080	0.057
Beryllium (Be)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total	79.5	164	49.0	175	131	179	195
Chromium (Cr)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	<0.020	<0.020	<0.020	<0.020	0.021	<0.020	<0.020
Copper (Cu)-Total	0.193	0.126	0.233	0.231	0.382	0.346	0.232
Lead (Pb)-Total	0.024	0.070	0.027	0.310	0.036	0.181	0.115
Lithium (Li)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	275	248	251	287	264	310	294
Manganese (Mn)-Total	0.088	0.115	0.092	0.155	0.129	0.166	0.117
Mercury (Hg)-Total	0.119	0.319	0.368	0.109	0.139	0.0400	0.0933
Molybdenum (Mo)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel (Ni)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	0.29	0.32	0.37	0.30	0.38	0.30	0.53
Strontium (Sr)-Total	0.078	0.155	0.030	0.159	0.122	0.317	0.278
Thallium (Tl)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	<0.010
Tin (Sn)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total	3.45	3.35	3.47	3.66	4.18	4.72	2.76

Appendix 3.3-4a. Tissue Metal Analysis — Raw Data, 2012

Project	833-002-04
Report To	Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No.	L1187074
Date Received	31-Jul-12 15:50
Date	30-Aug-12

RESULTS OF ANALYSIS						
Sample ID	**REF B RDWH 12**	**REF B RDWH 20**	**REF B RDWH 19**	**REF B RDWH 21**	**REF B RDWH 22**	**REF B RDWH 23**
Date Sampled	**28-JUL-12**	**28-JUL-12**	**28-JUL-12**	**28-JUL-12**	**28-JUL-12**	**28-JUL-12**
Time Sampled	**13:00**	**13:00**	**13:00**	**13:00**	**13:00**	**13:00**
ALS Sample ID	**L1187074-15**	**L1187074-16**	**L1187074-17**	**L1187074-18**	**L1187074-19**	**L1187074-20**
Matrix	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**
Physical Tests						
% Moisture	72.4	73.5	75.3	74.7	74.9	74.4
Metals						
Aluminum (Al)-Total	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Antimony (Sb)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	0.016	0.026	<0.010	<0.010	<0.010	<0.010
Barium (Ba)-Total	0.076	0.257	0.018	0.013	0.014	<0.010
Beryllium (Be)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total	187	533	37.8	19.2	39.2	21.7
Chromium (Cr)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Copper (Cu)-Total	0.281	0.421	0.043	0.040	0.041	0.040
Lead (Pb)-Total	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Lithium (Li)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	312	335	30.3	32.6	33.5	30.6
Manganese (Mn)-Total	0.104	0.270	0.025	0.025	0.020	0.013
Mercury (Hg)-Total	0.0663	0.0326	0.0359	0.0375	0.0501	0.0445
Molybdenum (Mo)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel (Ni)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	0.49	0.34	<0.20	<0.20	<0.20	<0.20
Strontium (Sr)-Total	0.285	1.14	0.078	0.035	0.078	0.038
Thallium (Tl)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Tin (Sn)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total	3.21	7.56	0.58	0.59	0.50	0.40

Appendix 3.3-4a. Tissue Metal Analysis — Raw Data, 2012

Project	833-002-04
Report To	Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No.	L1187074
Date Received	31-Jul-12 15:50
Date	30-Aug-12

RESULTS OF ANALYSIS						
Sample ID	**REF B RDWH 24**	**REF B RDWH 25**	**UMWELT LAKE LKTR 1**	**GOOSE LKTR 1**	**GOOSE LKTR 2**	**GOOSE LKTR 4**
Date Sampled	**28-JUL-12**	**28-JUL-12**	**26-JUL-12**	**21-JUL-12**	**21-JUL-12**	**21-JUL-12**
Time Sampled	**13:00**	**13:00**	**14:00**	**15:00**	**15:00**	**15:00**
ALS Sample ID	**L1187074-21**	**L1187074-22**	**L1187074-23**	**L1187074-24**	**L1187074-25**	**L1187074-26**
Matrix	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**
Physical Tests						
% Moisture	74.8	73.9	75.4	75.4	75.0	75.7
Metals						
Aluminum (Al)-Total	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Antimony (Sb)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	0.017	0.021	0.025	0.031	0.028	0.029
Barium (Ba)-Total	0.090	0.036	0.011	0.028	0.042	<0.010
Beryllium (Be)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total	270	172	52.1	90.0	94.8	95.4
Chromium (Cr)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Copper (Cu)-Total	0.286	0.334	0.296	0.237	0.169	0.317
Lead (Pb)-Total	<0.020	<0.020	0.022	0.070	0.047	<0.020
Lithium (Li)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	297	304	270	291	262	300
Manganese (Mn)-Total	0.142	0.119	0.114	0.097	0.094	0.091
Mercury (Hg)-Total	0.0707	0.0441	0.115	0.248	0.225	0.163
Molybdenum (Mo)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel (Ni)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	0.51	0.47	0.32	0.32	0.33	0.32
Strontium (Sr)-Total	0.470	0.278	0.060	0.103	0.110	0.106
Thallium (Tl)-Total	<0.010	<0.010	<0.010	<0.010	0.011	<0.010
Tin (Sn)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total	3.09	4.33	3.67	3.37	3.08	3.98

Appendix 3.3-4a. Tissue Metal Analysis — Raw Data, 2012

Project	833-002-04
Report To	Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No.	L1187074
Date Received	31-Jul-12 15:50
Date	30-Aug-12

RESULTS OF ANALYSIS						
Sample ID	**GOOSE LKTR 5**	**LLAMA RDWH 1**	**LLAMA RDWH 2**	**LLAMA RDWH 3**	**LLAMA RDWH 4**	**LLAMA RDWH 5**
Date Sampled	**21-JUL-12**	**25-JUL-12**	**25-JUL-12**	**25-JUL-12**	**25-JUL-12**	**25-JUL-12**
Time Sampled	**15:00**	**15:00**	**15:00**	**15:00**	**15:00**	**15:00**
ALS Sample ID	**L1187074-27**	**L1187074-28**	**L1187074-29**	**L1187074-30**	**L1187074-31**	**L1187074-32**
Matrix	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**
Physical Tests						
% Moisture	77.6	75.1	75.4	75.0	74.3	75.0
Metals						
Aluminum (Al)-Total	<2.0	44.3	3.5	2.8	2.6	2.4
Antimony (Sb)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	0.031	0.049	0.057	0.054	0.052	0.053
Barium (Ba)-Total	0.013	1.31	0.132	0.100	0.079	0.057
Beryllium (Be)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total	70.8	312	311	310	228	131
Chromium (Cr)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	<0.020	0.046	0.023	0.028	0.024	0.022
Copper (Cu)-Total	0.213	0.263	0.260	0.237	0.203	0.209
Lead (Pb)-Total	0.071	<0.020	<0.020	0.027	<0.020	<0.020
Lithium (Li)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	269	371	352	329	337	326
Manganese (Mn)-Total	0.096	1.12	0.274	0.247	0.213	0.126
Mercury (Hg)-Total	0.260	0.0384	0.0388	0.0484	0.0394	0.113
Molybdenum (Mo)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel (Ni)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	0.35	0.59	0.43	0.50	0.58	0.64
Strontium (Sr)-Total	0.060	0.545	0.554	0.546	0.386	0.151
Thallium (Tl)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Tin (Sn)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total	<0.10	0.23	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total	3.36	4.34	5.01	3.71	4.23	4.50

Appendix 3.3-4a. Tissue Metal Analysis — Raw Data, 2012

Project	833-002-04
Report To	Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No.	L1187074
Date Received	31-Jul-12 15:50
Date	30-Aug-12

RESULTS OF ANALYSIS					
Sample ID	**LLAMA LKTR 8**	**LLAMA LKTR 9A (SMALL)**	**LLAMA LKTR 9B (BIG)**	**LLAMA LKTR 13**	**LLAMA LKTR 14**
Date Sampled	**25-JUL-12**	**25-JUL-12**	**25-JUL-12**	**25-JUL-12**	**25-JUL-12**
Time Sampled	**15:00**	**15:00**	**15:00**	**15:00**	**15:00**
ALS Sample ID	**L1187074-33**	**L1187074-34**	**L1187074-35**	**L1187074-36**	**L1187074-37**
Matrix	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**
Physical Tests					
% Moisture	75.7	75.8	75.4	76.2	76.7
Metals					
Aluminum (Al)-Total	7.1	2.3	<2.0	<2.0	<2.0
Antimony (Sb)-Total	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	0.044	0.057	0.049	0.014	0.046
Barium (Ba)-Total	0.053	0.067	0.021	0.014	0.029
Beryllium (Be)-Total	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total	149	434	138	118	374
Chromium (Cr)-Total	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	<0.020	<0.020	<0.020	<0.020	<0.020
Copper (Cu)-Total	0.209	0.215	0.163	0.230	0.352
Lead (Pb)-Total	<0.020	0.029	<0.020	<0.020	<0.020
Lithium (Li)-Total	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	279	289	284	262	312
Manganese (Mn)-Total	0.150	0.211	0.113	0.082	0.188
Mercury (Hg)-Total	0.149	0.170	0.191	0.208	0.123
Molybdenum (Mo)-Total	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel (Ni)-Total	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	0.41	0.32	0.36	0.36	0.32
Strontium (Sr)-Total	0.192	0.566	0.139	0.111	0.483
Thallium (Tl)-Total	<0.010	<0.010	<0.010	<0.010	<0.010
Tin (Sn)-Total	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total	5.17	6.77	6.32	4.14	6.14

Appendix 3.3-4b. Tissue Metal Analysis — Raw Data, 2012

Project	833-002-04
Report To	Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No.	L1195853
Date Received	17-Aug-12 13:28
Date	14-Sep-12

RESULTS OF ANALYSIS							
Sample ID	**18 LKTR, GEORGE LAKE**	**19 LKTR, GEORGE LAKE**	**20 LKTR, GEORGE LAKE**	**21 LKTR, GEORGE LAKE**	**22 LKTR, GEORGE LAKE**	**23 LKTR, GEORGE LAKE**	**24 LKTR, GEORGE LAKE**
Date Sampled	**11-AUG-12**	**11-AUG-12**	**11-AUG-12**	**11-AUG-12**	**11-AUG-12**	**11-AUG-12**	**12-AUG-12**
Time Sampled	**10:00**	**10:00**	**10:00**	**10:00**	**10:00**	**10:00**	**10:00**
ALS Sample ID	**L1195853-1**	**L1195853-2**	**L1195853-3**	**L1195853-4**	**L1195853-5**	**L1195853-6**	**L1195853-7**
Matrix	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**
Physical Tests							
% Moisture	76.7	75.1	76.3	78.8	72.1	76.0	78.2
Metals							
Aluminum (Al)-Total	<2.0	2.8	<2.0	<2.0	<2.0	<2.0	2.6
Antimony (Sb)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	0.156	0.138	0.083	0.065	0.107	0.140	0.073
Barium (Ba)-Total	0.011	0.019	0.012	0.012	0.114	0.011	0.018
Beryllium (Be)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total	68.2	60.2	53.0	53.0	59.9	73.5	43.5
Chromium (Cr)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	0.064	0.078	0.055	0.112	0.139	0.084	0.083
Copper (Cu)-Total	0.363	0.371	0.503	0.248	0.334	0.326	0.452
Lead (Pb)-Total	<0.020	<0.020	<0.020	<0.020	0.036	<0.020	<0.020
Lithium (Li)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	251	262	276	240	271	301	265
Manganese (Mn)-Total	0.086	0.137	0.118	0.097	0.142	0.105	0.148
Mercury (Hg)-Total	0.0493	0.0615	0.0813	0.141	0.0375	0.0319	0.141
Molybdenum (Mo)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel (Ni)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	0.43	0.47	0.48	0.38	0.49	0.51	0.44
Strontium (Sr)-Total	0.064	0.067	0.051	0.038	0.059	0.073	0.025
Thallium (Tl)-Total	0.011	0.017	0.015	<0.010	0.013	0.019	0.013
Tin (Sn)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total	3.08	3.43	3.47	2.99	3.68	3.17	3.62

Appendix 3.3-4b. Tissue Metal Analysis — Raw Data, 2012

Project	833-002-04
Report To	Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No.	L1195853
Date Received	17-Aug-12 13:28
Date	14-Sep-12

RESULTS OF ANALYSIS							
Sample ID	**25 LKTR, GEORGE LAKE**	**13 RDWH, GANDER LAKE**	**16 RDWH, GANDER LAKE**	**27 RET C LAKE LAKE TROUT**	**30 RET C LAKE LAKE TROUT**	**31 RET C LAKE LAKE TROUT**	**32 RET C LAKE LAKE TROUT**
Date Sampled	**12-AUG-12**	**10-AUG-12**	**10-AUG-12**	**14-AUG-12**	**14-AUG-12**	**14-AUG-12**	**14-AUG-12**
Time Sampled	**10:00**	**10:00**	**10:00**	**10:00**	**10:00**	**10:00**	**10:00**
ALS Sample ID	**L1195853-8**	**L1195853-9**	**L1195853-10**	**L1195853-11**	**L1195853-12**	**L1195853-13**	**L1195853-14**
Matrix	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**
Physical Tests							
% Moisture	74.7	74.6	75.7	78.0	76.7	76.9	76.4
Metals							
Aluminum (Al)-Total	<2.0	4.6	10.9	<2.0	<2.0	<2.0	<2.0
Antimony (Sb)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	0.031	0.046	0.041	0.058	0.052	0.072	0.014
Barium (Ba)-Total	0.016	0.073	0.155	<0.010	0.020	<0.010	<0.010
Beryllium (Be)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total	81.5	127	311	53.3	63.7	59.1	65.2
Chromium (Cr)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	0.060	0.049	0.033	<0.020	<0.020	<0.020	<0.020
Copper (Cu)-Total	0.260	0.530	0.512	0.312	0.564	0.524	0.341
Lead (Pb)-Total	<0.020	0.090	0.026	<0.020	<0.020	<0.020	<0.020
Lithium (Li)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	294	301	343	256	292	270	302
Manganese (Mn)-Total	0.173	0.257	0.290	0.117	0.132	0.093	0.104
Mercury (Hg)-Total	0.124	0.111	0.0689	0.264	0.0478	0.430	0.116
Molybdenum (Mo)-Total	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel (Ni)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	0.43	0.20	0.27	0.23	0.21	0.26	0.22
Strontium (Sr)-Total	0.080	0.145	0.612	<0.010	0.013	<0.010	0.011
Thallium (Tl)-Total	0.017	<0.010	0.010	<0.010	<0.010	<0.010	<0.010
Tin (Sn)-Total	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total	3.32	5.80	7.06	3.09	3.86	3.71	3.71

Appendix 3.3-4b. Tissue Metal Analysis — Raw Data, 2012

Project	833-002-04
Report To	Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No.	L1195853
Date Received	17-Aug-12 13:28
Date	14-Sep-12

RESULTS OF ANALYSIS					
Sample ID	**39 RET C LAKE LAKE TROUT**	**40 RET C LAKE LAKE TROUT**	**41 RET C LAKE LAKE TROUT**	**42 RET C LAKE LAKE TROUT**	**43 RET C LAKE LAKE TROUT**
Date Sampled	**15-AUG-12**	**15-AUG-12**	**15-AUG-12**	**15-AUG-12**	**15-AUG-12**
Time Sampled	**10:00**	**10:00**	**10:00**	**10:00**	**10:00**
ALS Sample ID	**L1195853-15**	**L1195853-16**	**L1195853-17**	**L1195853-18**	**L1195853-19**
Matrix	**Tissue**	**Tissue**	**Tissue**	**Tissue**	**Tissue**
Physical Tests					
% Moisture	74.2	76.9	75.8	75.7	77.0
Metals					
Aluminum (Al)-Total	<2.0	<2.0	<2.0	<2.0	<2.0
Antimony (Sb)-Total	<0.010	<0.010	<0.010	<0.010	<0.010
Arsenic (As)-Total	0.036	0.018	0.068	0.024	0.026
Barium (Ba)-Total	0.011	<0.010	0.038	0.041	<0.010
Beryllium (Be)-Total	<0.10	<0.10	<0.10	<0.10	<0.10
Bismuth (Bi)-Total	<0.030	<0.030	<0.030	<0.030	<0.030
Cadmium (Cd)-Total	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Calcium (Ca)-Total	58.0	55.3	91.0	230	79.7
Chromium (Cr)-Total	<0.10	<0.10	<0.10	<0.10	<0.10
Cobalt (Co)-Total	<0.020	<0.020	<0.020	<0.020	<0.020
Copper (Cu)-Total	0.538	0.428	0.387	0.434	0.265
Lead (Pb)-Total	<0.020	<0.020	<0.020	<0.020	<0.020
Lithium (Li)-Total	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	294	282	294	305	280
Manganese (Mn)-Total	0.133	0.100	0.108	0.170	0.094
Mercury (Hg)-Total	0.0861	0.154	0.0940	0.159	0.238
Molybdenum (Mo)-Total	<0.010	<0.010	<0.010	<0.010	<0.010
Nickel (Ni)-Total	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium (Se)-Total	0.20	0.23	0.21	0.26	0.27
Strontium (Sr)-Total	<0.010	<0.010	0.020	0.027	<0.010
Thallium (Tl)-Total	<0.010	<0.010	<0.010	<0.010	<0.010
Tin (Sn)-Total	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Vanadium (V)-Total	<0.10	<0.10	<0.10	<0.10	<0.10
Zinc (Zn)-Total	3.78	3.95	3.58	5.37	3.70

Appendix 3.3-5

Tissue Metal Analysis — Replicate Results, 2012

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Appendix 3.3-5a. Tissue Metal Analysis — Replicate Results, 2012

Project 833-002-04
Report To Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No. L1187074
Date Received 31-Jul-12 15:50
Date 30-Aug-12

REPLICATE RESULTS											
Sample ID	**Matrix**	**ALS ID**	**Analyte**	**Replicate 1**	**Replicate 2**	**Units**	**RPD**	**RPD Limit**	**Diff**	**Diff Limit**	**Qualifier**
Physical Tests											
L1187074-10	Tissue	WG1531911-1	% Moisture	79.0	79.8	%	1.1	20	-	-	-
L1187074-30	Tissue	WG1531911-2	% Moisture	75.0	74.9	%	0.1	20	-	-	-
Metals											
L1187074-12	Tissue	WG1531912-3	Aluminum (Al)-Total	<2.0	<2.0	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Aluminum (Al)-Total	<2.0	<2.0	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Antimony (Sb)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Antimony (Sb)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Arsenic (As)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Arsenic (As)-Total	0.014	0.016	mg/kg wwt	9.2	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Barium (Ba)-Total	0.103	0.014	mg/kg wwt	152	30	-	-	DUP-H
L1187074-36	Tissue	WG1531912-4	Barium (Ba)-Total	0.014	0.130	mg/kg wwt	161	30	-	-	DUP-H
L1187074-12	Tissue	WG1531912-3	Beryllium (Be)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Beryllium (Be)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Bismuth (Bi)-Total	<0.030	<0.030	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Bismuth (Bi)-Total	<0.030	<0.030	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Cadmium (Cd)-Total	<0.0050	<0.0050	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Cadmium (Cd)-Total	<0.0050	<0.0050	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Calcium (Ca)-Total	131	112	mg/kg wwt	16	50	-	-	-
L1187074-36	Tissue	WG1531912-4	Calcium (Ca)-Total	118	111	mg/kg wwt	6.6	50	-	-	-
L1187074-12	Tissue	WG1531912-3	Chromium (Cr)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Chromium (Cr)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Cobalt (Co)-Total	0.021	<0.020	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Cobalt (Co)-Total	<0.020	<0.020	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Copper (Cu)-Total	0.382	0.228	mg/kg wwt	50	30	-	-	DUP-H
L1187074-36	Tissue	WG1531912-4	Copper (Cu)-Total	0.230	0.263	mg/kg wwt	13	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Lead (Pb)-Total	0.036	0.022	mg/kg wwt	-	-	0.014	0.04	J
L1187074-36	Tissue	WG1531912-4	Lead (Pb)-Total	<0.020	<0.020	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Lithium (Li)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Lithium (Li)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA

Appendix 3.3-5a. Tissue Metal Analysis — Replicate Results, 2012

Project 833-002-04
Report To Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No. L1187074
Date Received 31-Jul-12 15:50
Date 30-Aug-12

REPLICATE RESULTS

Sample ID	Matrix	ALS ID	Analyte	Replicate 1	Replicate 2	Units	RPD	RPD Limit	Diff	Diff Limit	Qualifier
Metals *(cont'd)*											
L1187074-12	Tissue	WG1531912-3	Magnesium (Mg)-Total	264	261	mg/kg wwt	1.0	30	-	-	-
L1187074-36	Tissue	WG1531912-4	Magnesium (Mg)-Total	262	261	mg/kg wwt	0.3	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Manganese (Mn)-Total	0.129	0.111	mg/kg wwt	15	30	-	-	-
L1187074-36	Tissue	WG1531912-4	Manganese (Mn)-Total	0.082	0.079	mg/kg wwt	4.7	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Mercury (Hg)-Total	0.139	0.152	mg/kg wwt	9.1	30	-	-	-
L1187074-36	Tissue	WG1531912-4	Mercury (Hg)-Total	0.208	0.205	mg/kg wwt	1.8	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Molybdenum (Mo)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Molybdenum (Mo)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Nickel (Ni)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Nickel (Ni)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Selenium (Se)-Total	0.38	0.37	mg/kg wwt	1.9	30	-	-	-
L1187074-36	Tissue	WG1531912-4	Selenium (Se)-Total	0.36	0.37	mg/kg wwt	3.6	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Strontium (Sr)-Total	0.122	0.101	mg/kg wwt	19	50	-	-	-
L1187074-36	Tissue	WG1531912-4	Strontium (Sr)-Total	0.111	0.102	mg/kg wwt	8.6	50	-	-	-
L1187074-12	Tissue	WG1531912-3	Thallium (Tl)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Thallium (Tl)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Tin (Sn)-Total	<0.050	<0.050	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Tin (Sn)-Total	<0.050	<0.050	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Uranium (U)-Total	<0.0020	<0.0020	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Uranium (U)-Total	<0.0020	<0.0020	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Vanadium (V)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Vanadium (V)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Zinc (Zn)-Total	4.18	3.62	mg/kg wwt	14	30	-	-	-
L1187074-36	Tissue	WG1531912-4	Zinc (Zn)-Total	4.14	3.97	mg/kg wwt	4.2	30	-	-	-

Qualifier	*Description*
RM-H	*Reference Material recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.*
RPD-NA	*Relative Percent Difference Not Available due to result(s) being less than detection limit.*
DUP-H	*Duplicate results outside ALS DQO, due to sample heterogeneity.*

Appendix 3.3-5b. Tissue Metal Analysis — Replicate Results, 2012

Project 833-002-04
Report To Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No. L1195853
Date Received 17-Aug-12 13:28
Date 14-Sep-12

REPLICATE RESULTS

Sample ID	Matrix	ALS ID	Analyte	Replicate 1	Replicate 2	Units	RPD	RPD Limit	Diff	Diff Limit	Qualifier
Metals											
L1195853-13	Tissue	WG1541330-3	Aluminum (Al)-Total	<2.0	<2.0	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Antimony (Sb)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Barium (Ba)-Total	<0.010	0.020	mg/kg wwt	N/A	30	-	-	DUP-H
L1195853-13	Tissue	WG1541330-3	Beryllium (Be)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Bismuth (Bi)-Total	<0.030	<0.030	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Cadmium (Cd)-Total	<0.0050	<0.0050	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Calcium (Ca)-Total	59.1	48.5	mg/kg wwt	20	50	-	-	-
L1195853-13	Tissue	WG1541330-3	Chromium (Cr)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Cobalt (Co)-Total	<0.020	<0.020	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Copper (Cu)-Total	0.524	0.450	mg/kg wwt	15	30	-	-	-
L1195853-13	Tissue	WG1541330-3	Lead (Pb)-Total	<0.020	<0.020	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Lithium (Li)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Magnesium (Mg)-Total	270	285	mg/kg wwt	5.5	30	-	-	-
L1195853-13	Tissue	WG1541330-3	Manganese (Mn)-Total	0.093	0.099	mg/kg wwt	6.2	30	-	-	-
L1195853-13	Tissue	WG1541330-3	Mercury (Hg)-Total	0.430	0.484	mg/kg wwt	12	30	-	-	-
L1195853-13	Tissue	WG1541330-3	Molybdenum (Mo)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Nickel (Ni)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Selenium (Se)-Total	0.26	0.26	mg/kg wwt	1.6	30	-	-	-
L1195853-13	Tissue	WG1541330-3	Strontium (Sr)-Total	<0.010	<0.010	mg/kg wwt	N/A	50	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Thallium (Tl)-Total	<0.010	<0.010	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Tin (Sn)-Total	<0.050	<0.050	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Uranium (U)-Total	<0.0020	<0.0020	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Vanadium (V)-Total	<0.10	<0.10	mg/kg wwt	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Zinc (Zn)-Total	3.71	3.61	mg/kg wwt	2.9	30	-	-	-
Physical Tests											
L1195853-15	Tissue	WG1541158-1	% Moisture	74.2	74.8	%	0.8	20	-	-	-

Qualifier	*Description*
RM-H	*Reference Material recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified.*
RPD-NA	*Relative Percent Difference Not Available due to result(s) being less than detection limit.*
DUP-H	*Duplicate results outside ALS DQO, due to sample heterogeneity.*

Appendix 3.3-6

Tissue Metal Analysis — Quality Control Results, 2012

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Appendix 3.3-6a. Tissue Metal Analysis — Quality Control Results, 2012

Project 833-002-04
Report To Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No. L1195853
Date Received 17-Aug-12 13:28
Date 14-Sep-12

QUALITY CONTROL RESULTS										
Matrix	**QC Type**	**Analyte**	**QC Spl. No.**	**Reference**	**Result**	**Target**	**Units**	**%**	**Limits**	**Qualifier**
Metals										
Tissue	CRM	Arsenic (As)-Total	WG1541330-4	VA-NRC-TORT2	20.9	21.6	mg/kg wwt	96.7	70-130	
Tissue	CRM	Cadmium (Cd)-Total	WG1541330-4	VA-NRC-TORT2	27.7	26.7	mg/kg wwt	103.9	70-130	
Tissue	CRM	Chromium (Cr)-Total	WG1541330-4	VA-NRC-TORT2	4.19	0.77	mg/kg wwt	544.5	70-130	RM-H
Tissue	CRM	Cobalt (Co)-Total	WG1541330-4	VA-NRC-TORT2	0.554	0.510	mg/kg wwt	108.7	70-130	
Tissue	CRM	Copper (Cu)-Total	WG1541330-4	VA-NRC-TORT2	103	106	mg/kg wwt	96.9	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1541330-4	VA-NRC-TORT2	0.362	0.350	mg/kg wwt	0.362	.15-.55	
Tissue	CRM	Manganese (Mn)-Total	WG1541330-4	VA-NRC-TORT2	12.8	13.6	mg/kg wwt	94.1	70-130	
Tissue	CRM	Molybdenum (Mo)-Total	WG1541330-4	VA-NRC-TORT2	0.965	0.950	mg/kg wwt	101.5	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1541330-4	VA-NRC-TORT2	4.25	2.50	mg/kg wwt	170.0	70-130	RM-H
Tissue	CRM	Selenium (Se)-Total	WG1541330-4	VA-NRC-TORT2	5.96	5.63	mg/kg wwt	105.8	70-130	
Tissue	CRM	Strontium (Sr)-Total	WG1541330-4	VA-NRC-TORT2	41.5	45.2	mg/kg wwt	91.9	70-130	
Tissue	CRM	Vanadium (V)-Total	WG1541330-4	VA-NRC-TORT2	1.75	1.64	mg/kg wwt	1.75	1.14-2.14	
Tissue	CRM	Zinc (Zn)-Total	WG1541330-4	VA-NRC-TORT2	172	180	mg/kg wwt	95.8	70-130	
Tissue	CRM	Arsenic (As)-Total	WG1541330-5	VA-NRC-DOLT4	9.46	9.66	mg/kg wwt	97.9	70-130	
Tissue	CRM	Cadmium (Cd)-Total	WG1541330-5	VA-NRC-DOLT4	25.1	24.3	mg/kg wwt	103.2	70-130	
Tissue	CRM	Calcium (Ca)-Total	WG1541330-5	VA-NRC-DOLT4	644	680	mg/kg wwt	94.7	70-130	
Tissue	CRM	Chromium (Cr)-Total	WG1541330-5	VA-NRC-DOLT4	1.33	1.40	mg/kg wwt	94.7	70-130	
Tissue	CRM	Cobalt (Co)-Total	WG1541330-5	VA-NRC-DOLT4	0.230	0.250	mg/kg wwt	0.230	.15-.35	
Tissue	CRM	Copper (Cu)-Total	WG1541330-5	VA-NRC-DOLT4	32.7	31.2	mg/kg wwt	104.8	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1541330-5	VA-NRC-DOLT4	0.137	0.160	mg/kg wwt	85.6	70-130	
Tissue	CRM	Magnesium (Mg)-Total	WG1541330-5	VA-NRC-DOLT4	1340	1500	mg/kg wwt	89.4	70-130	
Tissue	CRM	Molybdenum (Mo)-Total	WG1541330-5	VA-NRC-DOLT4	1.05	1.00	mg/kg wwt	105.4	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1541330-5	VA-NRC-DOLT4	1.04	0.97	mg/kg wwt	1.04	.47-1.47	
Tissue	CRM	Selenium (Se)-Total	WG1541330-5	VA-NRC-DOLT4	9.14	8.30	mg/kg wwt	110.1	70-130	
Tissue	CRM	Strontium (Sr)-Total	WG1541330-5	VA-NRC-DOLT4	5.22	5.50	mg/kg wwt	94.9	70-130	
Tissue	CRM	Tin (Sn)-Total	WG1541330-5	VA-NRC-DOLT4	0.142	0.170	mg/kg wwt	83.7	70-130	
Tissue	CRM	Vanadium (V)-Total	WG1541330-5	VA-NRC-DOLT4	0.65	0.60	mg/kg wwt	109.1	70-130	
Tissue	CRM	Zinc (Zn)-Total	WG1541330-5	VA-NRC-DOLT4	117	116	mg/kg wwt	100.6	70-130	
Tissue	MB	Aluminum (Al)-Total	WG1541330-1		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Antimony (Sb)-Total	WG1541330-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1541330-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1541330-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1541330-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1541330-1		<0.030	<0.03	mg/kg wwt	-	0.03	
Tissue	MB	Cadmium (Cd)-Total	WG1541330-1		<0.0050	<0.005	mg/kg wwt	-	0.005	
Tissue	MB	Calcium (Ca)-Total	WG1541330-1		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1541330-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1541330-1		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1541330-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Lead (Pb)-Total	WG1541330-1		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1541330-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1541330-1		<1.0	<1	mg/kg wwt	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1541330-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Mercury (Hg)-Total	WG1541330-1		<0.0010	<0.001	mg/kg wwt	-	0.001	
Tissue	MB	Molybdenum (Mo)-Total	WG1541330-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Nickel (Ni)-Total	WG1541330-1		<0.10	<0.1	mg/kg wwt	-	0.1	

Appendix 3.3-6a. Tissue Metal Analysis — Quality Control Results, 2012

Project 833-002-04
Report To Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No. L1195853
Date Received 17-Aug-12 13:28
Date 14-Sep-12

QUALITY CONTROL RESULTS

Matrix	QC Type	Analyte	QC Spl. No.	Reference	Result	Target	Units	%	Limits	Qualifier
Metals *(cont'd)*										
Tissue	MB	Selenium (Se)-Total	WG1541330-1		<0.20	<0.2	mg/kg wwt	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1541330-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1541330-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1541330-1		<0.050	<0.05	mg/kg wwt	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1541330-1		<0.0020	<0.002	mg/kg wwt	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1541330-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1541330-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Aluminum (Al)-Total	WG1541330-2		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Antimony (Sb)-Total	WG1541330-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1541330-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1541330-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1541330-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1541330-2		<0.030	<0.03	mg/kg wwt	-	0.03	
Tissue	MB	Cadmium (Cd)-Total	WG1541330-2		<0.0050	<0.005	mg/kg wwt	-	0.005	
Tissue	MB	Calcium (Ca)-Total	WG1541330-2		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1541330-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1541330-2		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1541330-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Lead (Pb)-Total	WG1541330-2		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1541330-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1541330-2		<1.0	<1	mg/kg wwt	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1541330-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Mercury (Hg)-Total	WG1541330-2		<0.0010	<0.001	mg/kg wwt	-	0.001	
Tissue	MB	Molybdenum (Mo)-Total	WG1541330-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Nickel (Ni)-Total	WG1541330-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Selenium (Se)-Total	WG1541330-2		<0.20	<0.2	mg/kg wwt	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1541330-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1541330-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1541330-2		<0.050	<0.05	mg/kg wwt	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1541330-2		<0.0020	<0.002	mg/kg wwt	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1541330-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1541330-2		<0.10	<0.1	mg/kg wwt	-	0.1	

Appendix 3.3-6b. Tissue Metal Analysis — Quality Control Results, 2012

Project 833-002-04
Report To Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No. L1187074
Date Received 31-Jul-12 15:50
Date 30-Aug-12

QUALITY CONTROL RESULTS

Matrix	QC Type	Analyte	QC Spl. No.	Reference	Result	Target	Units	%	Limits	Qualifier
Metals										
Tissue	CRM	Arsenic (As)-Total	WG1531912-5	VA-NRC-TORT2	20.6	21.6	mg/kg wwt	95.3	70-130	
Tissue	CRM	Cadmium (Cd)-Total	WG1531912-5	VA-NRC-TORT2	26.9	26.7	mg/kg wwt	100.7	70-130	
Tissue	CRM	Chromium (Cr)-Total	WG1531912-5	VA-NRC-TORT2	0.55	0.77	mg/kg wwt	71.6	70-130	
Tissue	CRM	Cobalt (Co)-Total	WG1531912-5	VA-NRC-TORT2	0.490	0.510	mg/kg wwt	96.1	70-130	
Tissue	CRM	Copper (Cu)-Total	WG1531912-5	VA-NRC-TORT2	96.0	106	mg/kg wwt	90.5	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1531912-5	VA-NRC-TORT2	0.360	0.350	mg/kg wwt	0.360	.15-.55	
Tissue	CRM	Manganese (Mn)-Total	WG1531912-5	VA-NRC-TORT2	12.3	13.6	mg/kg wwt	90.8	70-130	
Tissue	CRM	Mercury (Hg)-Total	WG1531912-5	VA-NRC-TORT2	0.276	0.270	mg/kg wwt	102.2	70-130	
Tissue	CRM	Molybdenum (Mo)-Total	WG1531912-5	VA-NRC-TORT2	0.961	0.950	mg/kg wwt	101.2	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1531912-5	VA-NRC-TORT2	2.10	2.50	mg/kg wwt	84.2	70-130	
Tissue	CRM	Selenium (Se)-Total	WG1531912-5	VA-NRC-TORT2	5.72	5.63	mg/kg wwt	101.6	70-130	
Tissue	CRM	Strontium (Sr)-Total	WG1531912-5	VA-NRC-TORT2	42.4	45.2	mg/kg wwt	93.7	70-130	
Tissue	CRM	Vanadium (V)-Total	WG1531912-5	VA-NRC-TORT2	1.72	1.64	mg/kg wwt	1.72	1.14-2.14	
Tissue	CRM	Zinc (Zn)-Total	WG1531912-5	VA-NRC-TORT2	172	180	mg/kg wwt	95.5	70-130	
Tissue	CRM	Arsenic (As)-Total	WG1531912-6	VA-NRC-DOLT4	9.44	9.66	mg/kg wwt	97.7	70-130	
Tissue	CRM	Cadmium (Cd)-Total	WG1531912-6	VA-NRC-DOLT4	25.6	24.3	mg/kg wwt	105.4	70-130	
Tissue	CRM	Calcium (Ca)-Total	WG1531912-6	VA-NRC-DOLT4	674	680	mg/kg wwt	99.1	70-130	
Tissue	CRM	Chromium (Cr)-Total	WG1531912-6	VA-NRC-DOLT4	1.16	1.40	mg/kg wwt	83.0	70-130	
Tissue	CRM	Cobalt (Co)-Total	WG1531912-6	VA-NRC-DOLT4	0.229	0.250	mg/kg wwt	0.229	.15-.35	
Tissue	CRM	Copper (Cu)-Total	WG1531912-6	VA-NRC-DOLT4	32.1	31.2	mg/kg wwt	102.9	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1531912-6	VA-NRC-DOLT4	0.127	0.160	mg/kg wwt	79.2	70-130	
Tissue	CRM	Magnesium (Mg)-Total	WG1531912-6	VA-NRC-DOLT4	1400	1500	mg/kg wwt	93.1	70-130	
Tissue	CRM	Mercury (Hg)-Total	WG1531912-6	VA-NRC-DOLT4	2.06	2.58	mg/kg wwt	79.8	70-130	
Tissue	CRM	Molybdenum (Mo)-Total	WG1531912-6	VA-NRC-DOLT4	1.12	1.00	mg/kg wwt	111.9	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1531912-6	VA-NRC-DOLT4	0.86	0.97	mg/kg wwt	0.86	.47-1.47	
Tissue	CRM	Selenium (Se)-Total	WG1531912-6	VA-NRC-DOLT4	8.93	8.30	mg/kg wwt	107.6	70-130	
Tissue	CRM	Strontium (Sr)-Total	WG1531912-6	VA-NRC-DOLT4	5.44	5.50	mg/kg wwt	99.0	70-130	
Tissue	CRM	Tin (Sn)-Total	WG1531912-6	VA-NRC-DOLT4	0.132	0.170	mg/kg wwt	77.8	70-130	
Tissue	CRM	Vanadium (V)-Total	WG1531912-6	VA-NRC-DOLT4	0.58	0.60	mg/kg wwt	96.0	70-130	
Tissue	CRM	Zinc (Zn)-Total	WG1531912-6	VA-NRC-DOLT4	120	116	mg/kg wwt	103.2	70-130	
Tissue	MB	Aluminum (Al)-Total	WG1531912-1		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Antimony (Sb)-Total	WG1531912-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1531912-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1531912-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1531912-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1531912-1		<0.030	<0.03	mg/kg wwt	-	0.03	
Tissue	MB	Cadmium (Cd)-Total	WG1531912-1		<0.0050	<0.005	mg/kg wwt	-	0.005	
Tissue	MB	Calcium (Ca)-Total	WG1531912-1		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1531912-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1531912-1		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1531912-1		0.024	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Lead (Pb)-Total	WG1531912-1		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1531912-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1531912-1		<1.0	<1	mg/kg wwt	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1531912-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Molybdenum (Mo)-Total	WG1531912-1		<0.010	<0.01	mg/kg wwt	-	0.01	

Appendix 3.3-6b. Tissue Metal Analysis — Quality Control Results, 2012

Project 833-002-04
Report To Kirsten Seymour, Rescan Environmental Services Ltd.
ALS File No. L1187074
Date Received 31-Jul-12 15:50
Date 30-Aug-12

QUALITY CONTROL RESULTS

Matrix	QC Type	Analyte	QC Spl. No.	Reference	Result	Target	Units	%	Limits	Qualifier
Metals *(cont'd)*										
Tissue	MB	Nickel (Ni)-Total	WG1531912-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Selenium (Se)-Total	WG1531912-1		<0.20	<0.2	mg/kg wwt	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1531912-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1531912-1		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1531912-1		<0.050	<0.05	mg/kg wwt	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1531912-1		<0.0020	<0.002	mg/kg wwt	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1531912-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1531912-1		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Aluminum (Al)-Total	WG1531912-2		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Antimony (Sb)-Total	WG1531912-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1531912-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1531912-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1531912-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1531912-2		<0.030	<0.03	mg/kg wwt	-	0.03	
Tissue	MB	Cadmium (Cd)-Total	WG1531912-2		<0.0050	<0.005	mg/kg wwt	-	0.005	
Tissue	MB	Calcium (Ca)-Total	WG1531912-2		<2.0	<2	mg/kg wwt	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1531912-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1531912-2		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1531912-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Lead (Pb)-Total	WG1531912-2		<0.020	<0.02	mg/kg wwt	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1531912-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1531912-2		<1.0	<1	mg/kg wwt	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1531912-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Molybdenum (Mo)-Total	WG1531912-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Nickel (Ni)-Total	WG1531912-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Selenium (Se)-Total	WG1531912-2		<0.20	<0.2	mg/kg wwt	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1531912-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1531912-2		<0.010	<0.01	mg/kg wwt	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1531912-2		<0.050	<0.05	mg/kg wwt	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1531912-2		<0.0020	<0.002	mg/kg wwt	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1531912-2		<0.10	<0.1	mg/kg wwt	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1531912-2		<0.10	<0.1	mg/kg wwt	-	0.1	

Appendix 3.3-7

Diet Data, 2012

Rescan™
Engineers and Scientists

Appendix 3.3-7. Diet Data, 2012

Cordillera Consulting

Project: Fish Stomachs
Rescan (Smithers), Kirsten Seymour
Taxonomist: Sue Salter
suesalter@shaw.ca
250-494-7553
Date Prepared: 11/7/2012

Site:	Gander Lake	George Lake	George Lake	George Lake	George Lake	George Lake	George Lake	George Lake	George Lake	Goose Lake	Goose Lake	Goose Lake	Goose Lake	Llama Lake	Llama Lake	Llama Lake
Sample:	RDWH 13	LKTR 18	LKTR 19	LKTR 20	LKTR 21	LKTR 22	LKTR 23	LKTR 24	LKTR 25	LKTR 01	LKTR 02	LKTR 04	LKTR 05	LKTR 07	LKTR 08	LKTR 09
CC#:	CC130488	CC130489	CC130490	CC130491	CC130492	CC130493	CC130494	CC130495 EMPTY	CC130496	CC130497	CC130498	CC130499	CC130500	CC130501	CC130502	CC130503
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Ephemerellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella doddsii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Heptageniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trichoptera	0	0	0	0	0	0	0	0	0	2	0	29	2	0	0	0
| Family: Brachycentridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micrasema sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Limnephilidae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Grensia praeterita	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Curculionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Diptera	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
| Family: Chironomidae	0	0	0	0	0	0	0	0	0	21	94	11	0	4	2	80
| Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cryptochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicrotendipes sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endochironomus sp.	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
Parachironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus sp.	0	2	0	12	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0
Corynocera sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paratanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protanypus	0	8	0	32	2	5	4	0	0	0	0	0	0	0	0	0
| Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrissocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parametriocnemus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psectrocladius sp.	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Orthocladiini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
| Subfamily: Prodiamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monodiamesa sp.	0	5	0	20	0	6	0	0	0	0	0	0	0	0	0	0

Appendix 3.3-7. Diet Data, 2012

Site:	Gander Lake	George Lake	George Lake	George Lake	George Lake	George Lake	George Lake	George Lake	George Lake	Goose Lake	Goose Lake	Goose Lake	Goose Lake	Llama Lake	Llama Lake	Llama Lake
Sample:	RDWH 13	LKTR 18	LKTR 19	LKTR 20	LKTR 21	LKTR 22	LKTR 23	LKTR 24	LKTR 25	LKTR 01	LKTR 02	LKTR 04	LKTR 05	LKTR 07	LKTR 08	LKTR 09
CC#:	CC130488	CC130489	CC130490	CC130491	CC130492	CC130493	CC130494	CC130495 EMPTY	CC130496	CC130497	CC130498	CC130499	CC130500	CC130501	CC130502	CC130503
| Subfamily: Tanypodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Pentaneurini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ablabesmyia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
| Tribe: Procladiini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Procladius sp.	0	0	0	0	0	3	0	0	0	0	0	0	2	0	0	0
| Family: Simuliidae	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Ostracoda	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
| Class: Branchiopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Cladocera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Daphniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Daphnia sp.	0	3	0	0	8	101	30	0	0	0	0	0	54	224	0	32
| Class: Copepoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Calanoida	0	0	0	0	0	10	6	0	0	0	1	0	2	0	4	8
| Order: Cyclopoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Malacostraca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
| Family: Gammaridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus sp.	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lebertiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia sp.	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hydrozetidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Sphaeriidae	9	0	0	0	0	6	0	0	6	2	0	0	0	0	0	0
Pisidium sp.	10	9	20	20	1	14	0	0	37	0	0	0	0	0	0	0
Sphaerium sp.	7	1	1	2	1	1	0	0	16	0	0	0	0	0	0	0
| Class: Gastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Heterostropha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Valvatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Valvata sincera	2	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0
Valvata sp.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Naididae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Phylum: Nemata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All others	0	0	0	0	0	0	0	0	0	22	0	0	0	4	0	0
No Invertebrates Found	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Totals:	**36**	**32**	**52**	**86**	**12**	**155**	**44**	**0**	**59**	**47**	**96**	**41**	**60**	**252**	**6**	**130**

Appendix 3.3-7. Diet Data, 2012

Cordillera Consulting

Project: Fish Stomachs
Rescan (Smithers), Kirsten Seymour
Taxonomist: Sue Salter
suesalter@shaw.ca
250-494-7553
Date Prepared: 11/7/2012

Site:	Llama Lake	Llama Lake	Llama Lake	Llama Lake	Llama Lake	Llama Lake	Llama Lake	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B
Sample:	LKTR 13	LKTR 14	RDWH 01	RDWH 02	RDWH 03	RDWH 04	RDWH 05	LKTR 02	LKTR 04	LKTR 05	LKTR 06	LKTR 07	LKTR 08	LKTR 09	LKTR 10	LKTR 11	LKTR 14	LKTR 15	LKTR 16
CC#:	CC130504	CC130505	CC130506	CC130507	CC130508	CC130509	CC130510	CC130511	CC130512	CC130513	CC130514	CC130515	CC130516	CC130517	CC130518	CC130519	CC130520	CC130521	CC130522
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Ephemerellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella doddsii	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0
| Family: Heptageniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Brachycentridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micrasema sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Limnephilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grensia praeterita	0	0	6	0	20	2	4	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Curculionidae	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
| Order: Diptera	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0
| Family: Chironomidae	12	52	152	34	438	260	20	0	0	0	0	0	0	0	0	0	0	24	1
| Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chironomus sp.	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	16	0
Cryptochironomus sp.	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Dicrotendipes sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parachironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corynocera sp.	0	0	8	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0
Paratanytarsus sp.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanytarsus sp.	0	0	12	3	0	50	0	0	0	0	0	0	0	0	0	0	0	8	0
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protanypus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrissocladius sp.	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parametriocnemus sp.	0	0	28	0	0	90	22	0	0	0	0	0	0	0	0	0	0	0	0
Psectrocladius sp.	0	0	6	5	0	30	3	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Orthocladiini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Prodiamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monodiamesa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 3.3-7. Diet Data, 2012

Site:	Llama Lake	Llama Lake	Llama Lake	Llama Lake	Llama Lake	Llama Lake	Llama Lake	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B
Sample:	LKTR 13	LKTR 14	RDWH 01	RDWH 02	RDWH 03	RDWH 04	RDWH 05	LKTR 02	LKTR 04	LKTR 05	LKTR 06	LKTR 07	LKTR 08	LKTR 09	LKTR 10	LKTR 11	LKTR 14	LKTR 15	LKTR 16
CC#:	CC130504	CC130505	CC130506	CC130507	CC130508	CC130509	CC130510	CC130511	CC130512	CC130513	CC130514	CC130515	CC130516	CC130517	CC130518	CC130519	CC130520	CC130521	CC130522
| Subfamily: Tanypodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Pentaneurini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ablabesmyia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Procladiini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Procladius sp.	0	0	0	0	0	4	0	384	0	872	652	1720	1664	3488	1752	804	1328	832	22
| Family: Simuliidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Ostracoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Branchiopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Cladocera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Daphniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Daphnia sp.	14	7	52	0	12	130	5	0	8	16	0	8	8	32	0	0	8	192	0
| Class: Copepoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0
| Order: Calanoida	0	0	0	0	0	0	0	0	8	8	0	0	0	0	0	8	0	40	0
| Order: Cyclopoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Malacostraca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Gammaridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lebertiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hydrozetidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Sphaeriidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pisidium sp.	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
Sphaerium sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Gastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Heterostropha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Valvatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Valvata sincera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Valvata sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Naididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Nemata	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0
All others	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	8	0	0
No Invertebrates Found	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals:	**26**	**59**	**266**	**46**	**470**	**566**	**58**	**404**	**28**	**896**	**656**	**1728**	**1680**	**3520**	**1752**	**812**	**1352**	**1128**	**23**

Appendix 3.3-7. Diet Data, 2012

Cordillera Consulting

Project: Fish Stomachs
Rescan (Smithers), Kirsten Seymour
Taxonomist: Sue Salter
suesalter@shaw.ca
250-494-7553
Date Prepared: 11/7/2012

Site:	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref C	Ref C	Ref C	Ref C	Ref C	Ref C	Ref C	Ref C
Sample:	LKTR 41	RDWH 01	RDWH 03	RDWH 12	RDWH 19	RDWH 20	RDWH 21	RDWH 22	RDWH 23	RDWH 24	RDWH 25	LKTR 27	LKTR 30	LKTR 31	LKTR 32	LKTR 39	LKTR 40	LKTR 42	LKTR 43
CC#:	CC130523	CC130524	CC130525	CC130526	CC130527	CC130528	CC130529	CC130530	CC130531	CC130532	CC130533	CC130534	CC130535	CC130536	CC130537	CC130538	CC130539	CC130540	CC130541
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Ephemerellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella doddsii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Heptageniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhithrogena sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Brachycentridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micrasema sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
| Family: Limnephilidae	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Grensia praeterita	0	0	0	4	0	1	2	8	2	1	22	5	0	1	0	0	0	0	2
| Order: Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Curculionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Chironomidae	12	1	8	0	56	8	20	24	20	14	1	2	6	4	35	6	1	36	3
| Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cryptochironomus sp.	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0
Dicrotendipes sp.	0	0	0	0	55	0	45	0	0	0	0	0	0	0	0	0	0	0	0
Endochironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parachironomus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus sp.	16	0	0	0	20	11	0	0	0	0	0	0	0	0	0	2	0	0	0
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corynocera sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paratanytarsus sp.	0	0	0	0	210	75	235	4	1	0	0	0	0	0	0	0	0	0	0
Tanytarsus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protanypus	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0
| Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterotrissocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parametriocnemus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psectrocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3	7
| Tribe: Orthocladiini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaetocladius sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Prodiamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monodiamesa sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 3.3-7. Diet Data, 2012

Site:	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref B	Ref C	Ref C	Ref C	Ref C	Ref C	Ref C	Ref C	Ref C
Sample:	LKTR 41	RDWH 01	RDWH 03	RDWH 12	RDWH 19	RDWH 20	RDWH 21	RDWH 22	RDWH 23	RDWH 24	RDWH 25	LKTR 27	LKTR 30	LKTR 31	LKTR 32	LKTR 39	LKTR 40	LKTR 42	LKTR 43
CC#:	CC130523	CC130524	CC130525	CC130526	CC130527	CC130528	CC130529	CC130530	CC130531	CC130532	CC130533	CC130534	CC130535	CC130536	CC130537	CC130538	CC130539	CC130540	CC130541
| Subfamily: Tanypodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Pentaneurini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ablabesmyia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
| Tribe: Procladiini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Procladius sp.	8	1	160	708	24	26	23	0	5	0	0	1	2	1	0	0	0	0	0
| Family: Simuliidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Ostracoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Branchiopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Cladocera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Daphniidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Daphnia sp.	4	85	1368	236	0	0	0	0	0	0	0	0	178	0	2	4	0	24	0
| Class: Copepoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Calanoida	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	22	0
| Order: Cyclopoida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	0	0	0
| Class: Malacostraca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Amphipoda	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
| Family: Gammaridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus sp.	28	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lebertiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebertia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hydrozetidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Sphaeriidae	0	0	8	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	1
Pisidium sp.	16	0	0	4	0	0	0	0	0	0	0	0	70	0	0	3	1	0	0
Sphaerium sp.	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	2	0	0	0
| Class: Gastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Heterostropha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Valvatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Valvata sincera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Valvata sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Naididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Nemata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All others	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	1	6	0	4
No Invertebrates Found	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals:	**108**	**88**	**1544**	**952**	**365**	**121**	**325**	**39**	**29**	**15**	**23**	**11**	**296**	**7**	**40**	**31**	**8**	**86**	**22**