

Appendix V6-6A

Back River Project: 2010 Fish and Fish Habitat Baseline Report

Sabina Gold & Silver Corp.

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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Executive Summary

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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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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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:

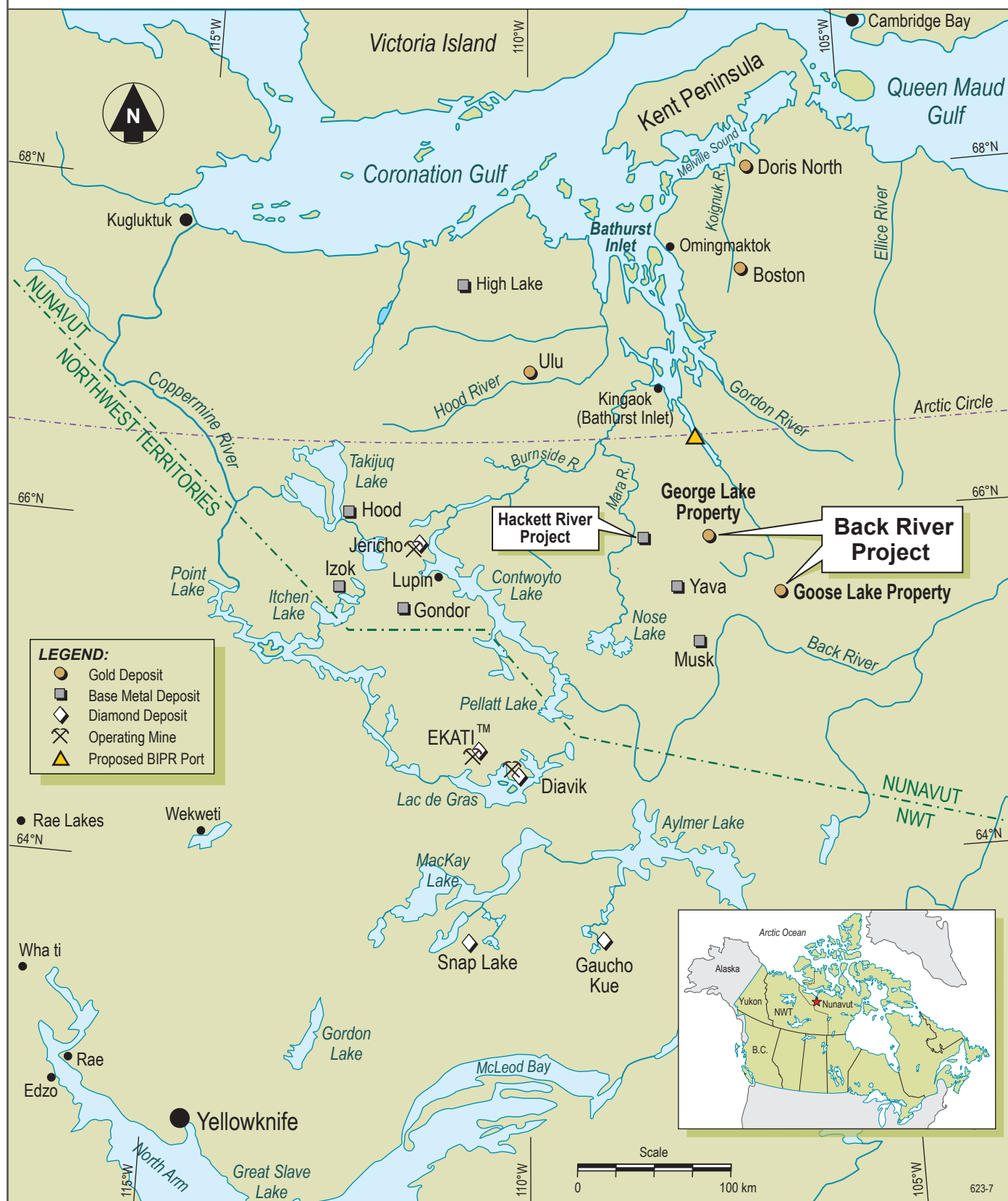
- Hydrology Baseline Program;
- Lake Bathymetry, Water and Sediment Baseline Program;
- Fish and Fish Habitat Baseline Program;
- Archaeological Survey Program; and
- Regional Wildlife Program.

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.



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

Lake	Watershed	Date Assessed	UTM Location	
			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.

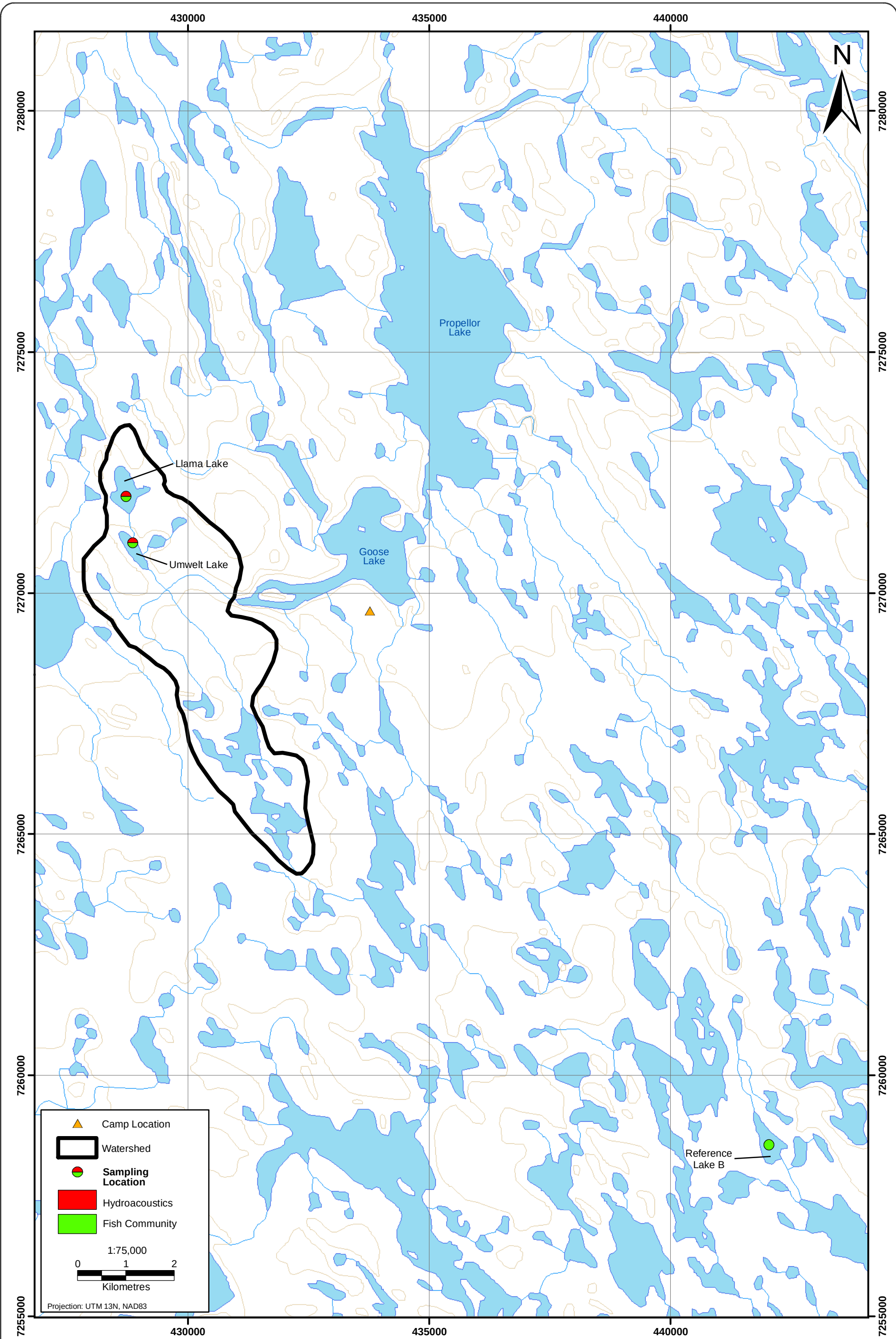


Table 2.1-2. Hydroacoustic System Specifications for Surveys of Llama and Umwelt Lakes, Back River Project, 2010

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
Data Analysis	DGPS	Type	WAAS-differential ³
		Datum	NAD83
	Other	Transecting speed	1.4-1.9 m/s
	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
<i>Bottom Sampling Windows</i>	
First bottom, first part	16 samples
First bottom, second part	48 samples
Second bottom	100 samples
Sediment layer	42 samples
<i>Bottom Tracker Settings</i>	
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.

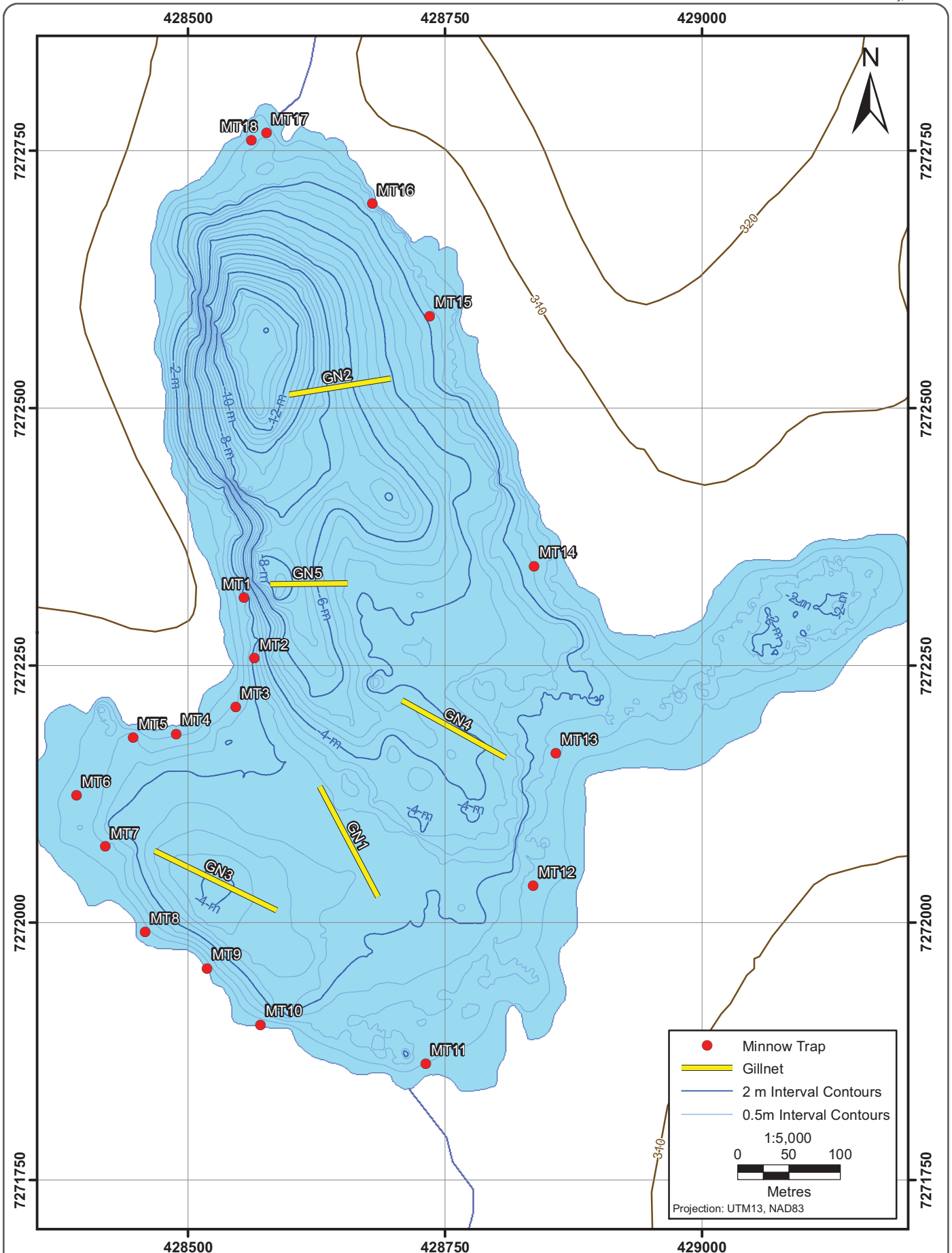
Table 2.2-1. Fish Community Sampling Locations, Back River Project, 2010

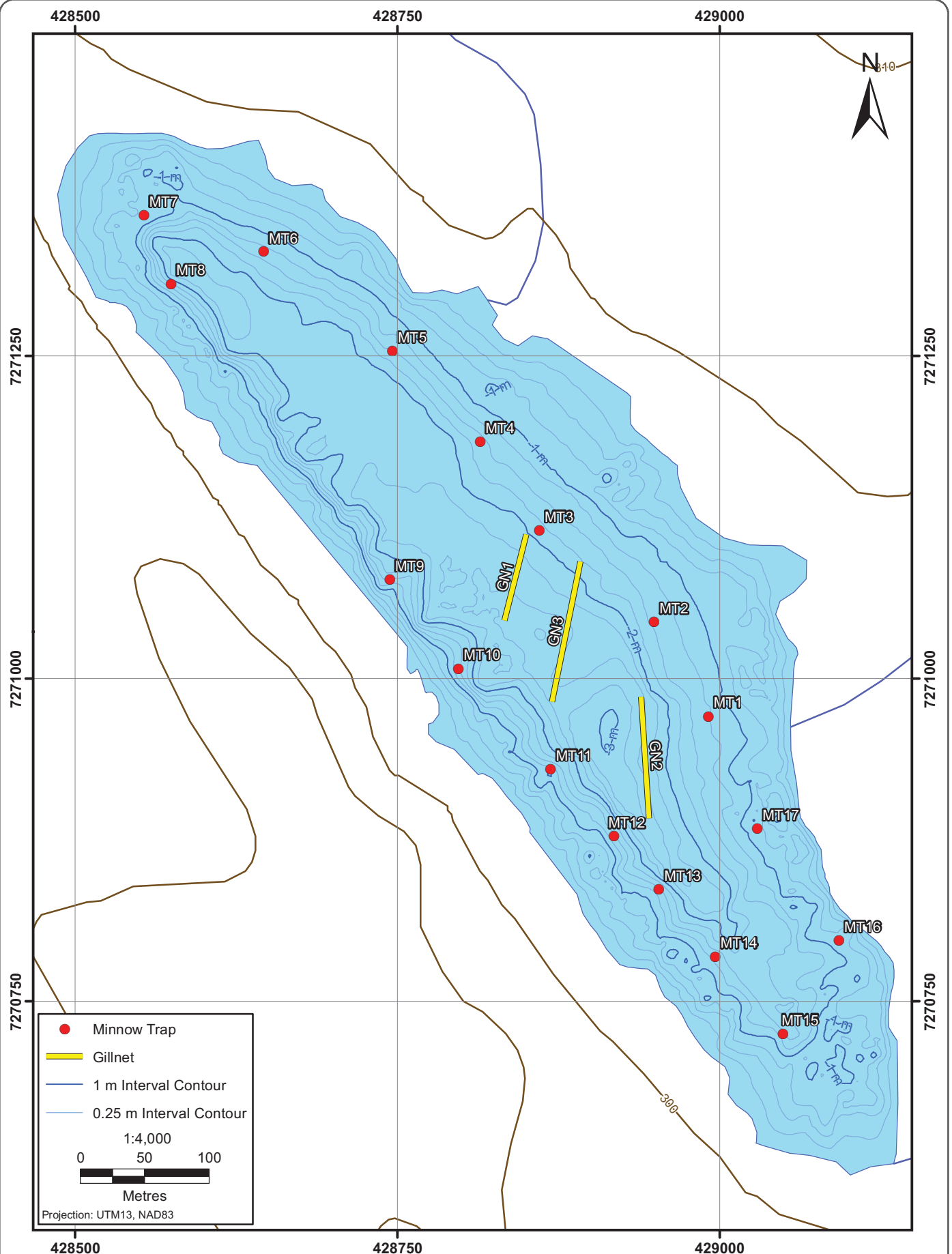
Location	Watershed	UTM Location		Method		
		Easting	Northing	AC	GN	MT
Llama Lake	Llama	429000	7272000	X	X	X
Umwelt Lake	Llama	429000	7270500	X	X	X
Reference Lake B	Reference	442000	7258500	-	X	X

Method codes: AC = hydroacoustics, GN = gillnet, MT = minnow trap.

Dashes indicate no data were collected.

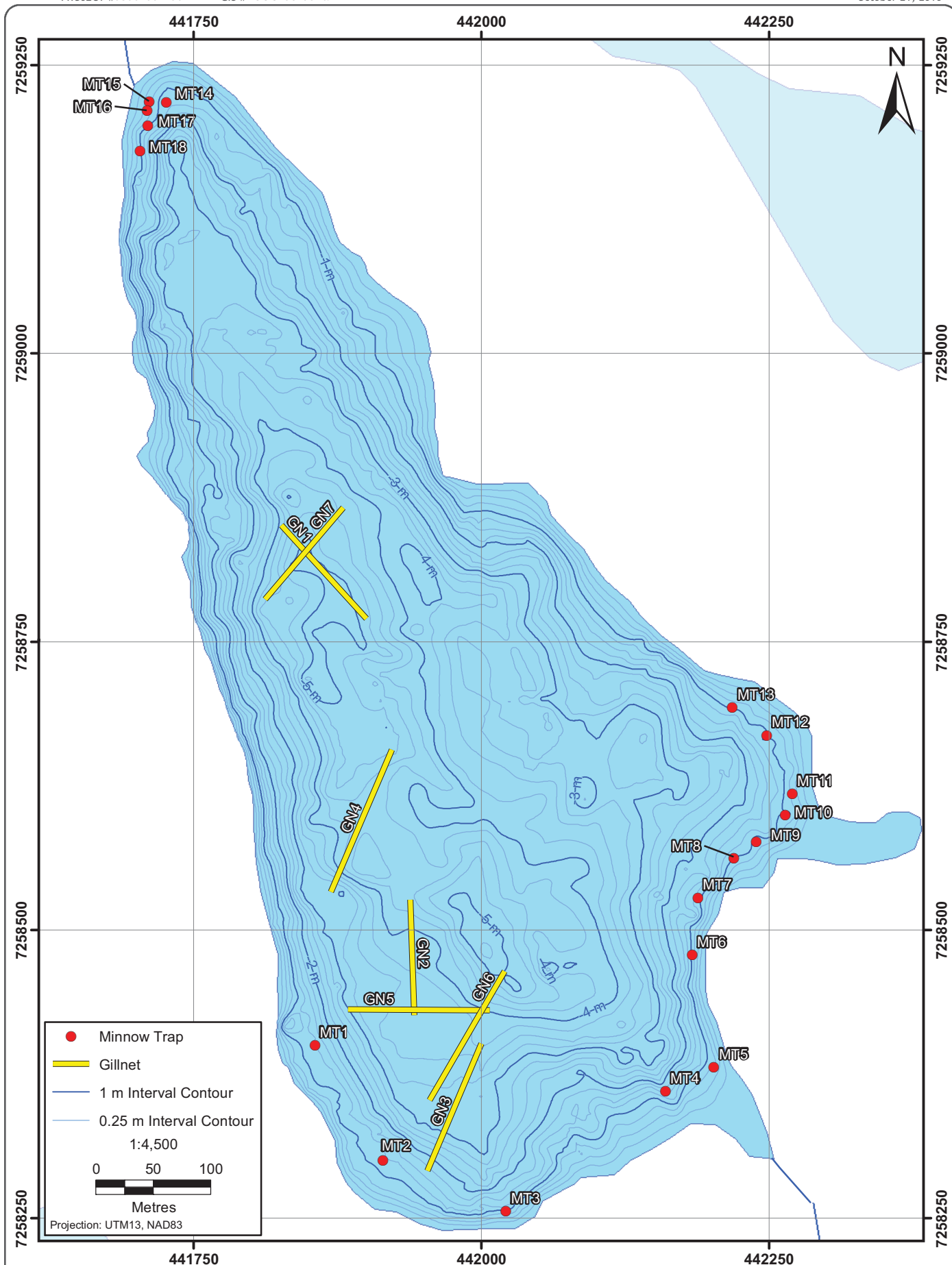
Lakes were sampled using three forms of monofilament gillnet gangs. Standard RISC (floating and sinking forms) gillnet gangs consisted of six panels, ranging from 25 to 89 mm stretched mesh. Each RISC gillnet gang was tied in the following order: Panel 1 - 25 mm; Panel 2 - 76 mm; Panel 3 - 51 mm; Panel 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 m² and a total area of 218.88 m² 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 m², with a total area of 109.44 m². 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.





Gillnet and Minnow Trap Set Locations on Umwelt Lake, Back River Project Area, 2010

Figure 2.2-2



Gillnet and Minnow Trap Set Locations on
Reference Lake B, Back River Project Area, 2010

Figure 2.2-3

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.

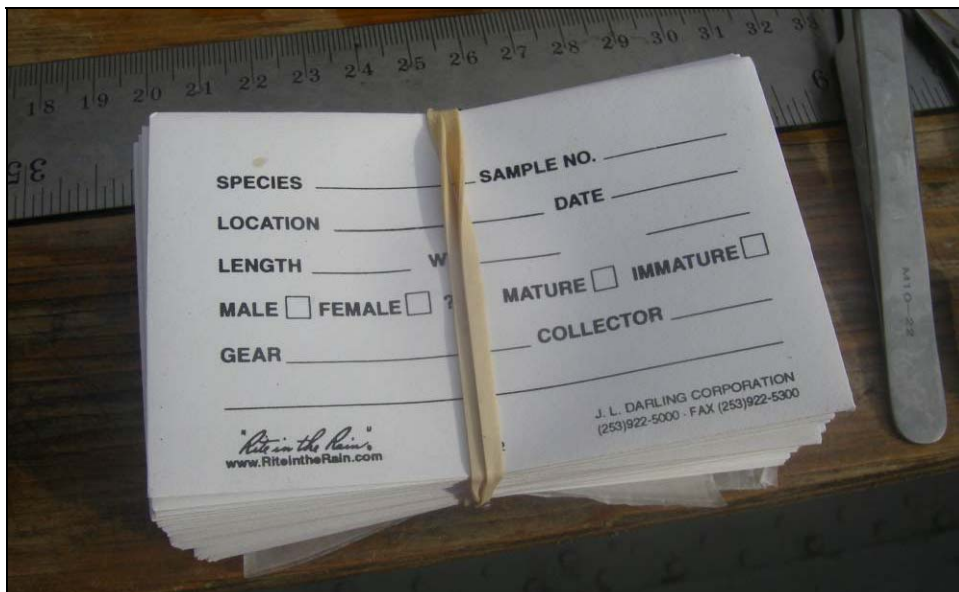


Plate 2.2-2. Envelopes used for the storage of fish aging structures, Back River Project, 2010.

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 $TS \geq -65$ 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/m² or fish/ha for population estimates and spatial analysis. For each spatial cell of interest, fish/m³ 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/m² 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 m² of net per 1 hour.

$$\text{CPUE} = \text{number of fish caught per net} \times [100/\text{total net area (m}^2\text{)}] \times [1/\text{set time (h)}]$$

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 10⁵ 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

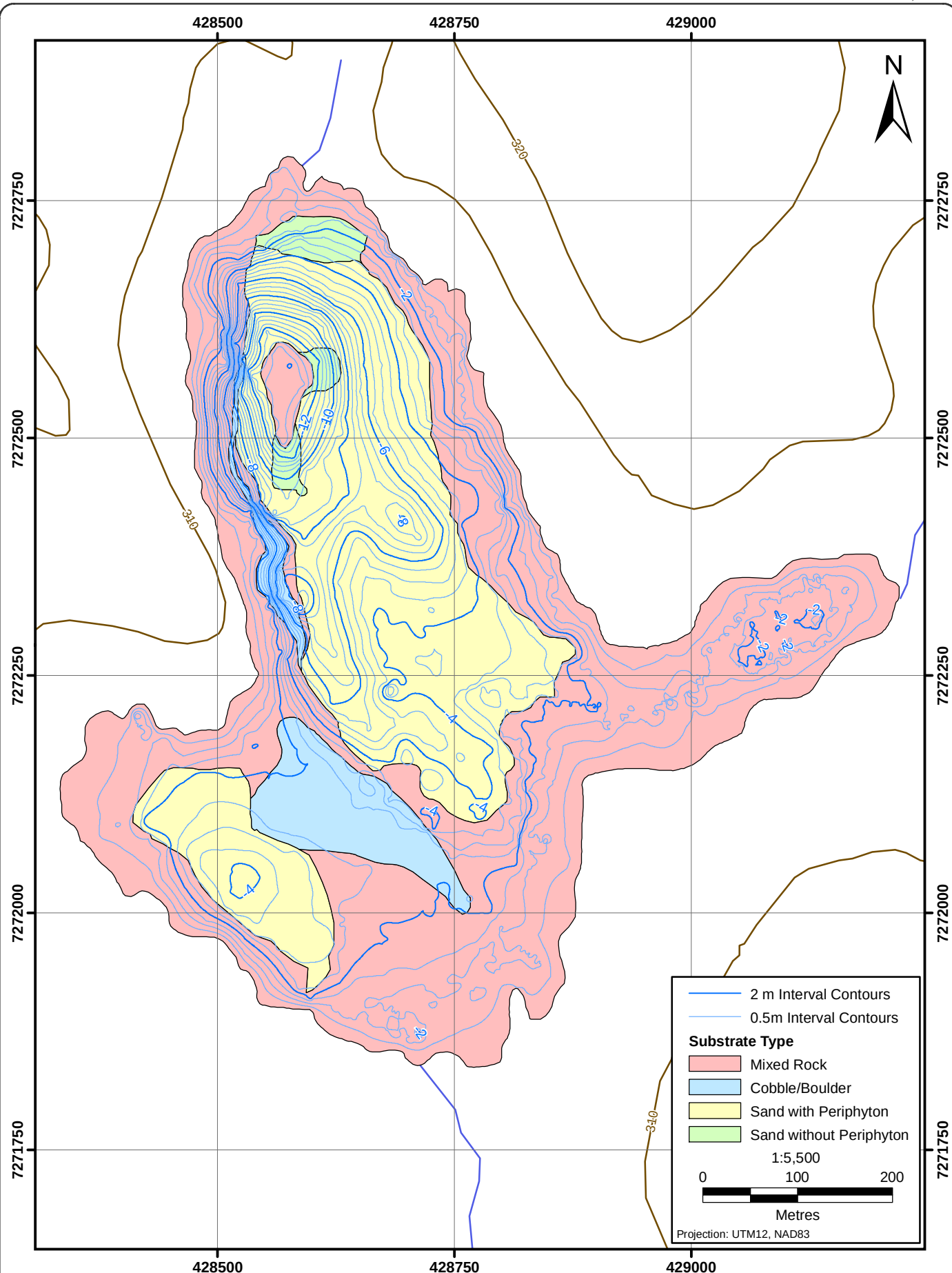
Appendix 3.1-1 presents substrate data collected from hydroacoustics surveys of Llama Lake. Figure 3.1-1 and Table 3.1-1 show the distribution of substrate. The predominant substrate category found at Llama Lake was mixed rock (Plate 3.1-1), representing 57% of the overall bottom area. The subdominant 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.



**Substrate Composition of Llama Lake Derived
from Hydroacoustic and Underwater Video
Surveys, Back River Project, 2010**

Figure 3.1-1



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

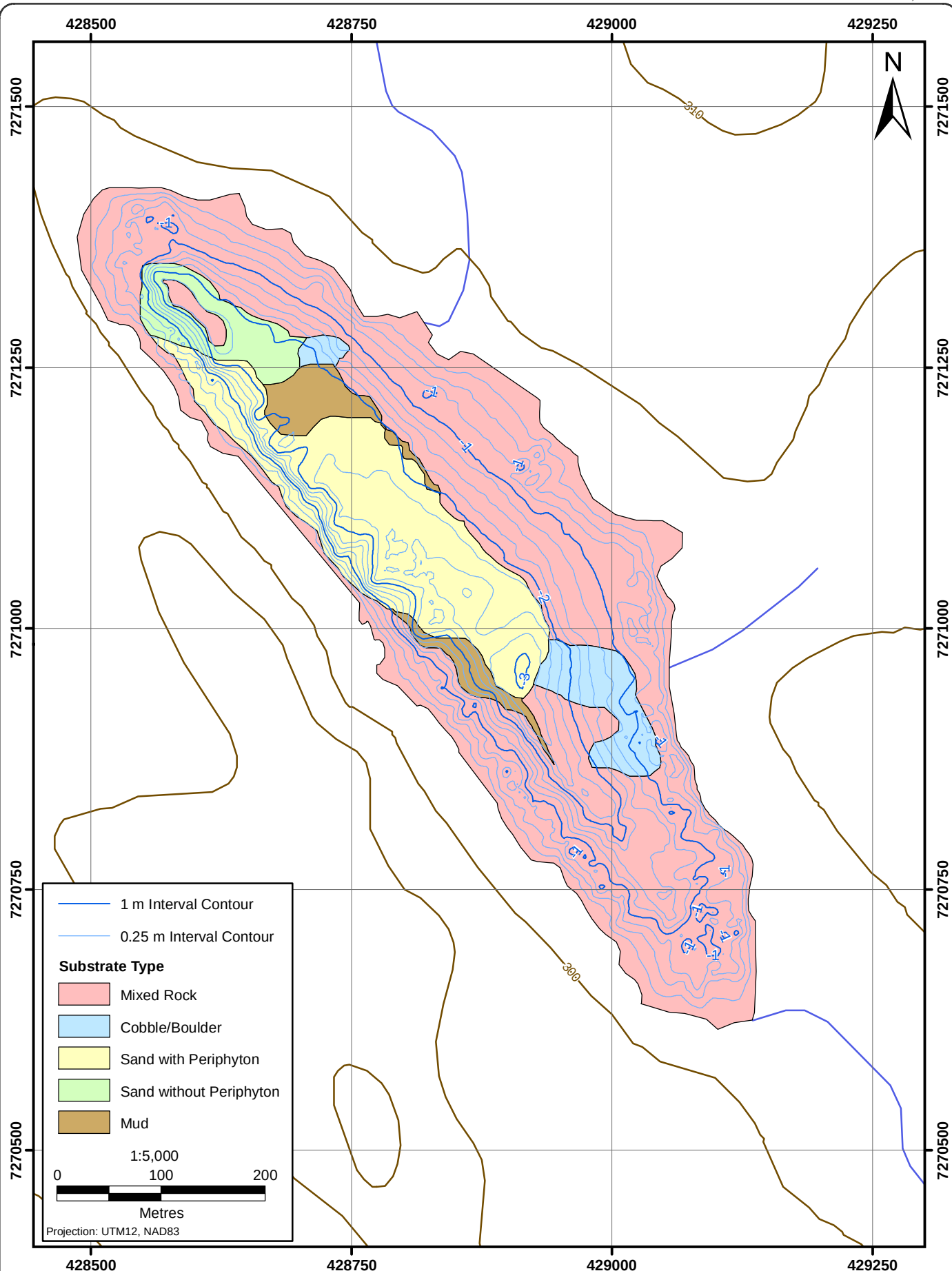
Appendix 3.1-2 presents substrate data collected from hydroacoustics surveys of Umwelt Lake. Figure 3.1-2 and Table 3.1-2 shows the distribution of substrate. As with Llama Lake, the predominant substrate category found at Umwelt Lake was mixed rock, representing 67% of the overall bottom area. The subdominant 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.



Substrate Composition of Umwelt Lake Derived
from Hydroacoustic and Underwater Video
Surveys, Back River Project, 2010

Figure 3.1-2

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 gillnets 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

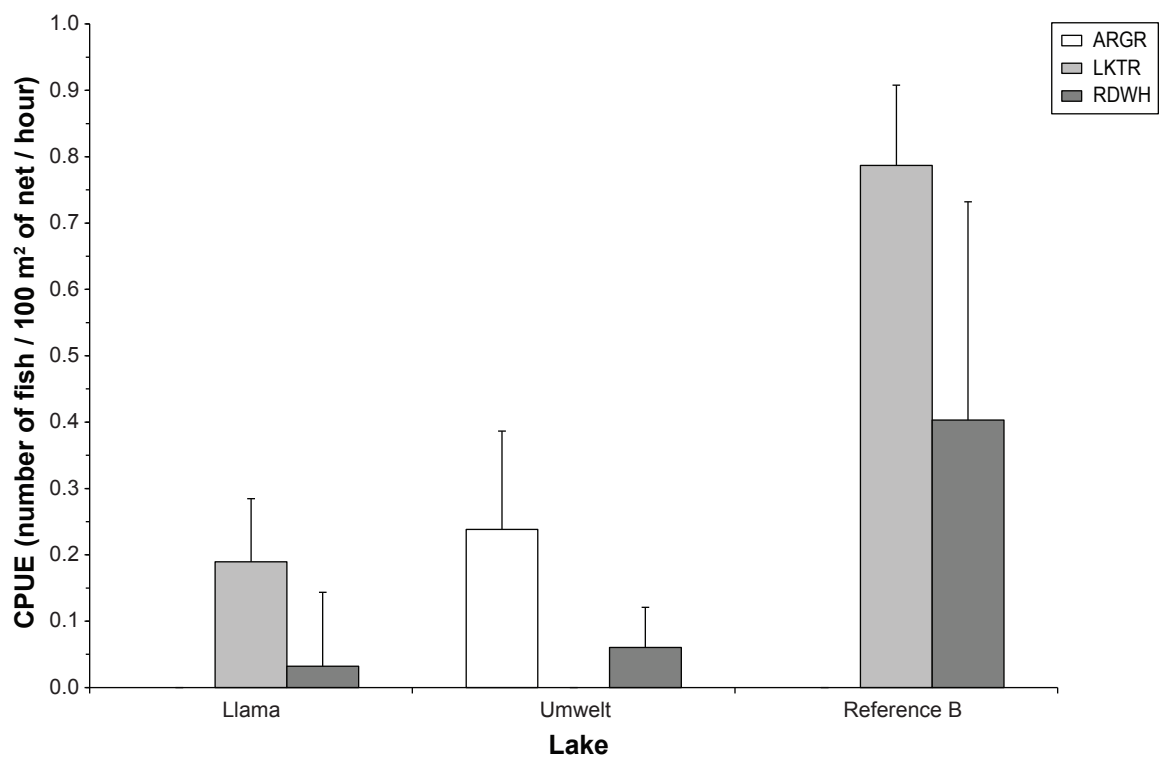
Lake	Watershed	Number of Traps Set	Total Effort	Catch per Species	Total Catch	Mean Total CPUE	SE
				NSSB			
Llama	Llama	18	342.0	0	0	0	0
Umwelt	Llama	17	340.0	1	1	0.003	0.0029
Reference B	Reference	18	385.5	0	0	0	0
Totals		53	1,067.5	1	1	0.0009	0.0009

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.

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

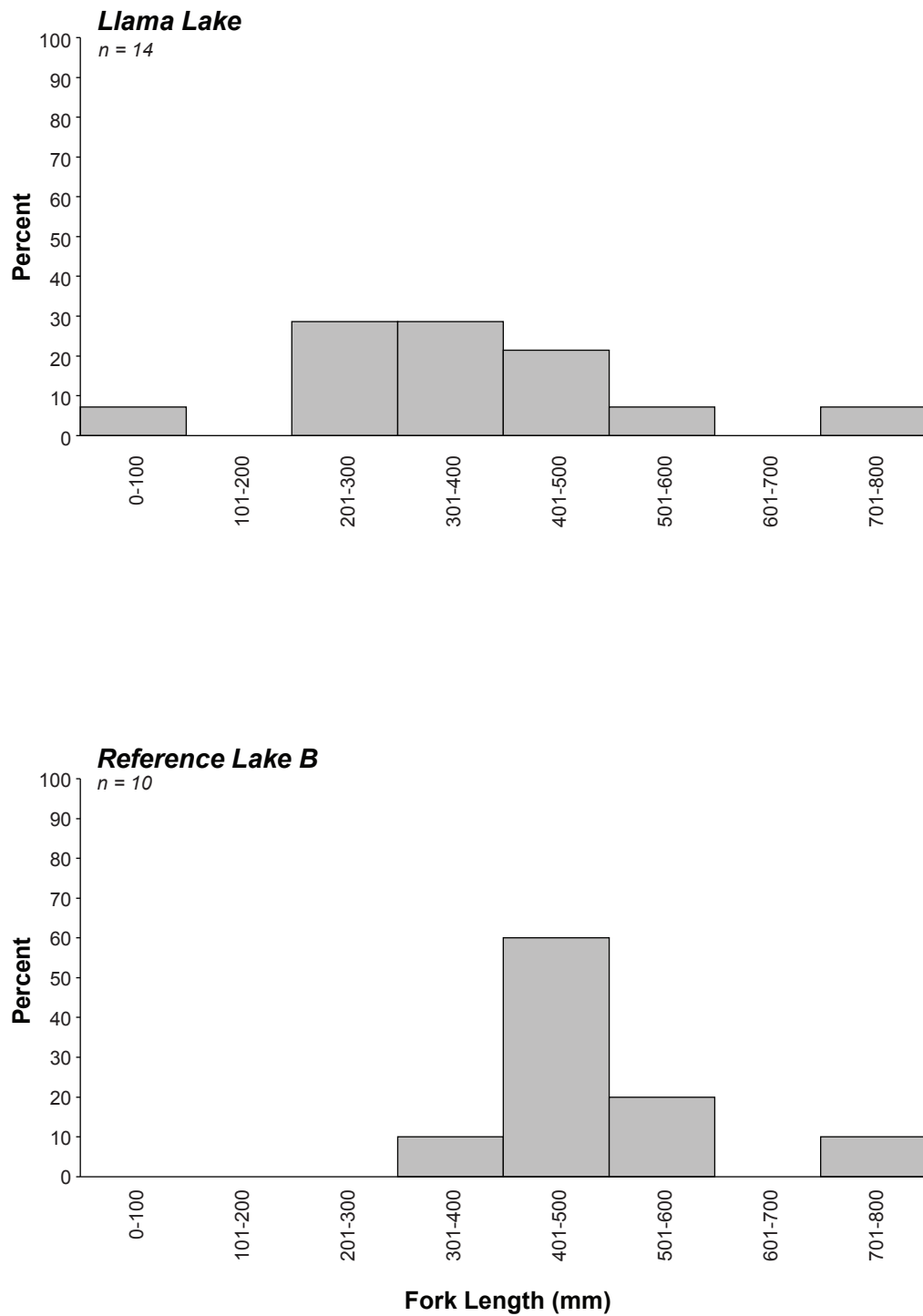
Lake	Watershed	Species	Length (mm)				Weight (g)				Condition (g/mm ³)			
			n	Range	Mean	SE	n	Range	Mean	SE	n	Range	Mean	SE
Llama	Llama	LKTR	14	97 - 724	363	11	14	11 - 3,625	772	68	14	0.91 - 1.93	1.12	0.02
		RDWH	4	290 - 404	371	14	4	292 - 809	648	60	4	1.18 - 1.26	1.21	0.01
Umwelt	Llama	ARGR	20	134 - 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

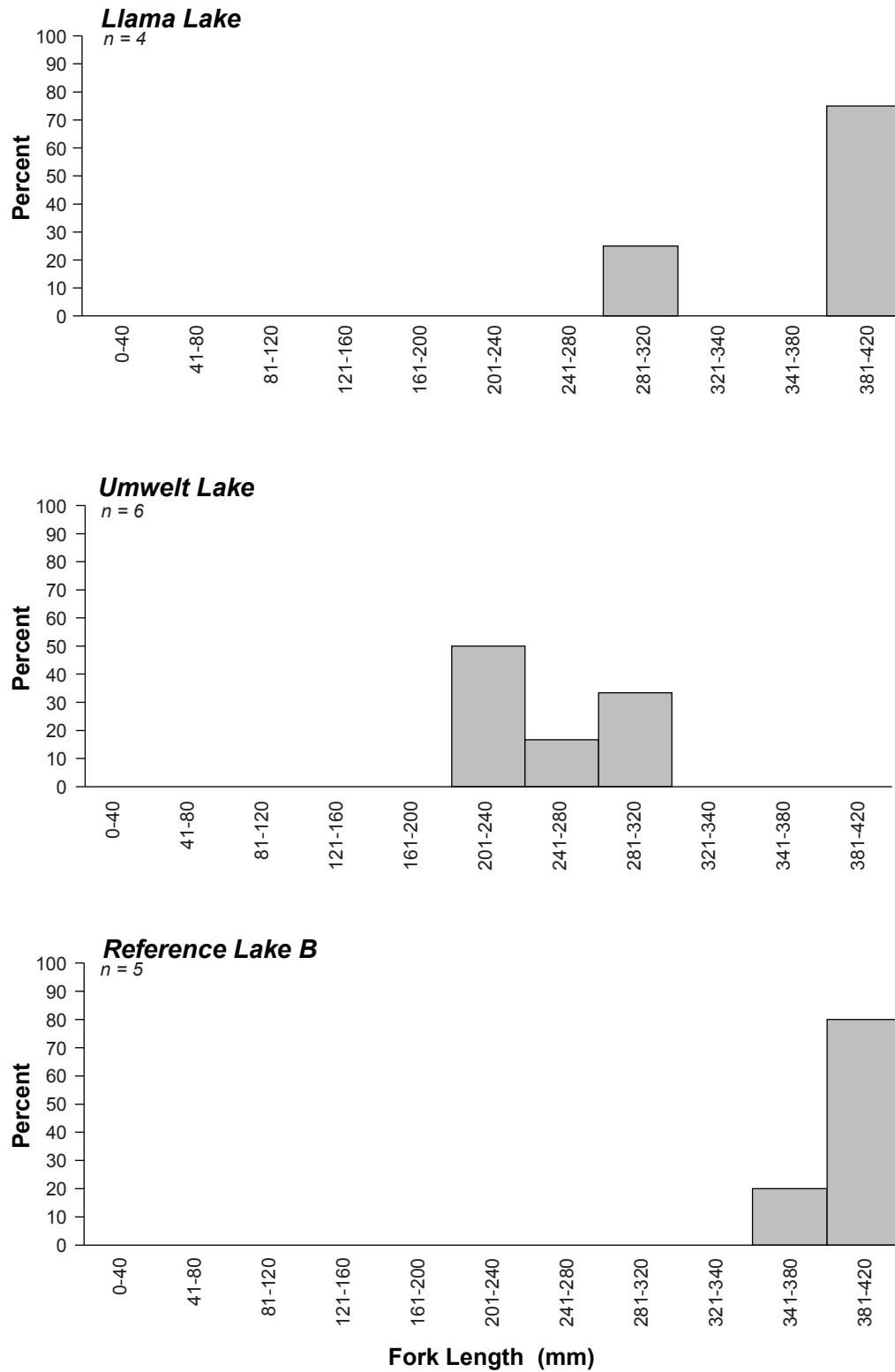
Species codes: ARGR = Arctic grayling, LKTR = lake trout, RDWH = round whitefish
n = number, SE = standard error

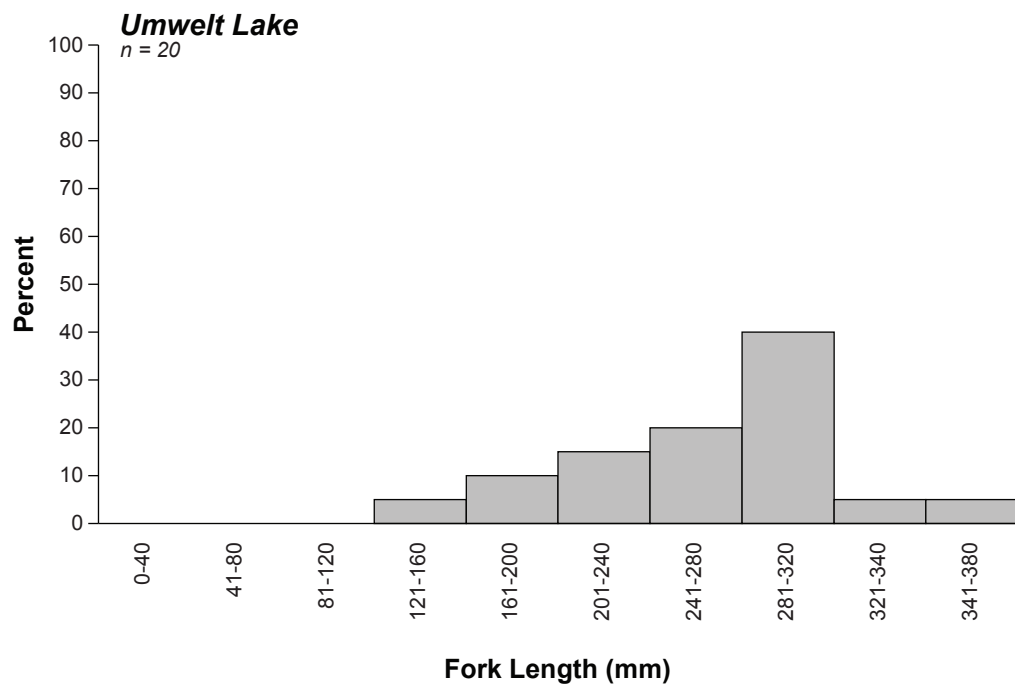
Lake trout were the largest fish species with mean lengths ranging from 363 mm (Llama Lake) to 503 mm (Reference Lake B). The dominant size classes of lake trout at Reference Lake B were between 401 to 500 mm. The dominant size classes of lake trout from Llama Lake ranged from 201 to 400 mm. Round whitefish 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.

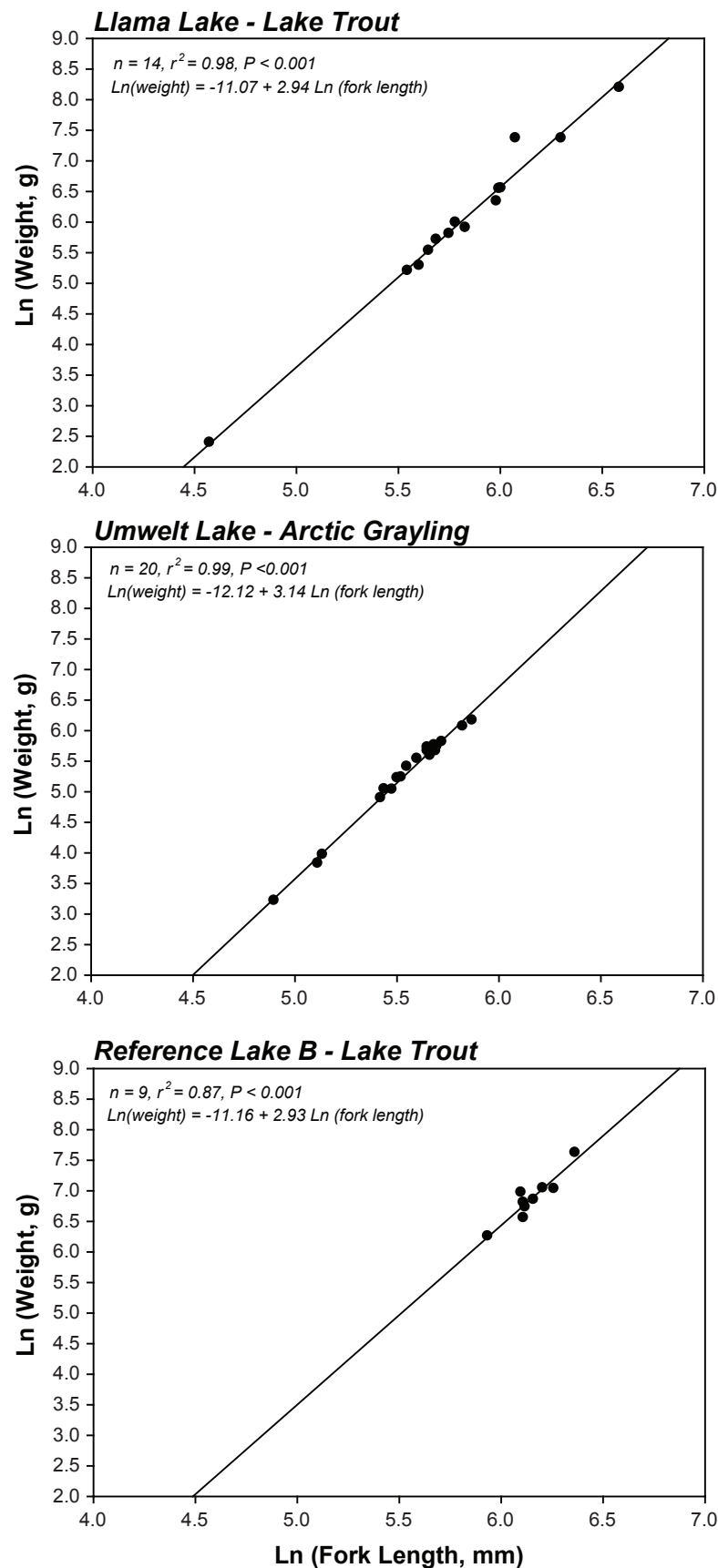
Lake trout was also the heaviest species. Lake trout mean weights ranged from 772 g (Llama Lake) to 1,035 g (Reference Lake B). Round whitefish mean weight ranged from 195 g (Umwelt Lake) to 701 g (Reference Lake B). Arctic grayling mean weight in Umwelt Lake was 238 g.

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 $\ln(\text{weight})$. Similarly, the regression for Arctic grayling from Umwelt Lake was highly significant ($P < 0.001$) and explained 99% of the variation in $\ln(\text{weight})$. The weight-length regression for lake trout from Reference Lake B was also significant ($P < 0.001$) and explained 87% of the variation in $\ln(\text{weight})$.









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/mm³ (Umwelt Lake) to 1.21 g/mm³ (Llama Lake). Lake trout condition ranged from 0.95 g/mm³ (Reference Lake B) to 1.12 g/mm³ (Llama Lake). Arctic grayling also displayed relatively high condition values in Umwelt Lake (mean 1.18 g/mm³).

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.

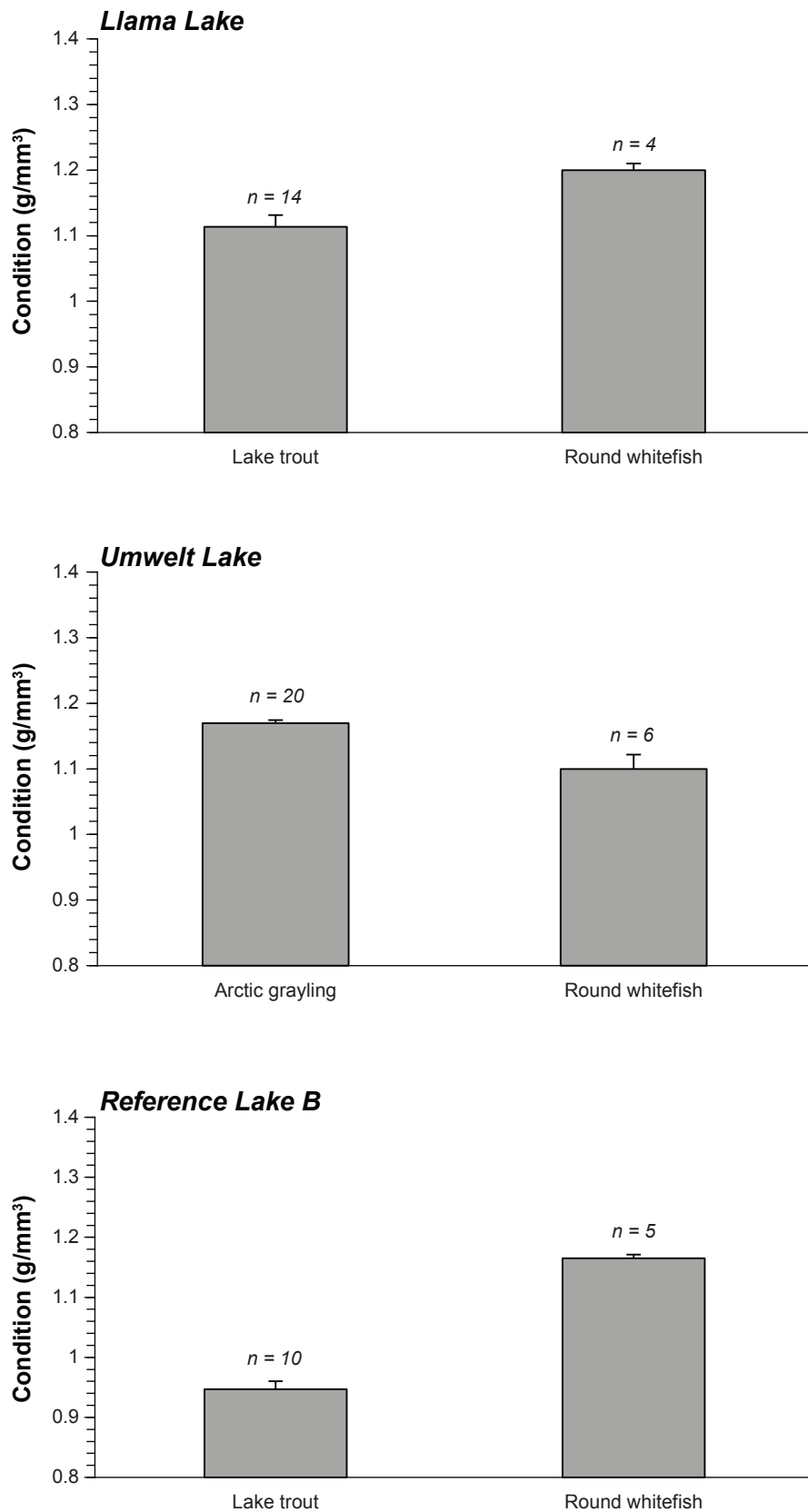
Table 3.2-6. Summary of Age Data for Sampled Fish, Back River Project, 2010

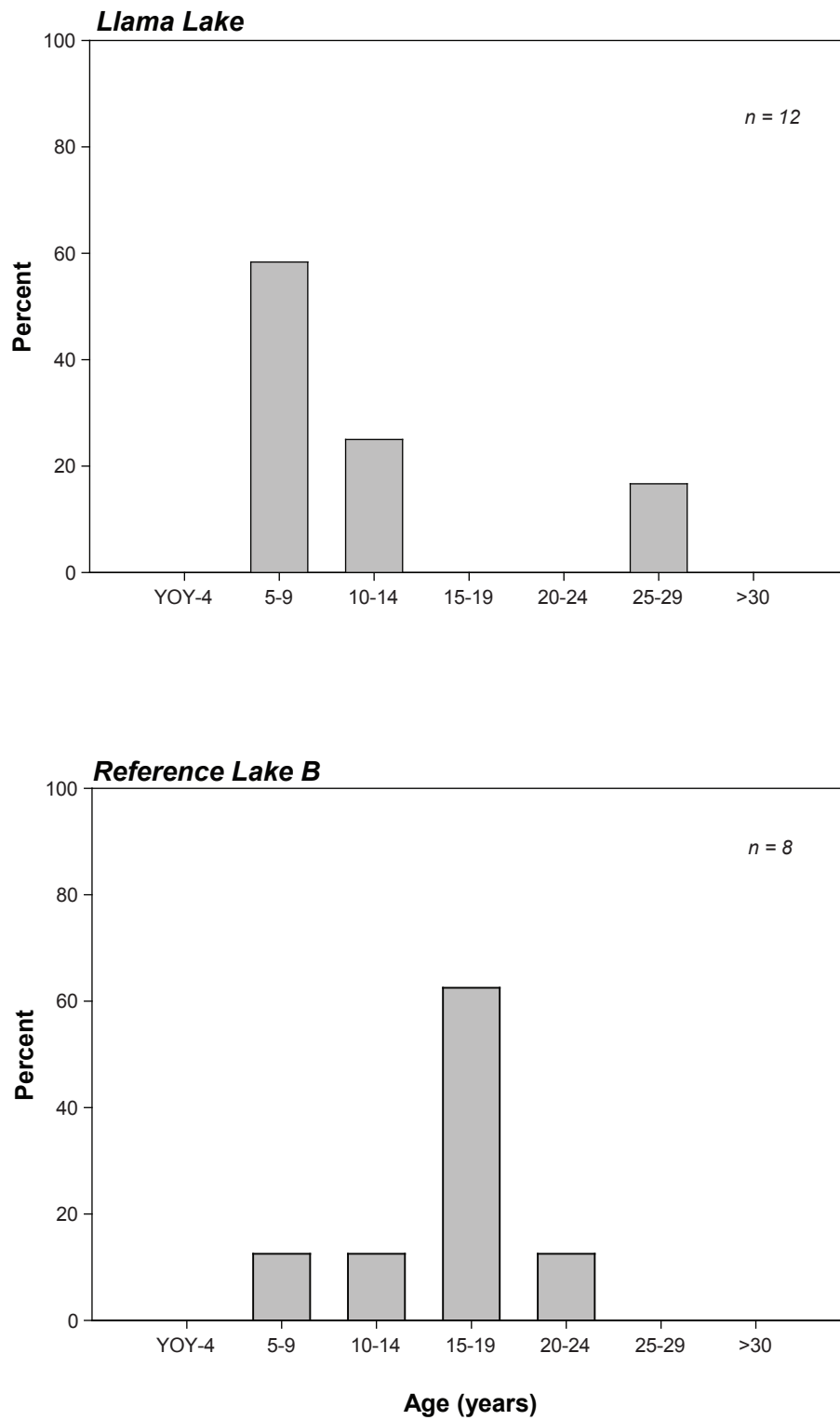
Lake	Watershed	Species	Age (years)				
			n	Mean	SE	Min	Max
Llama	Llama	LKTR	12	12	2.0	6	26
		RDWH	4	10	1.8	4	12
Umwelt	Llama	ARGR	14	5	0.6	2	9
		RDWH	5	3	0.4	2	4
Reference B	Reference	LKTR	8	16	1.4	8	22
		RDWH	5	13	0.3	12	14

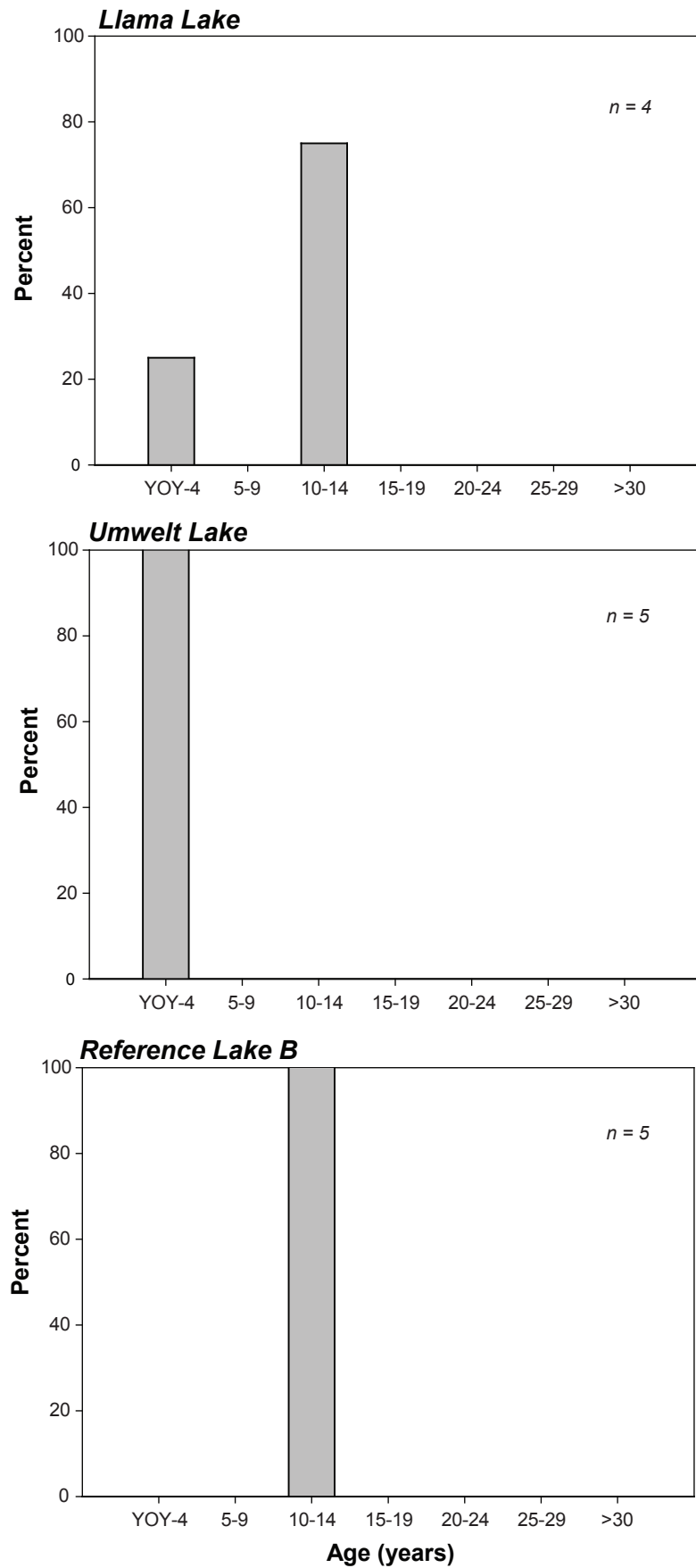
Species codes: ARGR = Arctic grayling, LKTR = lake trout, RDWH = round whitefish
n = number, SE = standard error, min = minimum, max = maximum

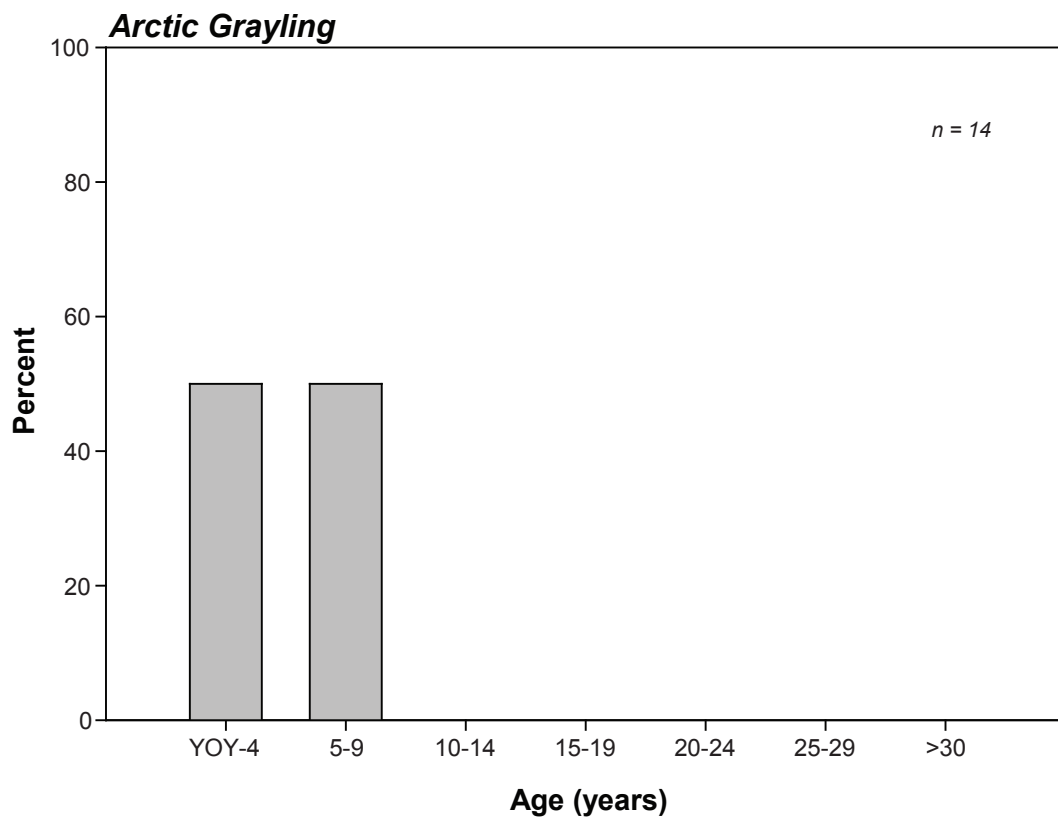
Figures 3.2-7 to 3.2-9 show age-frequency distributions for lake trout, round whitefish and Arctic grayling, respectively. The age-frequency distributions for lake trout sampled from Llama and Reference Lake B show dominant age classes ranging from 5 to 9 years and 15 to 19 years, respectively. The age-frequency 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.









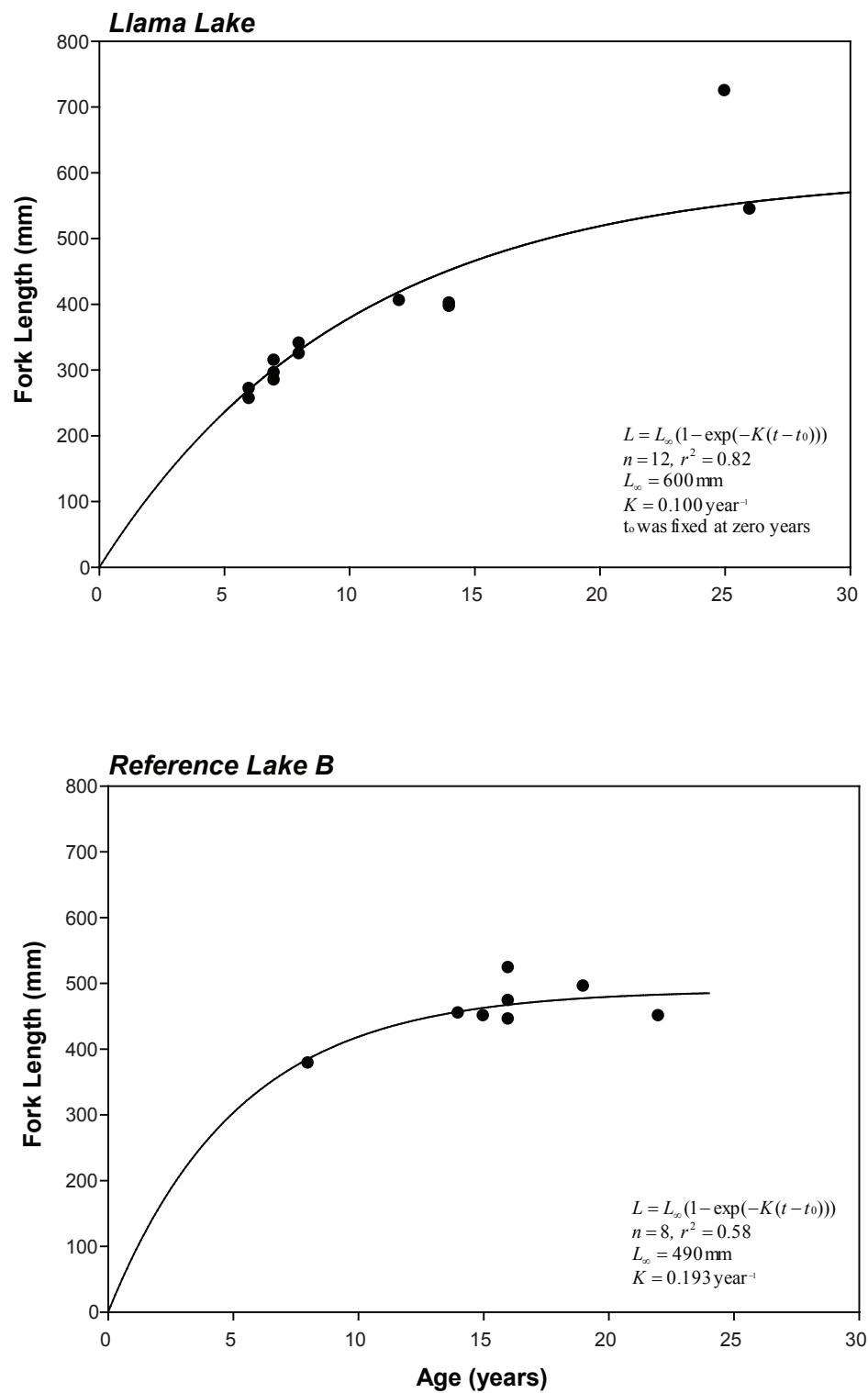


Figure 3.2-10

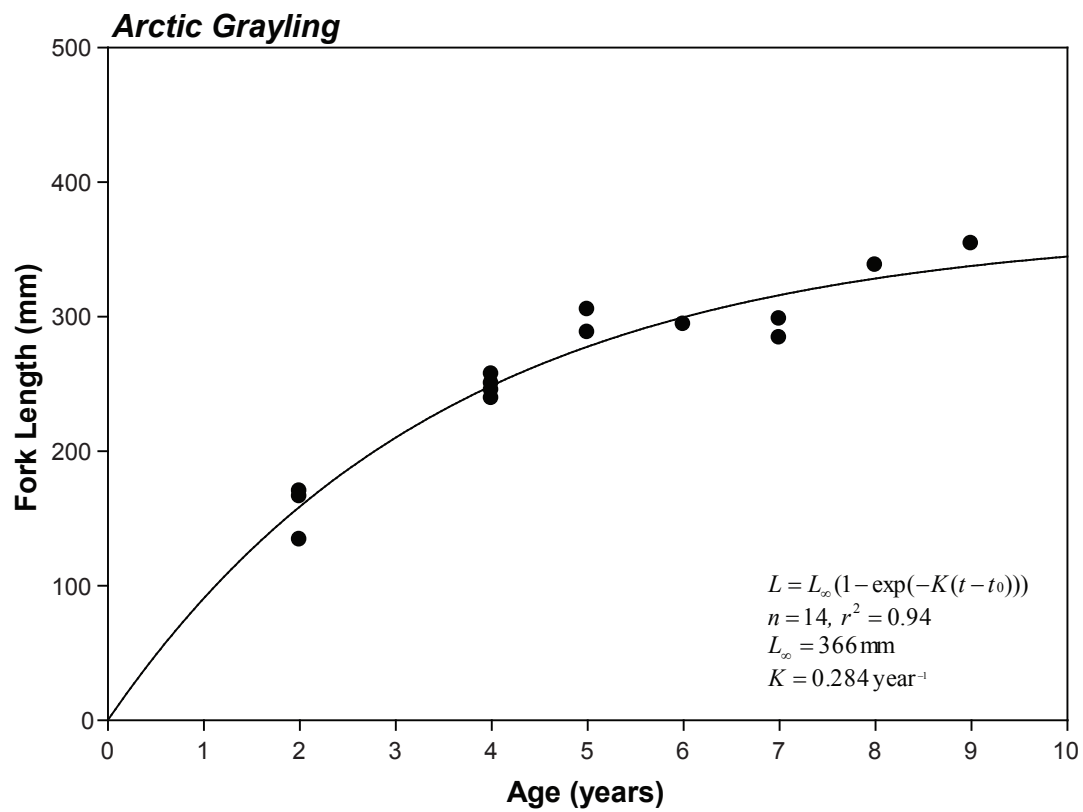


Figure 3.2-11

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

Appendix 2.2-1. Set Times, Retrieval Times and Locations for Gillnets, Back River Project, 2010

Water Body	Net Number	Net Type	Set		Retrieval		UTM 1		UTM 2		Catch per Species			
			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

Appendix 2.2-2. Set Times, Retrieval Times and Locations for Minnow Traps, Back River Project, 2010

Water Body	Set	Set		Retrieval		UTM 1		Catch per
	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

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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphon, 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 periphyton, 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 periphon, 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 periphon, 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 periphon, 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 periphyton, 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 periphon, 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 periphon, 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 periphon, 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 periphyton, 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 periphon, 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 periphon, 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 periphon, 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 periphon, 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 periphon, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphon, 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 periphyton, 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 periphyton, 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 periphon, 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 periphon, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphon, 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 periphon, 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 periphyton, 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 periphon, 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 periphyton, 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 periphon, 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 periphon, 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 periphyton, 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 periphon, 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 periphyton, 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 periphon, 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 periphon, 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 periphyton, 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 periphon, 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 periphon, 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 periphon, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphon, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphon, 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

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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphyton, 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 periphon, 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

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

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	Ping	Mean Target Strength	Wedge Volume
						Type			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

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		Mean Target Strength	Wedge Volume Sampled
						Type	Ping		
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

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

April 2012
Project #833-002-04

Citation:

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Prepared for:



Sabina Gold & Silver Corp.

Prepared by:



Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

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

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

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:

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

- o 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.



Figure 1-1

- o 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 m² 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 m² 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:

$$Condition (K) = \frac{weight (g) \times 10^5}{length (mm)^3}$$

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.

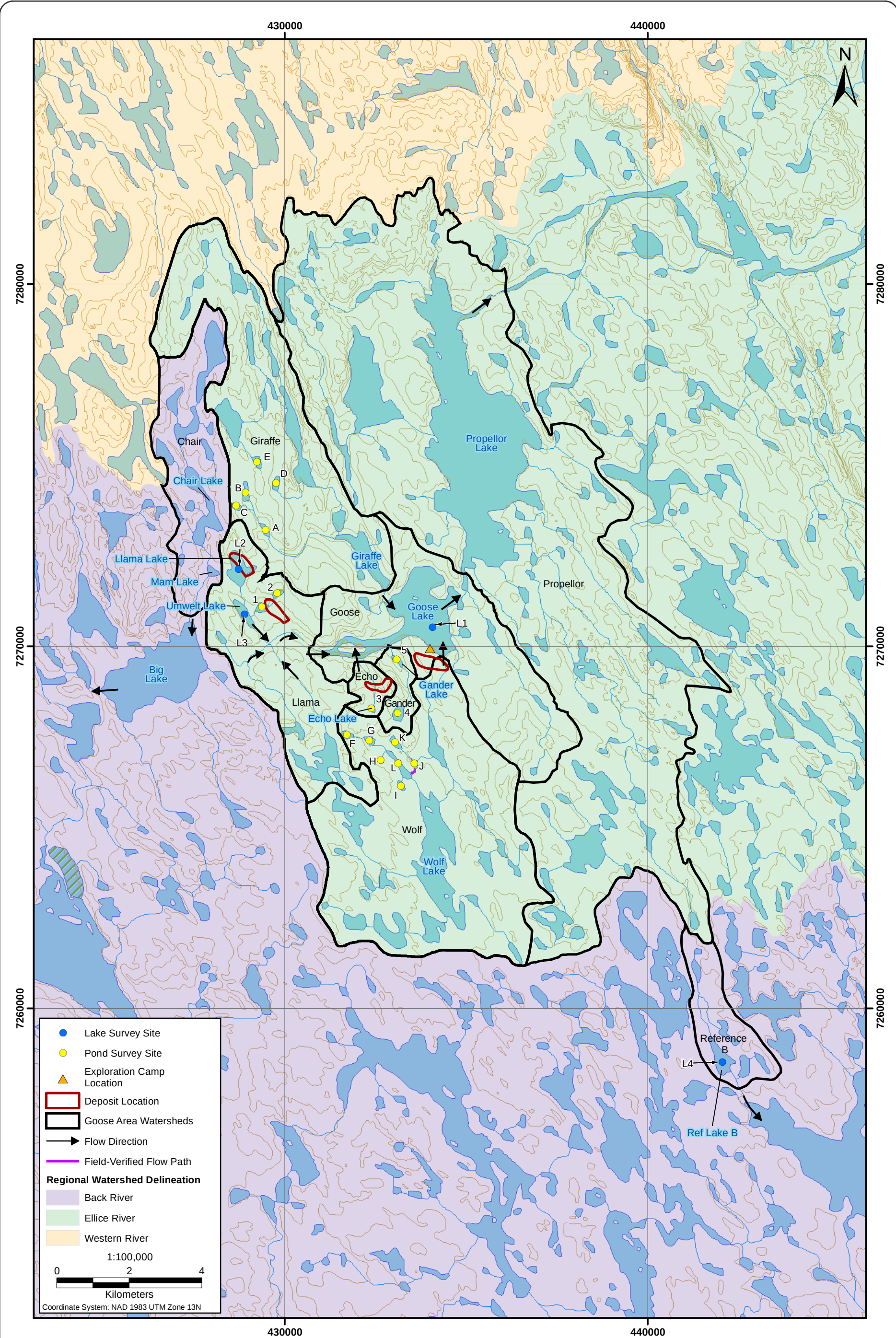
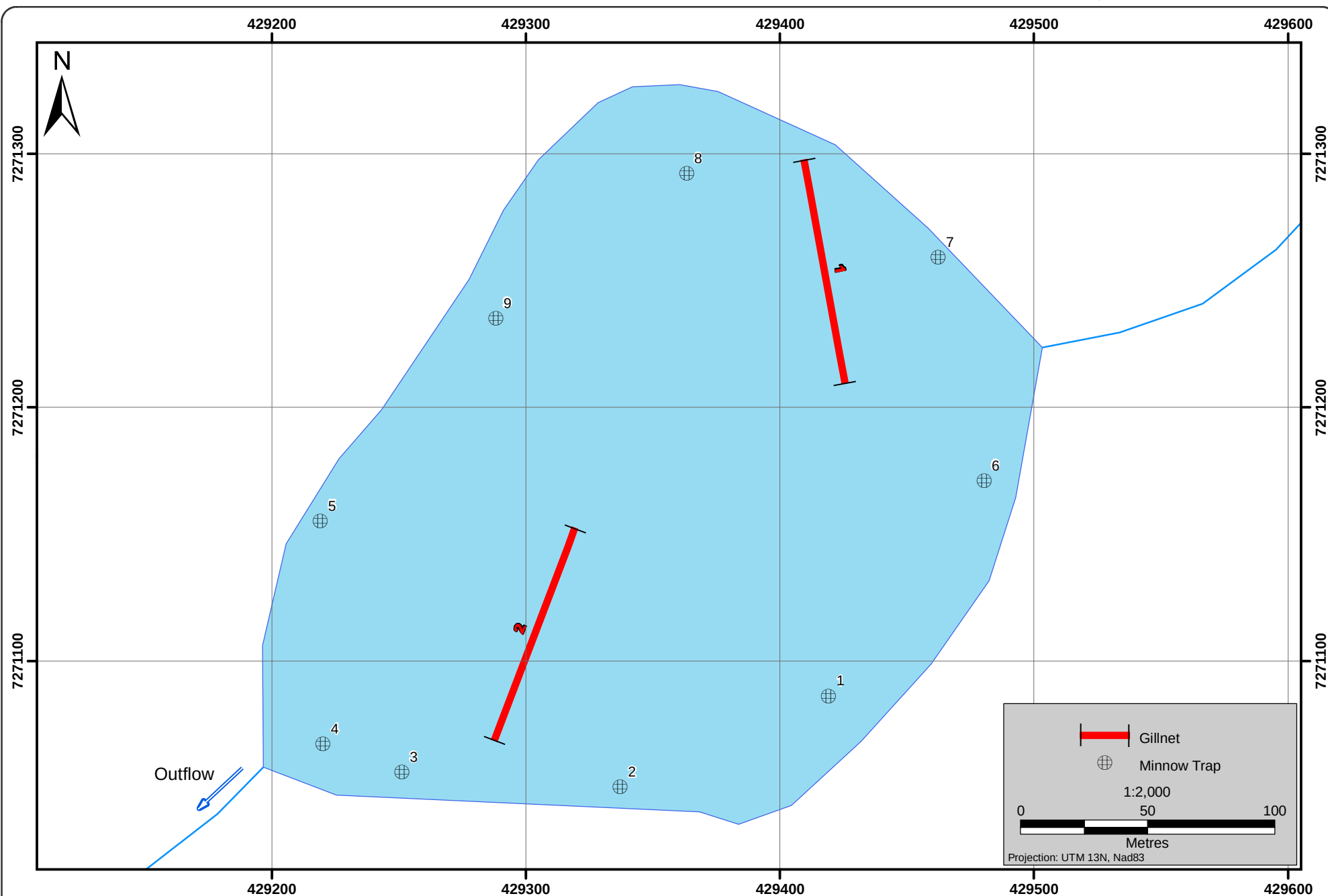
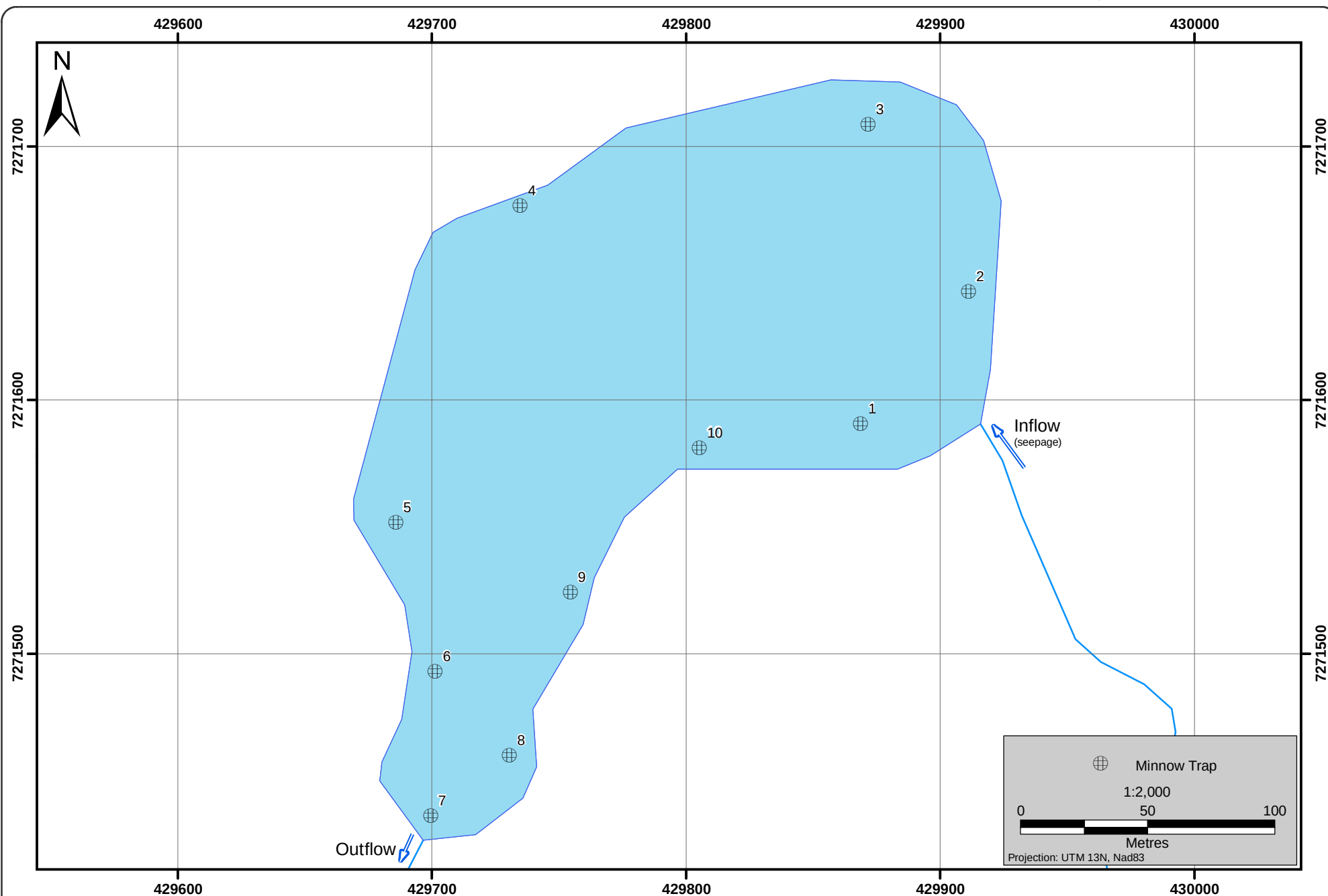
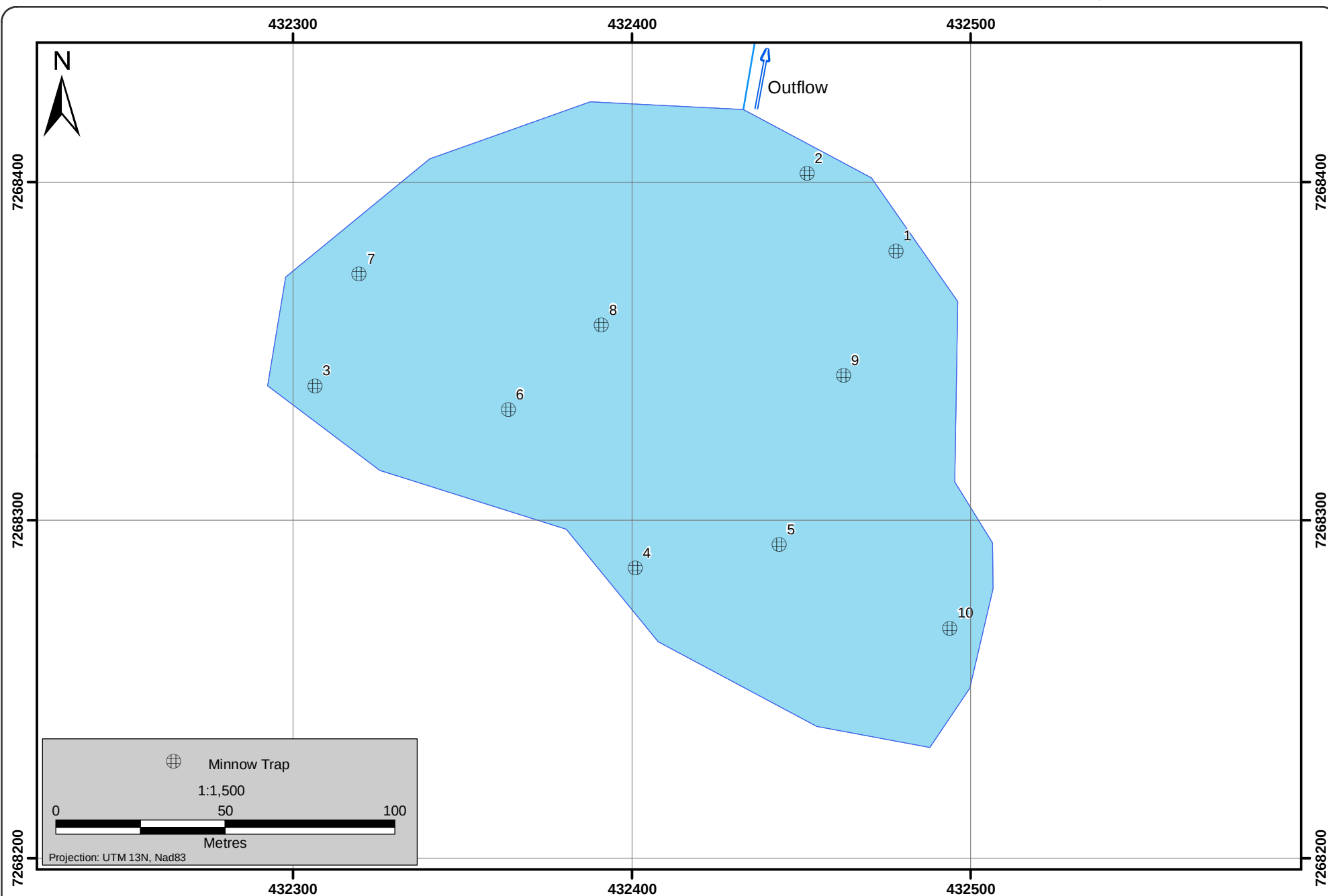
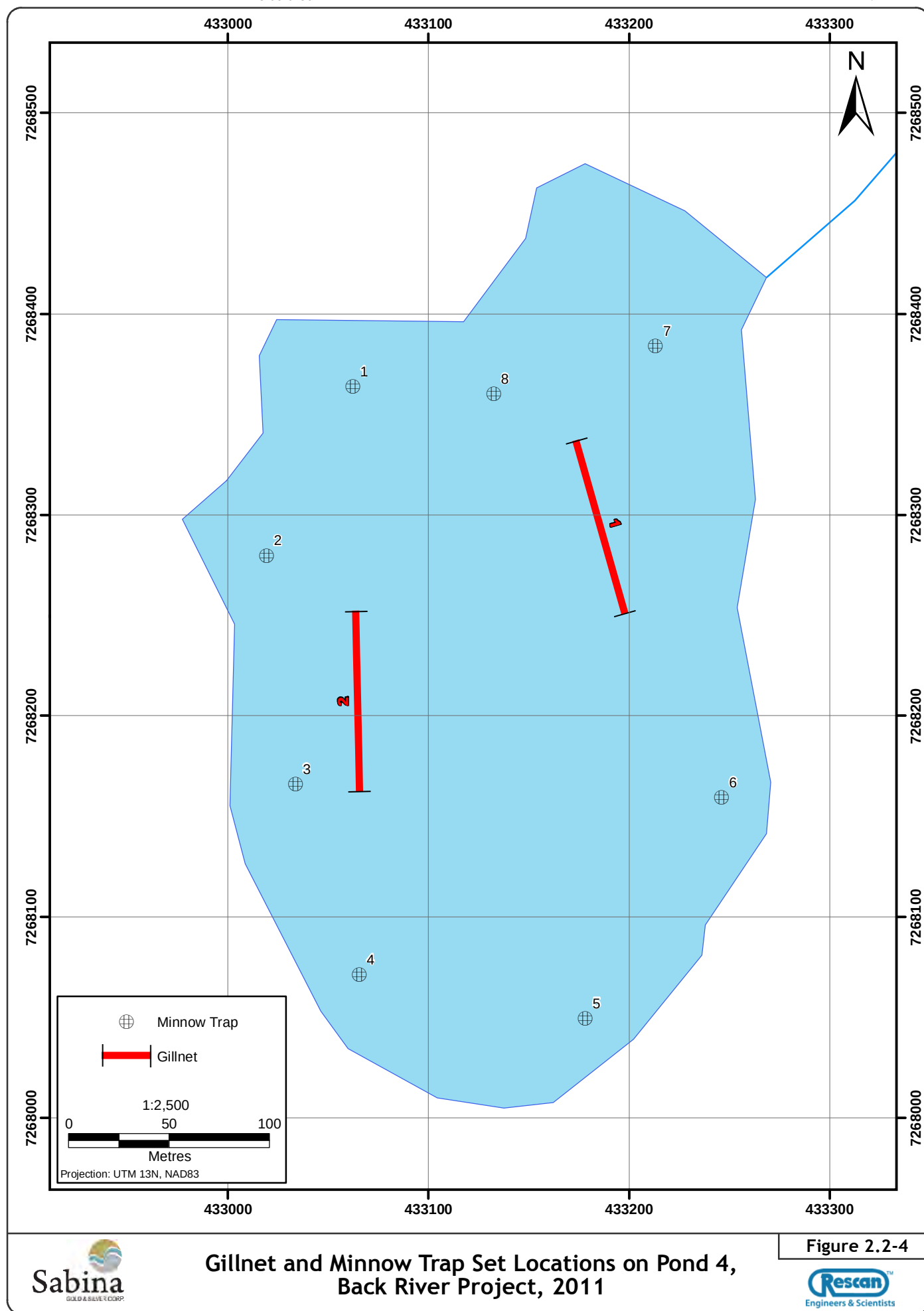


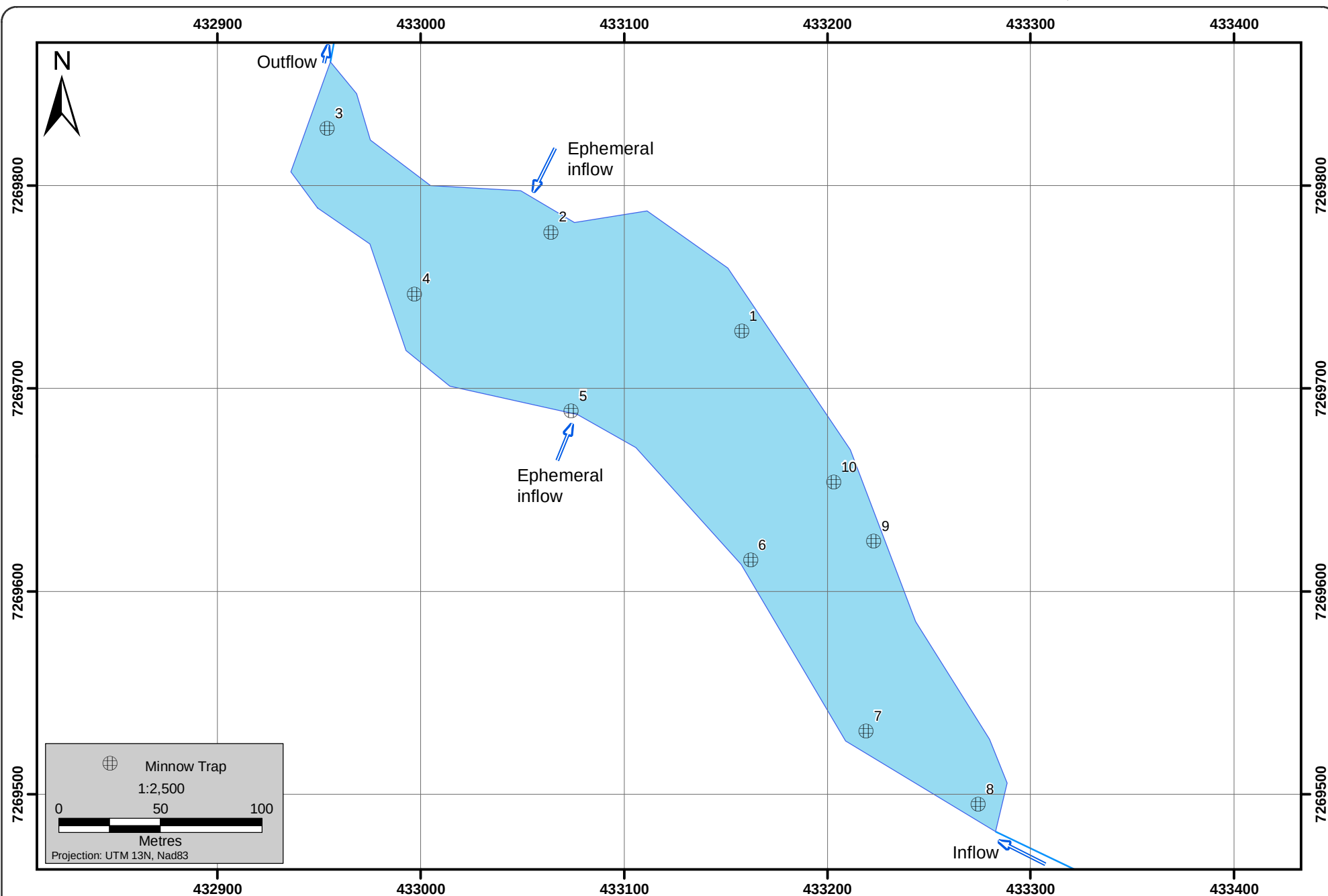
Figure 2.1-1

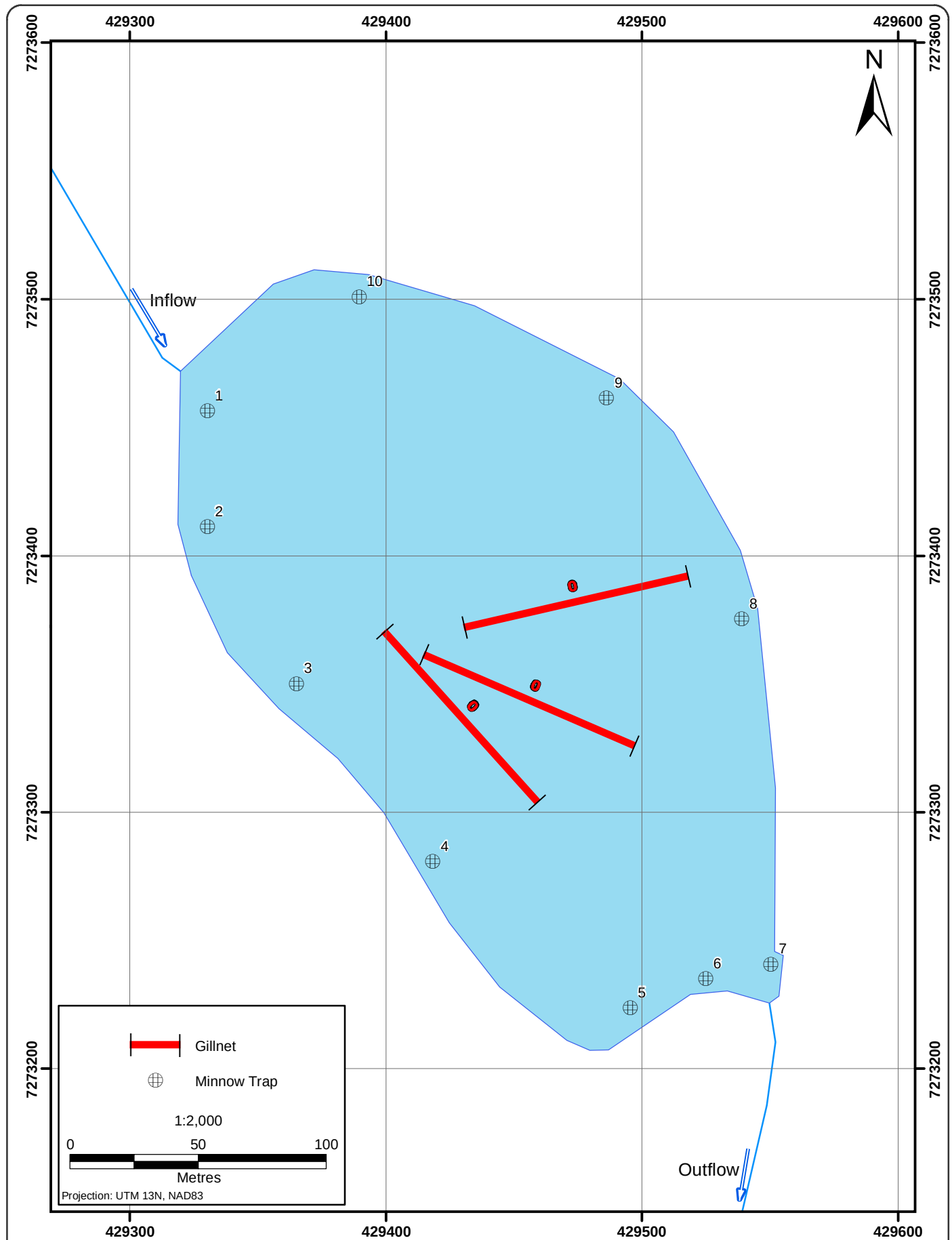






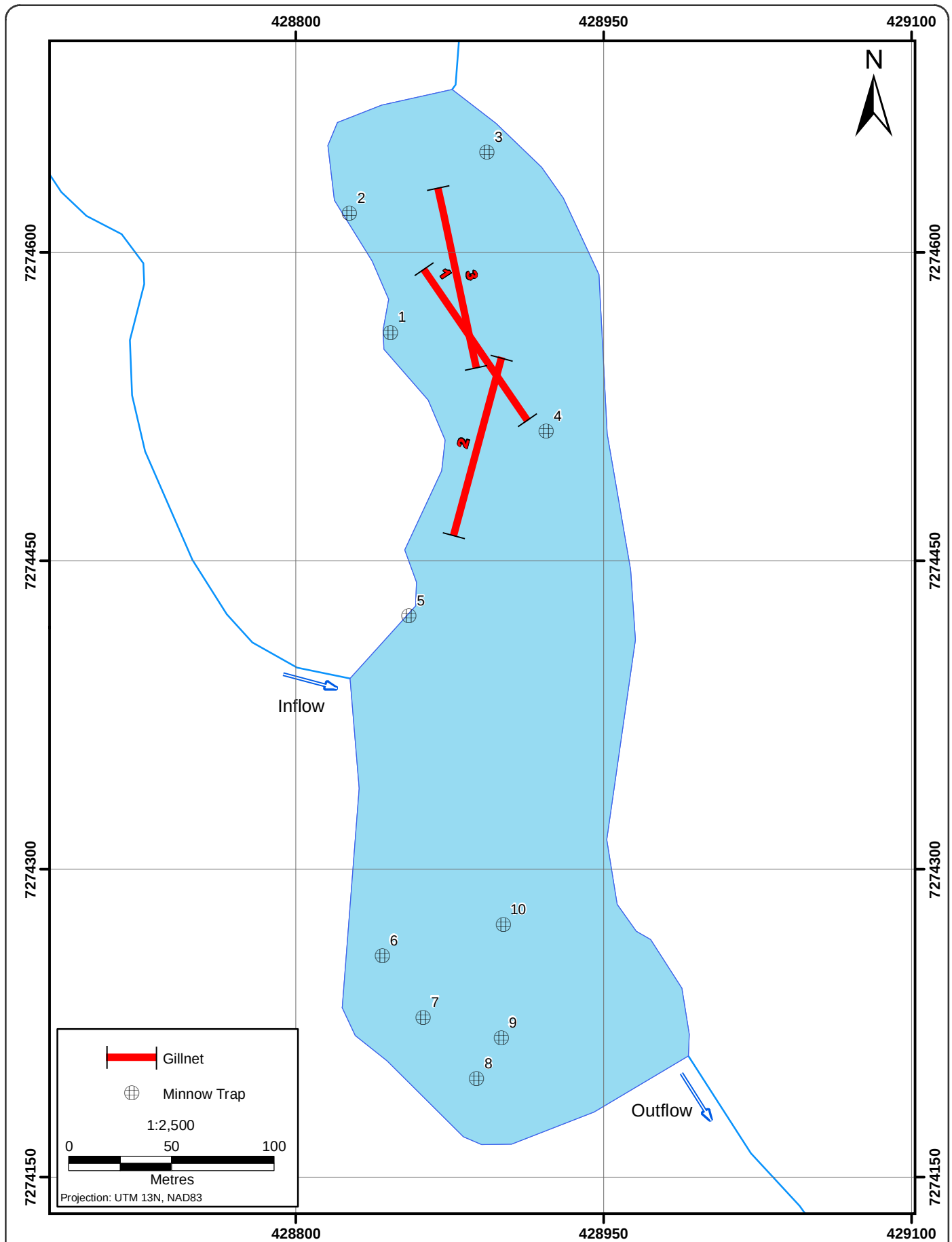






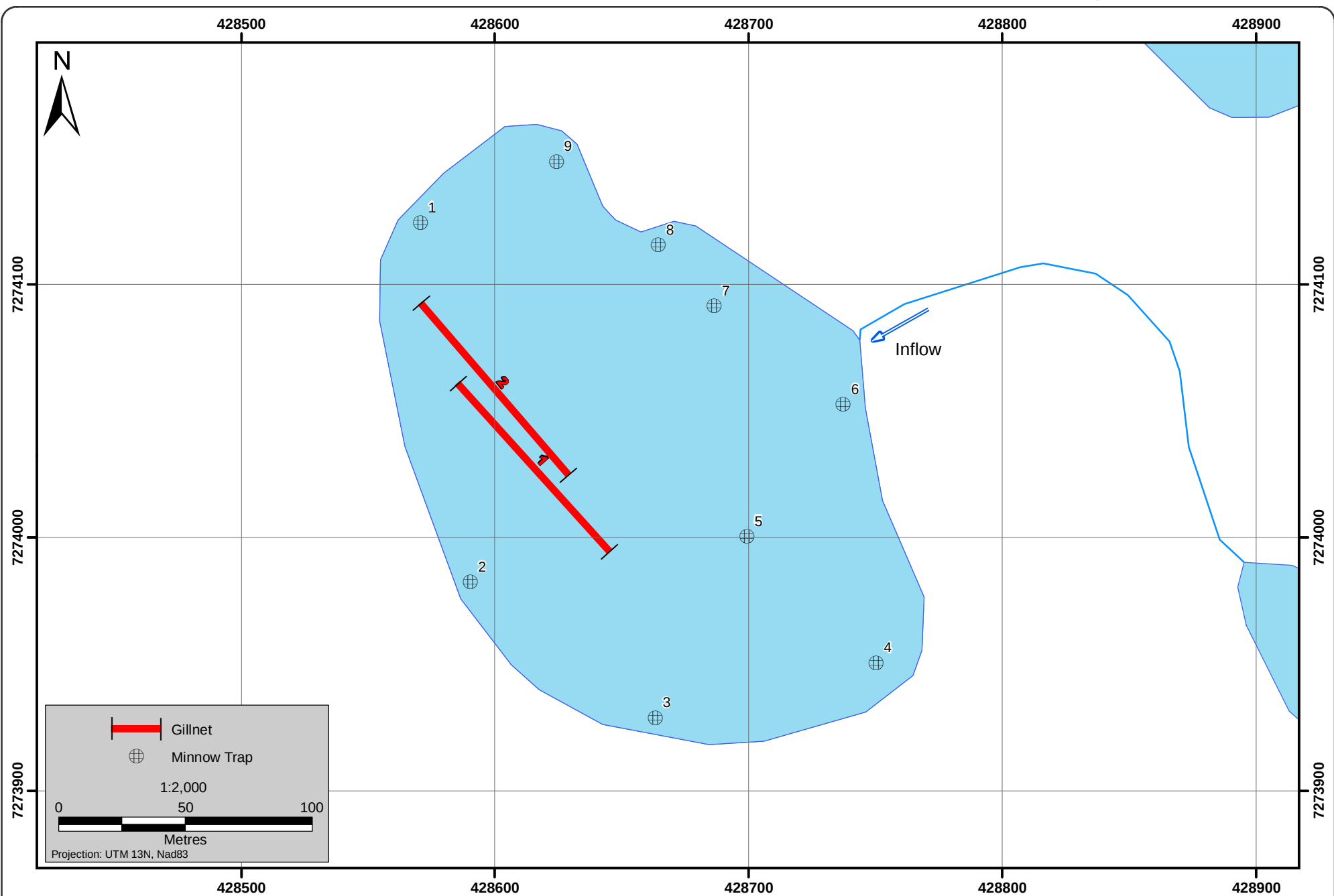
Gillnet and Minnow Trap Set Locations on Pond A,
Back River Project, 2011

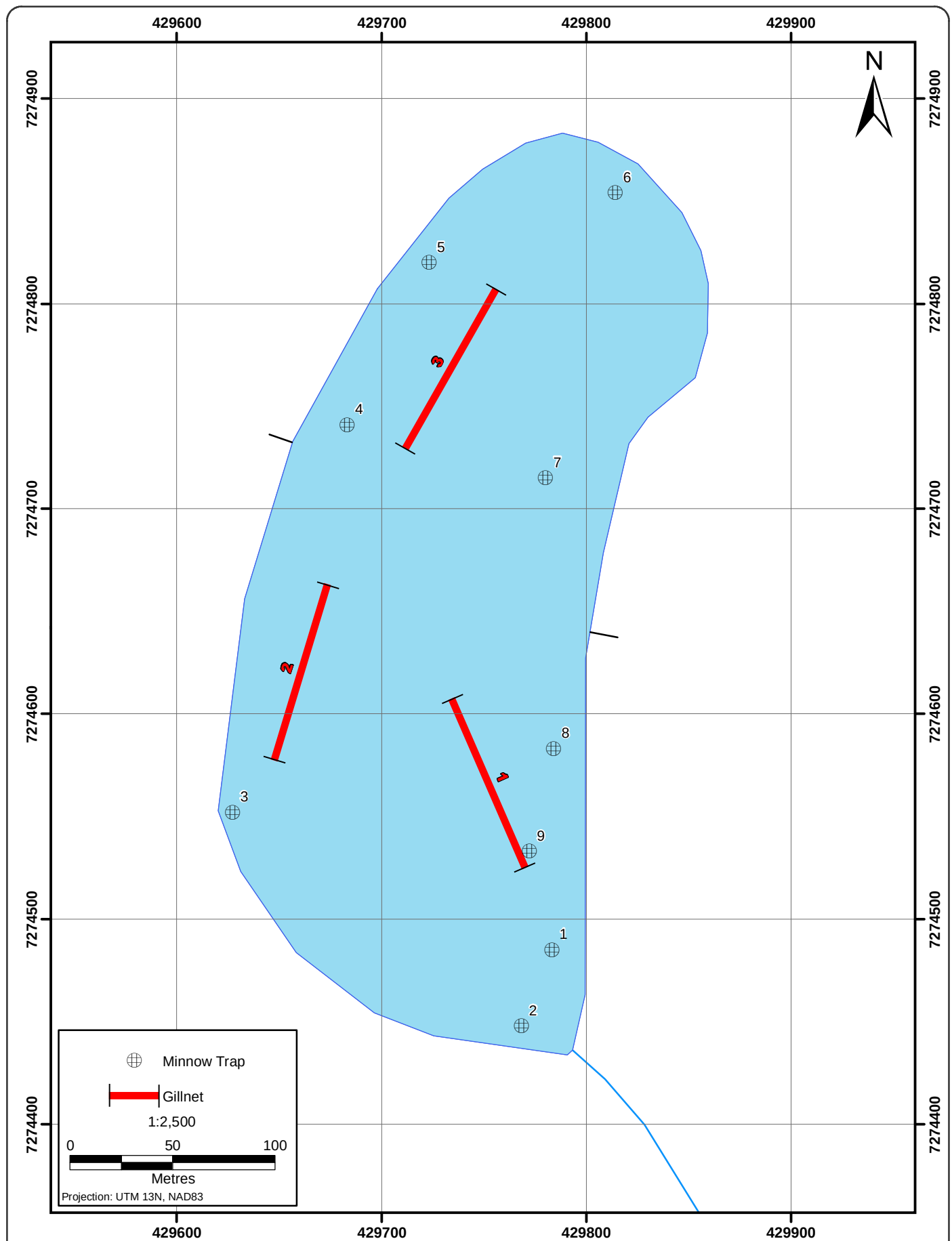
Figure 2.2-6



Gillnet and Minnow Trap Set Locations on Pond B,
Back River Project, 2011

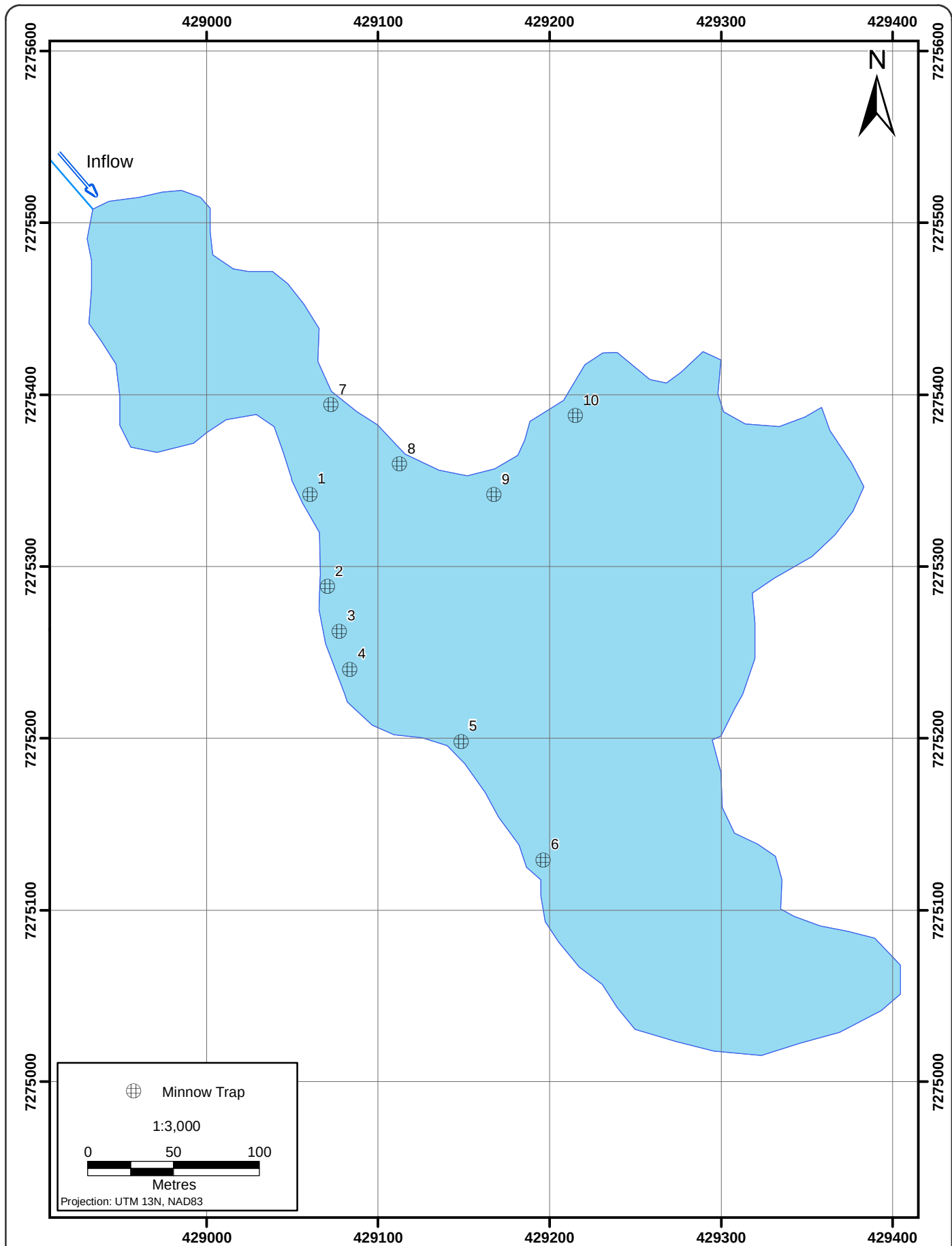
Figure 2.2-7





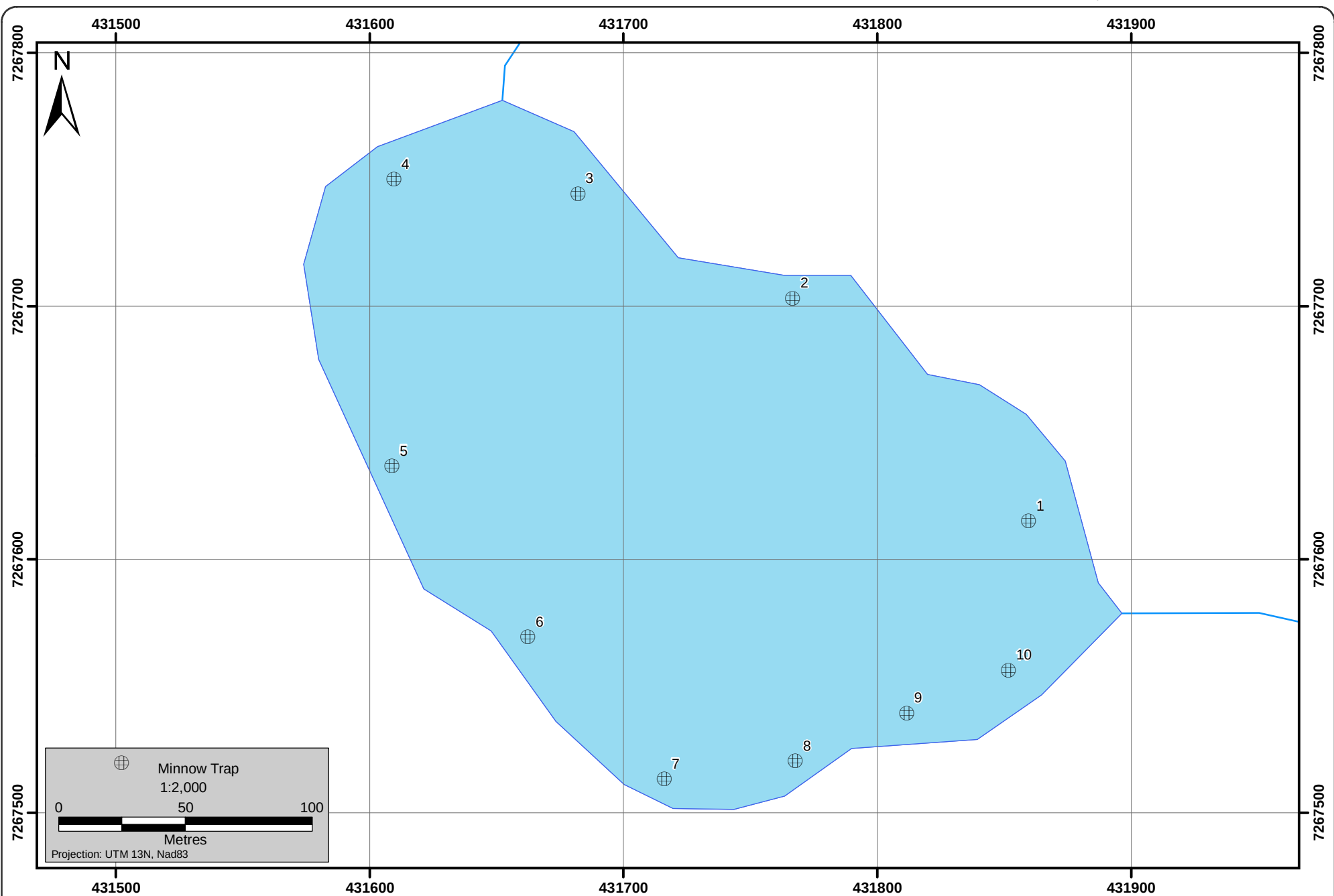
Gillnet and Minnow Trap Set Locations on Pond D,
Back River Project, 2011

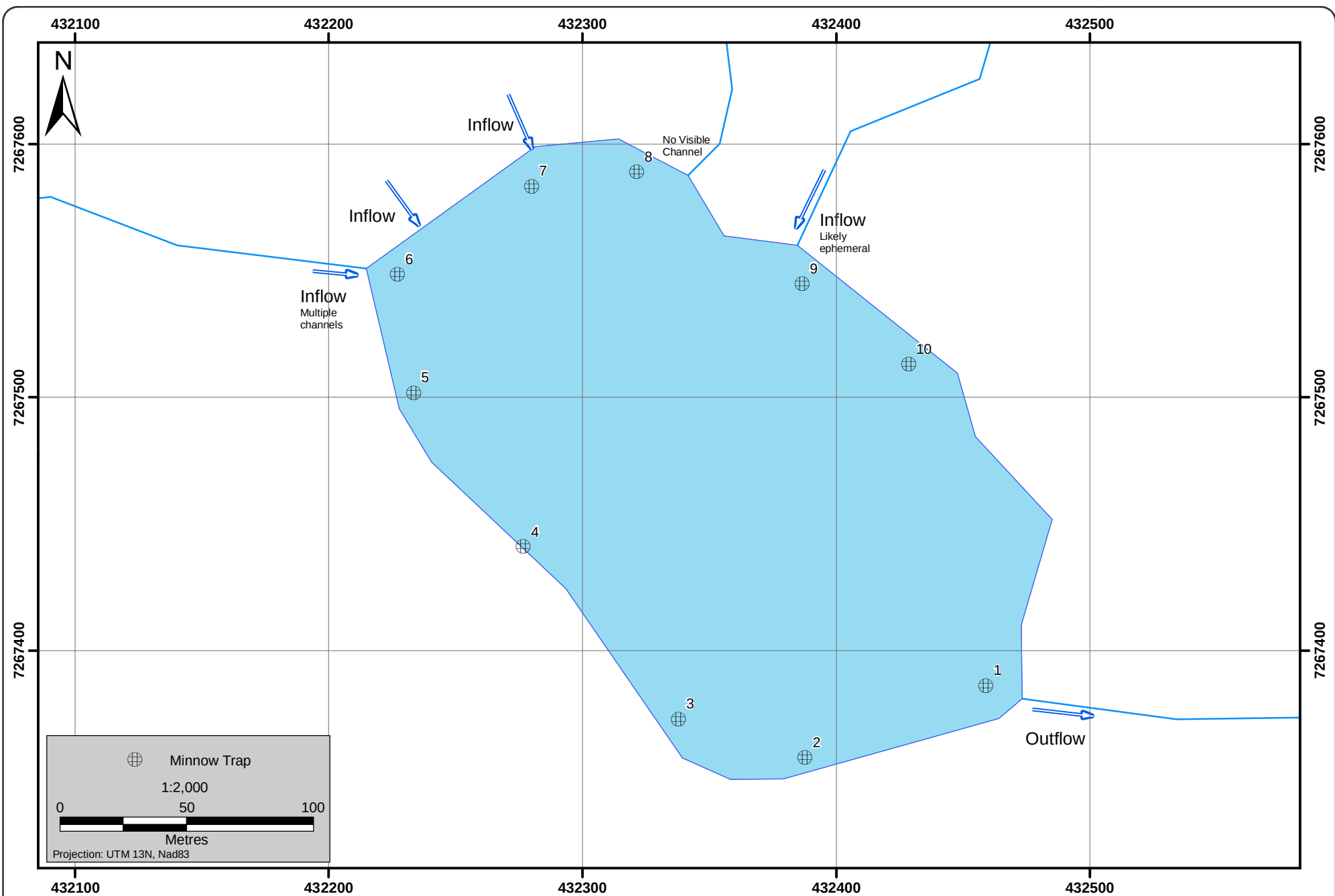
Figure 2.2-9

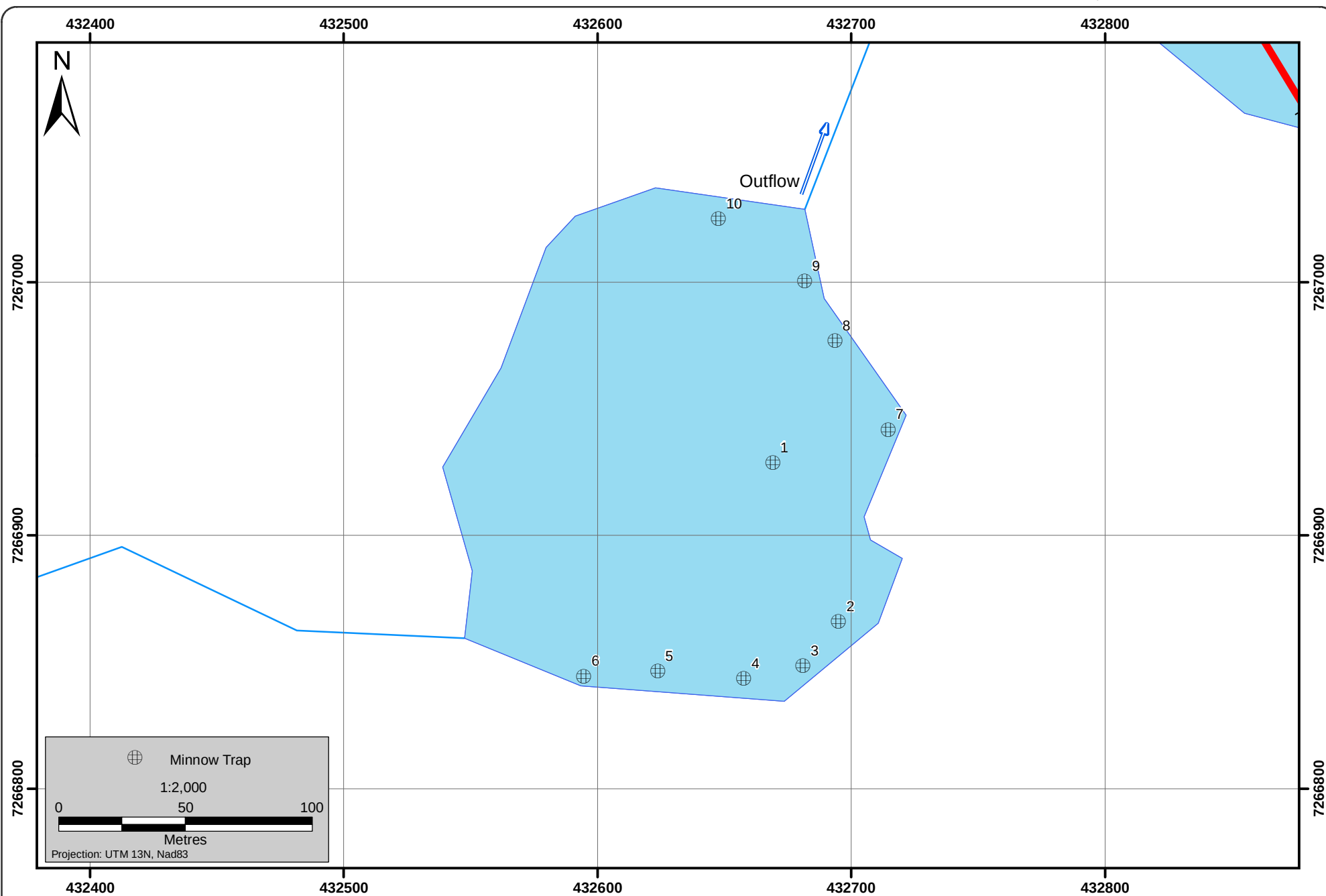


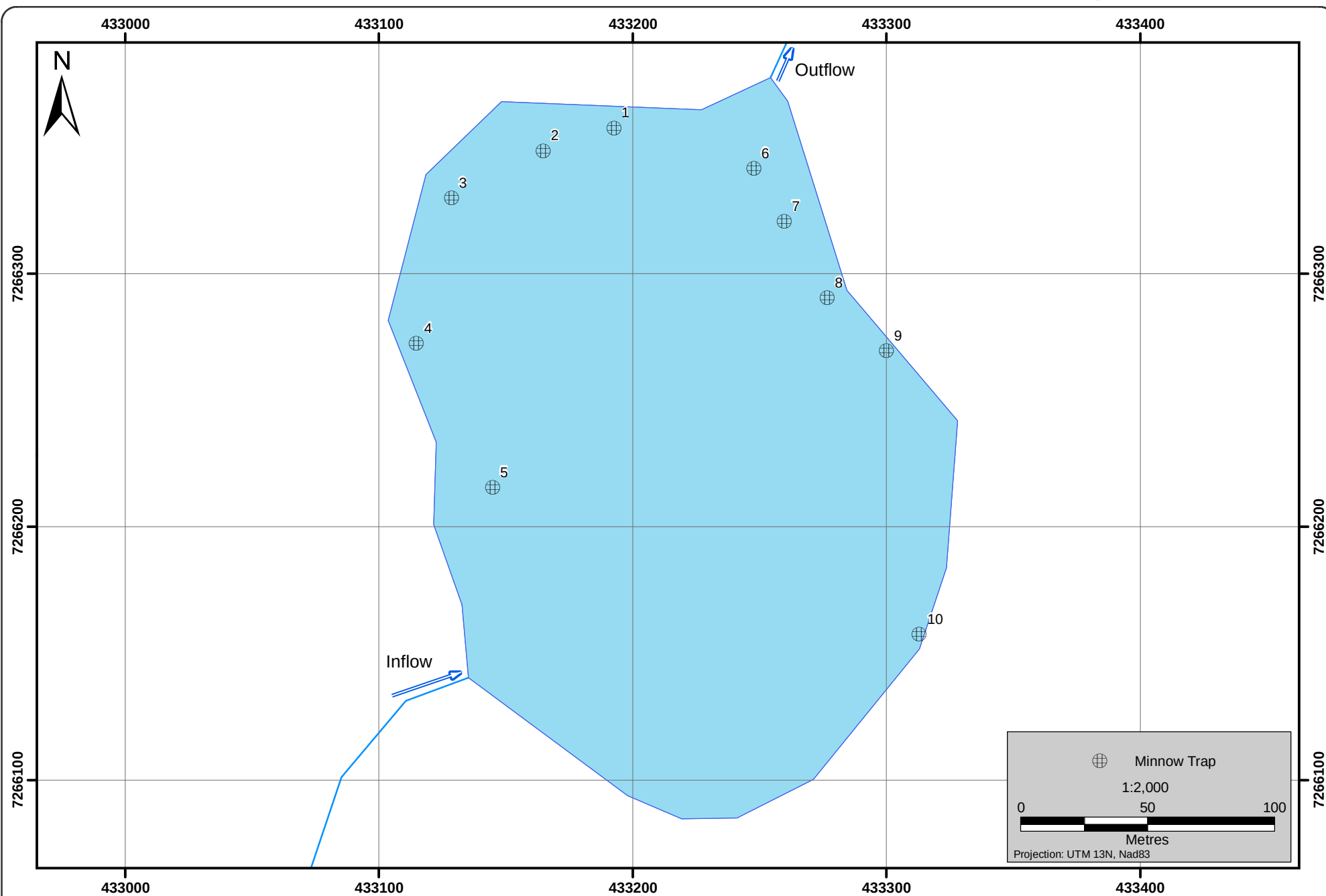
Gillnet and Minnow Trap Set Locations on Pond E,
Back River Project, 2011

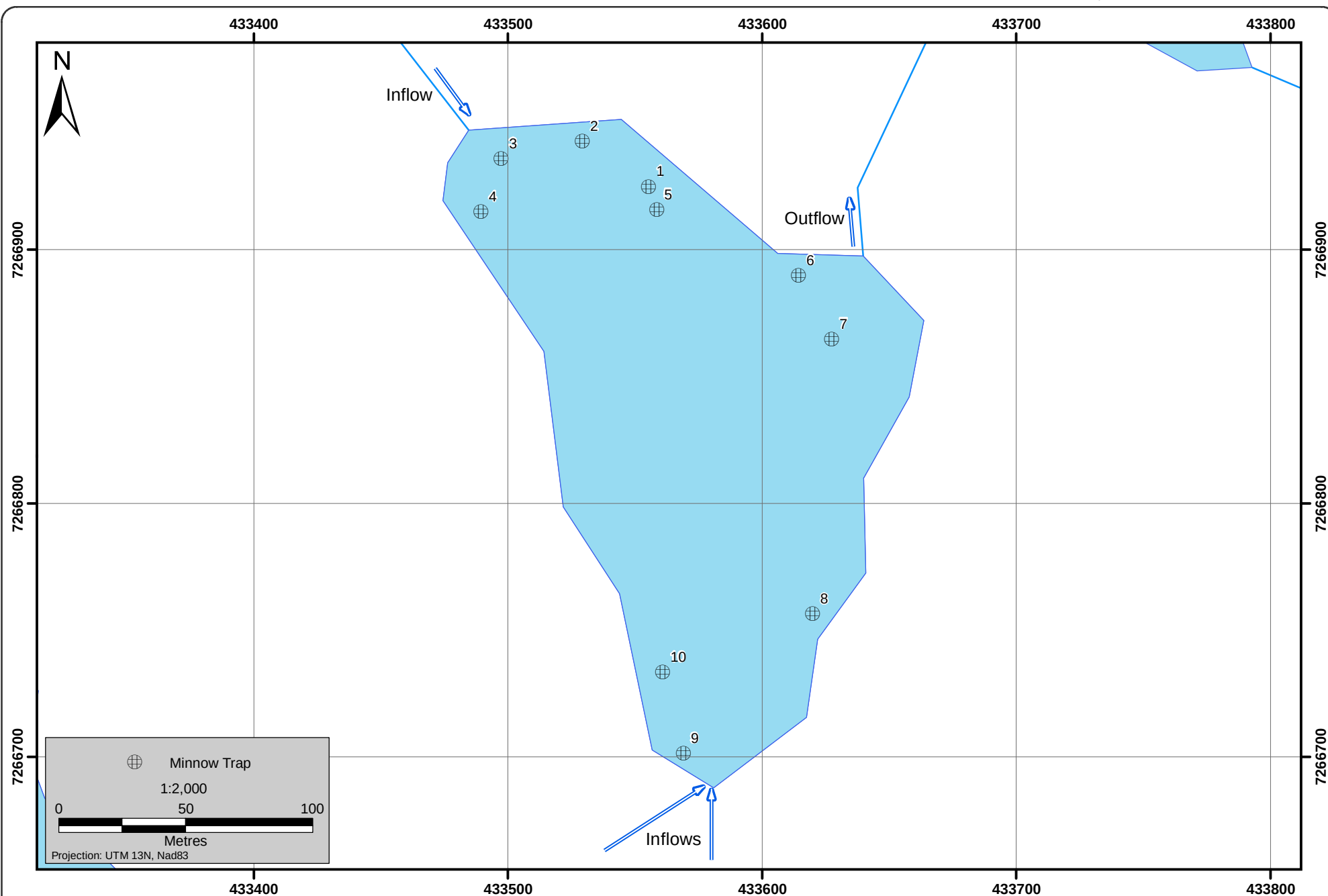
Figure 2.2-10

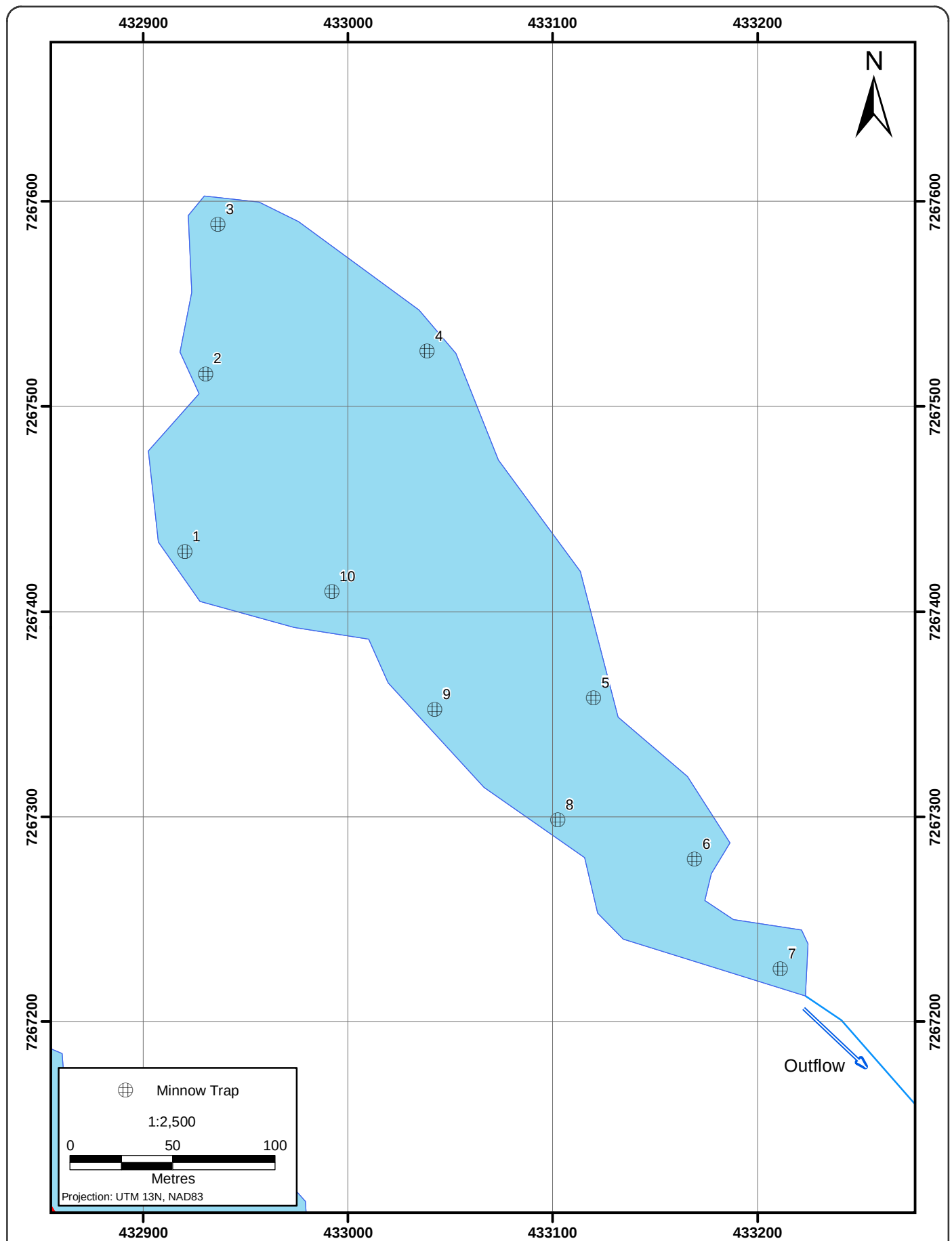






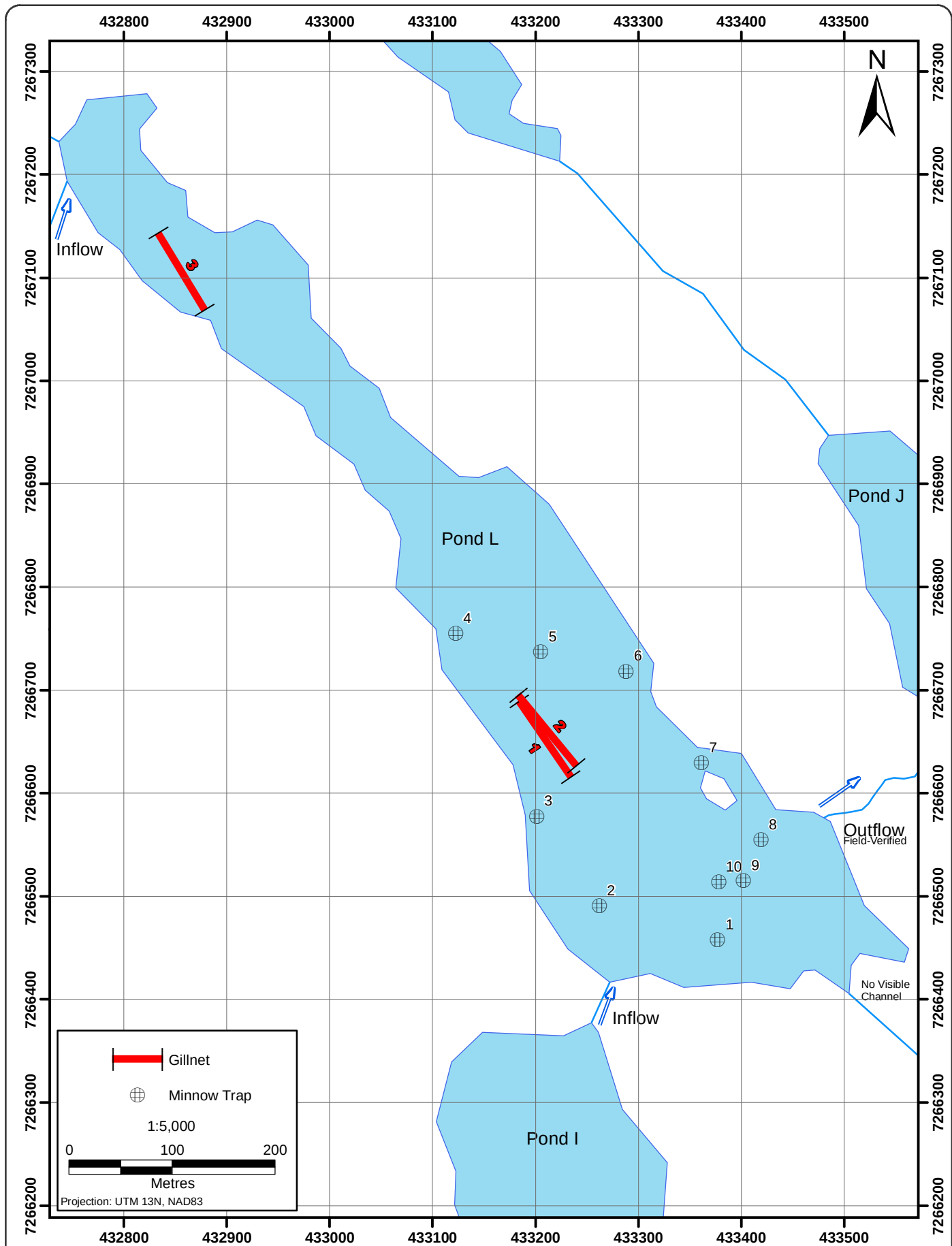






Gillnet and Minnow Trap Set Locations on Pond K,
Back River Project, 2011

Figure 2.2-16



Gillnet and Minnow Trap Set Locations on Pond L,
Back River Project, 2011

Figure 2.2-17

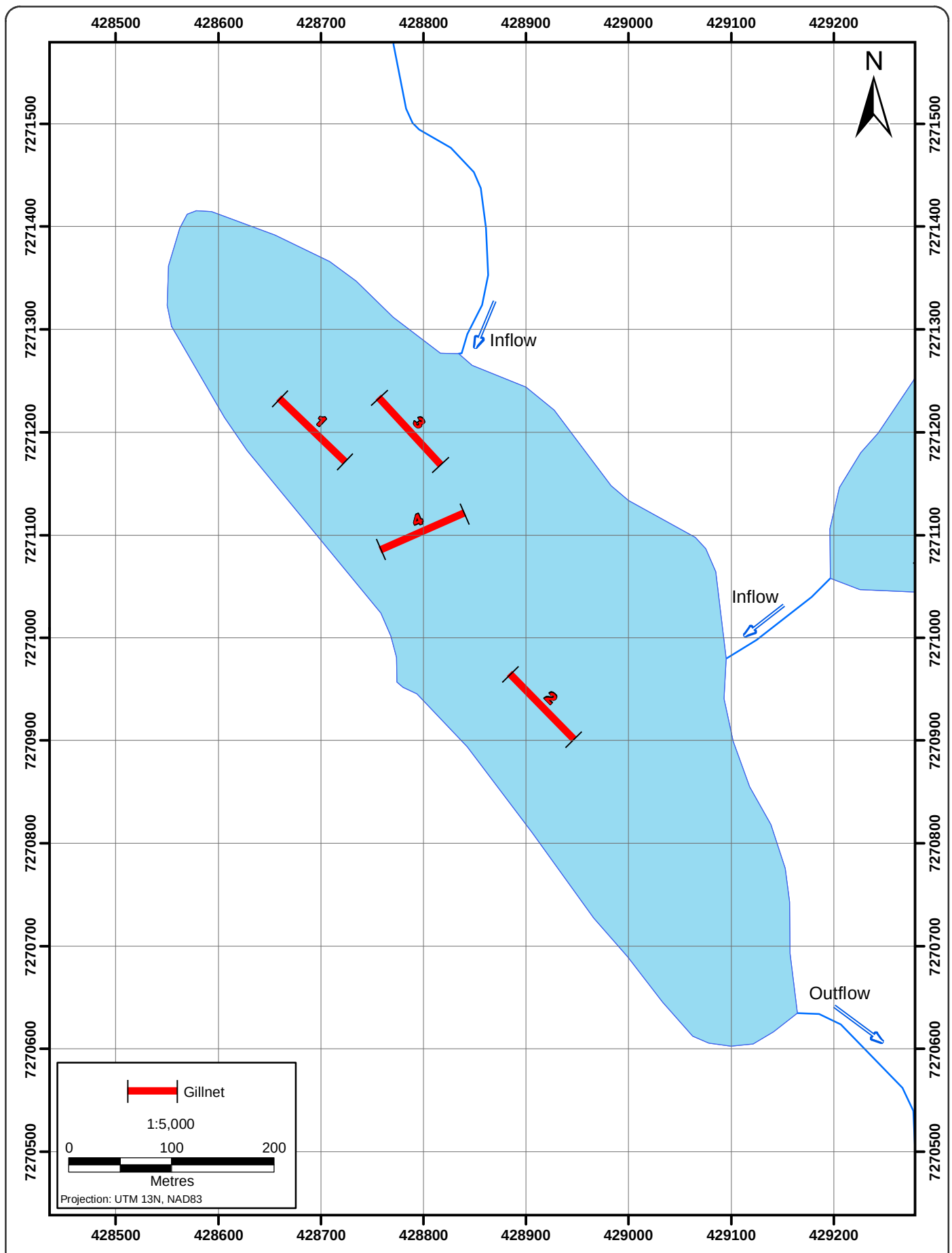
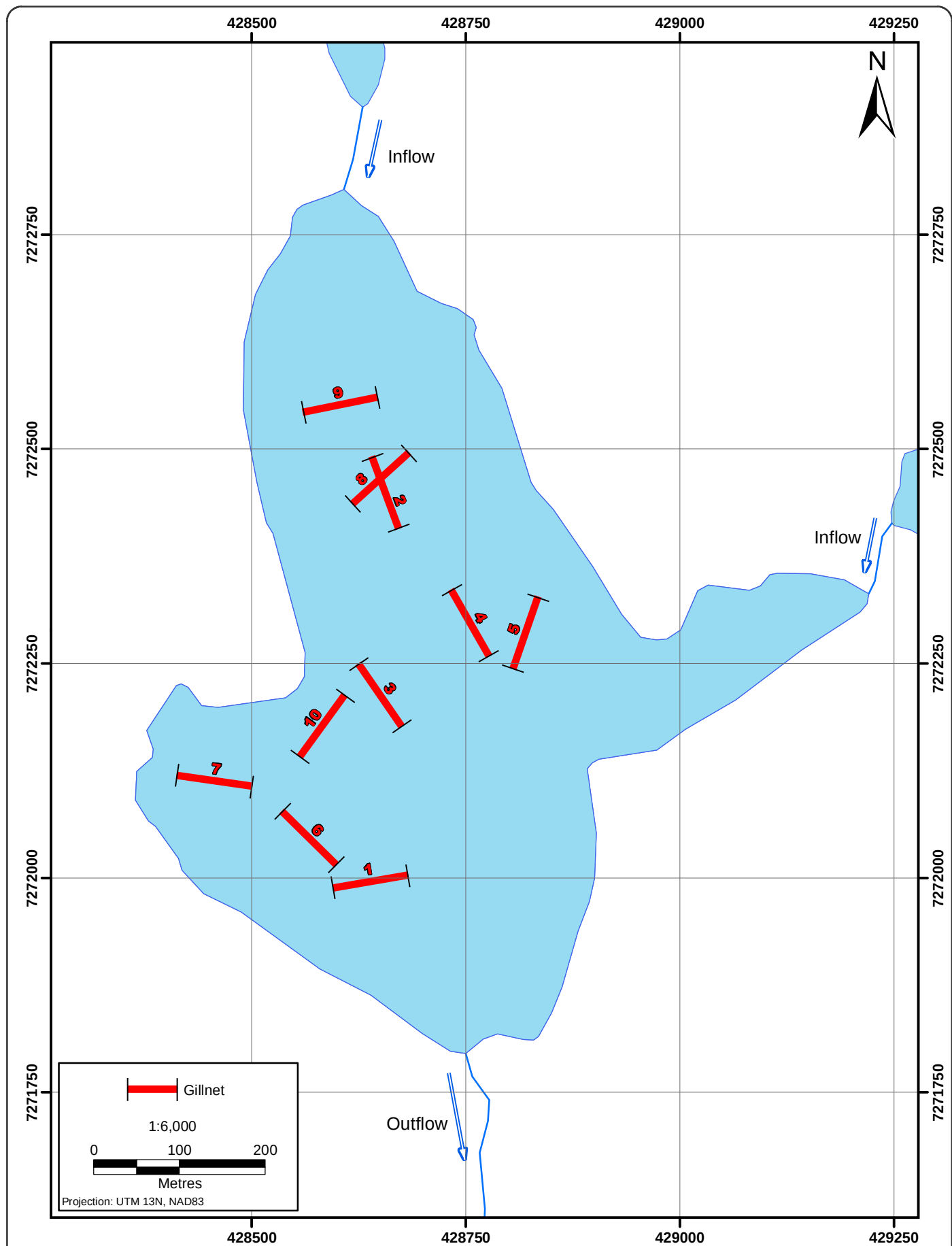
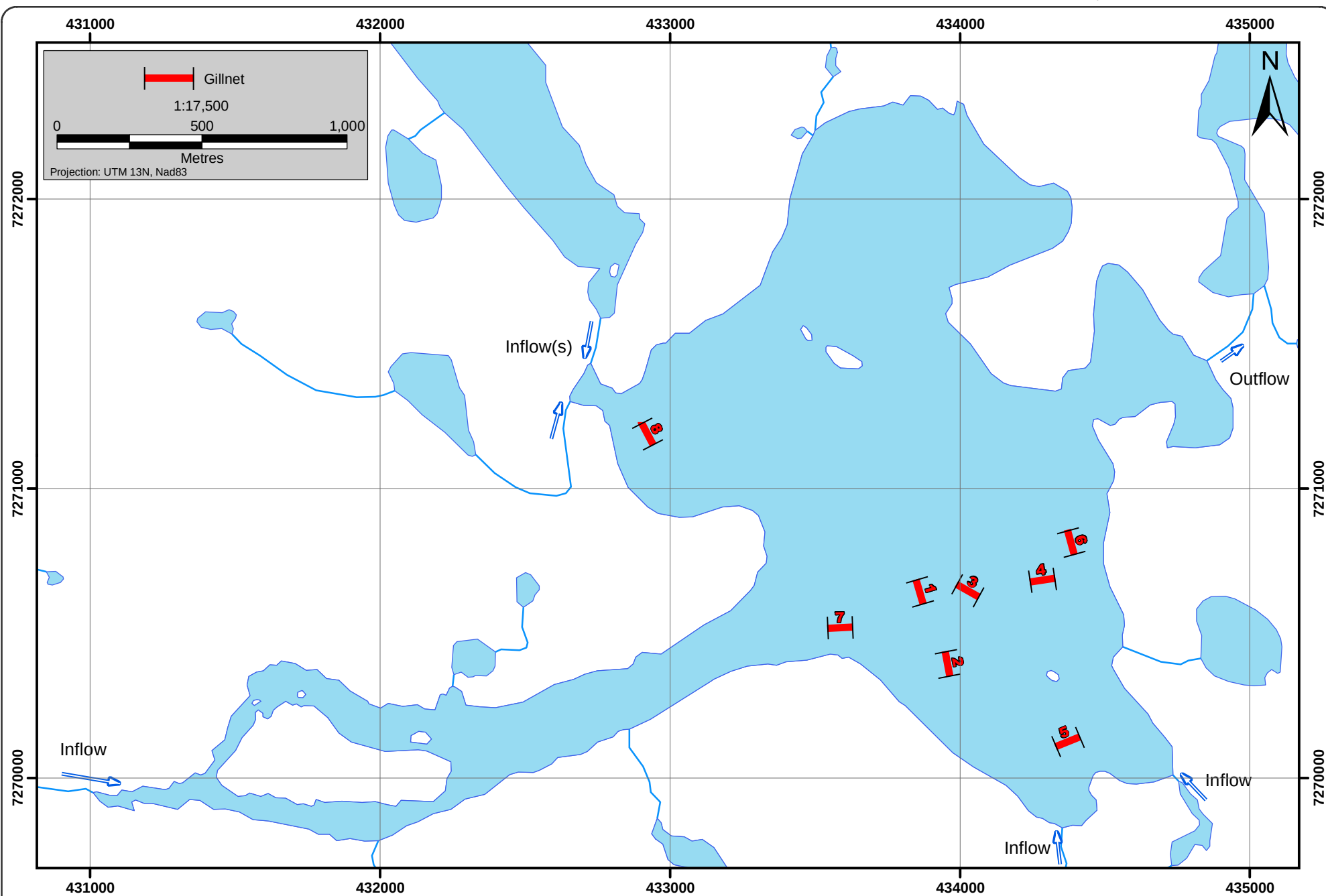


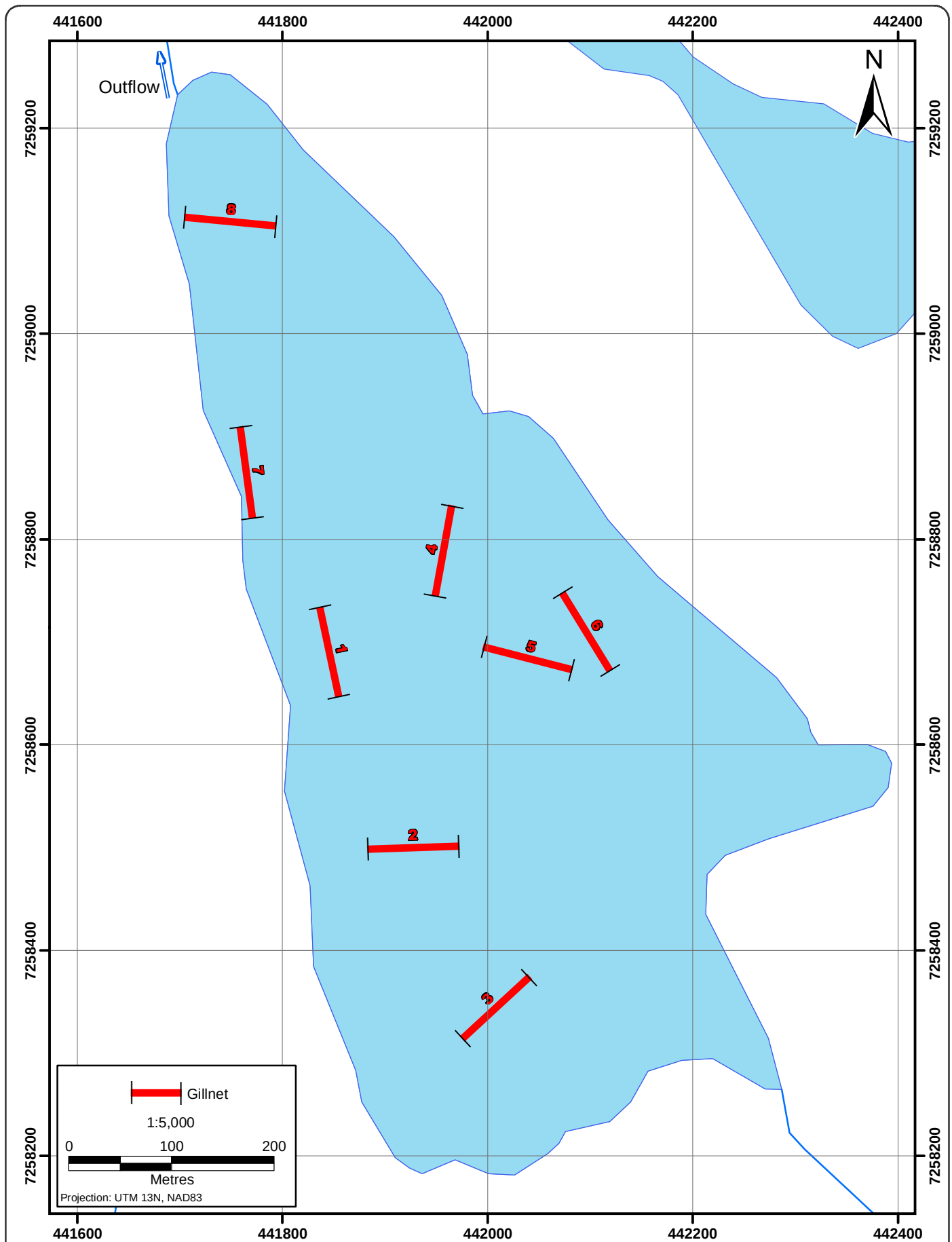
Figure 2.3-1



Gillnet Sampling Locations on Llama Lake,
Back River Project

Figure 2.3-2





Gillnet Sampling Locations on Reference B Lake,
Back River Project

Figure 2.3-4

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.

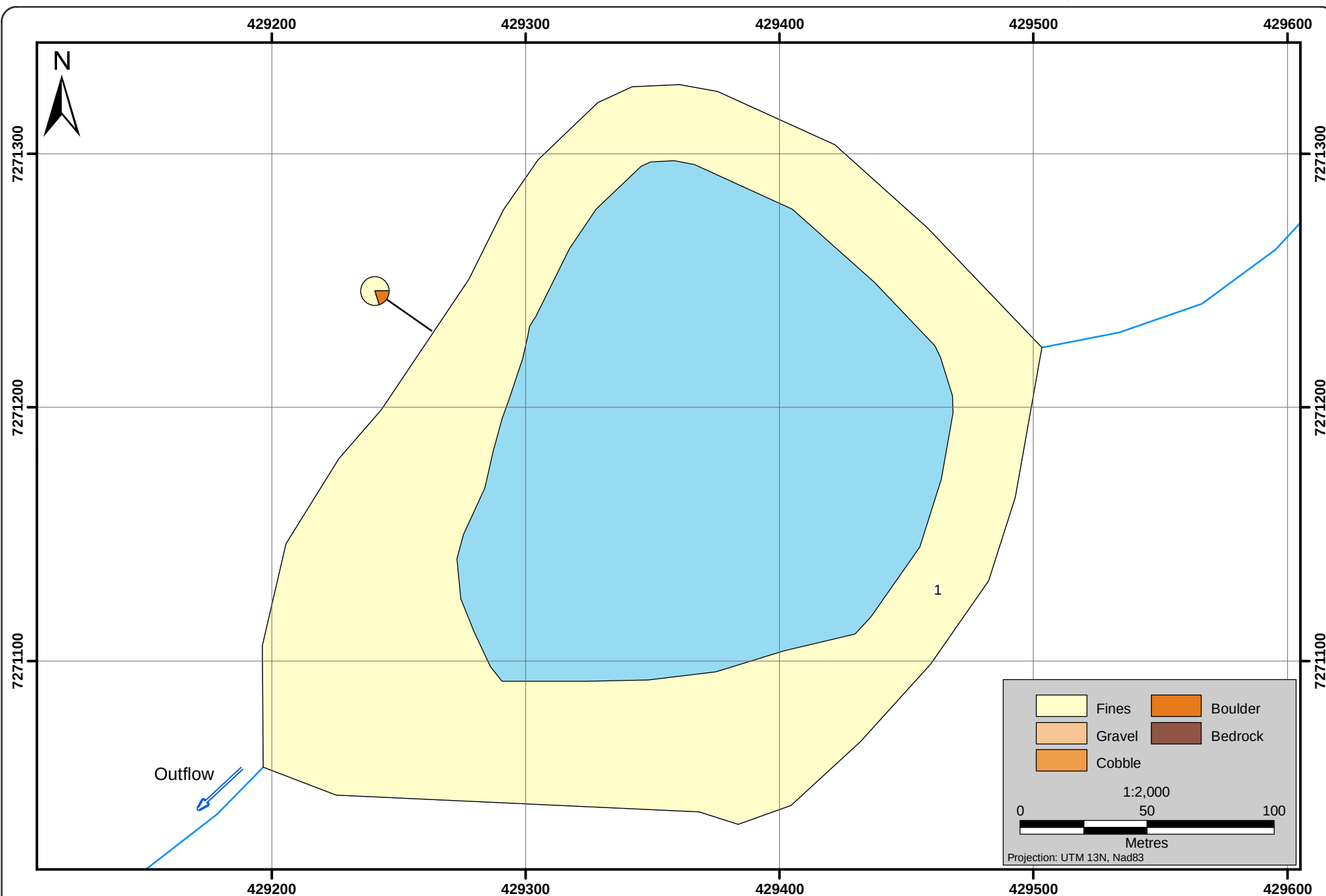
Llama Watershed

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.



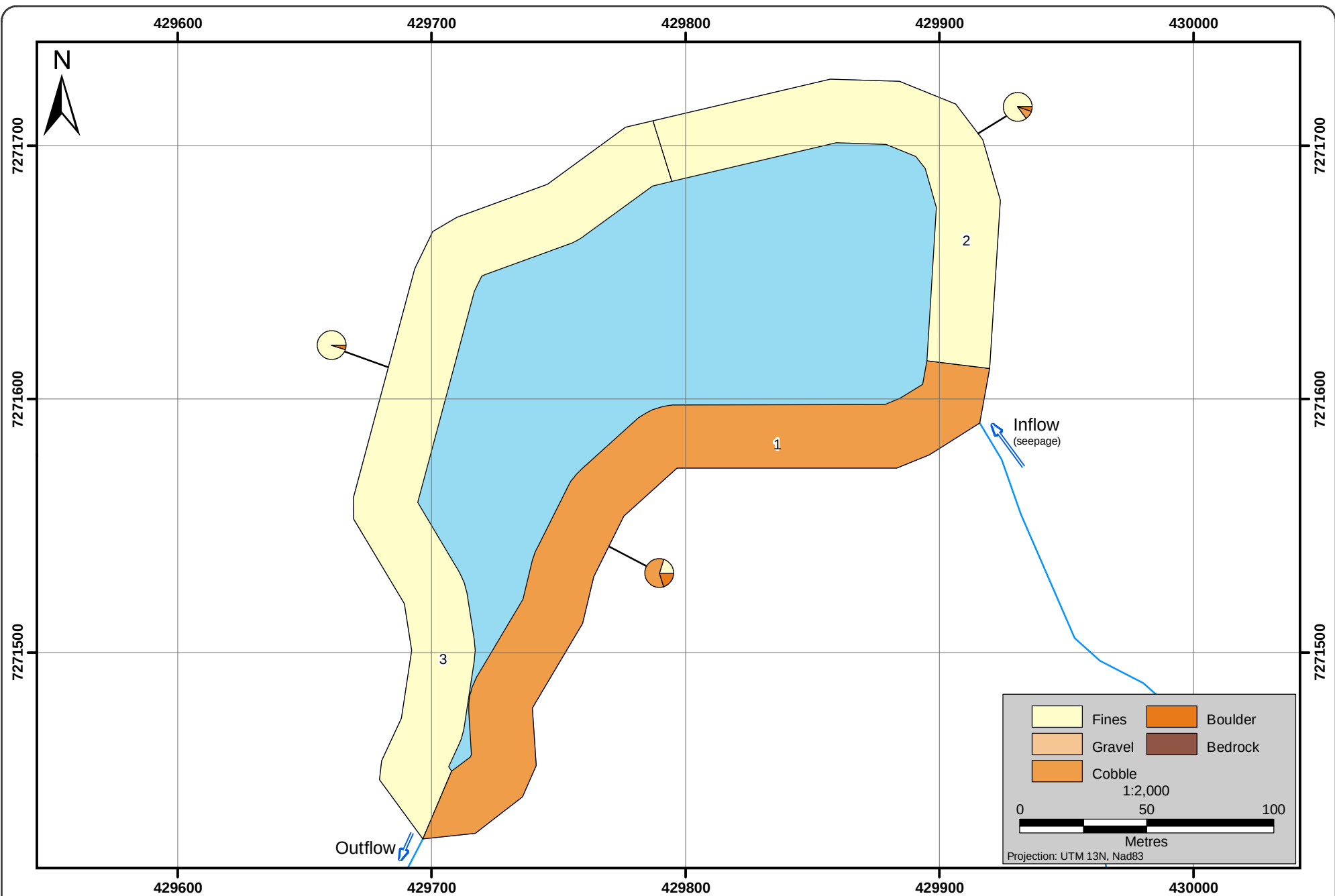




Plate 3.1-2. Shoreline substrate and minnow trap at Pond 2, Llama watershed, looking north on July 5, 2011.

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.

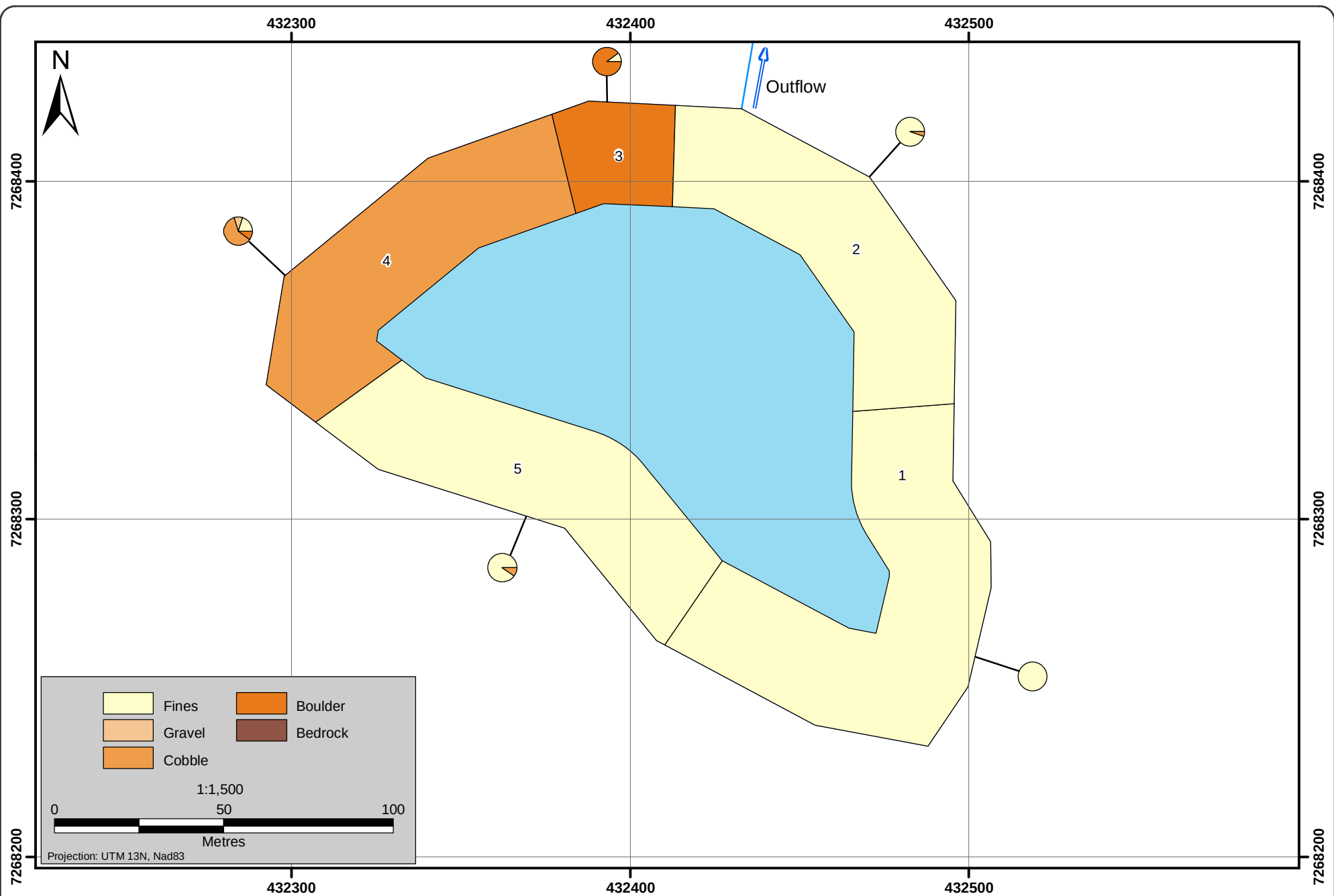
Gander Watershed

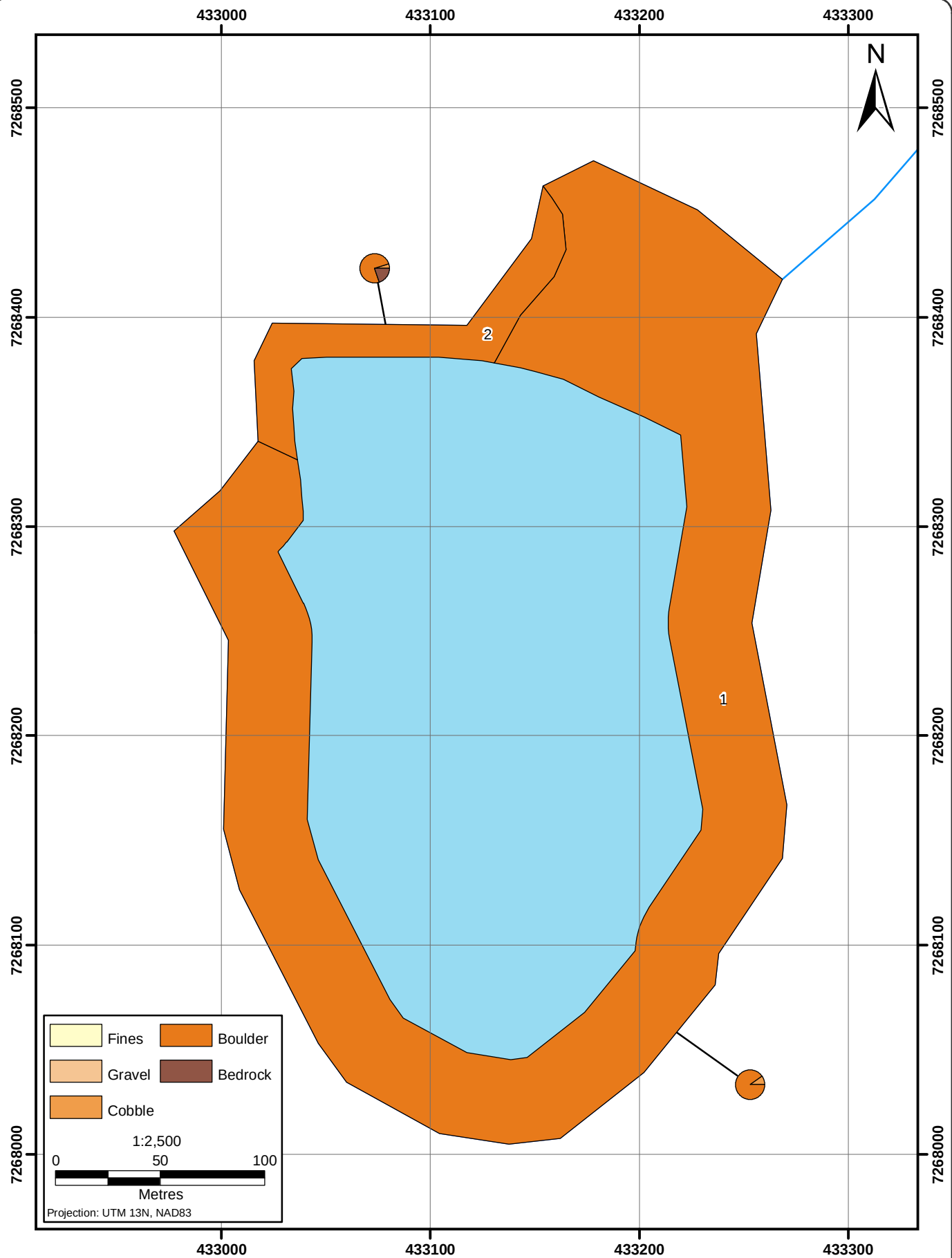
Pond 4 is located south of Goose Lake at the headwaters of a small watershed that drains into Goose Lake. The shoreline of the pond is dominated by boulder substrate with occasional cobble and bedrock. The pond has a single outflow and no permanent inflow. The maximum depth of the pond was estimated 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.





Shoreline Substrate of Pond 4,
Gander Watershed, Back River Project

Figure 3.1-4

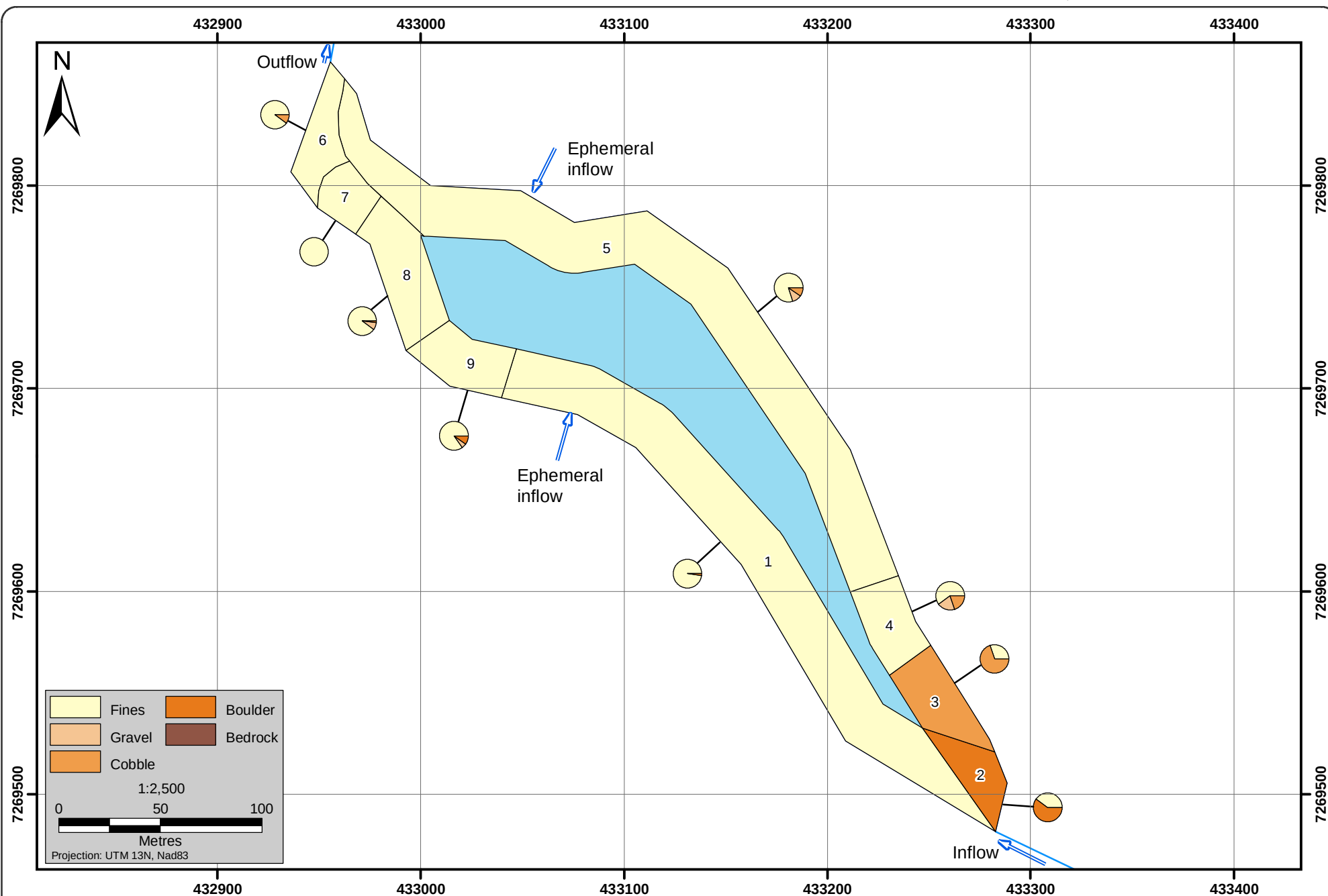
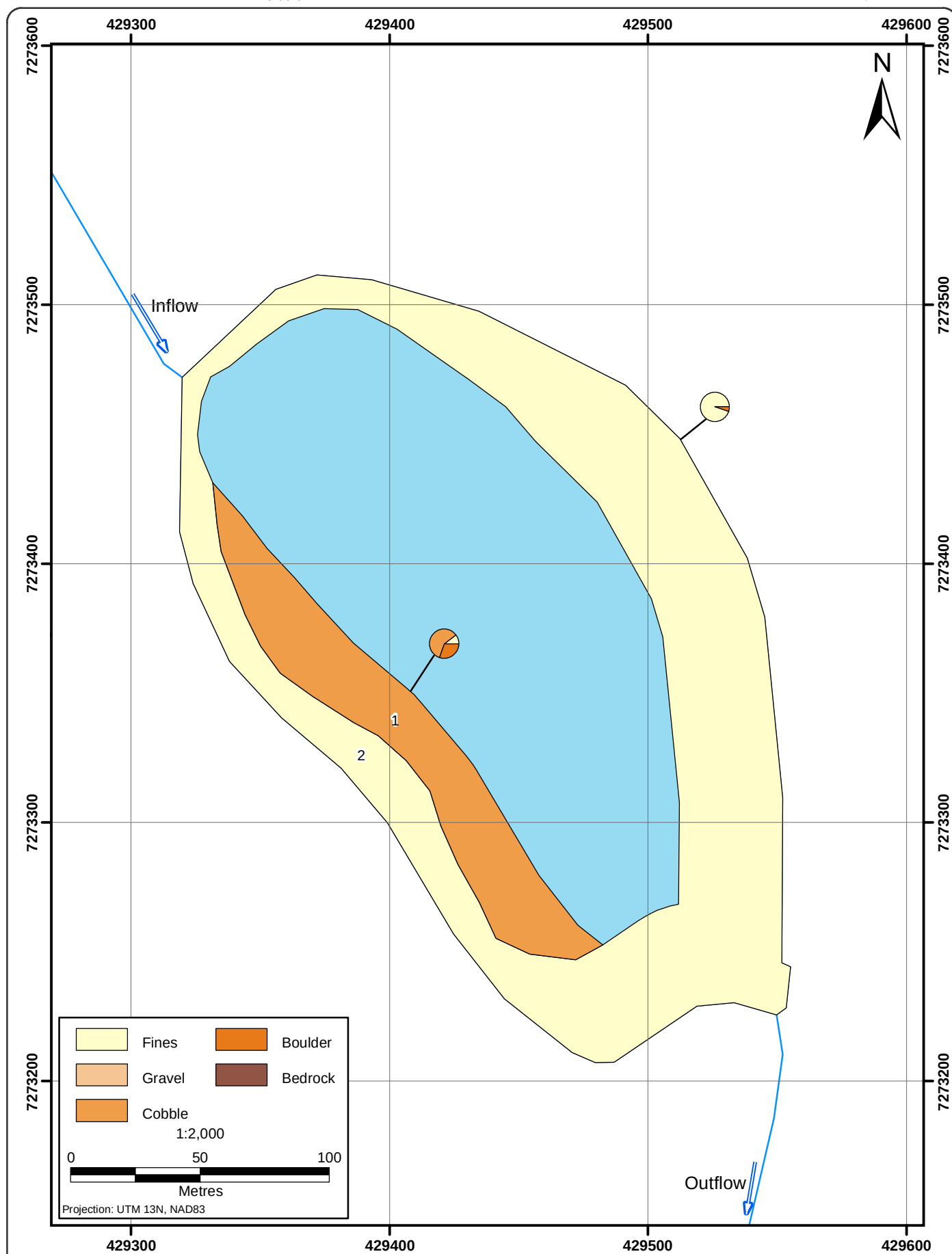


Figure 3.1-5



Shoreline Substrate of Pond A,
Giraffe Watershed, Back River Project

Figure 3.1-6



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.

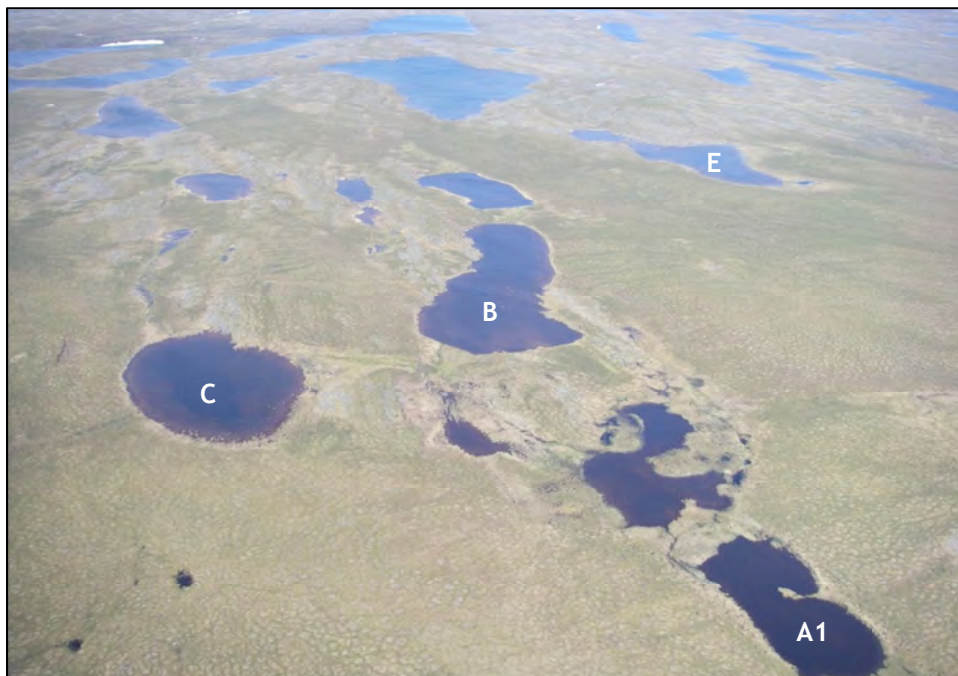
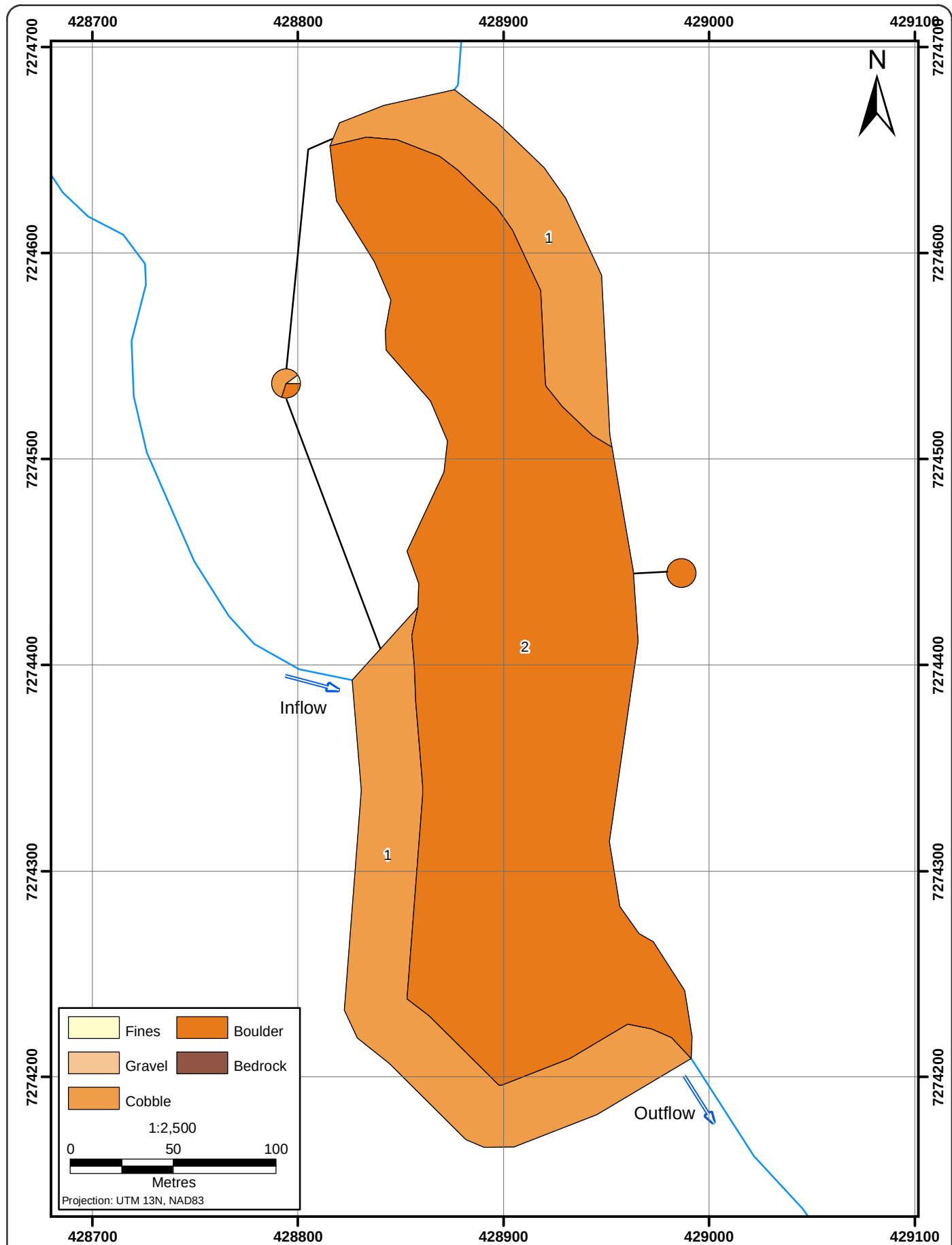


Plate 3.1-5. Aerial view of Ponds A1 - C in the Giraffe watershed. Pond A1 is in the lower right. Pond C lies to the left, and Pond B is the elongate waterbody at center. Taken on July 5, 2011.

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.



Shoreline Substrate of Pond B,
Giraffe Watershed, Back River Project

Figure 3.1-7

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.



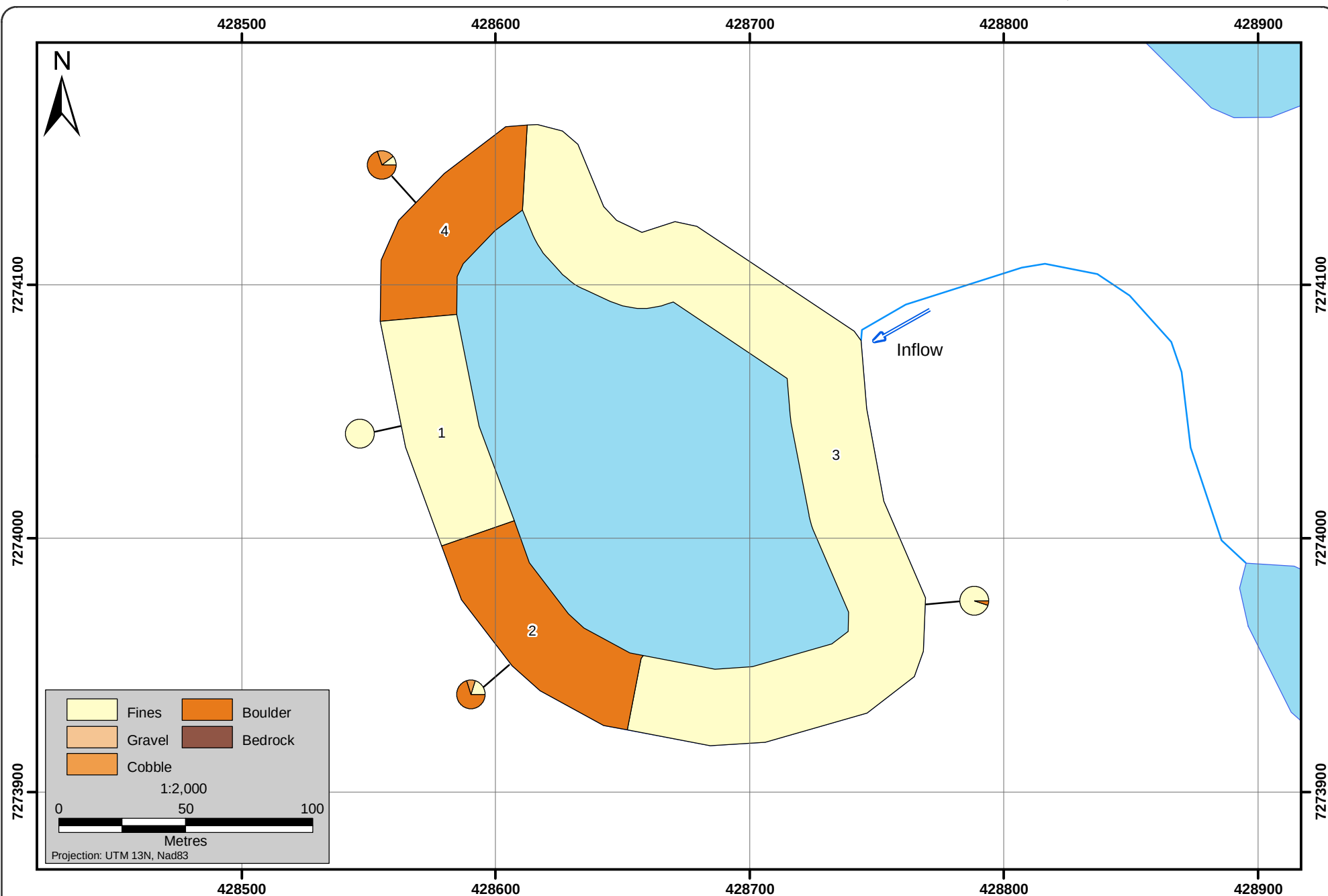
Plate 3.1-7. Shoreline substrate and minnow trap at Pond D in the Giraffe watershed, July 6, 2011.

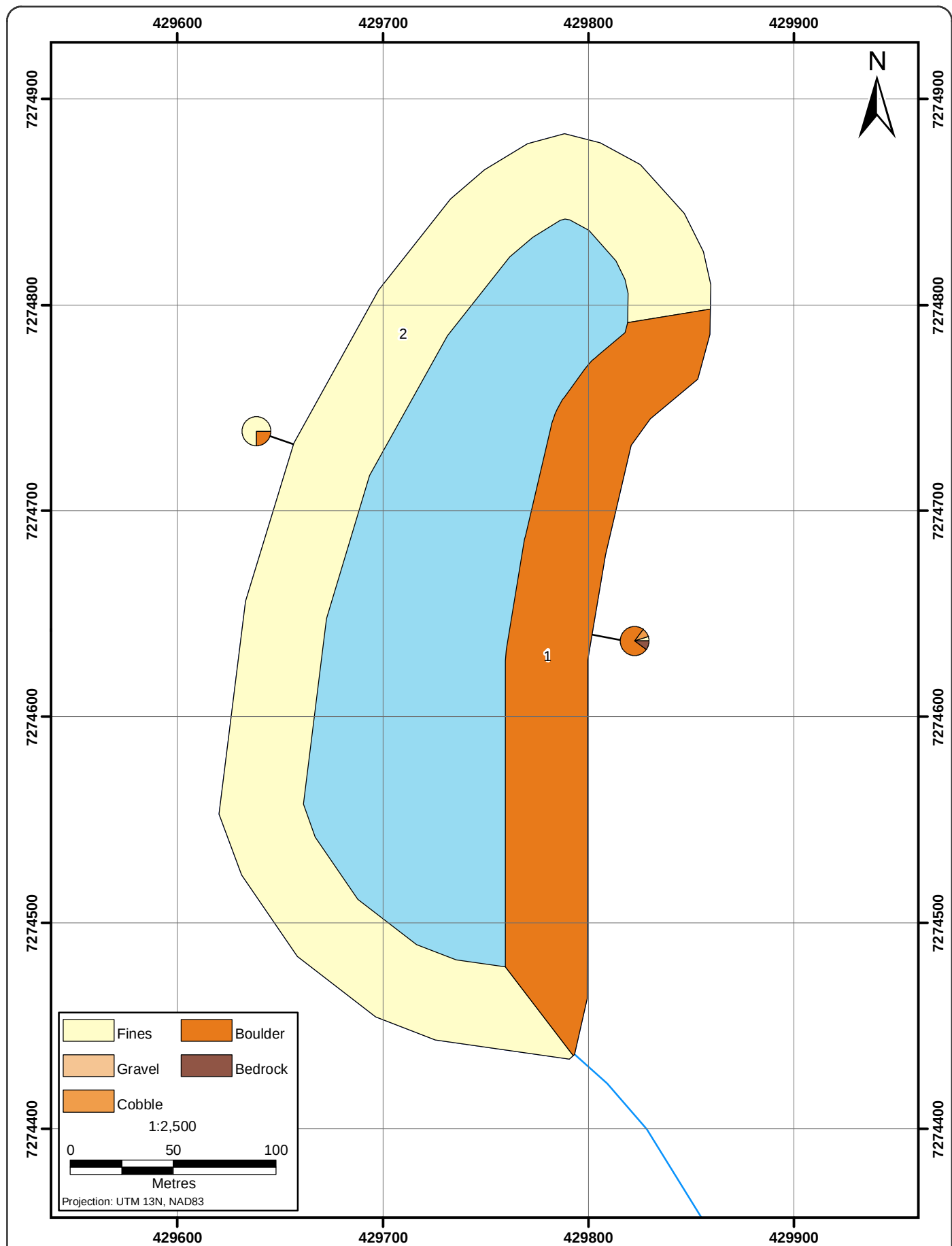
Pond E is a large, shallow pond located north of Pond D in the Giraffe watershed. It has a single inflow and is presumed to have a single outflow (the outflow was not observed in the field). The shoreline and substrate of the lake are dominated by boulders, with some areas of bedrock and fines (Plate 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.

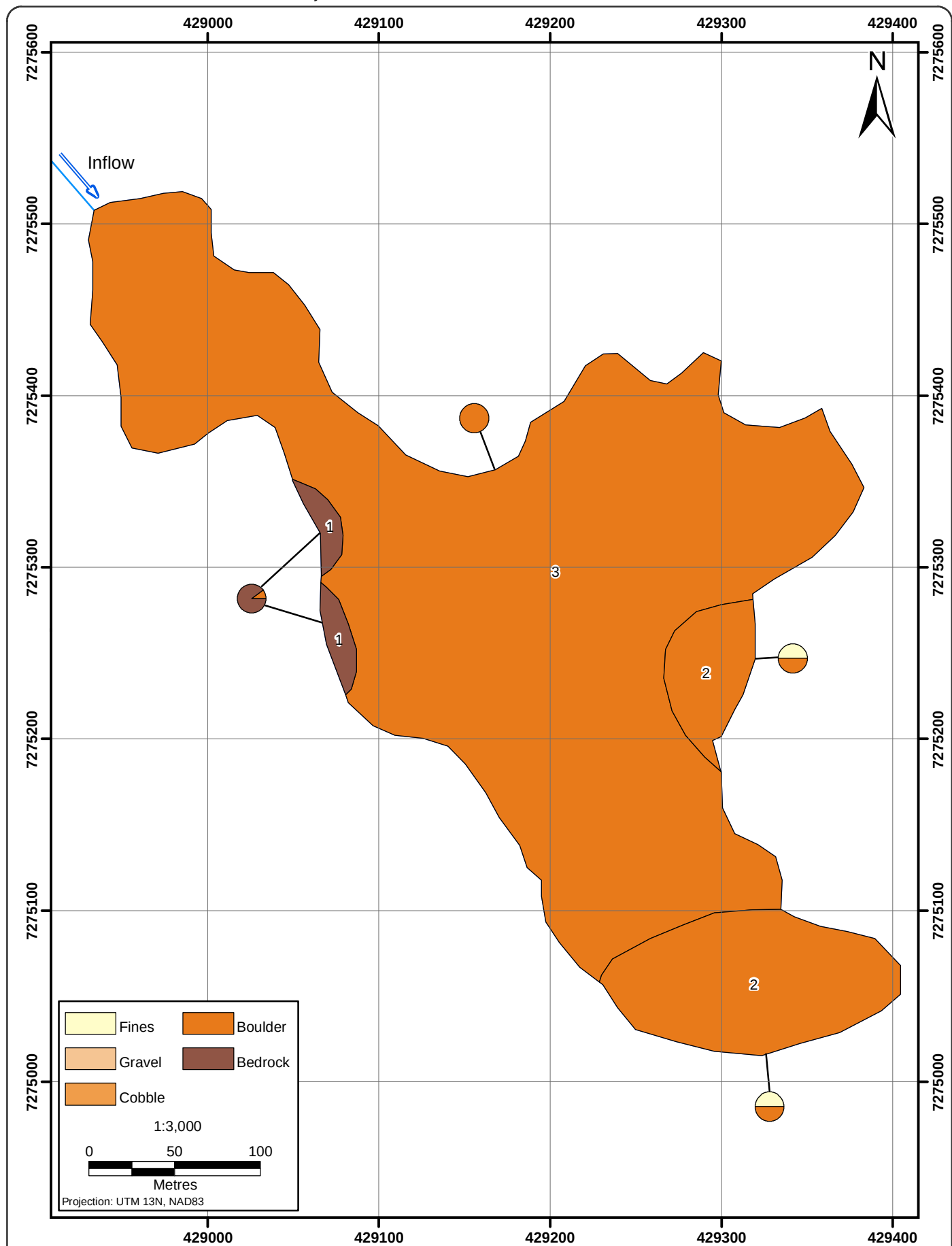
Pond G is located downstream of Pond F in the Wolf watershed. It has one main inflow with multiple channels and several ephemeral inflows. One outflow flows towards the southeast. The shoreline is dominated by boulder habitat, followed by fines and small proportions of cobble and bedrock (Plate 3.1-10). 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.

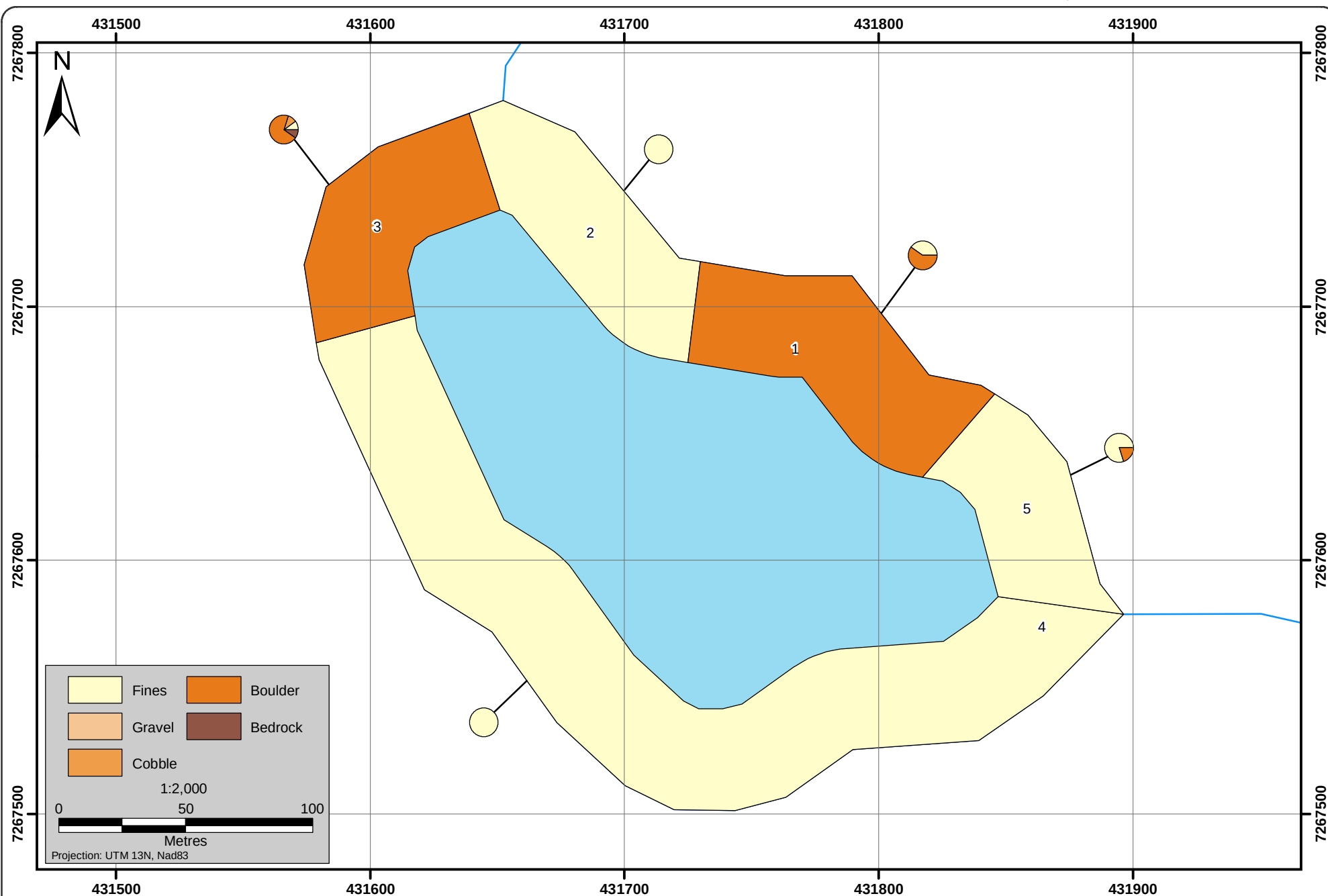


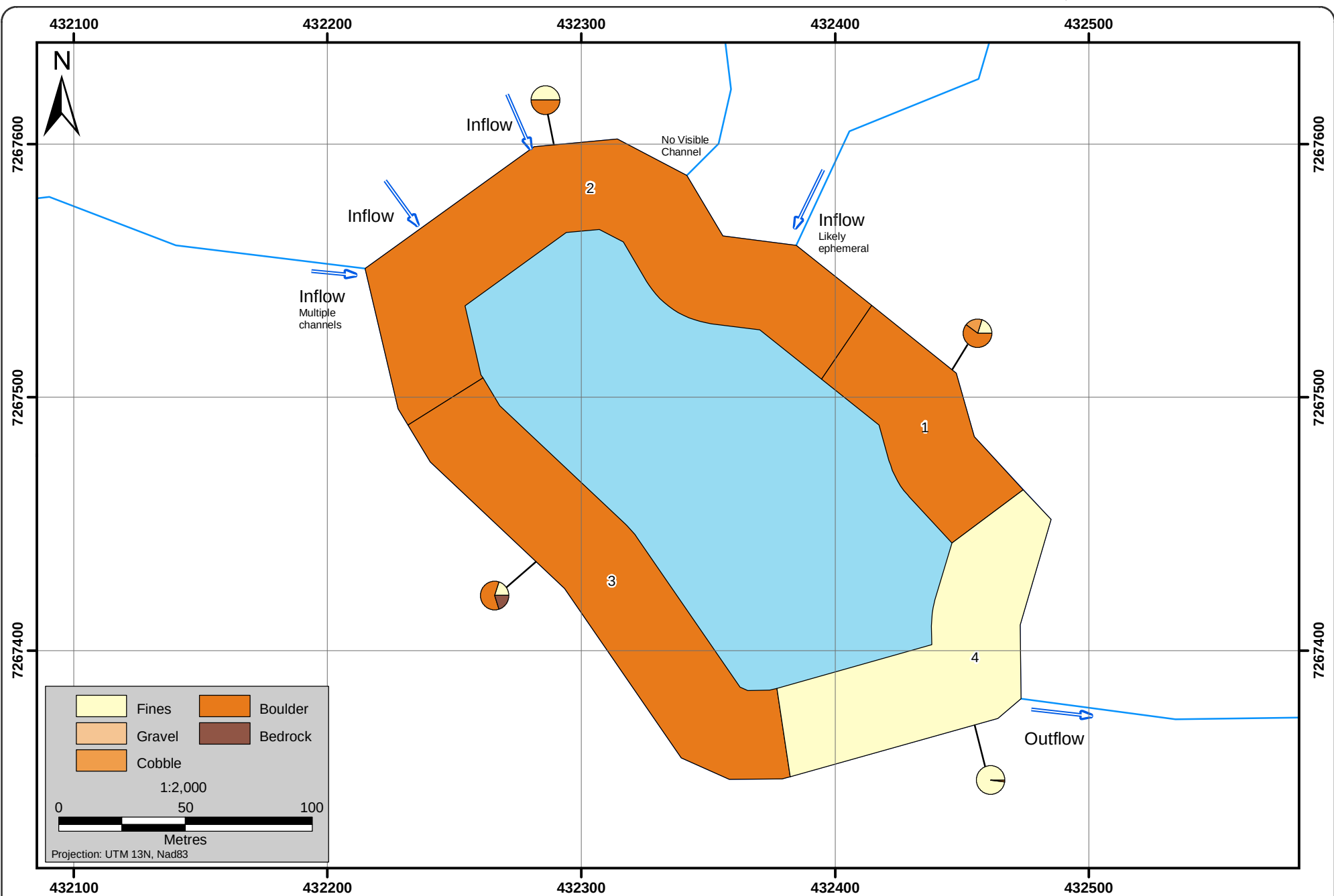


Shoreline Substrate of Pond D,
Giraffe Watershed, Back River Project

Figure 3.1-9







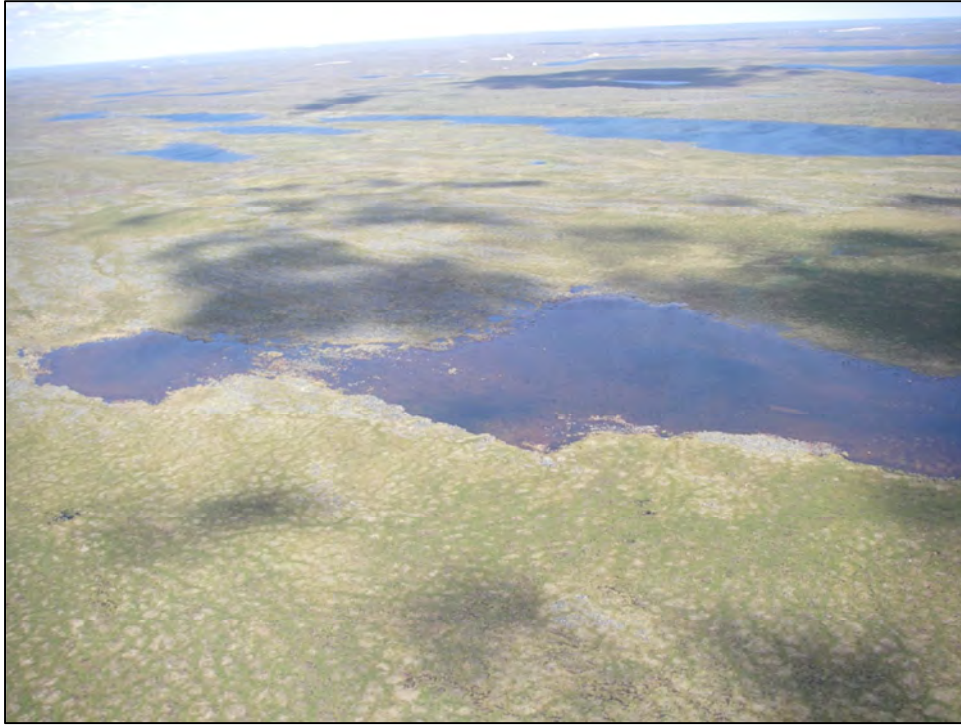


Plate 3.1-8. Aerial view of Pond E, Giraffe watershed, looking east on July 5, 2011.



Plate 3.1-9. Shoreline of Pond F, Wolf watershed, looking northwest on July 4, 2011.

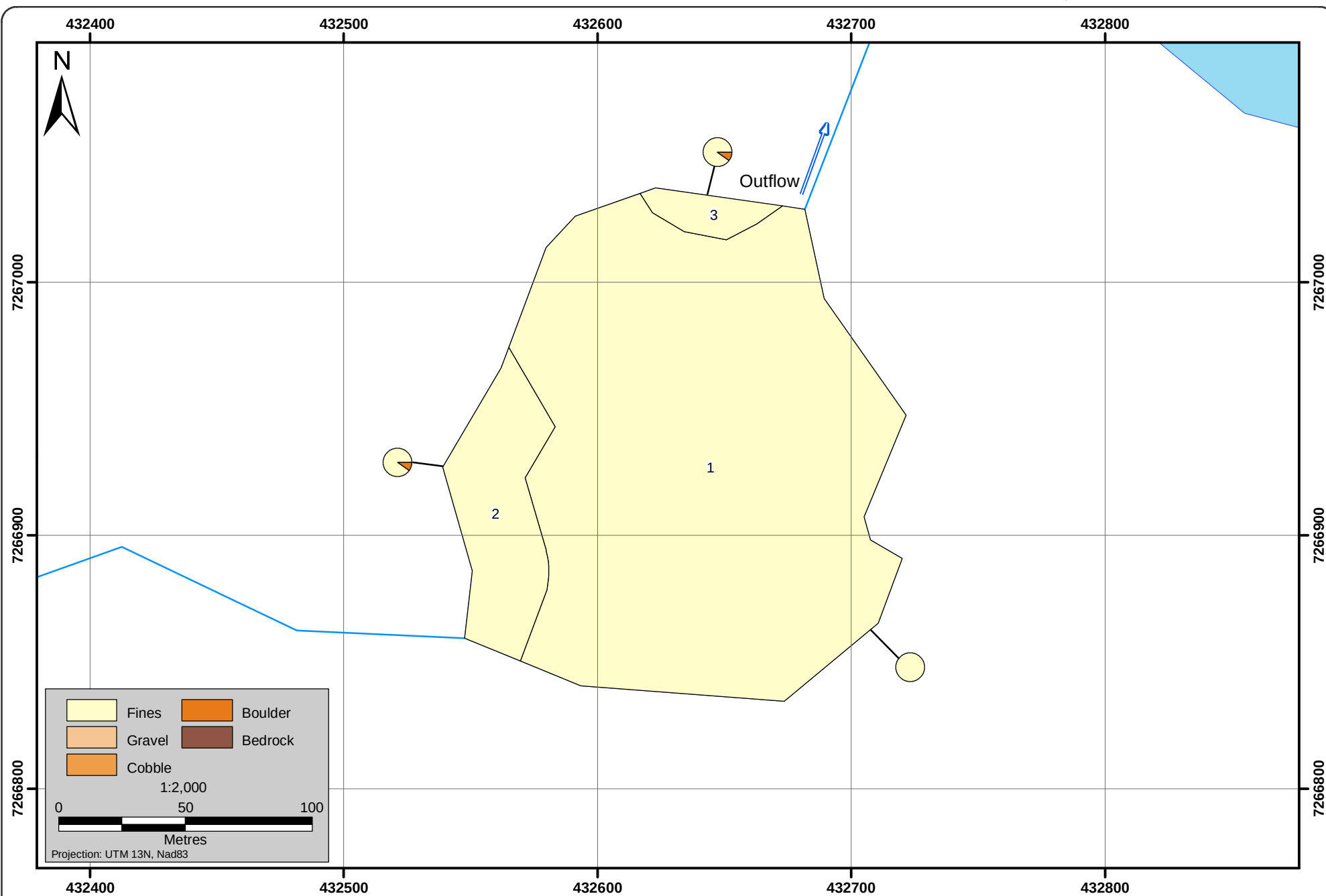


Plate 3.1-10. Pond G in the Wolf watershed, looking northeast on July 3, 2011.

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.



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.

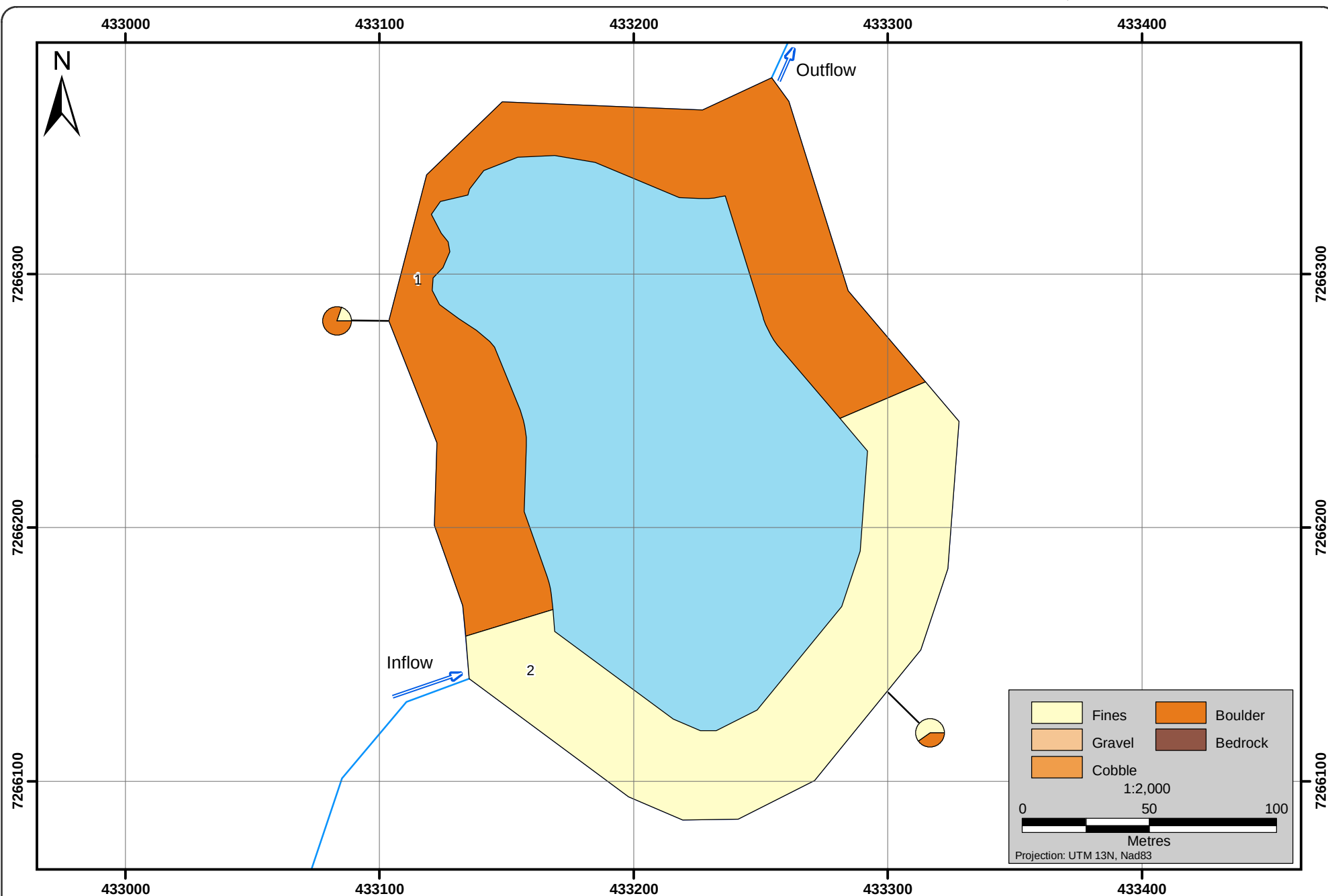
Pond K is located north of Pond J in the Wolf watershed. It has one outflow and no permanent inflows. The pond was too shallow to launch a boat, and the maximum depth was estimated from the air to be less than 2 m. The shoreline is dominated by fine sediment with a few areas of boulder and bedrock. Figure 3.1-16 shows a map of the shoreline and littoral zone.

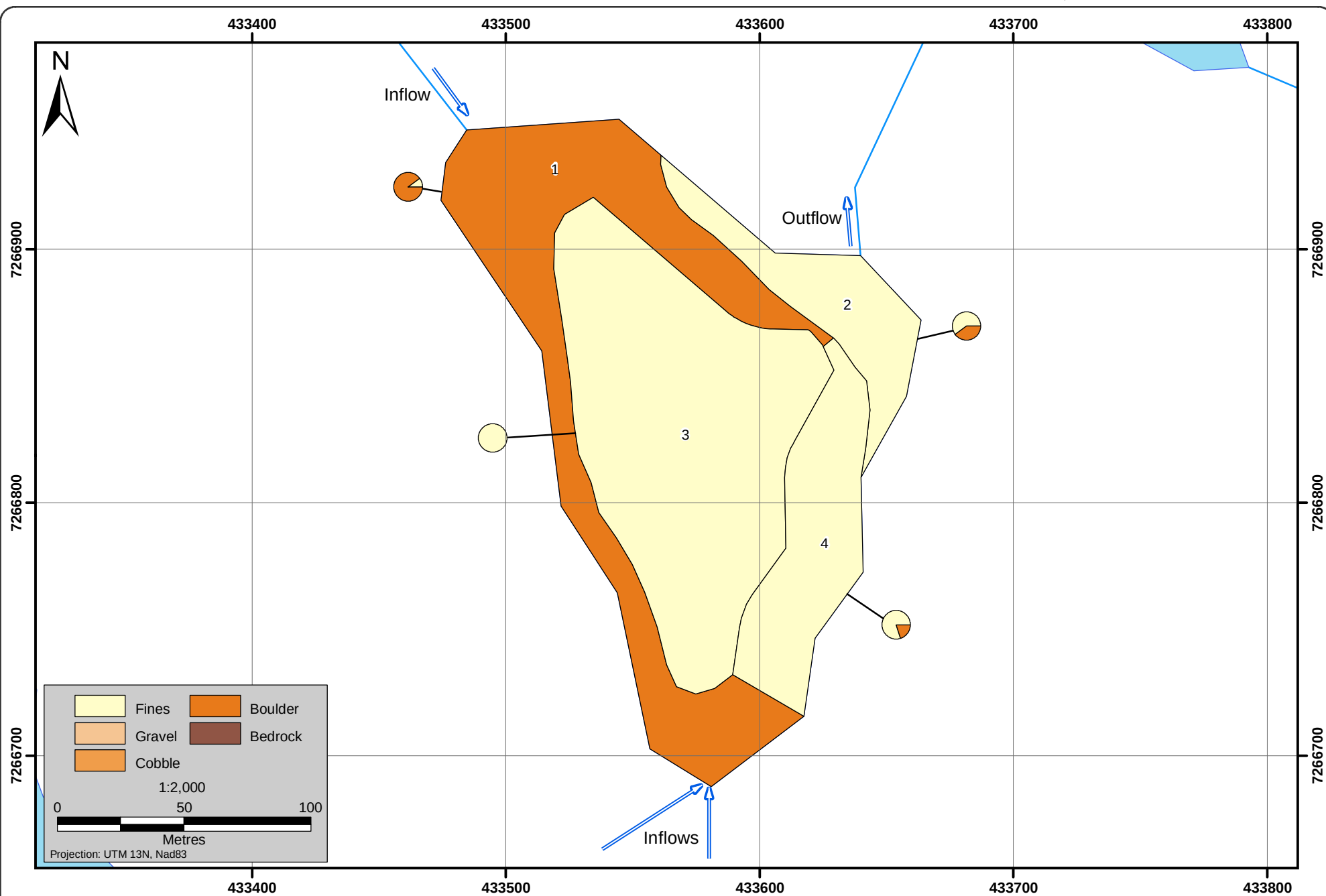
Pond L is an elongate pond located north of Wolf Lake. It is mostly shallow, with a shoreline and substrate dominated by boulders, except for a fine sediment beach at the north end (Plate 3.1-14). The maximum depth is approximately 2.5 m. The pond has three inflows and one outflow. The outflow is shown 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.

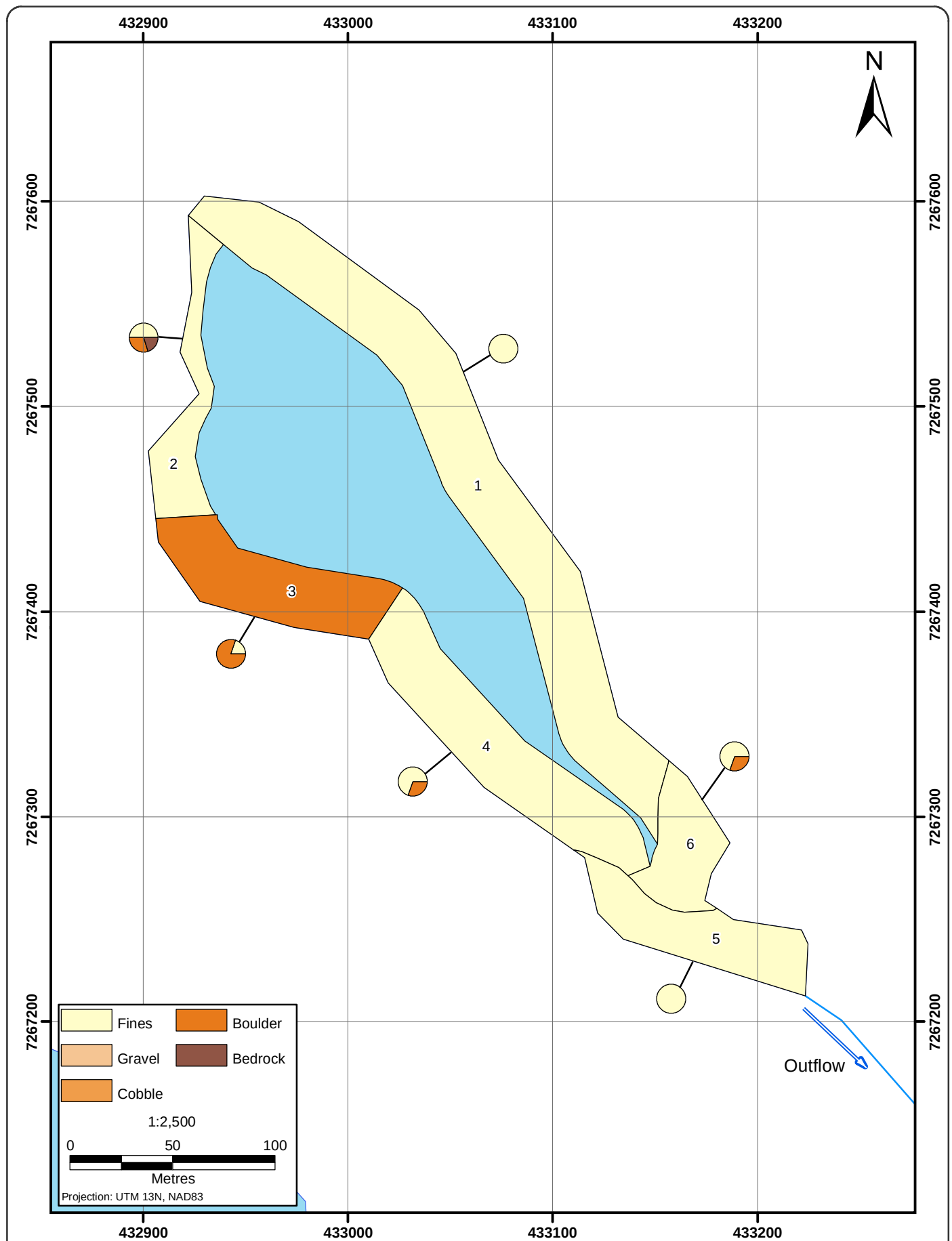
3.1.2 Fish Community

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.







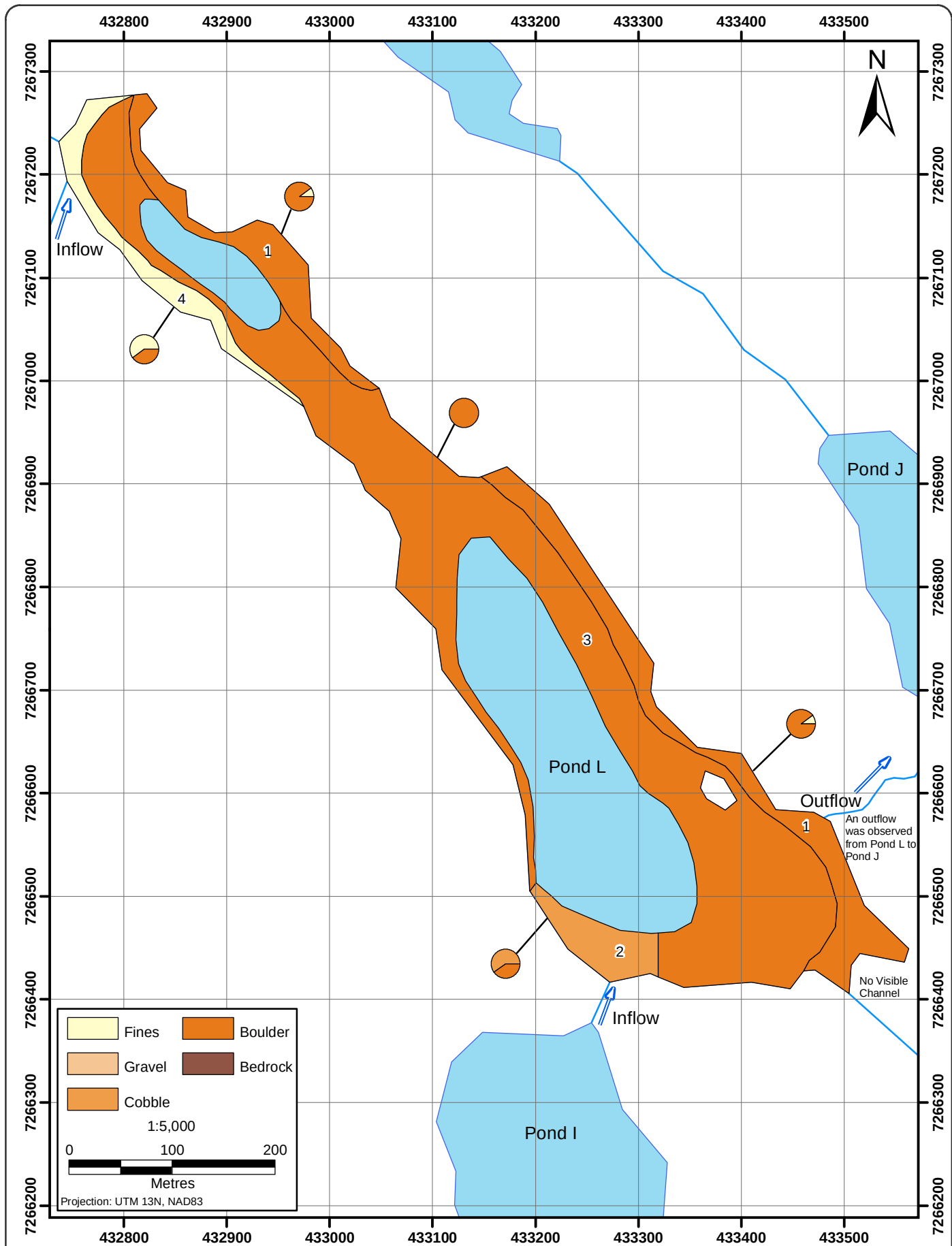




Plate 3.1-13. Eastern shoreline of Pond J in the Wolf watershed, looking north, with a minnow trap in the foreground. July 2, 2011.



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 m²/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

Pond	Species Captured	
	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.

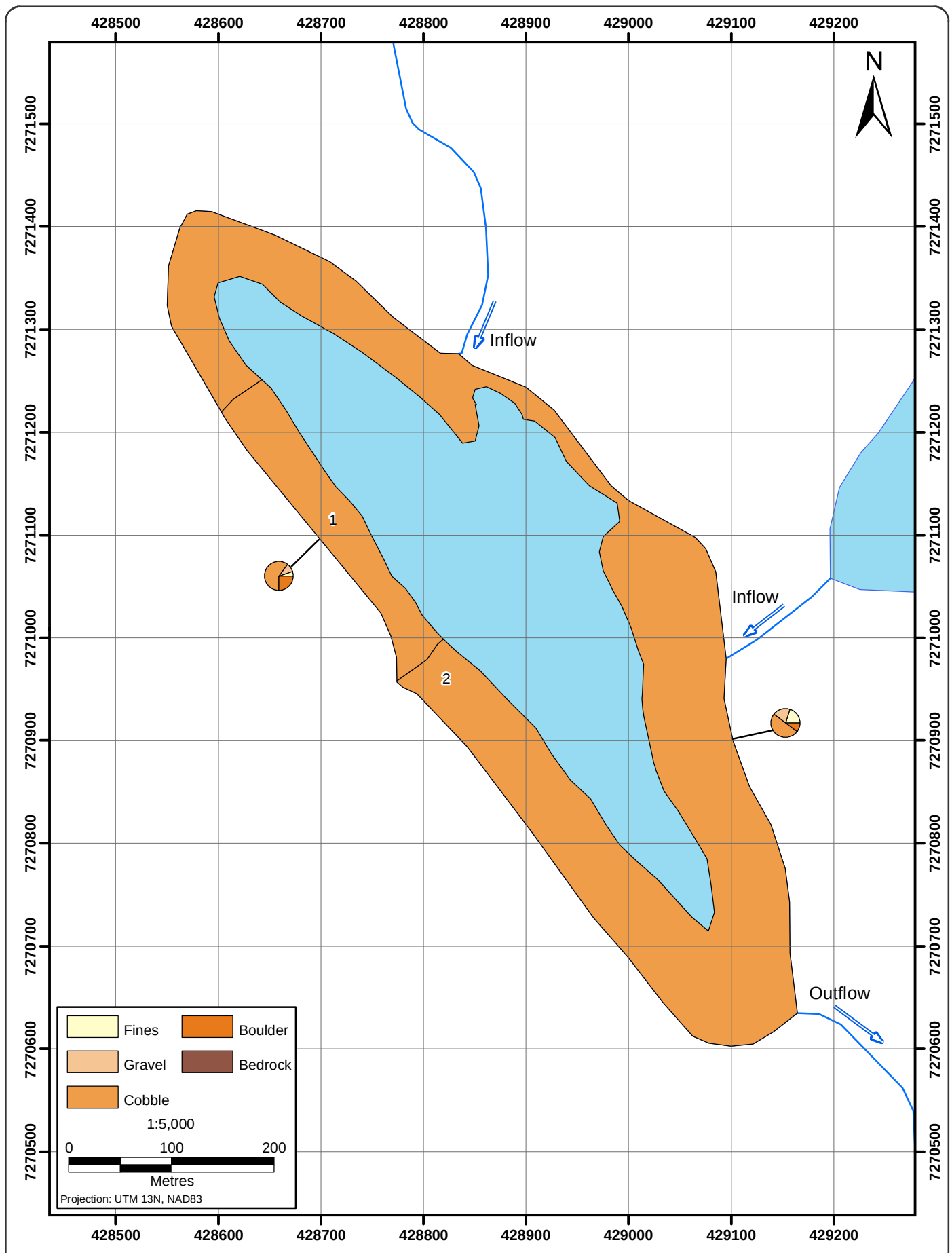
Reference B Lake is located south of the Project area in the Back River regional watershed (Reference B local watershed). The shoreline substrate is dominated by cobble and boulder habitat with very few fines (Figure 3.2-4). There is a single inflow and outflow. The maximum depth is approximately 5 m (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 m²/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.

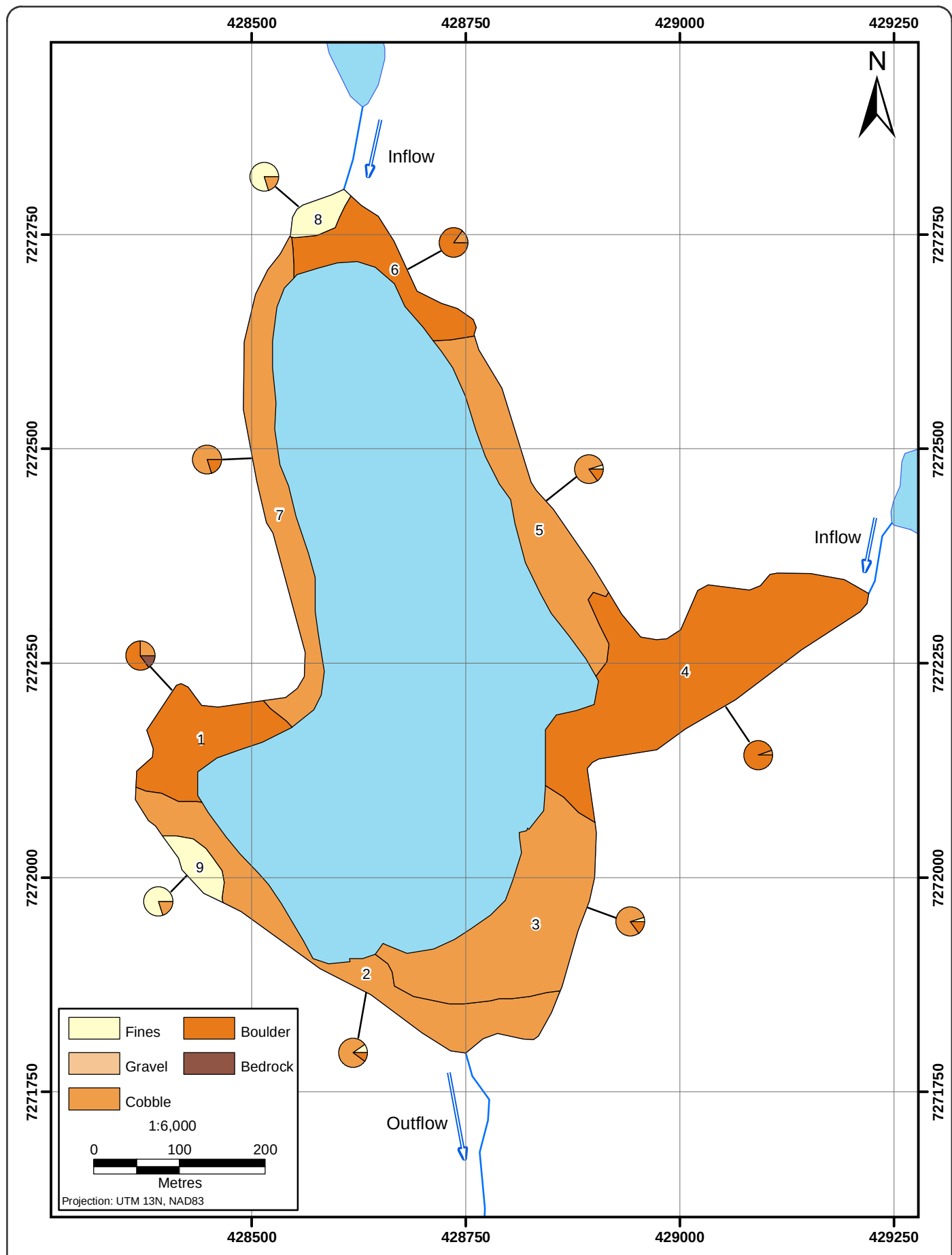
Table 3.2-1. Catch Summary for Lakes Sampled for MMER, 2011

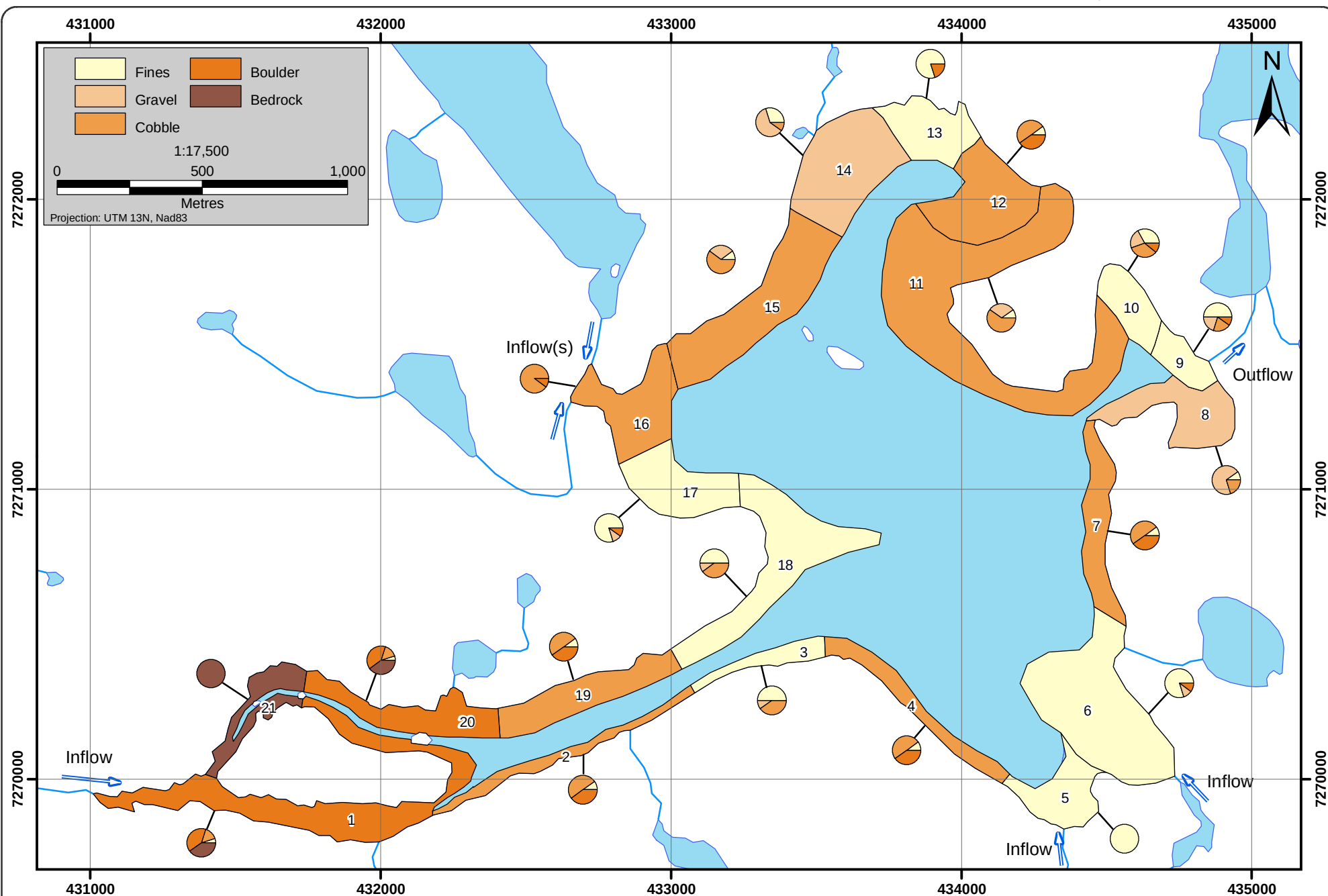
Lake	Species Captured		Mean Total CPUE (fish/100 m ² /h)
	Lake trout	Round whitefish	
Llama Watershed			
Umwelt	0	2	0.34
Llama	6	1	0.52
Goose Watershed			
Goose	6	0	0.78
Reference B Watershed			
Reference B	7	13	2.89

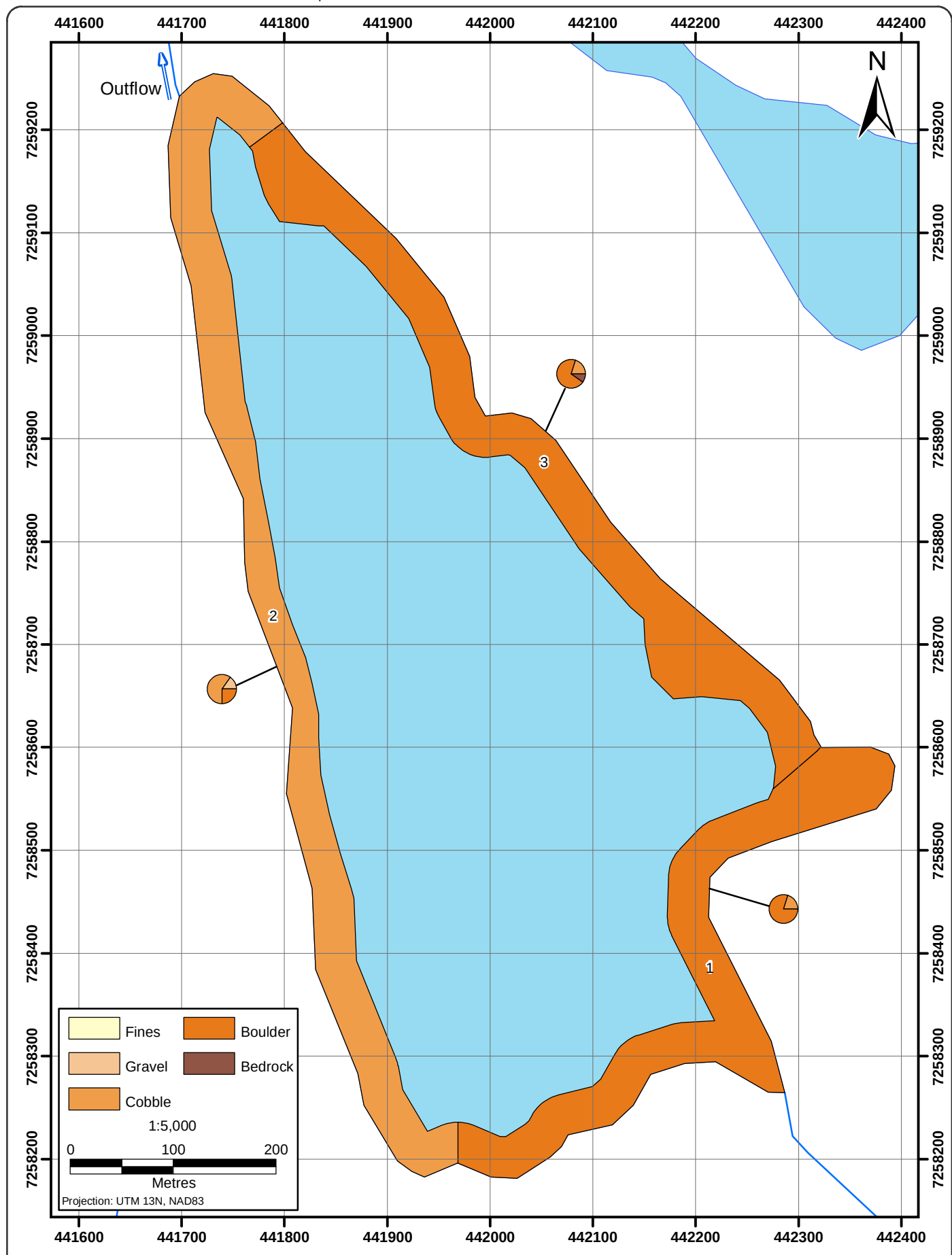


Shoreline Substrate of Umwelt Lake,
Llama Watershed, Back River Project

Figure 3.2-1







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
Fork length (mm)	6	5	7	4	2
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.

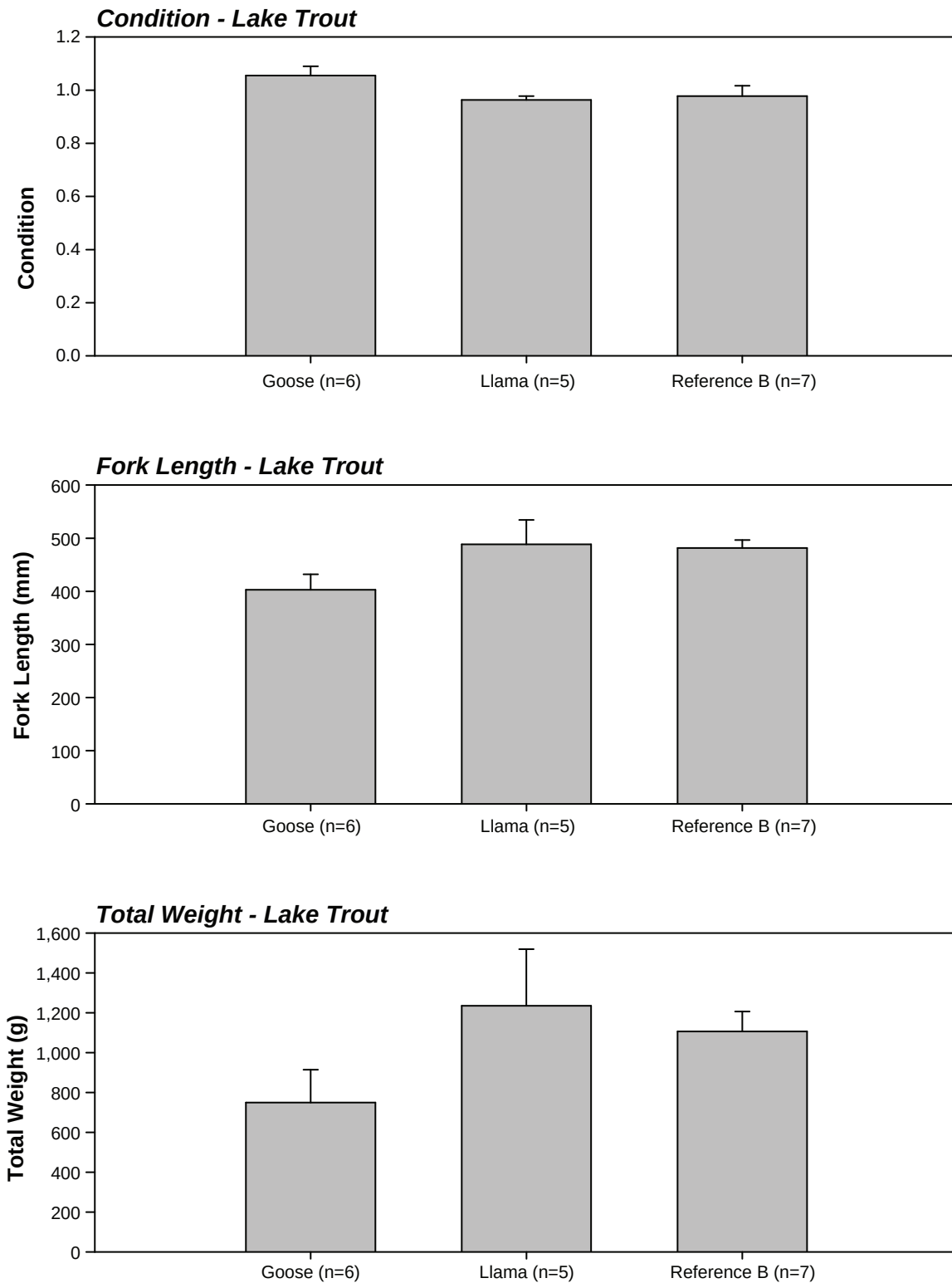
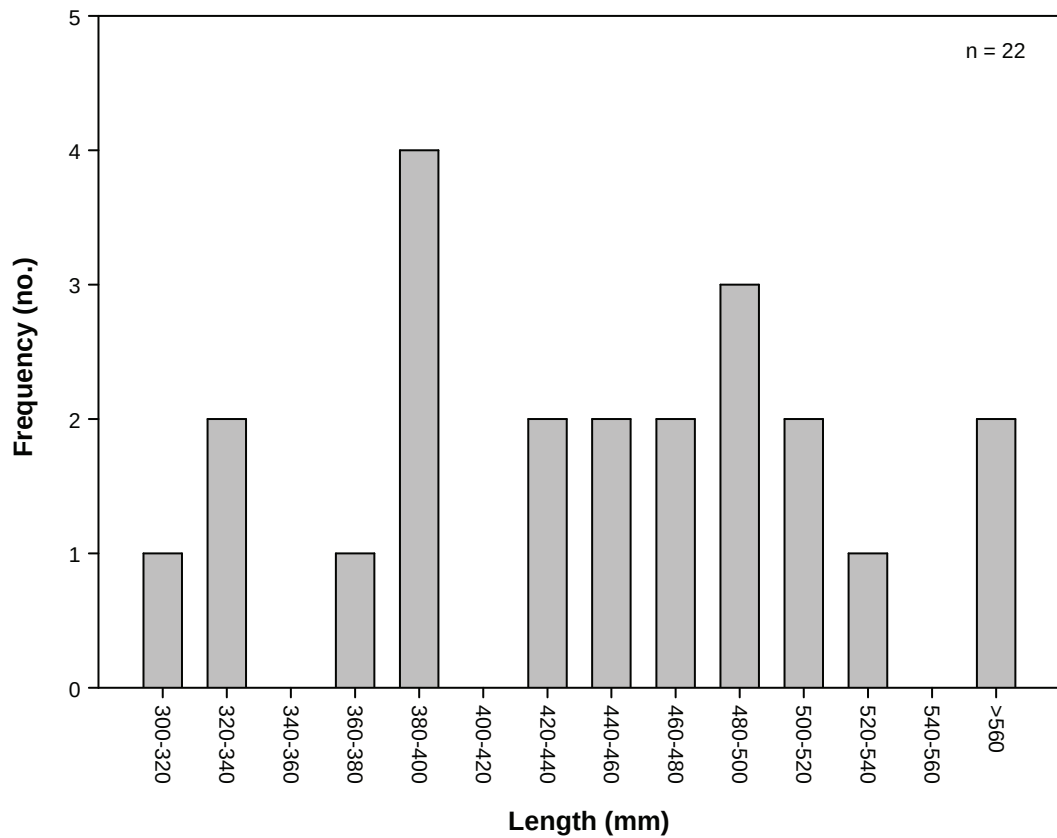
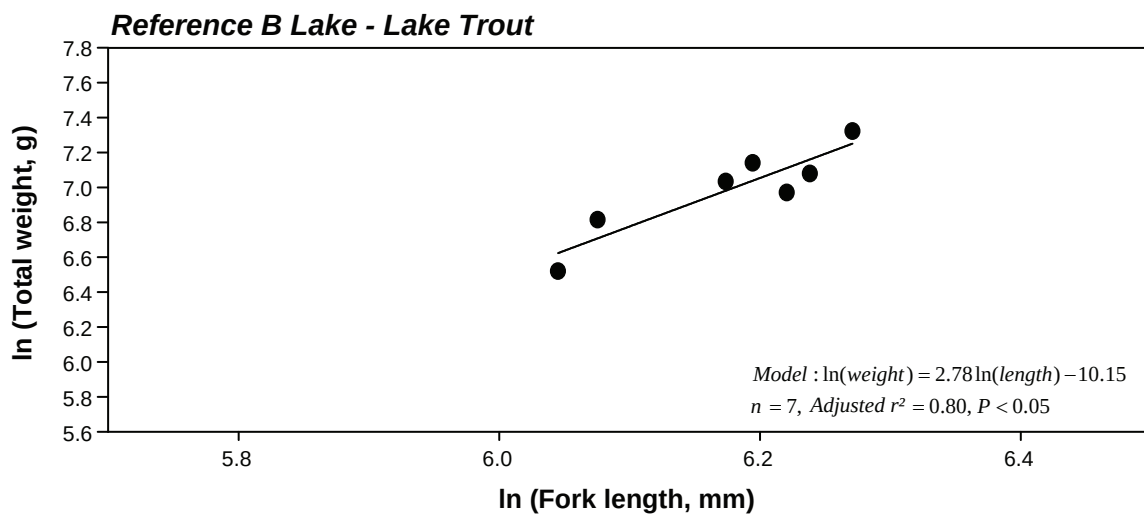
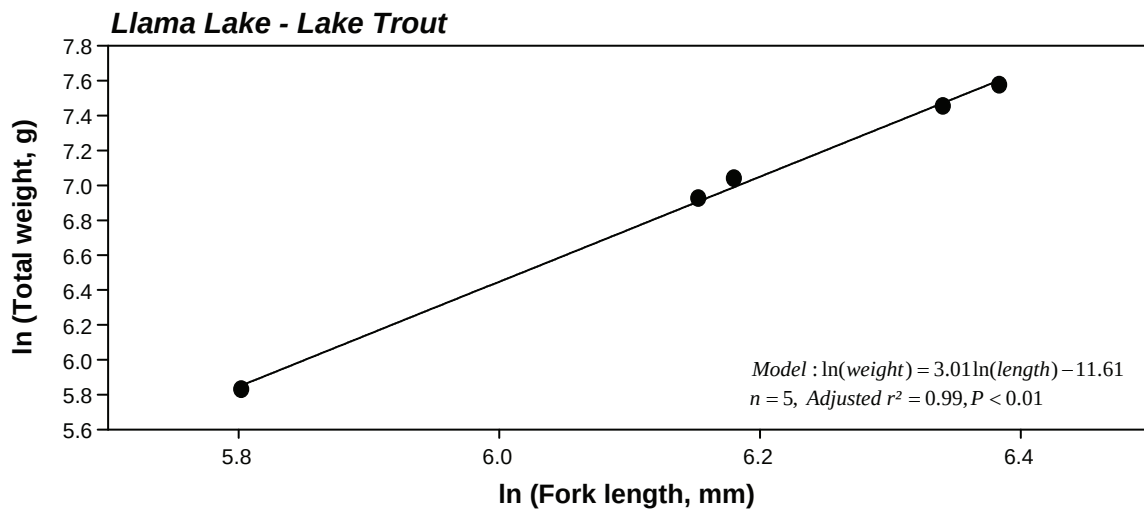
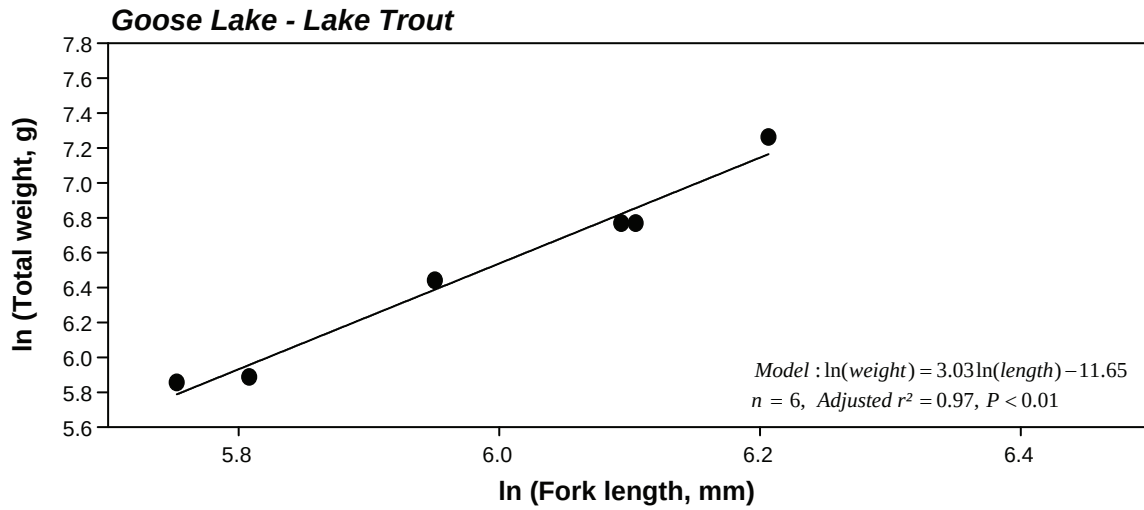


Figure 3.2-5





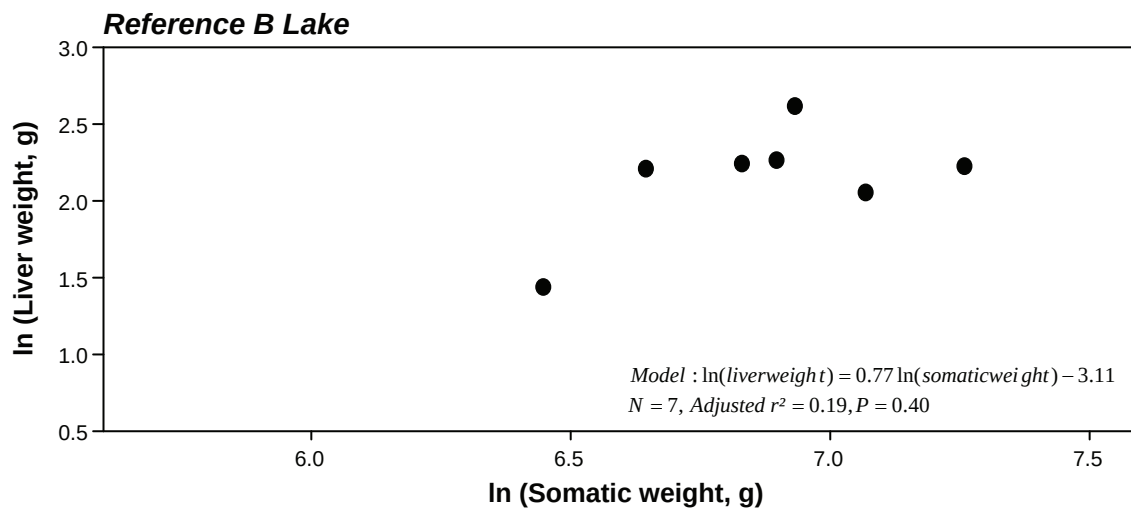
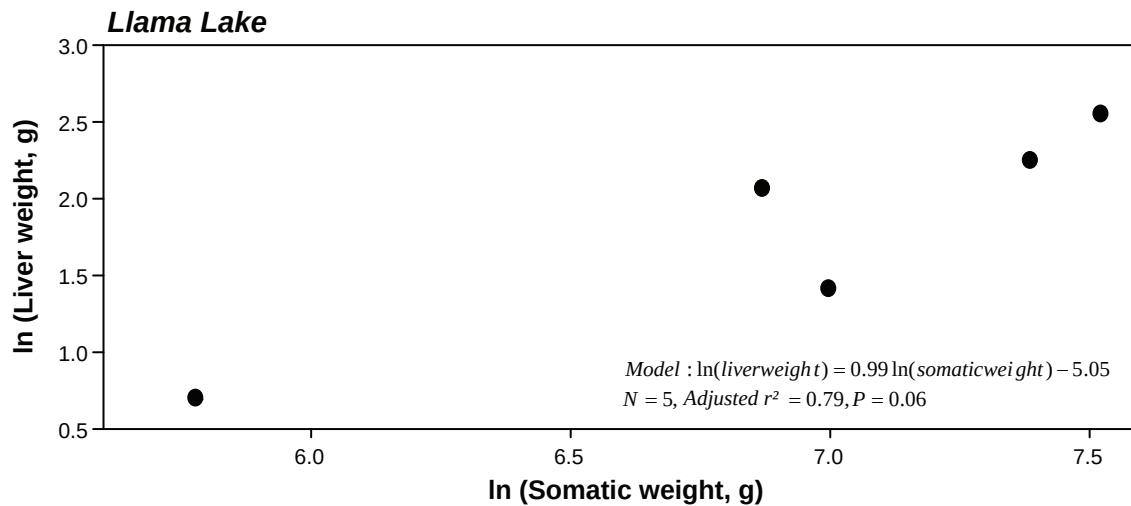
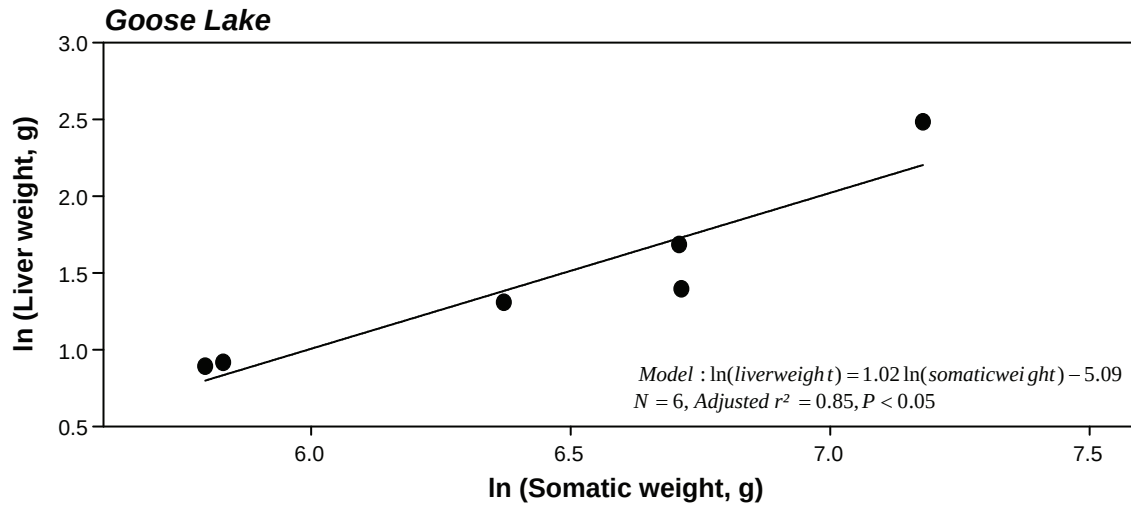
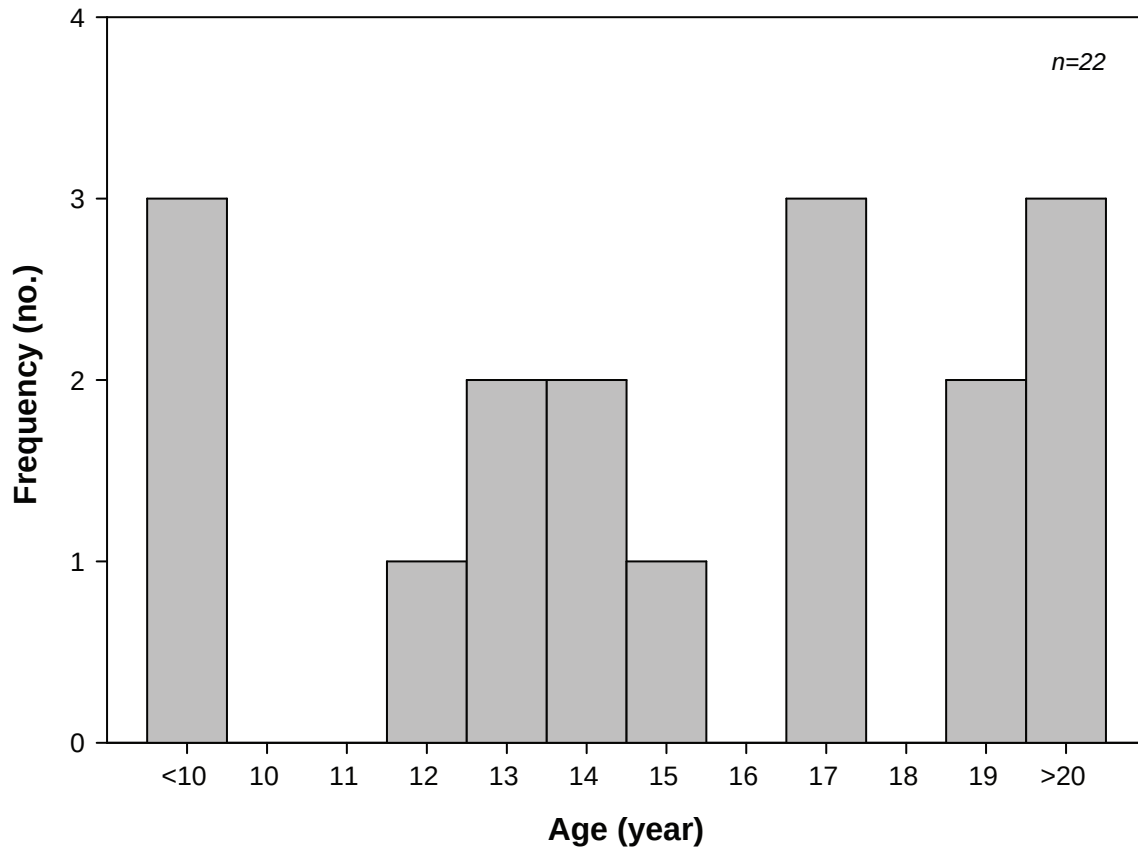
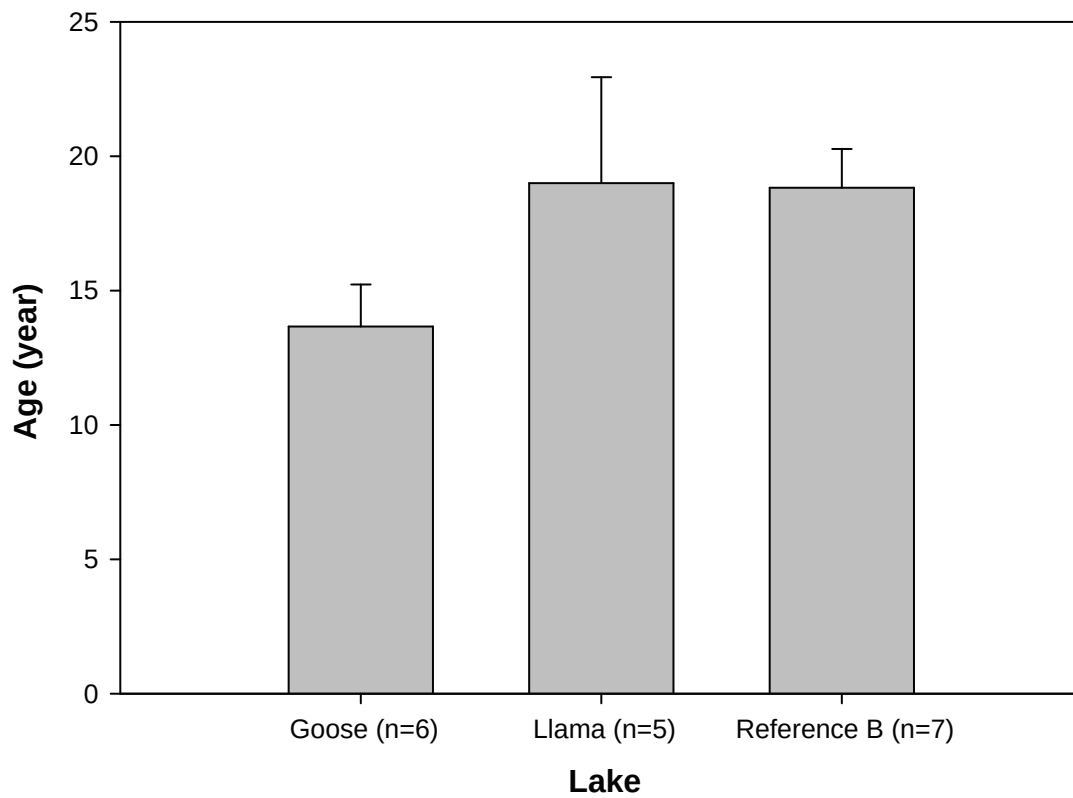
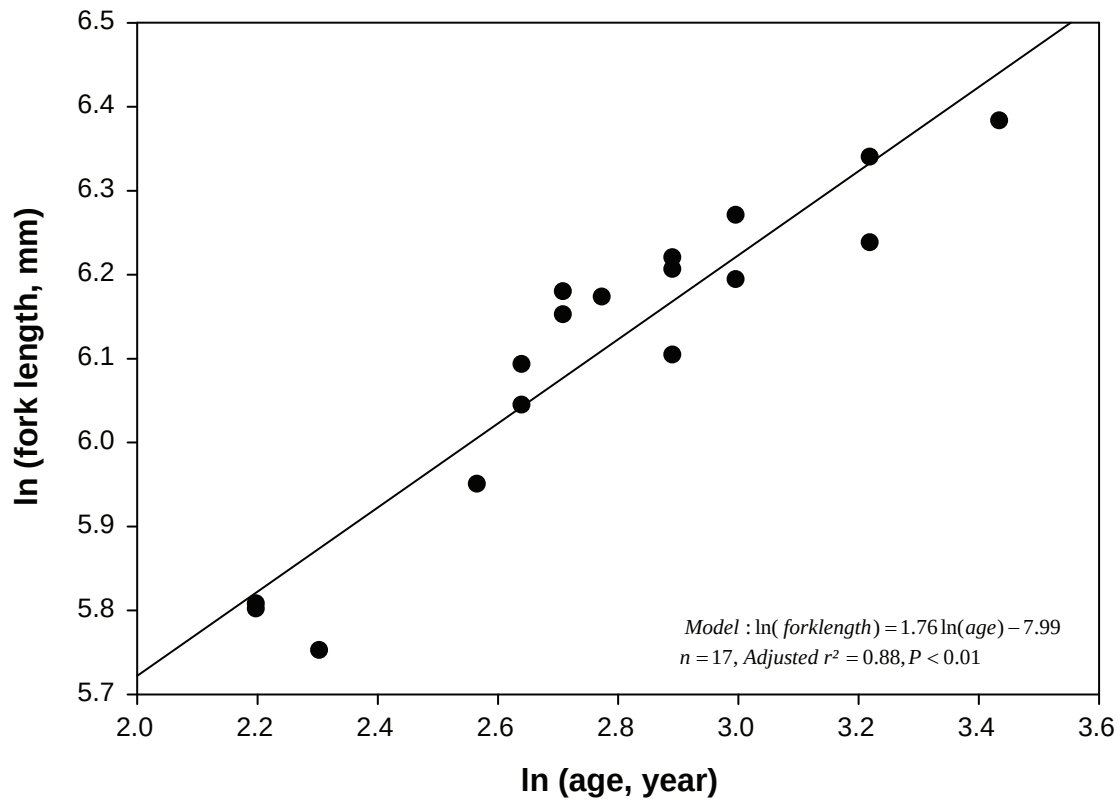


Figure 3.2-8





Note: Error bars represent standard error of the mean.



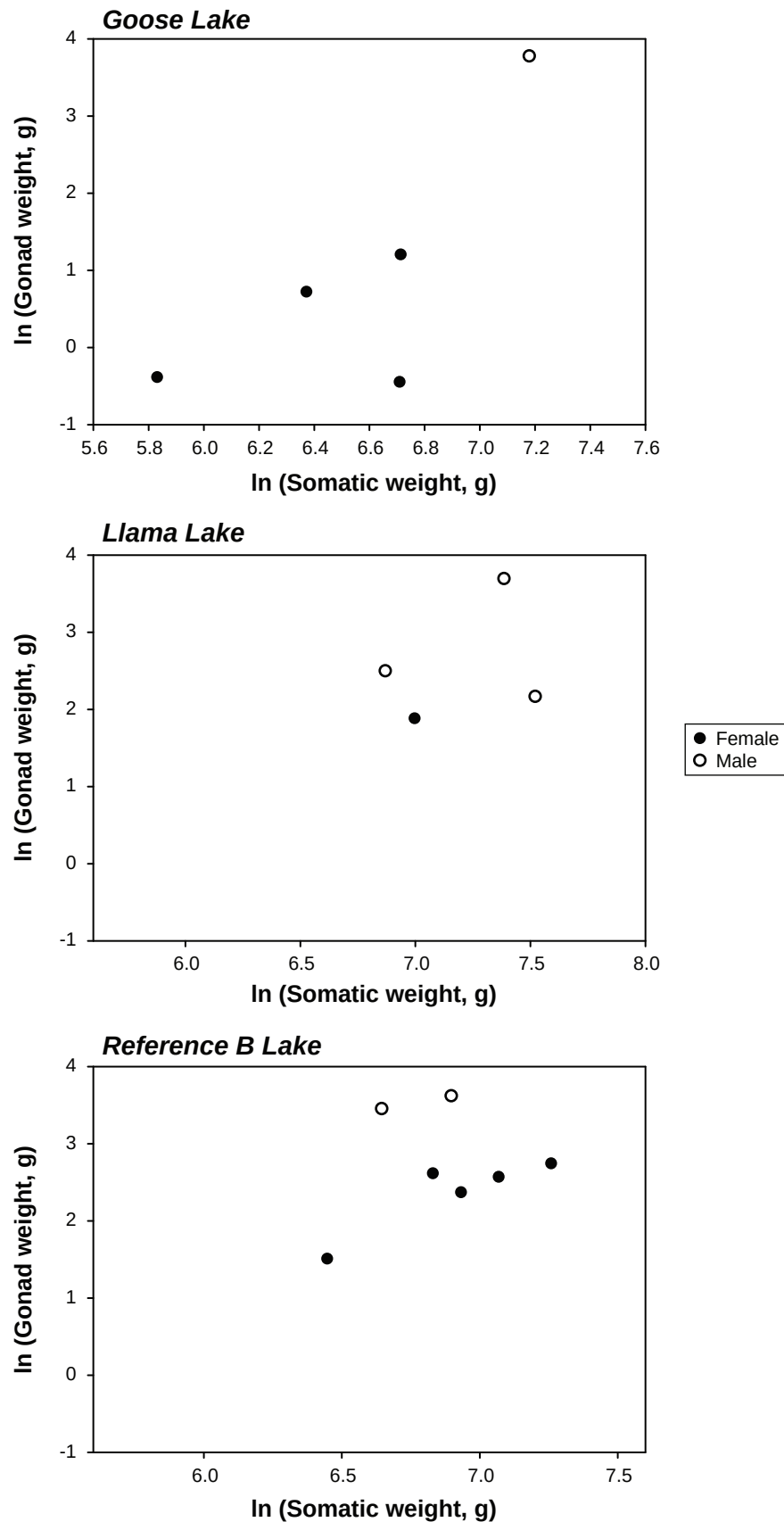


Figure 3.2-12

Table 3.2-3. Maturity of Lake Trout Collected from in August 2011

Maturity	Goose			Llama			Reference B	
	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.

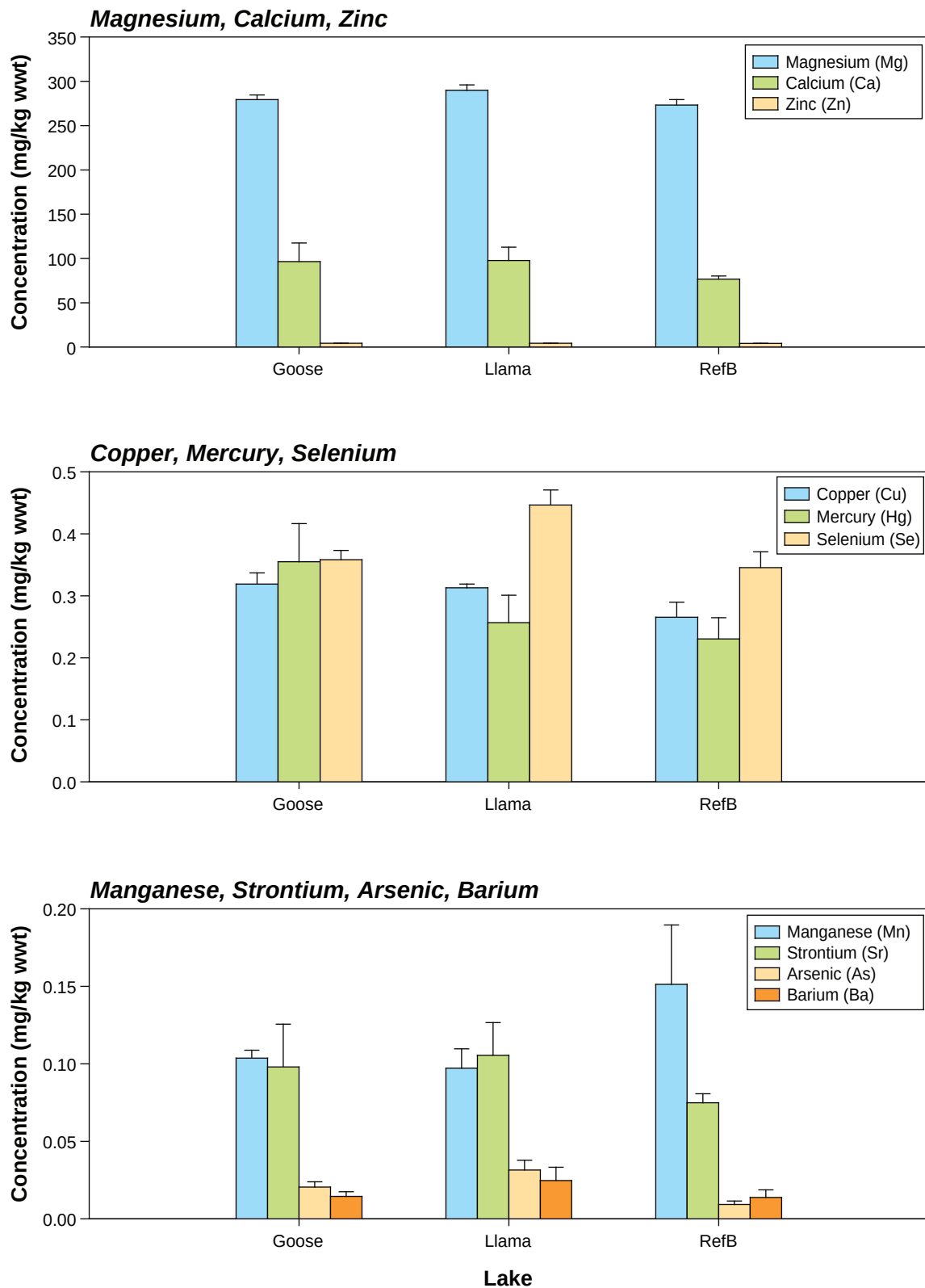
A Pearson product moment correlation analysis indicated that fish somatic weight (i.e., total weight minus the weight of internal organs) was significantly correlated with the concentrations of four metals: barium ($P<0.05$), calcium ($P<0.01$), mercury ($P<0.05$), and strontium ($P<0.01$). Further analysis 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

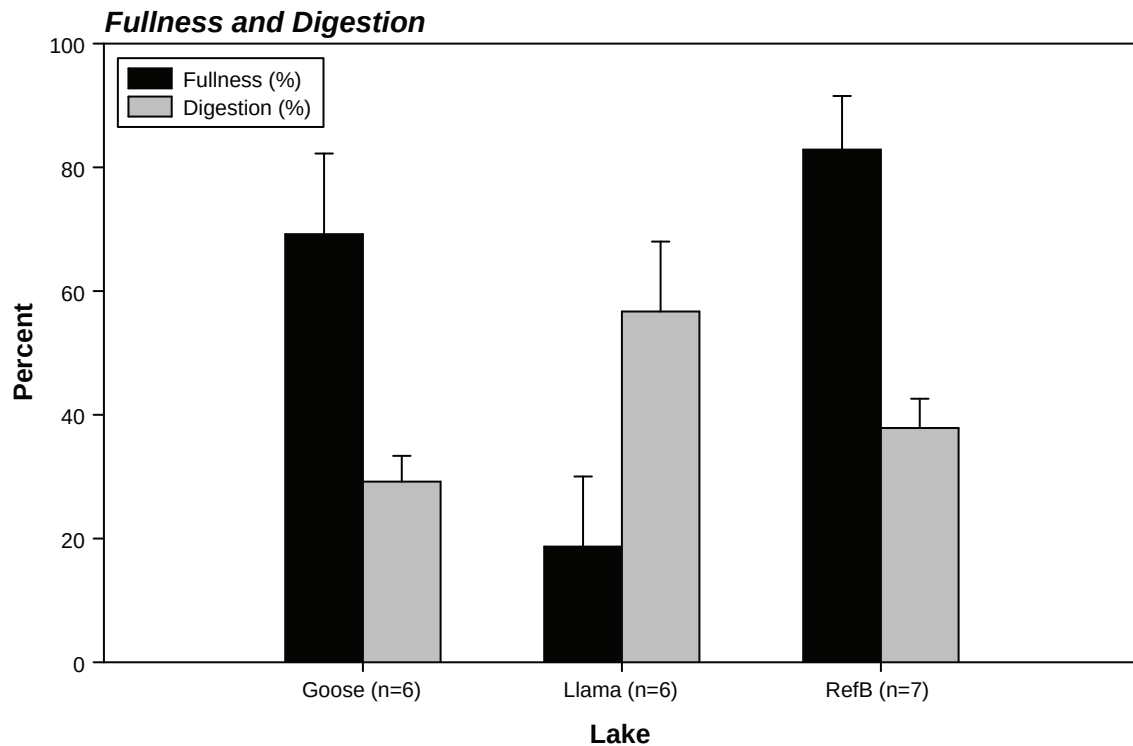
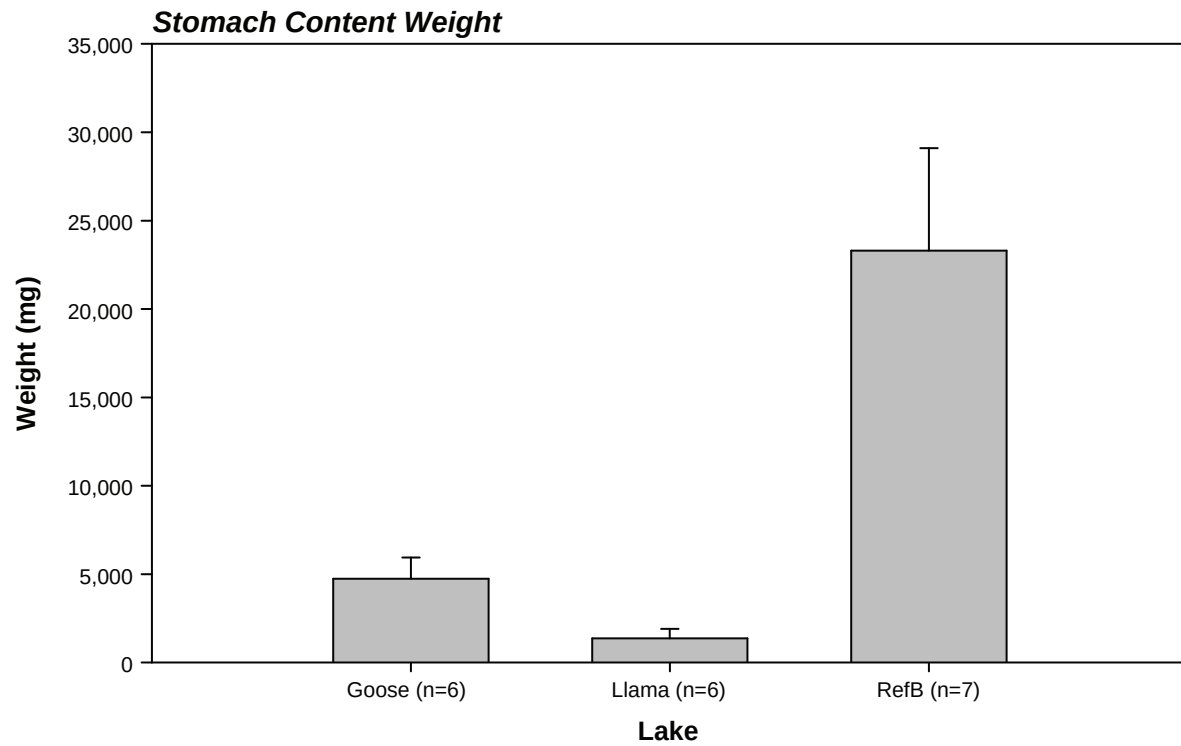
Diet

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).

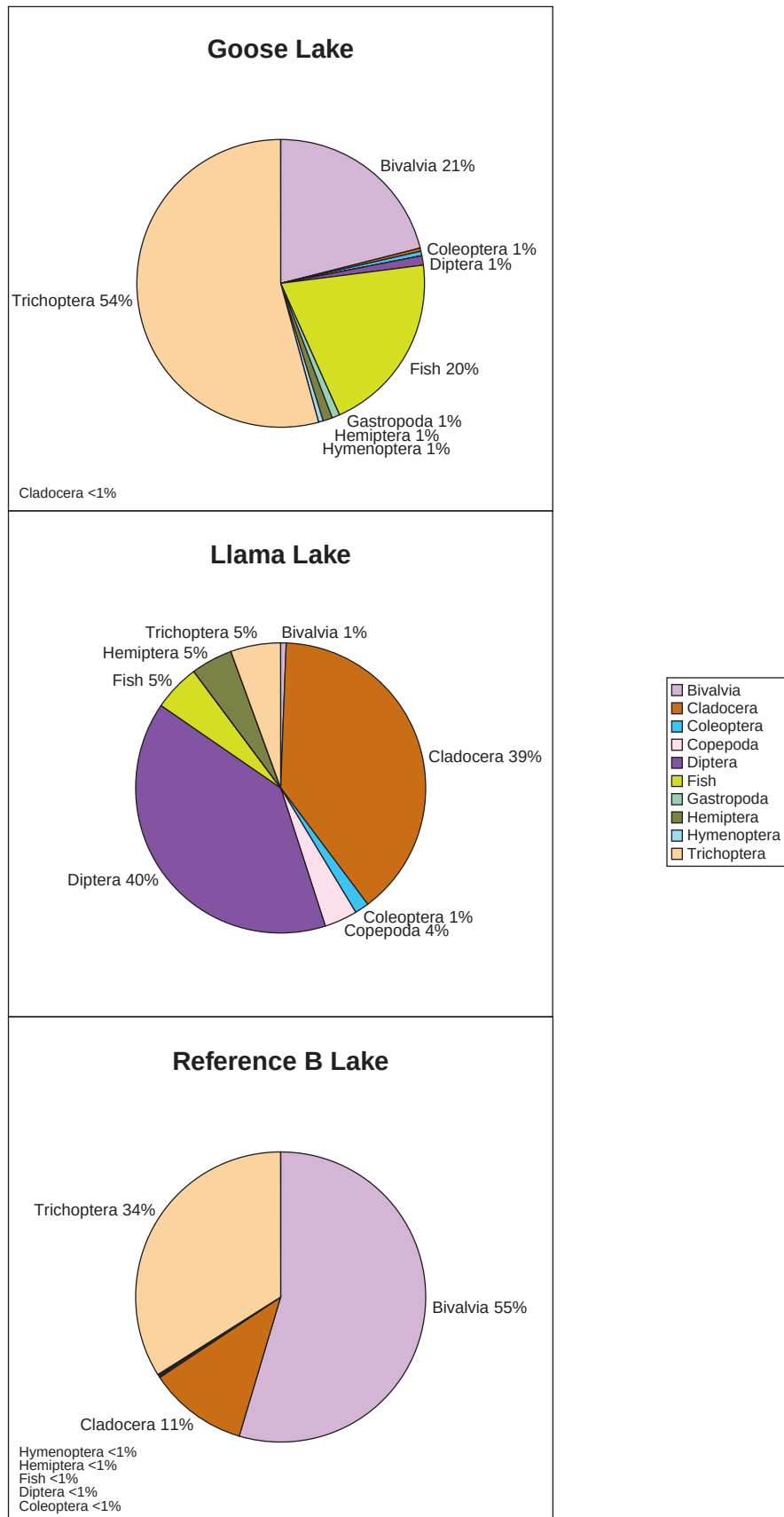
The biomass of prey items in lake trout stomachs tells a different story from the number of prey items (Figure 3.2-17). In Goose Lake, 44% of the prey biomass came from fish, followed by trichoptera and bivalves. Prey biomass was split between benthic (46% of biomass) and water column (46% of biomass) (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.



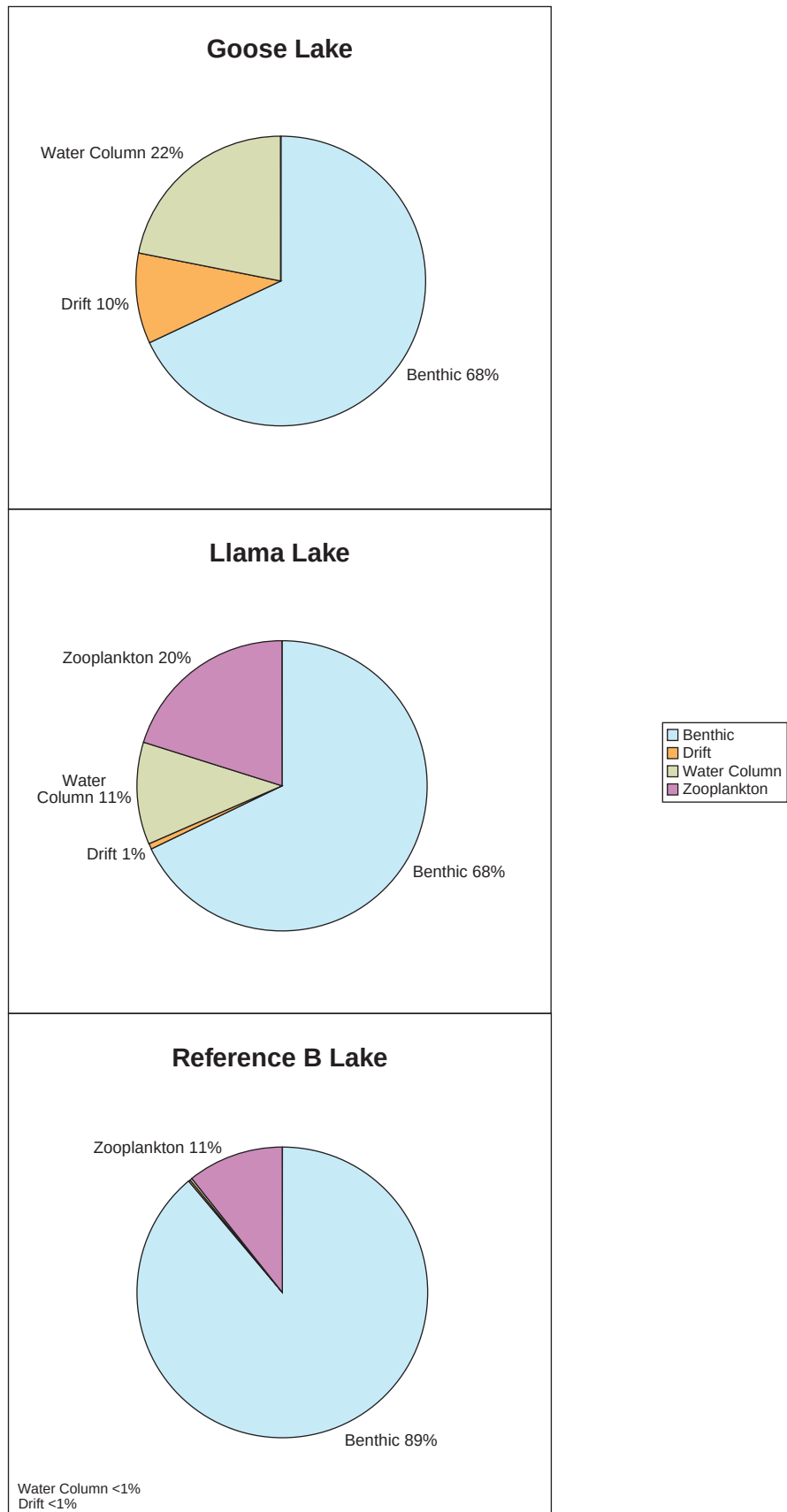
Note: Error bars indicate +/- 1 standard error of the mean

Figure 3.2-14



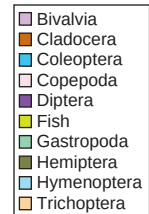
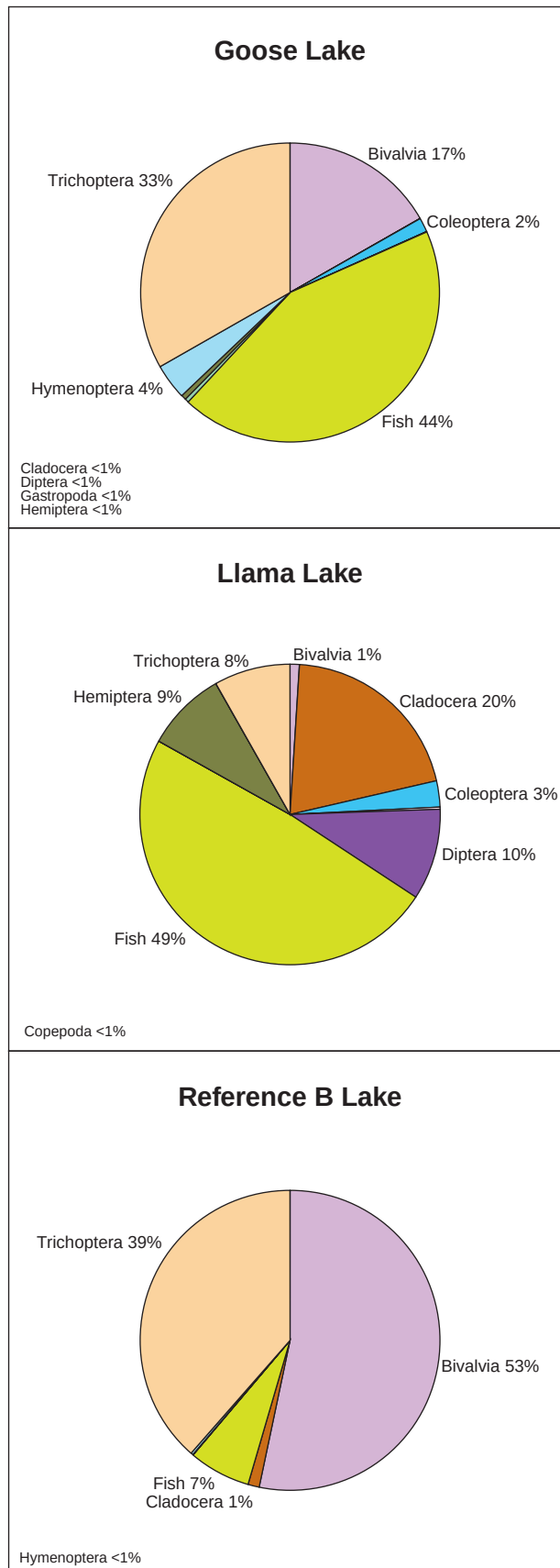
Mean Percent Composition (by Number) of Prey Items in the Diet of Lake Trout from Goose, Llama and Reference B Lakes, 2011

Figure 3.2-15



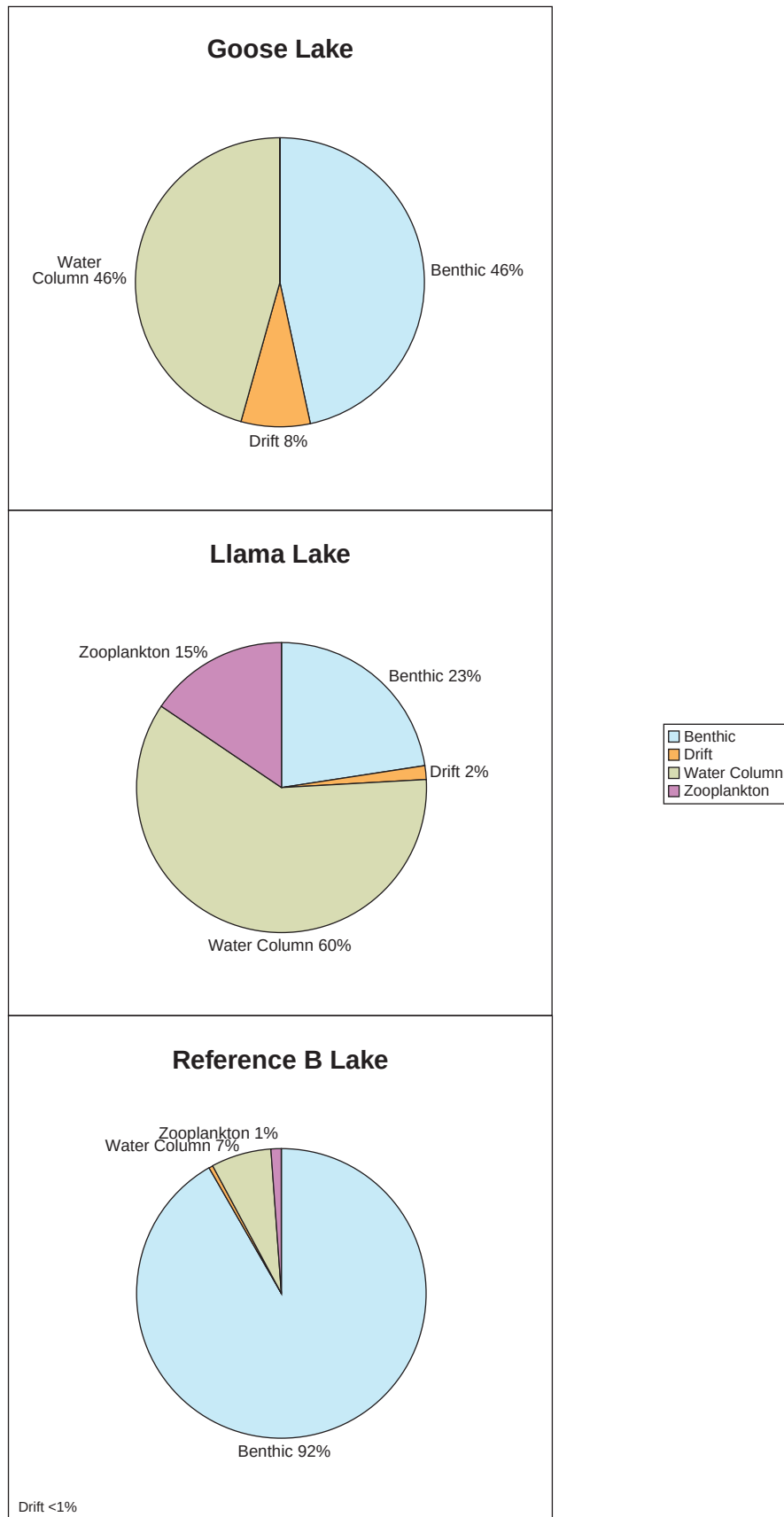
**Mean Percent Composition
(by Number) of Prey Items by Origin in Goose,
Llama and Reference B Lakes, 2011**

Figure 3.2-16



**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



**Mean Percent Composition (by Weight)
of Prey Items by Origin in Goose,
Llama and Reference B Lakes, 2011**

Figure 3.2-18

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

References

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- Scott, W. B. and E. J. Crossman. 1973. Freshwater Fishes of Canada. *Bulletin of the Fisheries Research Board of Canada*, 184.

Appendix 2.4-1

Quality Assurance and Quality Control Results for Tissue
Metal Sampling at Back River, 2011

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 ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Antimony (Sb)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Arsenic (As)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Barium (Ba)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Beryllium (Be)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Bismuth (Bi)-Total	<0.030	<0.030	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Cadmium (Cd)-Total	<0.0050	<0.0050	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Calcium (Ca)-Total	68.1	68.0	mg/kg ww	0.17	50	-	-	-
L1053002-7	Tissue	WG1353265-3	Chromium (Cr)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Cobalt (Co)-Total	0.021	0.020	mg/kg ww	4.8	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Copper (Cu)-Total	0.275	0.249	mg/kg ww	9.9	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Lead (Pb)-Total	<0.020	<0.020	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Lithium (Li)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Magnesium (Mg)-Total	264	262	mg/kg ww	0.65	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Manganese (Mn)-Total	0.139	0.135	mg/kg ww	2.7	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Mercury (Hg)-Total	0.178	0.189	mg/kg ww	6.0	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Molybdenum (Mo)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Nickel (Ni)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Selenium (Se)-Total	0.37	0.36	mg/kg ww	1.6	30	-	-	-
L1053002-7	Tissue	WG1353265-3	Strontium (Sr)-Total	0.066	0.063	mg/kg ww	5.0	50	-	-	-
L1053002-7	Tissue	WG1353265-3	Thallium (Tl)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Tin (Sn)-Total	<0.050	<0.050	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Uranium (U)-Total	<0.0020	<0.0020	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Vanadium (V)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1053002-7	Tissue	WG1353265-3	Zinc (Zn)-Total	4.05	4.14	mg/kg ww	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 ww	113	70-130	
Tissue	CRM	Cadmium (Cd)-Total	WG1353265-4	VA-NRC-TORT2	29.8	26.7	mg/kg ww	112	70-130	
Tissue	CRM	Chromium (Cr)-Total	WG1353265-4	VA-NRC-TORT2	0.86	0.77	mg/kg ww	0.86	0-1.77	
Tissue	CRM	Cobalt (Co)-Total	WG1353265-4	VA-NRC-TORT2	0.553	0.510	mg/kg ww	108	70-130	
Tissue	CRM	Copper (Cu)-Total	WG1353265-4	VA-NRC-TORT2	105	106	mg/kg ww	105	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1353265-4	VA-NRC-TORT2	0.318	0.350	mg/kg ww	0.318	.15-.55	
Tissue	CRM	Manganese (Mn)-Total	WG1353265-4	VA-NRC-TORT2	13.5	13.6	mg/kg ww	99	70-130	
Tissue	CRM	Mercury (Hg)-Total	WG1353265-4	VA-NRC-TORT2	0.234	0.270	mg/kg ww	87	70-130	
Tissue	CRM	Molybdenum (Mo)-Total	WG1353265-4	VA-NRC-TORT2	1.06	0.950	mg/kg ww	112	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1353265-4	VA-NRC-TORT2	2.28	2.50	mg/kg ww	91	70-130	
Tissue	CRM	Selenium (Se)-Total	WG1353265-4	VA-NRC-TORT2	6.97	5.63	mg/kg ww	124	70-130	
Tissue	CRM	Strontium (Sr)-Total	WG1353265-4	VA-NRC-TORT2	46.2	45.2	mg/kg ww	102	70-130	
Tissue	CRM	Vanadium (V)-Total	WG1353265-4	VA-NRC-TORT2	1.93	1.64	mg/kg ww	1.93	.64-2.64	
Tissue	CRM	Zinc (Zn)-Total	WG1353265-4	VA-NRC-TORT2	198	180	mg/kg ww	110	70-130	
Tissue	CRM	Arsenic (As)-Total	WG1353265-5	VA-NRC-DOLT4	9.51	9.66	mg/kg ww	98	70-130	
Tissue	CRM	Cadmium (Cd)-Total	WG1353265-5	VA-NRC-DOLT4	24.2	24.3	mg/kg ww	99	70-130	
Tissue	CRM	Copper (Cu)-Total	WG1353265-5	VA-NRC-DOLT4	32.5	31.2	mg/kg ww	104	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1353265-5	VA-NRC-DOLT4	0.153	0.160	mg/kg ww	0.153	.06-.26	
Tissue	CRM	Mercury (Hg)-Total	WG1353265-5	VA-NRC-DOLT4	2.41	2.58	mg/kg ww	93	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1353265-5	VA-NRC-DOLT4	0.76	0.97	mg/kg ww	0.76	.47-1.47	
Tissue	CRM	Selenium (Se)-Total	WG1353265-5	VA-NRC-DOLT4	9.60	8.30	mg/kg ww	116	70-130	
Tissue	CRM	Zinc (Zn)-Total	WG1353265-5	VA-NRC-DOLT4	124	116	mg/kg ww	107	70-130	
Tissue	MB	Aluminum (Al)-Total	WG1353265-1		<2.0	<2	mg/kg ww	-	2	
Tissue	MB	Antimony (Sb)-Total	WG1353265-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1353265-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1353265-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1353265-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1353265-1		<0.030	<0.03	mg/kg ww	-	0.03	
Tissue	MB	Cadmium (Cd)-Total	WG1353265-1		<0.0050	<0.005	mg/kg ww	-	0.005	
Tissue	MB	Calcium (Ca)-Total	WG1353265-1		<2.0	<2	mg/kg ww	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1353265-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1353265-1		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1353265-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Lead (Pb)-Total	WG1353265-1		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1353265-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1353265-1		<1.0	<1	mg/kg ww	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1353265-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Mercury (Hg)-Total	WG1353265-1		<0.0010	<0.001	mg/kg ww	-	0.005	
Tissue	MB	Molybdenum (Mo)-Total	WG1353265-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Nickel (Ni)-Total	WG1353265-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Selenium (Se)-Total	WG1353265-1		<0.20	<0.2	mg/kg ww	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1353265-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1353265-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1353265-1		<0.050	<0.05	mg/kg ww	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1353265-1		<0.0020	<0.002	mg/kg ww	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1353265-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1353265-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Aluminum (Al)-Total	WG1353265-2		<2.0	<2	mg/kg ww	-	2	
Tissue	MB	Antimony (Sb)-Total	WG1353265-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1353265-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1353265-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1353265-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1353265-2		<0.030	<0.03	mg/kg ww	-	0.03	
Tissue	MB	Cadmium (Cd)-Total	WG1353265-2		<0.0050	<0.005	mg/kg ww	-	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 ww	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1353265-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1353265-2		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1353265-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Lead (Pb)-Total	WG1353265-2		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1353265-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1353265-2		<1.0	<1	mg/kg ww	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1353265-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Mercury (Hg)-Total	WG1353265-2		<0.0010	<0.001	mg/kg ww	-	0.005	
Tissue	MB	Molybdenum (Mo)-Total	WG1353265-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Nickel (Ni)-Total	WG1353265-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Selenium (Se)-Total	WG1353265-2		<0.20	<0.2	mg/kg ww	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1353265-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1353265-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1353265-2		<0.050	<0.05	mg/kg ww	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1353265-2		<0.0020	<0.002	mg/kg ww	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1353265-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1353265-2		<0.10	<0.1	mg/kg ww	-	0.1	

Appendix 3.1-1

Shoreline Substrate and Habitat Unit Data for Back River Ponds

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

Appendix 3.1-2. Fish Sampling Locations and Catch Summary in Back River Ponds

Date	Lake	Crew	Method	Net/Trap		Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1	Zone	Easting 1	Northing 1
				No.									
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		Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1	Zone	Easting 1	Northing 1
				No.									
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		Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1	Zone	Easting 1	Northing 1
				No.									
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		Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1	Zone	Easting 1	Northing 1
				No.									
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		Easting 2	Northing 2	Number of Fish Captured		Gillnet CPUE (# fish/h)	Minnow Trap CPUE (# fish/h/trap)
			No.	Depth 2			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		Easting 2	Northing 2	Number of Fish Captured		Gillnet CPUE (# fish/h)	Minnow Trap CPUE (# fish/h/trap)
			No.	Depth 2			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		Easting 2	Northing 2	Number of Fish Captured		Gillnet CPUE (# fish/h)	Minnow Trap CPUE (# fish/h/trap)
			No.	Depth 2			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		Easting 2	Northing 2	Number of Fish Captured		Gillnet CPUE	Minnow Trap CPUE
			No.	Depth 2			Arctic grayling	Slimy sculpin	(# fish/h)	(# fish/h/trap)
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

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

Appendix 3.2-1. Shoreline Substrate and Habitat Data for Back River Lakes

Lake	Habitat Unit ID	Lake Area (ha)	Dominant Substrate	Substrate Composition (%)				
				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**

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 (# fish/100 m ² /h)
														Lake Trout	Round Whitefish	
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

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

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

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
<u>CRUSTACEA</u>																					
CLADOCERA																					
Daphnidae																					
<i>Daphnia middendorffiana</i>																					
Chydoridae																					
<i>Eurycercus</i>																					
COPEPODA																					
<i>Hetercope septentriona</i>																					
<u>INSECTA</u>																					
HEMIPTERA																					
Hemiptera																					
Corixidae																					
<i>Corisella</i>																					
TRICHOPTERA																					
Trichoptera damaged																					
Limnephilidae																					
Limnephilidae																					
<i>Grensia</i>																					
COLEOPTERA																					
Coleoptera damaged																					
Dytiscidae																					
<i>Colymbetes</i>																					
HYMENOPTERA																					
Apidae																					
DIPTERA																					
Nematocera																					
<u>Chironomidae</u>																					
Chironomidae damaged																					
Tanypodinae																					
<i>Procladius</i>																					

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				
<i>Phaenopsectra</i>	L	B																	1	1				
Orthocladinae	P	B											2							2				
<i>Psectrocladius</i>	P	B													2						2			
Diamesinae		B																	0					
<i>Monodiamesa</i>	P	B											21	1	2	1	4				29			
<i>Protanypus</i>	P	B											5	8			2	2			17			
MOLLUSCA																					0			
Bivalvia																					0			
Sphaeridae																					0			
<i>Pisidium</i>		B						3	1												4			
<i>Sphaerium</i>		B	600	1025	880	870		1			54	1			1					3432				
Gastropoda																					0			
Valvatidae																					0			
<i>Valvata sincera sincera</i>		B						1			2										3			
FISH																					0			
Fish	damaged									1							1	1	1			4		
<u>Gasterostidae</u>																					0			
<i>Pungitius pungitius</i>		W						1	1	3	7	1			5	8					26			
NON-FOOD ITEMS																					0			
Case materials		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																					
Daphnidae																					
<i>Daphnia middendorffiana</i>																					
Chydoridae																					
<i>Eurycercus</i>																					
COPEPODA																					
<i>Hetercope septentriona</i>																					
INSECTA																					
HEMIPTERA																					
Hemiptera																					
Corixidae																					
<i>Corisella</i>																					
TRICHOPTERA																					
Trichoptera damaged																					
Limnephilidae																					
Limnephilidae																					
<i>Grensia</i>																					
COLEOPTERA																					
Coleoptera damaged																					
Dytiscidae																					
<i>Colymbetes</i>																					
HYMENOPTERA																					
Apidae																					
DIPTERA																					
Nematocera																					
<i>Chironomidae</i>																					
Chironomidae damaged																					
Tanypodinae																					
<i>Procladius</i>																					

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			
<i>Phaenopsectra</i>	L	B																		3			
Orthocladinae	P	B												8						8			
<i>Psectrocladius</i>	P	B														1				1			
Diamesinae		B																		0			
<i>Monodiamesa</i>	P	B												192	11	15	10	32		260			
<i>Protanypus</i>	P	B												41	53			9	10	113			
MOLLUSCA																				0			
Bivalvia																				0			
Sphaeridae																				0			
<i>Pisidium</i>		B							37	34										71			
<i>Sphaerium</i>		B	24268	36276	24615		44302	26				1816	42			31				131376			
Gastropoda																				0			
Valvatidae																				0			
<i>Valvata sincera sincera</i>		B							21			40								61			
FISH																				0			
Fish	damaged										200					297	840	1067		2404			
<i>Gasterostidae</i>																				0			
<i>Pungitius pungitius</i>		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

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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by Rescan Environmental Services Ltd.

Prepared for:



Sabina Gold & Silver Corp.

Prepared by:



Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

Executive Summary

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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BACK RIVER PROJECT

2012 FISH AND FISH HABITAT BASELINE REPORT

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Glossary and Abbreviations

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

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:

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



Figure 1-1

- o assess fish habitat and fish presence at stream crossings located on proposed site roads;
- o assess fish habitat and community composition in lakes and streams that could be affected by mine development at the Goose and George properties;
- o collect baseline tissue metal samples and stomach content samples from potential receiving environment lakes in the Goose and George areas; and
- o 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
<i>Goose Property</i>			
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
<i>George Property</i>			
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.

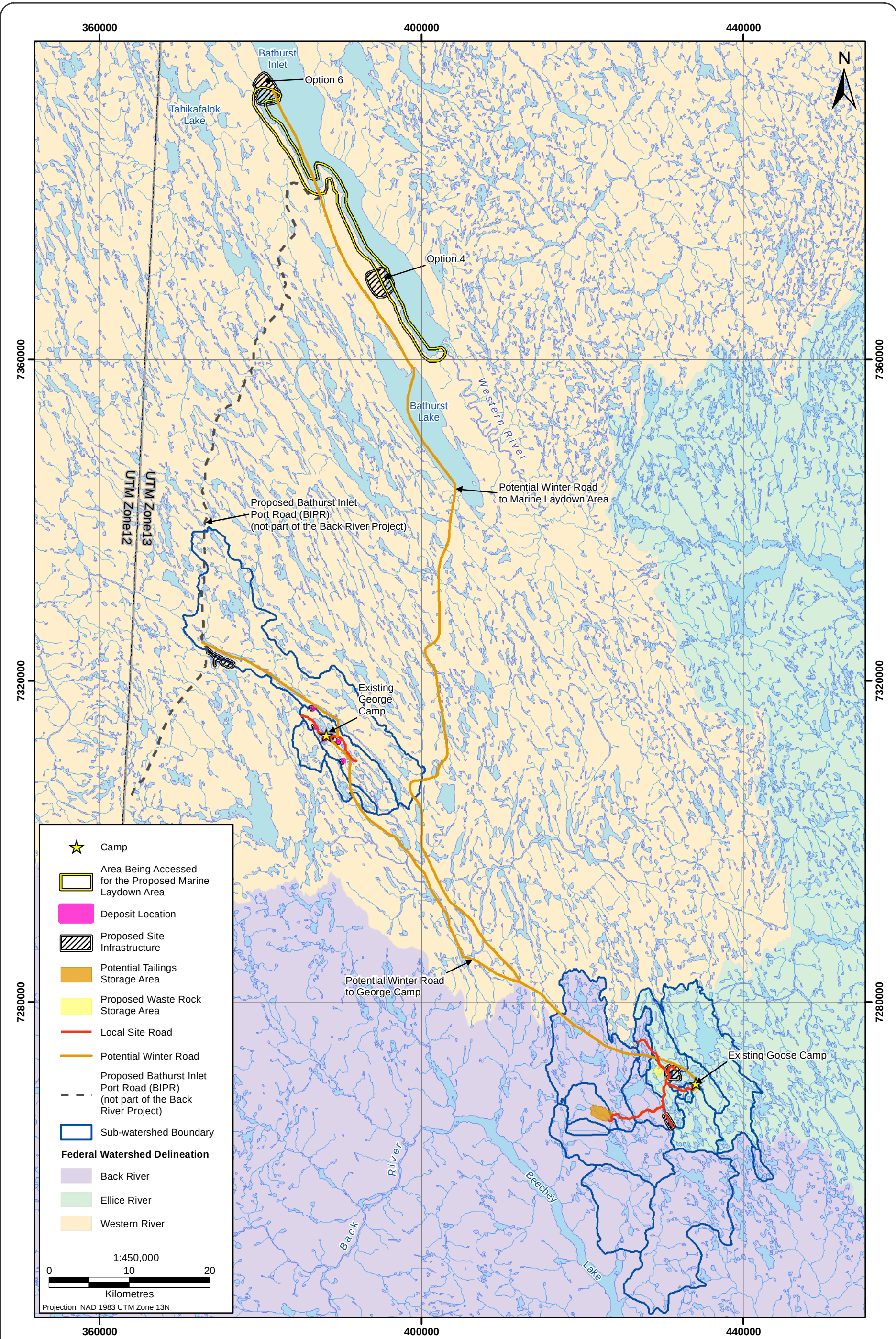
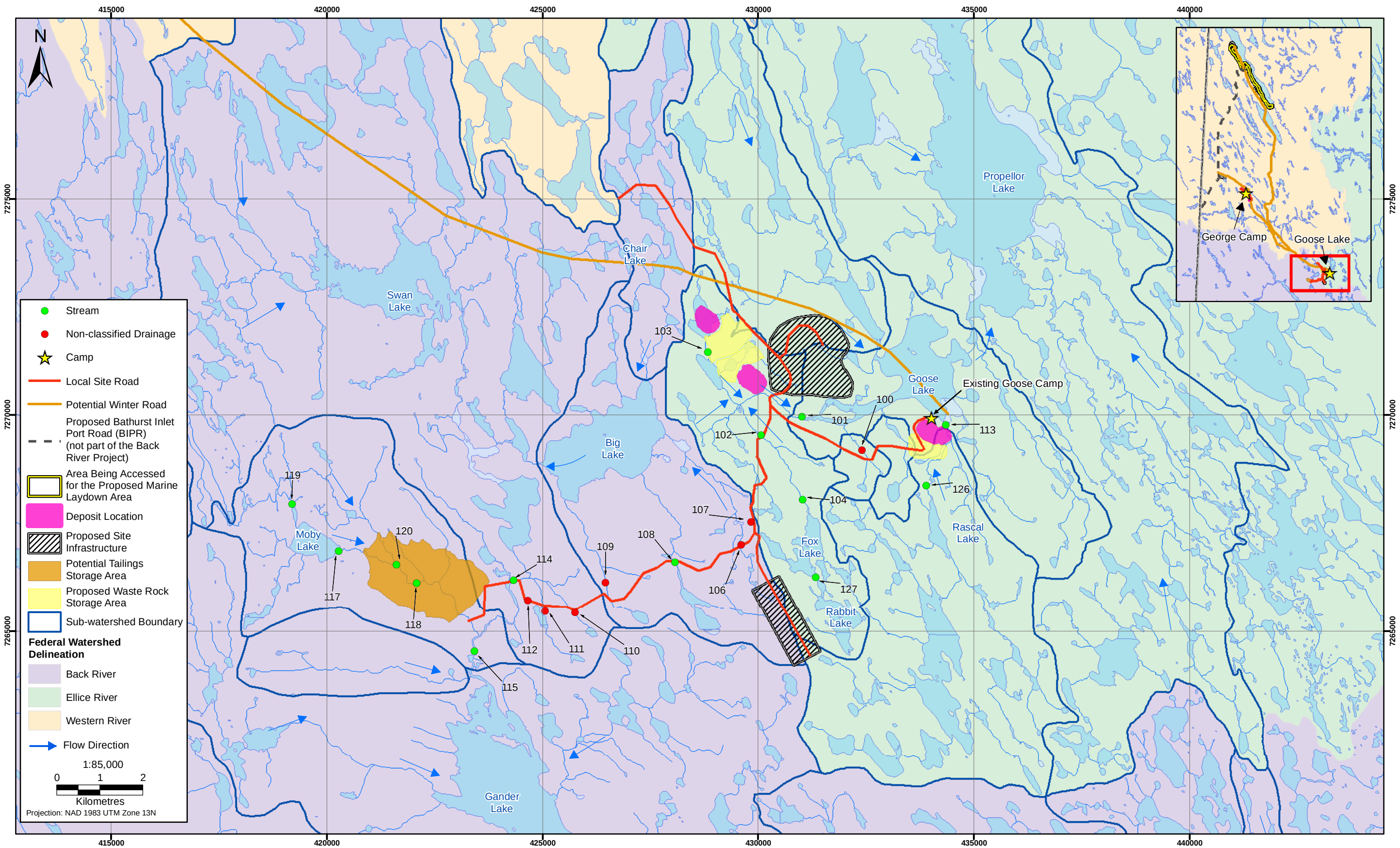
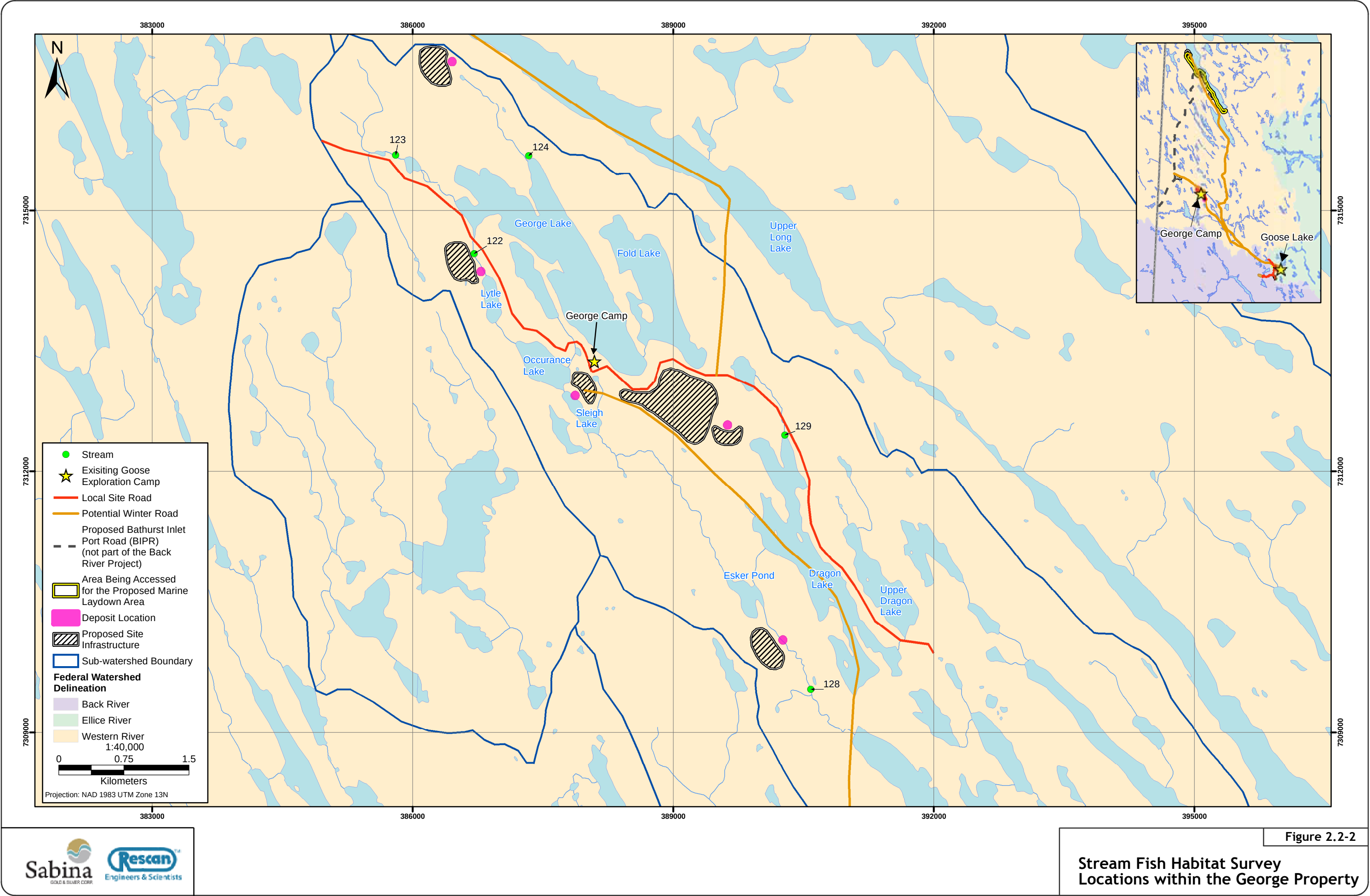
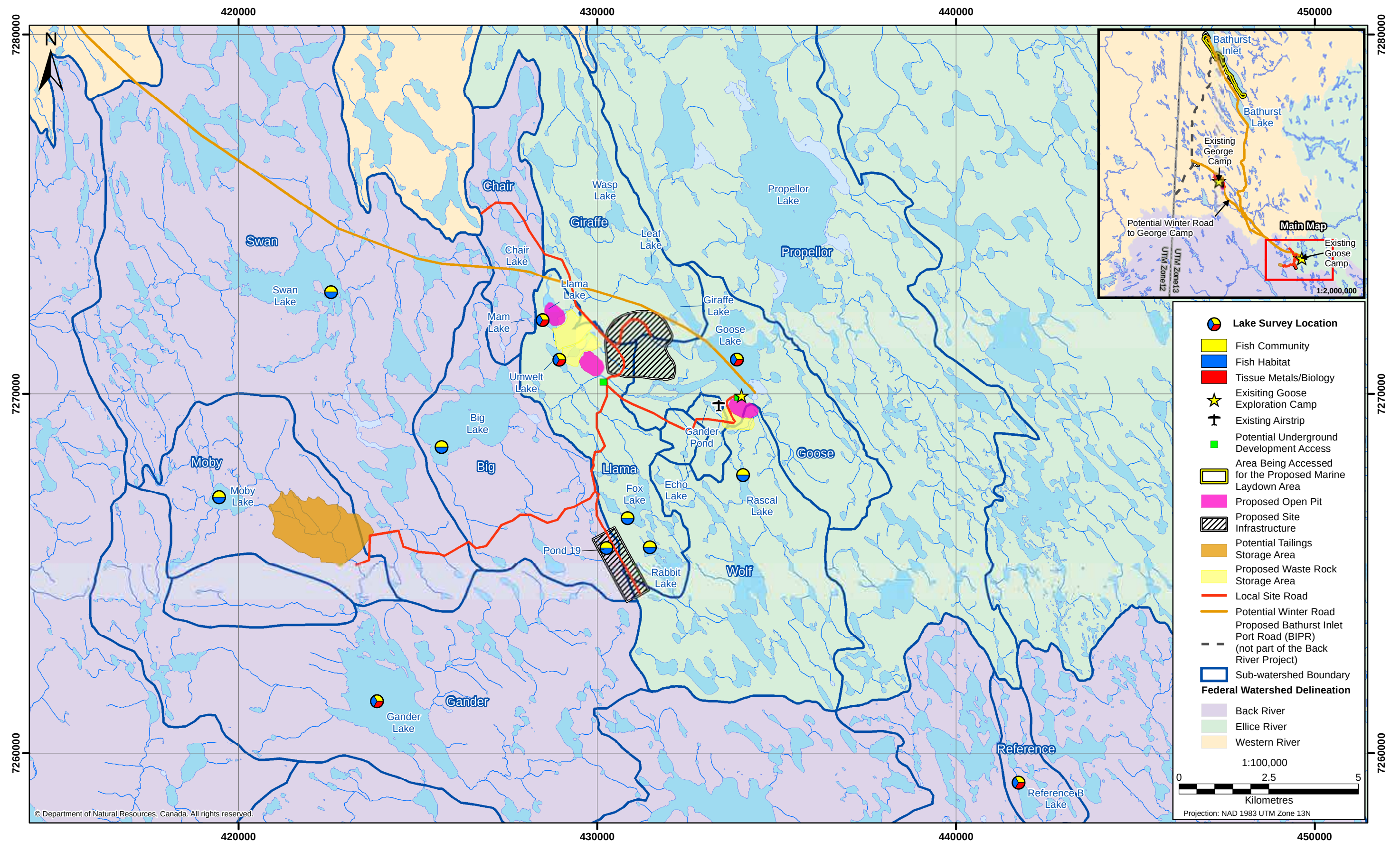
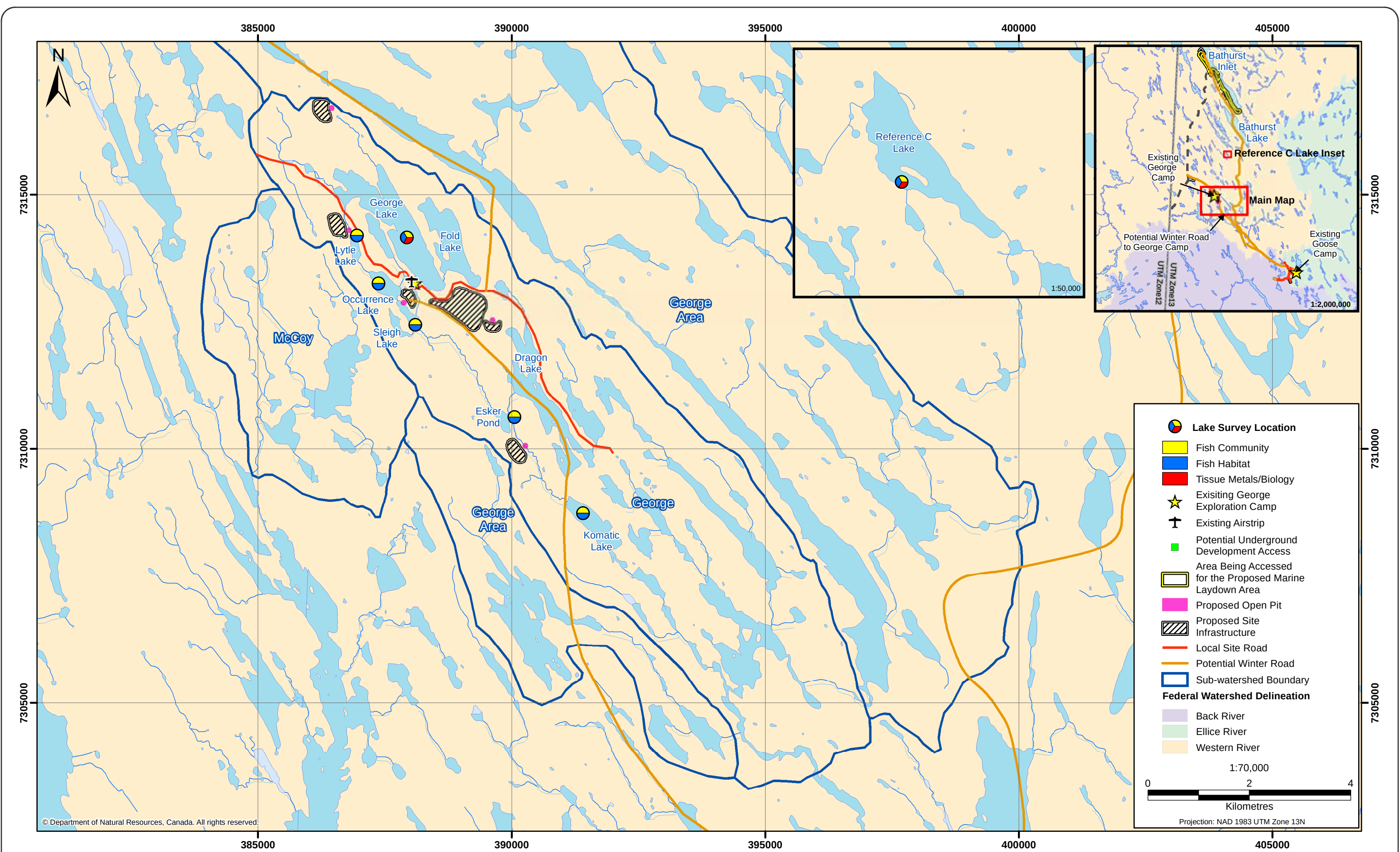


Figure 2.1-1









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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:

- o Pool – low velocity area with smooth, non-turbulent flow, low gradient (near 0%), and a concave bottom;
- o Glide – an area of smooth, non-turbulent flowing water with moderate velocity and gradient less than 4%;
- o Riffle – an area of turbulent, fast-flowing water with a gradient less than 4%; and
- o 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:

- o Channel characteristics – length assessed, number of reaches, channel morphology, bankfull width, wetted width, bankfull depth, wetted depth, residual pool depth and gradient;
- o Instream habitat characteristics – habitat unit ratio, weighted substrate composition, weighted cover composition, bank height, and bank stability; and
- o 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

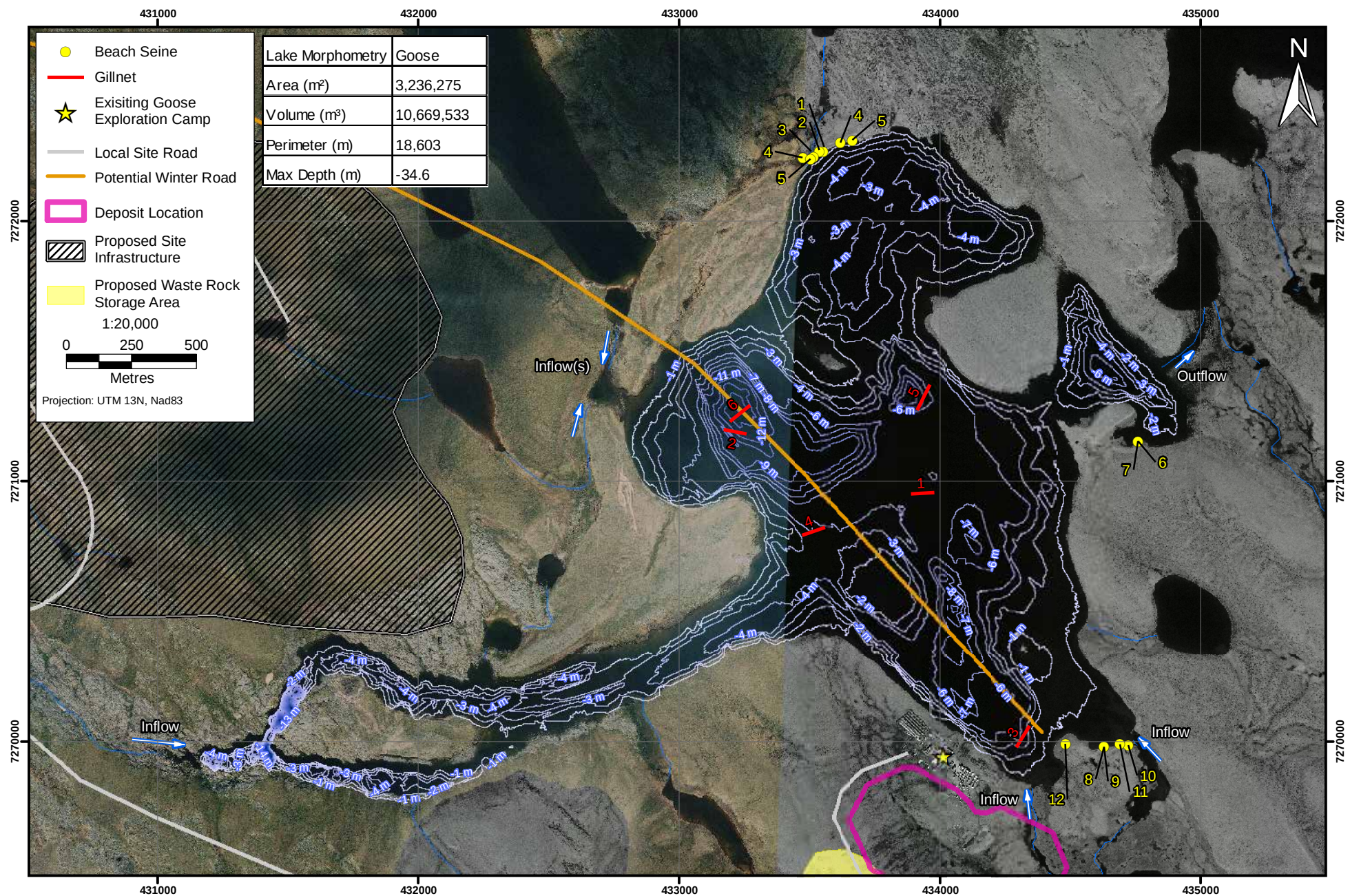
The fish community in each lake was sampled using a combination of gillnets (for pelagic areas) and beach seines (for shallow, shoreline areas). Each gillnet consisted of a standard gang of six panels of different mesh sizes (25 mm, 76 mm, 51 mm, 89 mm, 38 mm and 64 mm) (RIC 2001). Each panel was 15.2 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.



Goose Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-1

Table 2.4-1. Sampling Locations for Fish Tissue Metal Samples, 2012

Site	Species Collected	Rationale
<i>Goose Property</i>		
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
<i>George Property</i>		
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 m² of net per hour. For beach seining, CPUE was calculated as the number of fish captured per 100 m² of seined area. Where less than 10 sampling sets were conducted, CPUE data was bootstrapped to provide more accurate summary statistics.

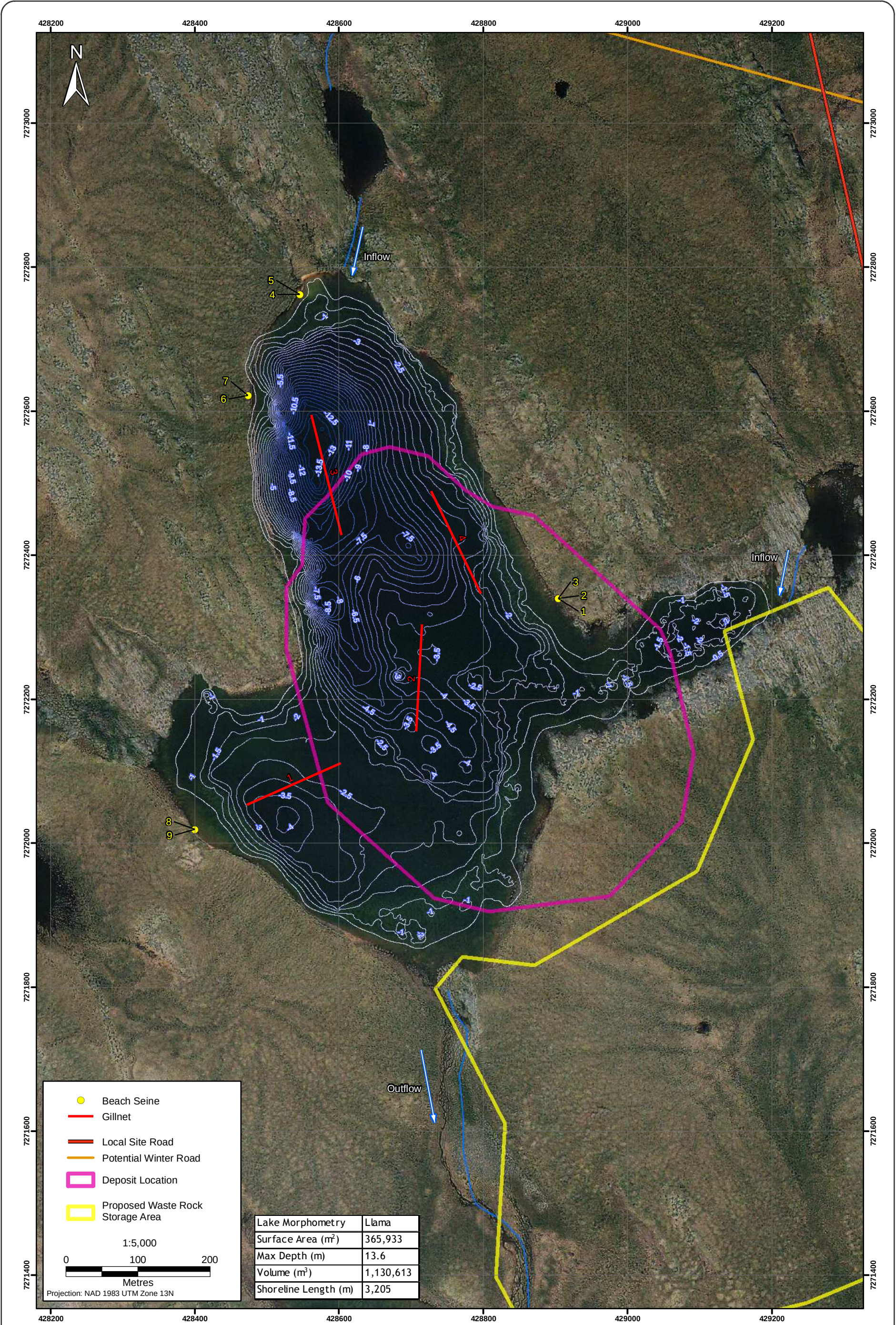


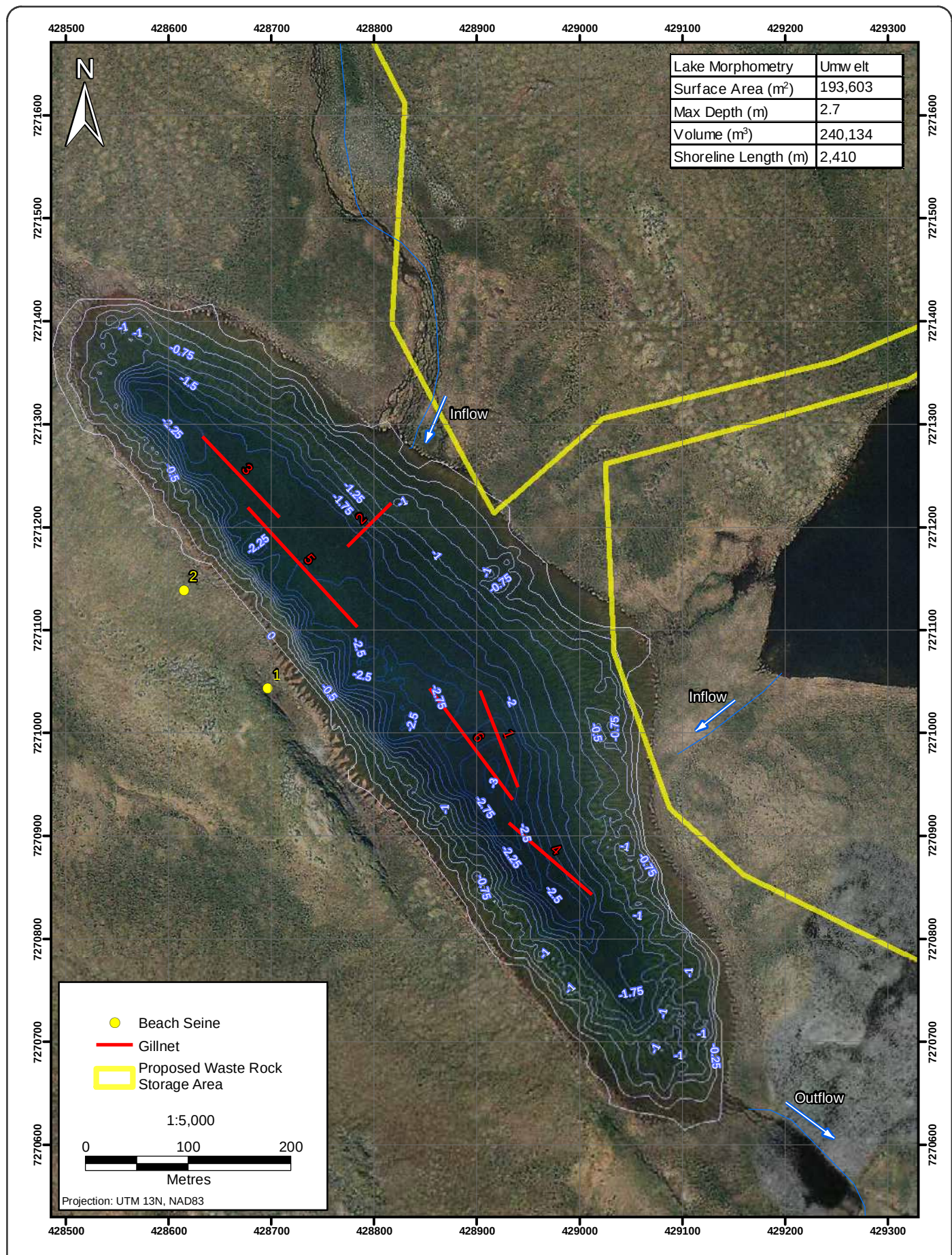
Figure 2.4-2



Llama Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-2





Umwelt Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-3

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:

$$\text{Condition (K)} = \frac{\text{weight (g)} \times 10^5}{\text{length (mm)}^3}$$

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.



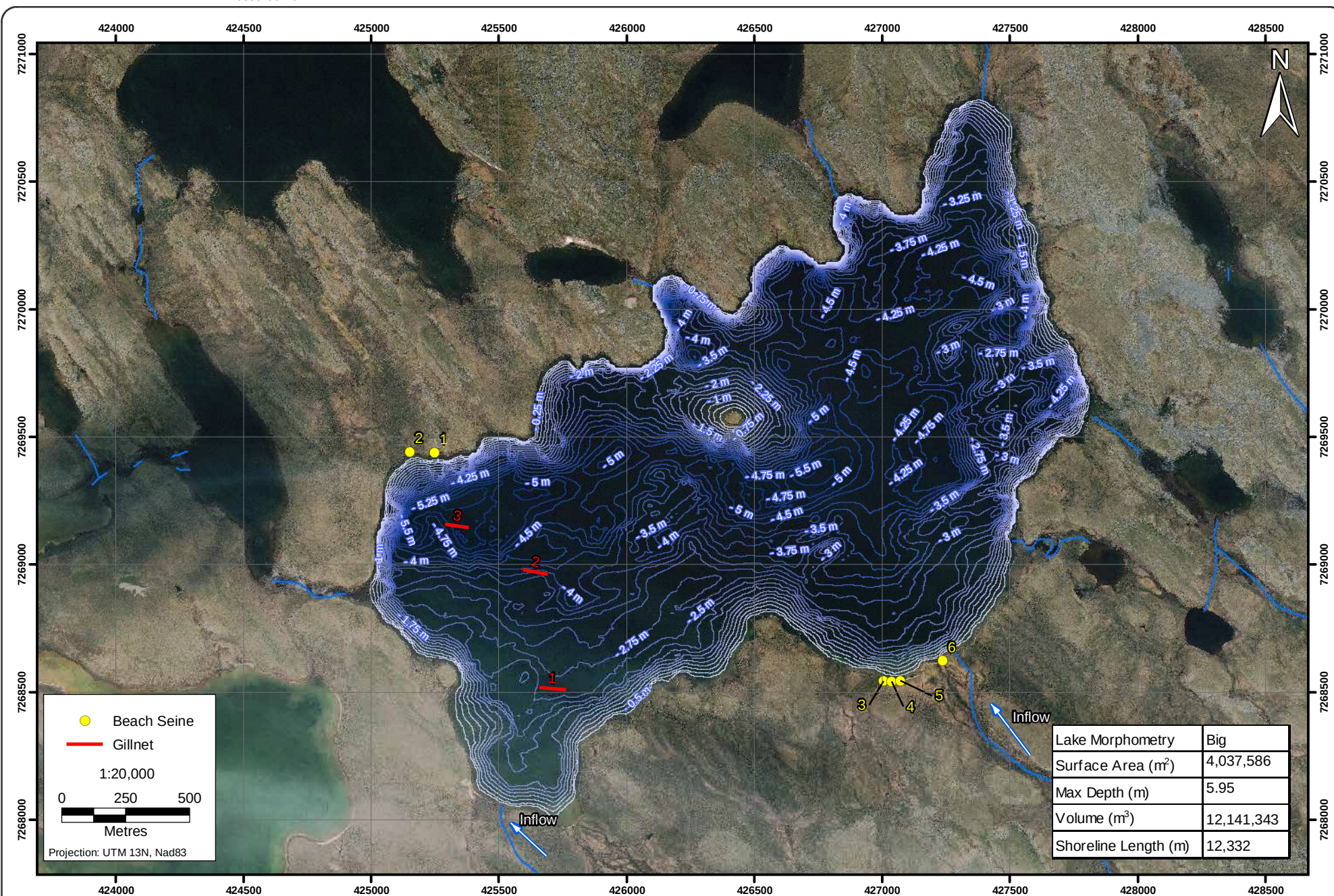
Figure 2.4-4



Gander Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

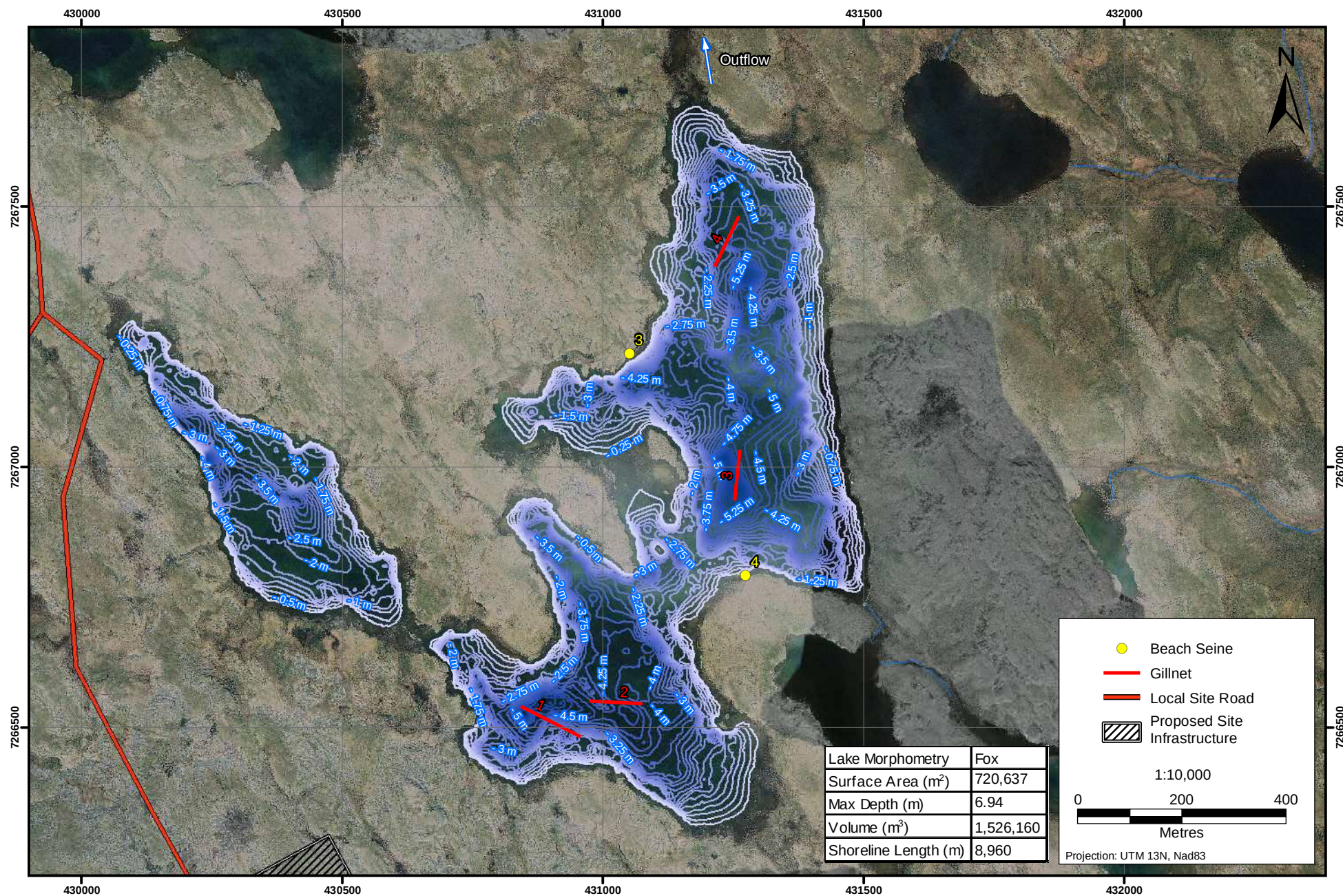
Figure 2.4-4





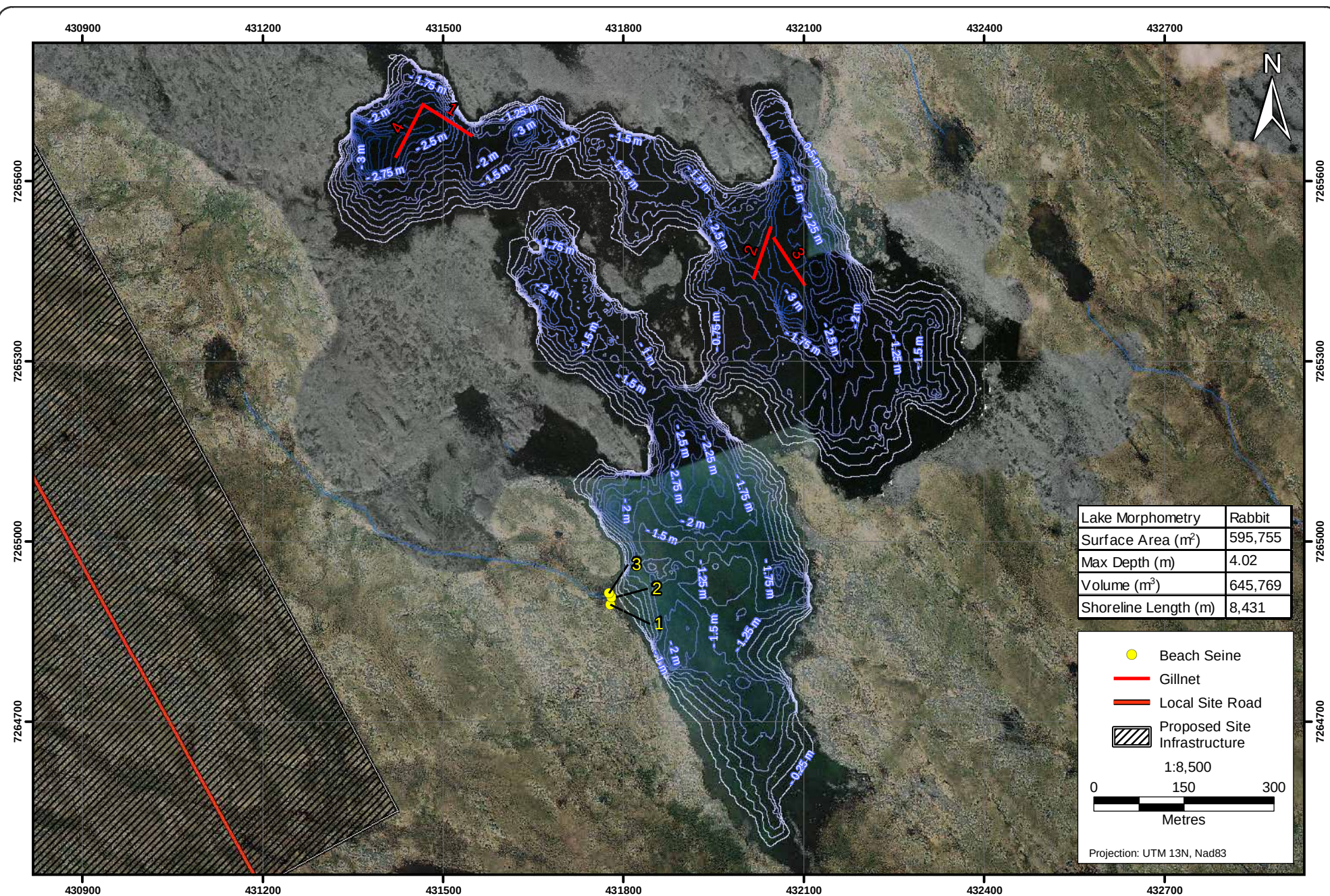
Big Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-5



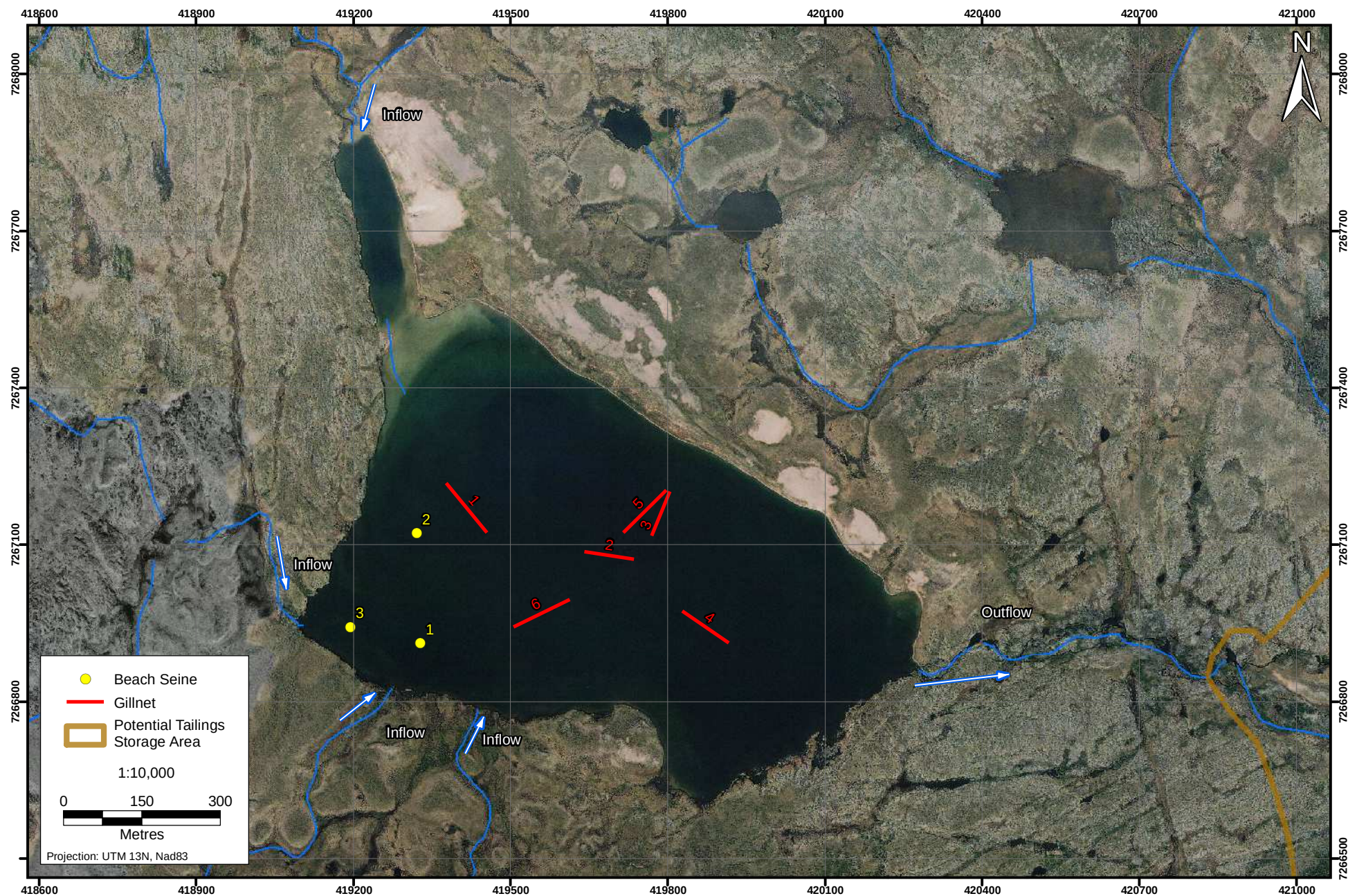
Fox Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-6



Rabbit Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-7



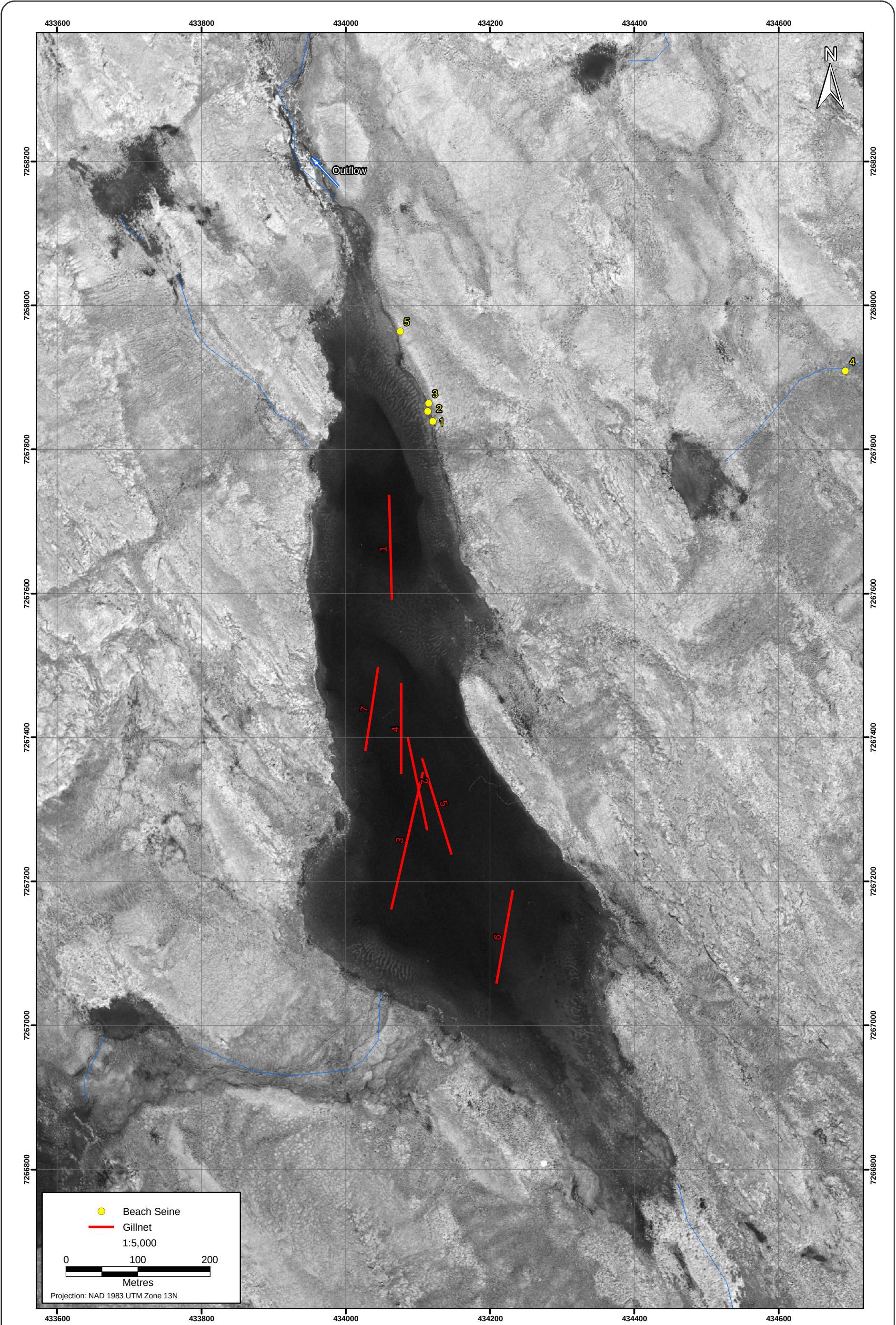


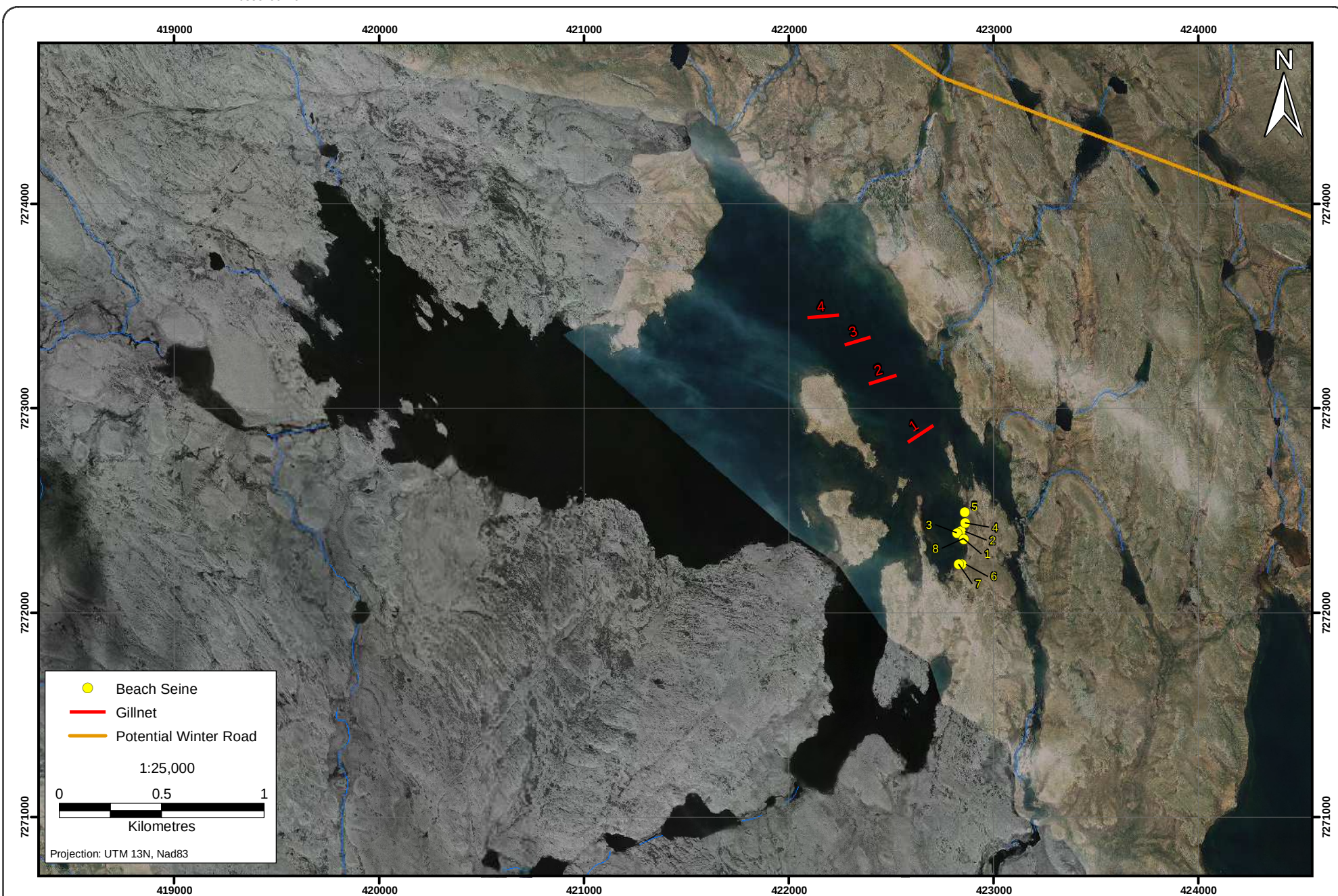
Figure 2.4-9



Rascal Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

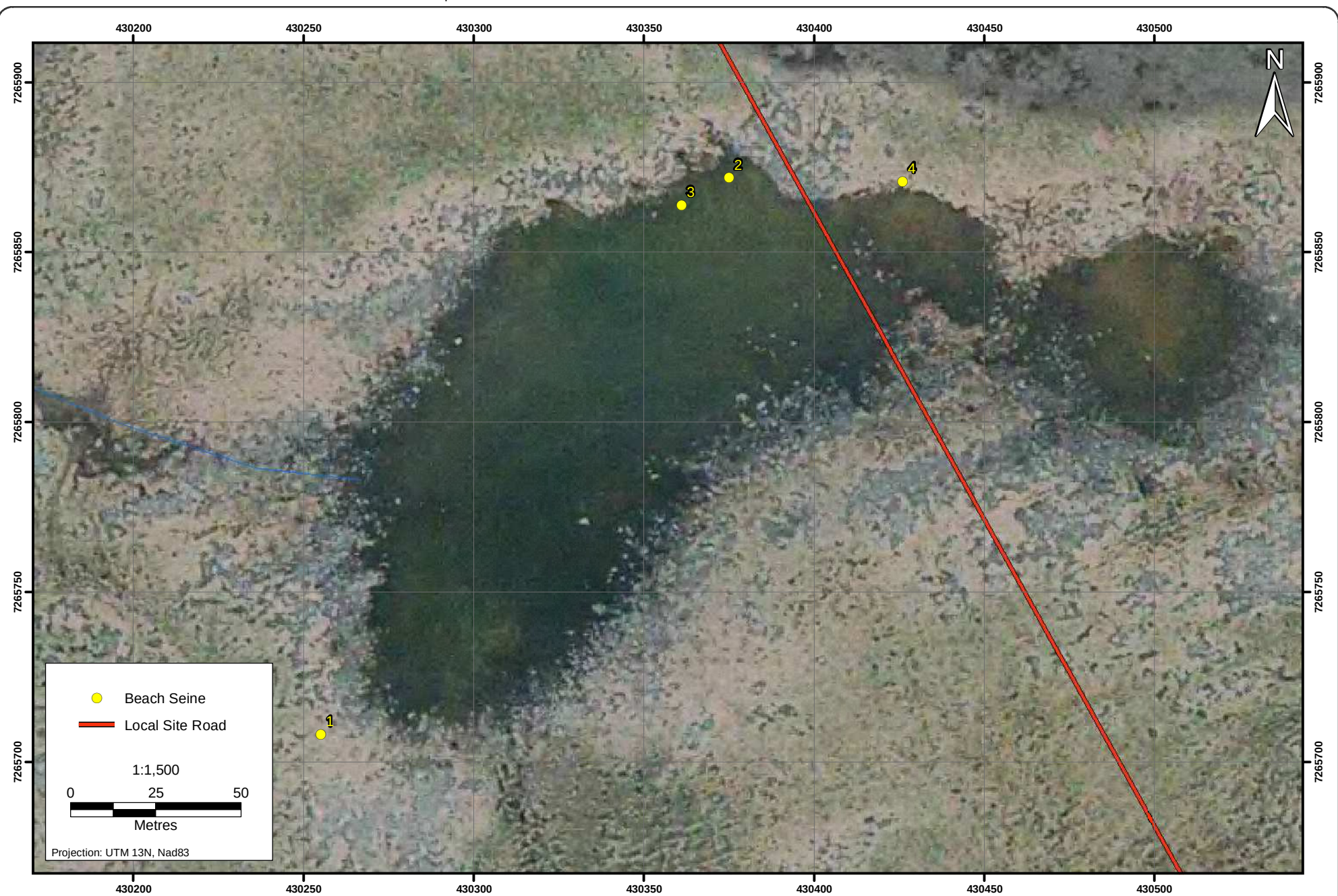
Figure 2.4-9





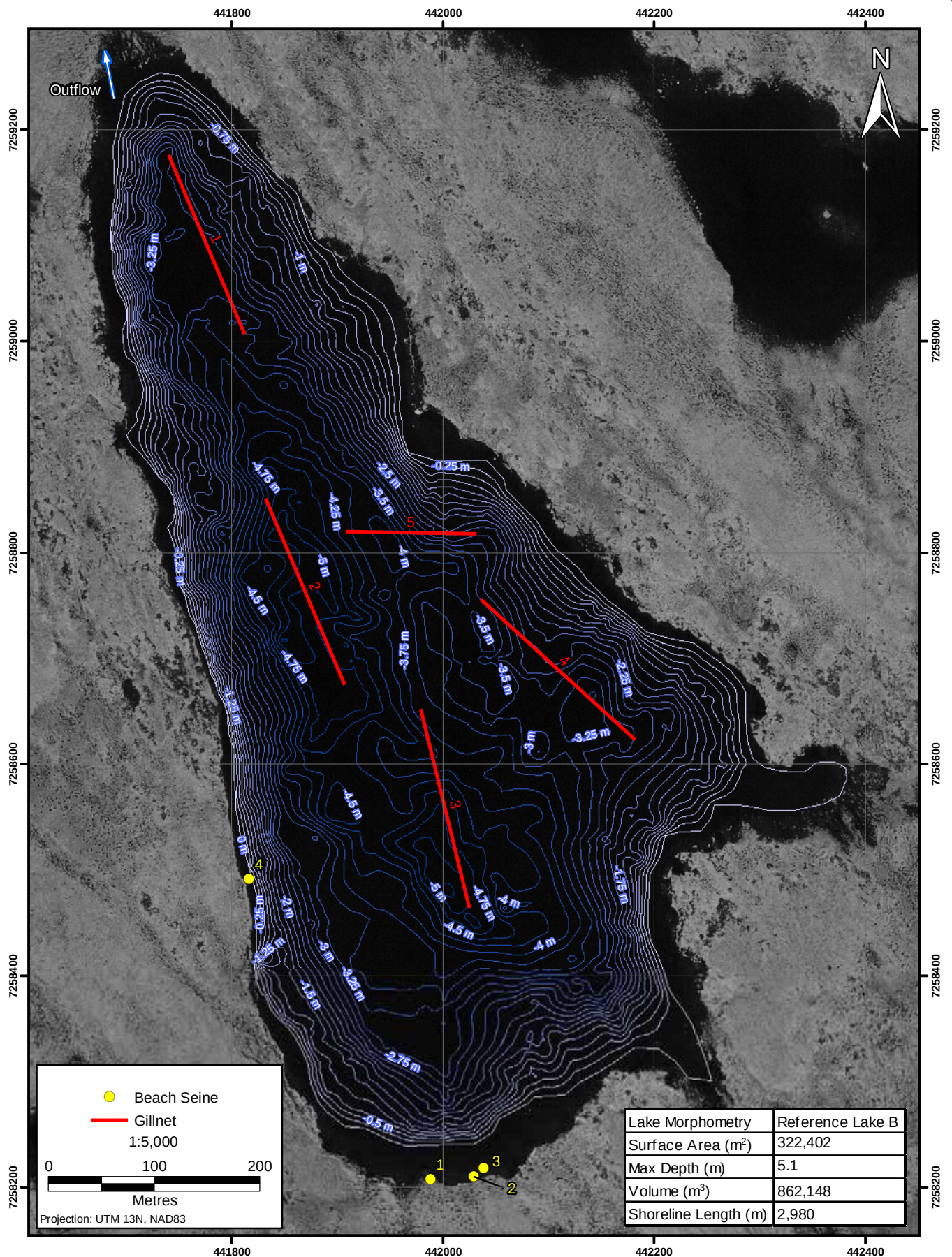
Swan Lake Gillnet and Beach Seine Sampling
Locations, Goose Property, 2012

Figure 2.4-10



Pond 19 Gillnet and Beach Seine Sampling
Locations, Goose Property, 2012

Figure 2.4-11



Reference B Lake Gillnet and Beach Seine Sampling Locations, Goose Property, 2012

Figure 2.4-12

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.

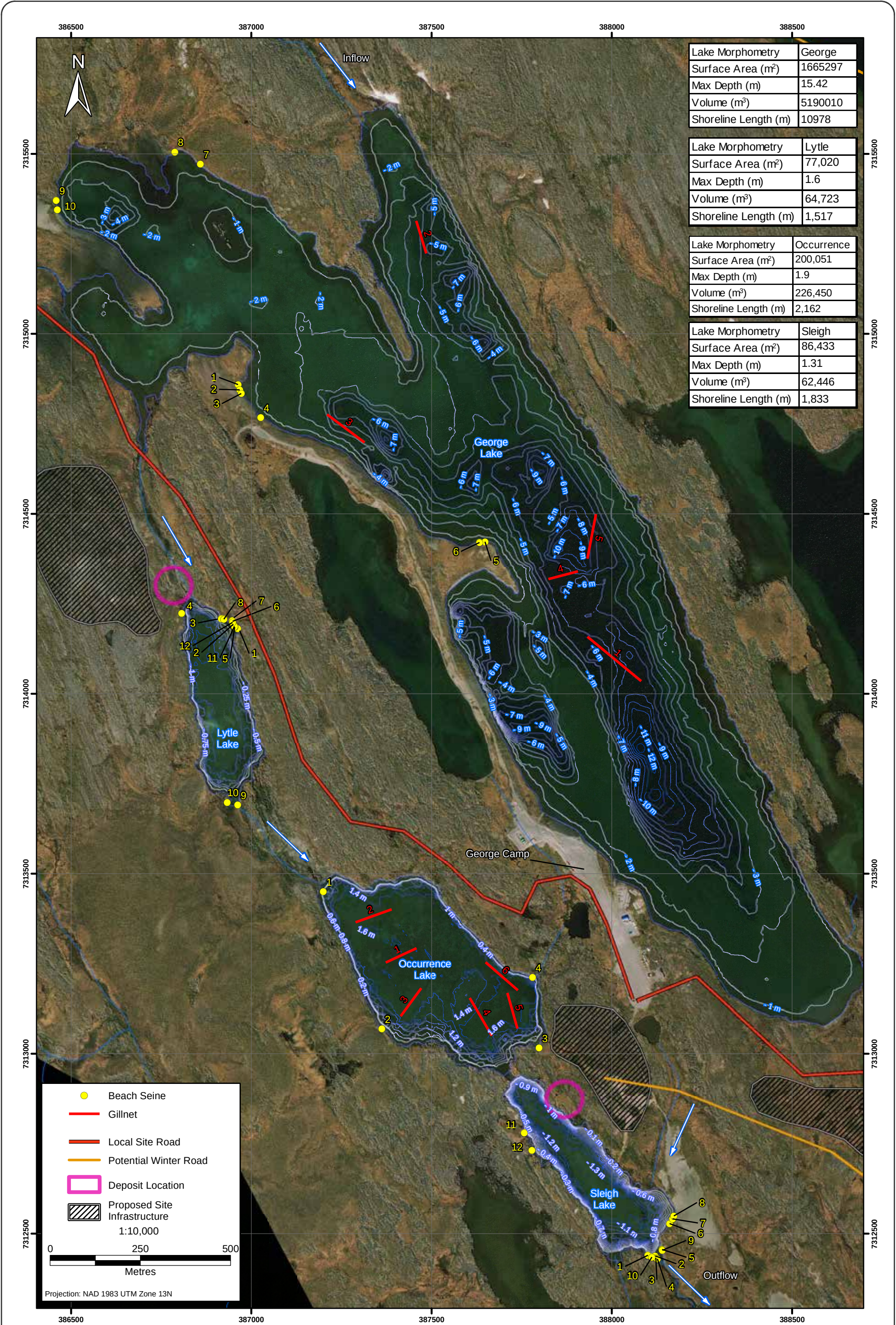


Figure 2.4-13



George, Sleigh, Lytle and Occurrence Lakes Gillnet and Beach Seine Sampling Locations, George Property, 2012

Figure 2.4-13



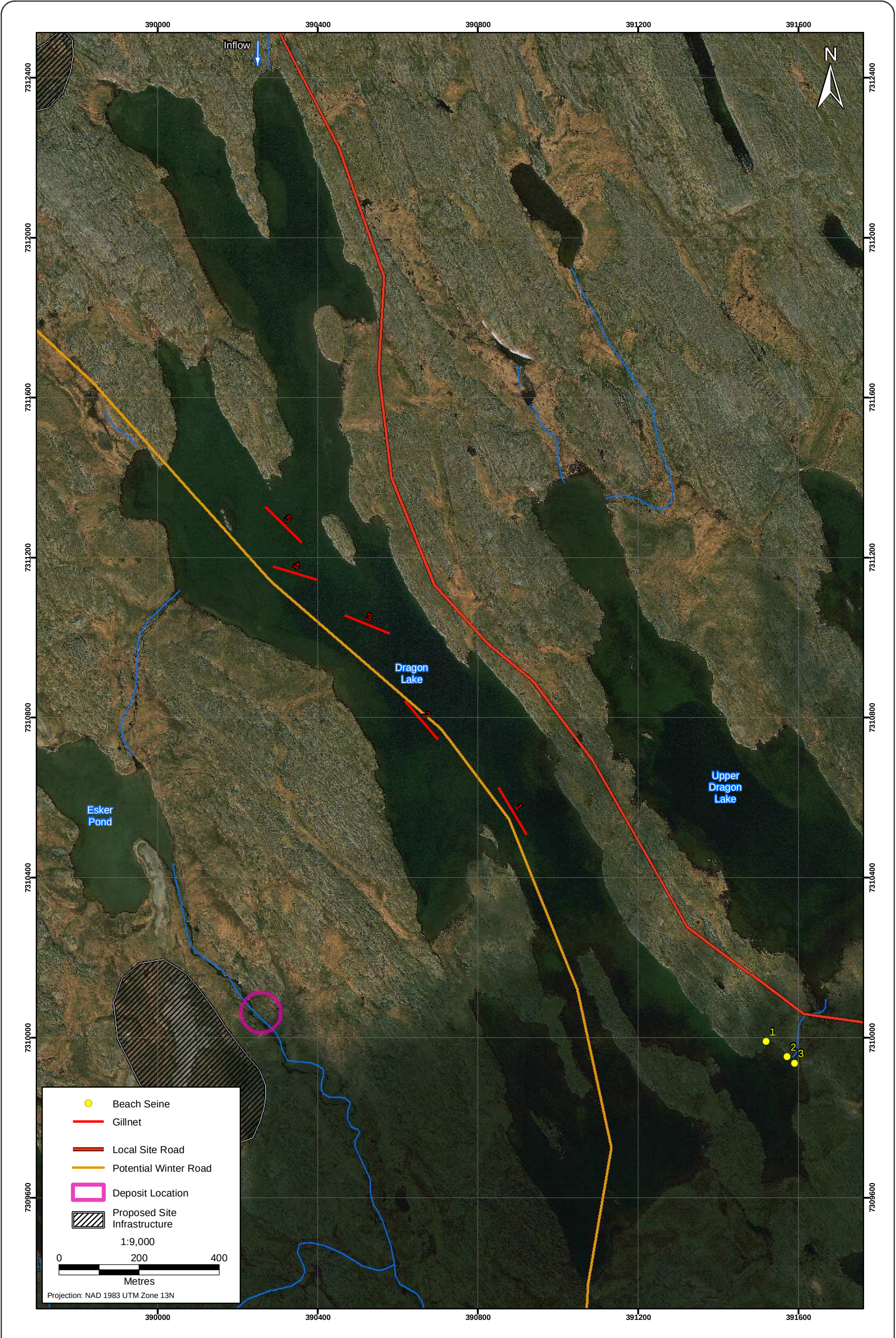


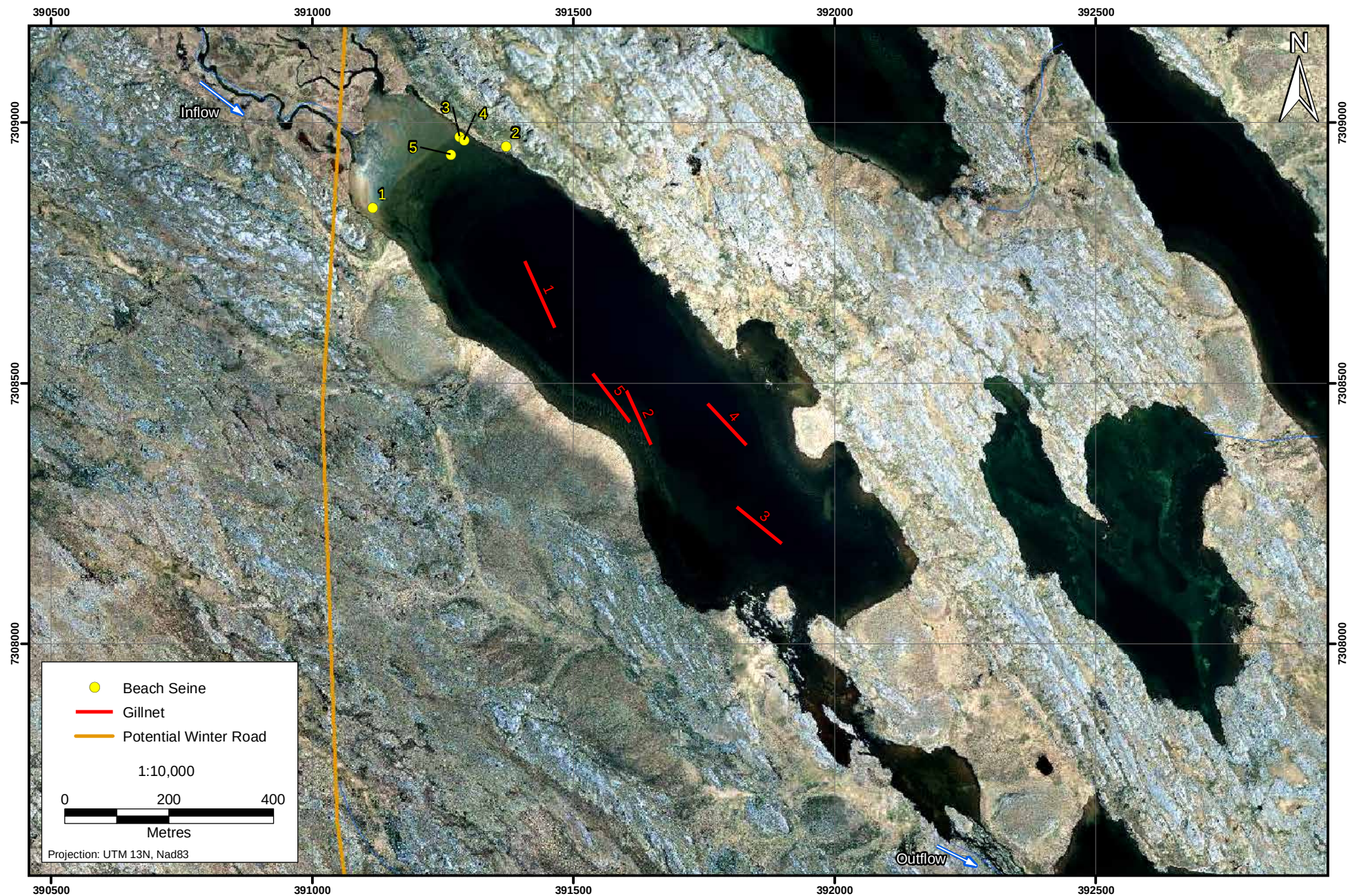
Figure 2.4-14

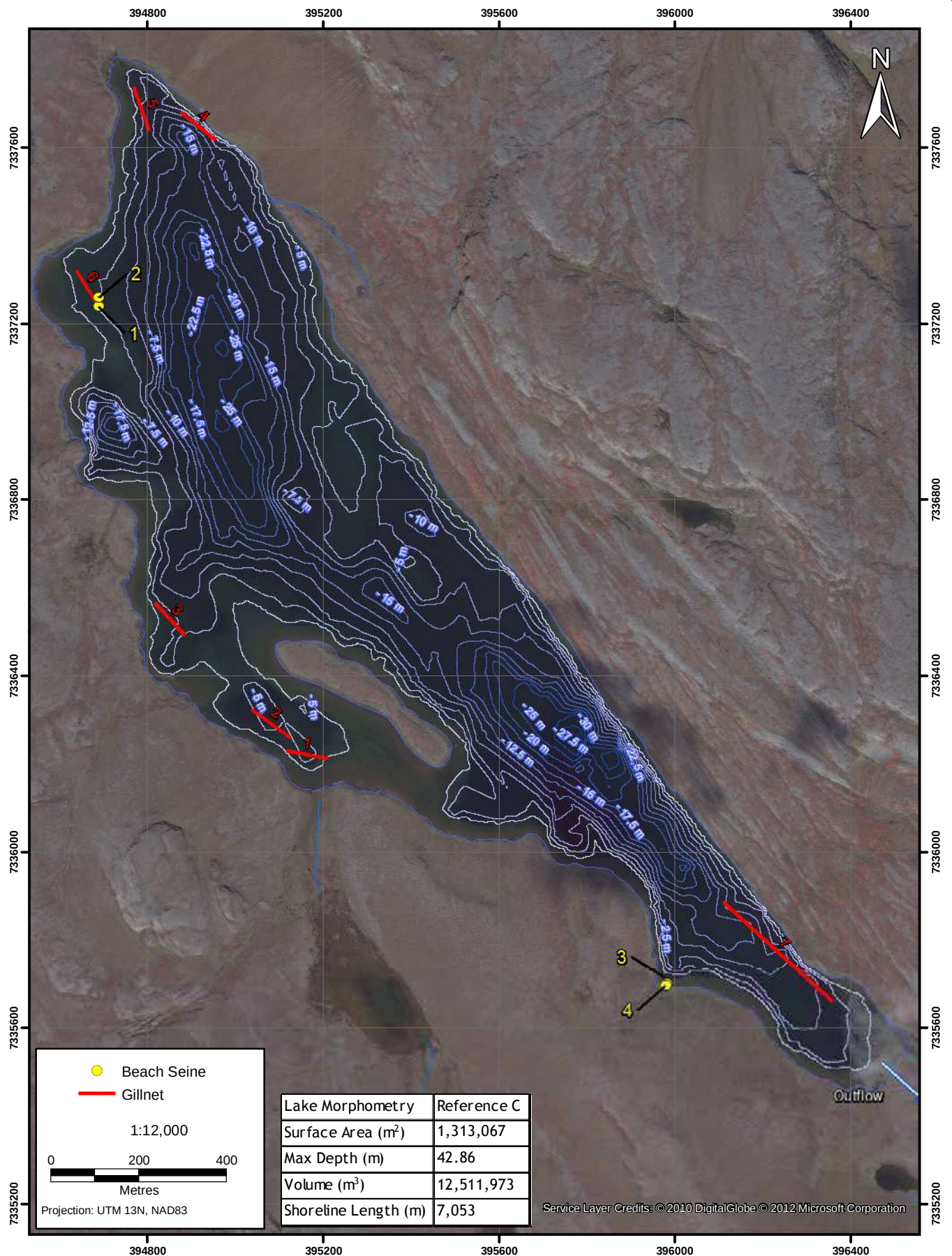


Dragon Lake Gillnet and Beach Seine Sampling Locations, George Property, 2012

Figure 2.4-14







Reference C Lake Gillnet and Beach Seine Sampling Locations, George Property, 2012

Figure 2.4-16

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

				Weighted Mean Depth (m)		Weighted Mean Width (m)	
Description	Site #	Survey Distance (m)	Weighted Mean Slope (%)	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)

				Weighted Mean Depth (m)		Weighted Mean Width (m)	
Description	Site #	Survey	Weighted Mean	Wetted	Bankfull	Wetted	Bankfull
		Distance (m)	Slope (%)				
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

		Percent Composition					
Description	Site #	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)
<i>Goose Property</i>					
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
<i>George Property</i>					
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					
		Pool (%)	Boulder (%)	Instream Vegetation (%)	Overhanging Vegetation (%)	Undercut Bank (%)	
Description	Site #						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
<i>George Property</i>							
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/mm³.

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 CPUE (fish/100 s)	Visual Observation (No.)		
			Arctic Grayling	Burbot	Lake Trout	Lake Whitefish	Ninespine Stickleback	Slimy Sculpin	Total		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

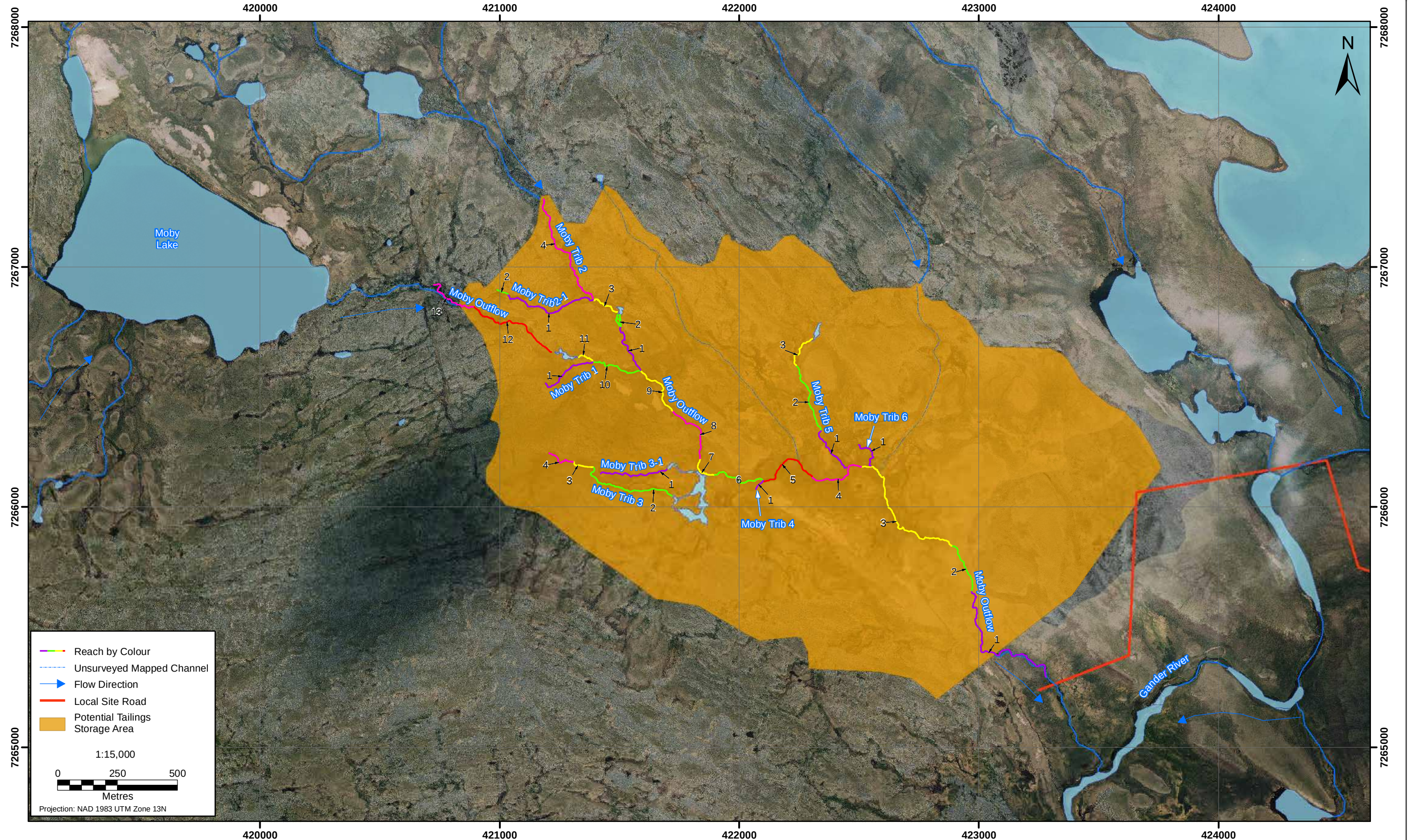




Plate 3.2-1. Moby Outflow (foreground) with seepage tributaries along the south bank (looking south). September 2, 2012.

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 of 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 a 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.



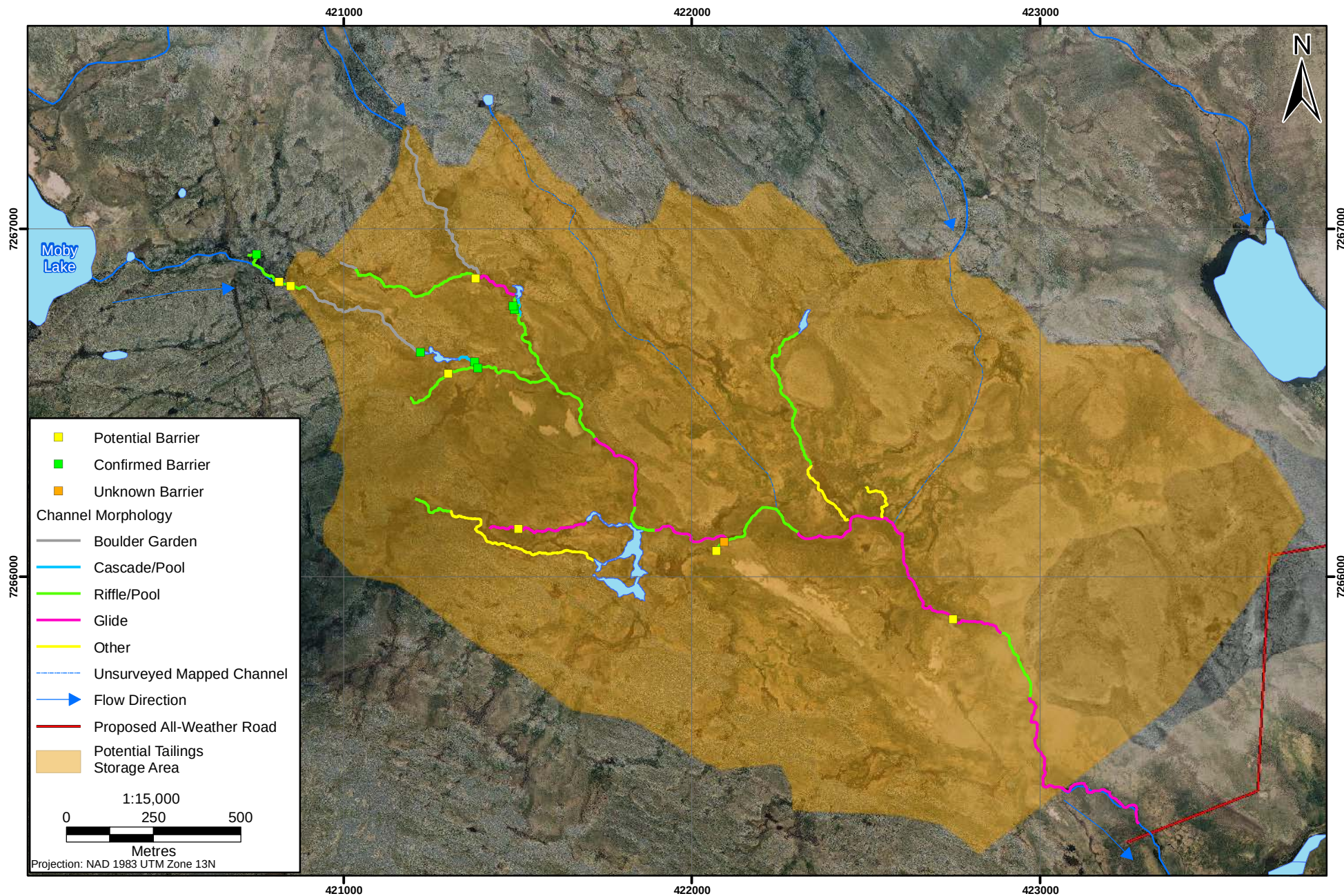
Plate 3.2-29. Seepage reach of Moby Tributary 6 looking upstream from Moby Outflow. September 2012.

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



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 is 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 -	Pool	14.9	12.9	8.3	0.0	8.1	0.0	4.8	2.1	0.0	0.0
Weighted	Boulder	0.0	0.0	12.2	0.0	0.0	12.7	1.7	0.0	4.8	1.0
Substrate	Instream Veg	17.7	8.1	31.8	8.6	18.5	2.9	0.9	11.0	0.7	0.3
Composition -	Overhang Veg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% by unit area	Undercut Bank	8.4	13.1	5.0	0.0	15.8	4.4	14.9	0.9	2.7	8.6
	<i>Total</i>	<i>41.0</i>	<i>34.1</i>	<i>57.2</i>	<i>8.6</i>	<i>42.5</i>	<i>19.9</i>	<i>22.3</i>	<i>14.1</i>	<i>8.2</i>	<i>9.8</i>

Attribute	Descriptor	Moby Outflow (<i>cont'd</i>)			Tributary 1	Tributary 2			Tributary 2-1
		11	12	13	1	1	2	3	1
Habitat -	Pool	11	12	13	0.0	2.2	0.0	0.8	0.0
Weighted	Boulder	0.0	0.0	0.0	5.2	5.5	15.7	7.9	0.0
Substrate	Instream Veg	20.9	0.0	28.6	4.1	1.8	0.0	8.3	3.3
Composition -	Overhang Veg	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0
% by unit area	Undercut Bank	0.0	0.0	2.9	15.0	10.9	2.4	4.4	11.5
	<i>Total</i>	<i>1.4</i>	<i>0.0</i>	<i>0.0</i>	<i>24.3</i>	<i>20.5</i>	<i>19.9</i>	<i>21.3</i>	<i>14.8</i>

Attribute	Descriptor	Tributary 3			Tributary 3-1	Tributary 4	Tributary 5			Tributary 6
		2	3	4	1	1	1	2	3	1
Habitat -	Pool	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weighted	Boulder	6.3	0.0	0.0	0.0	8.5	0.0	0.0	0.0	0.0
Substrate	Instream Veg	7.9	0.0	0.0	40.0	13.1	0.0	0.0	0.0	0.0
Composition -	Overhang Veg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% by unit area	Undercut Bank	1.5	0.0	0.0	0.0	0.0	0.0	4.6	14.5	0.0
	<i>Total</i>	<i>15.7</i>	<i>0.0</i>	<i>0.0</i>	<i>40.0</i>	<i>21.6</i>	<i>0.0</i>	<i>4.6</i>	<i>14.5</i>	<i>0.0</i>

Veg = vegetation

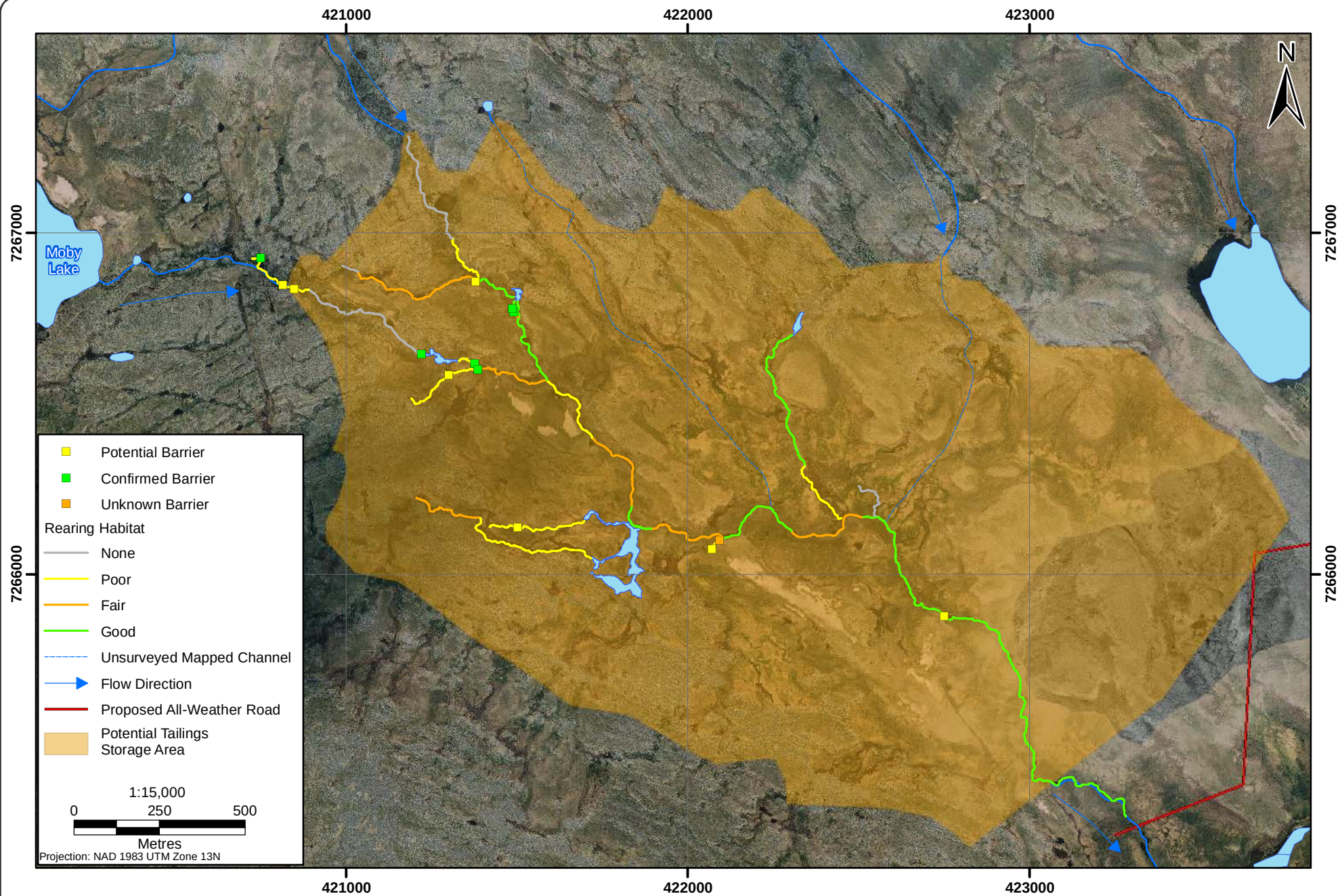
Table 3.2-5. Bank Height and Stability of Assessed Streams within the Moby Watershed

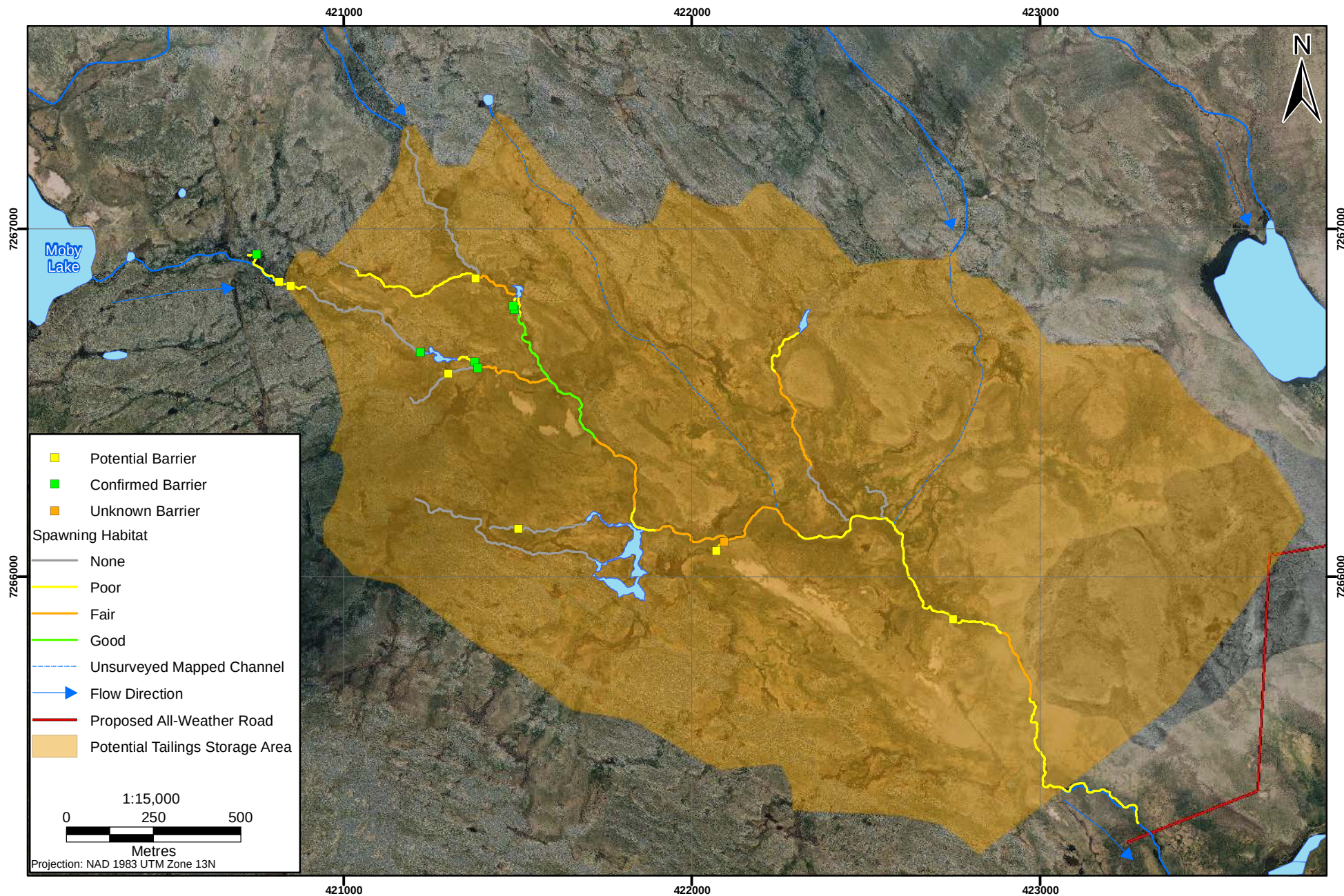
Attribute	Descriptor	Moby Outflow									
		1	2	3	4	5	6	7	8	9	10
Left Bank Height	m	0.28	0.36	0.30	0.22	0.20	0.26	0.25	0.18	0.20	0.19
Right Bank Height	m	0.36	0.27	0.34	0.23	0.20	0.16	0.18	0.22	0.25	0.18
Left Bank Stability	0 = unstable, 0.5 = stable, 1.0 = highly stable	0.50	0.43	0.50	0.50	0.50	0.50	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

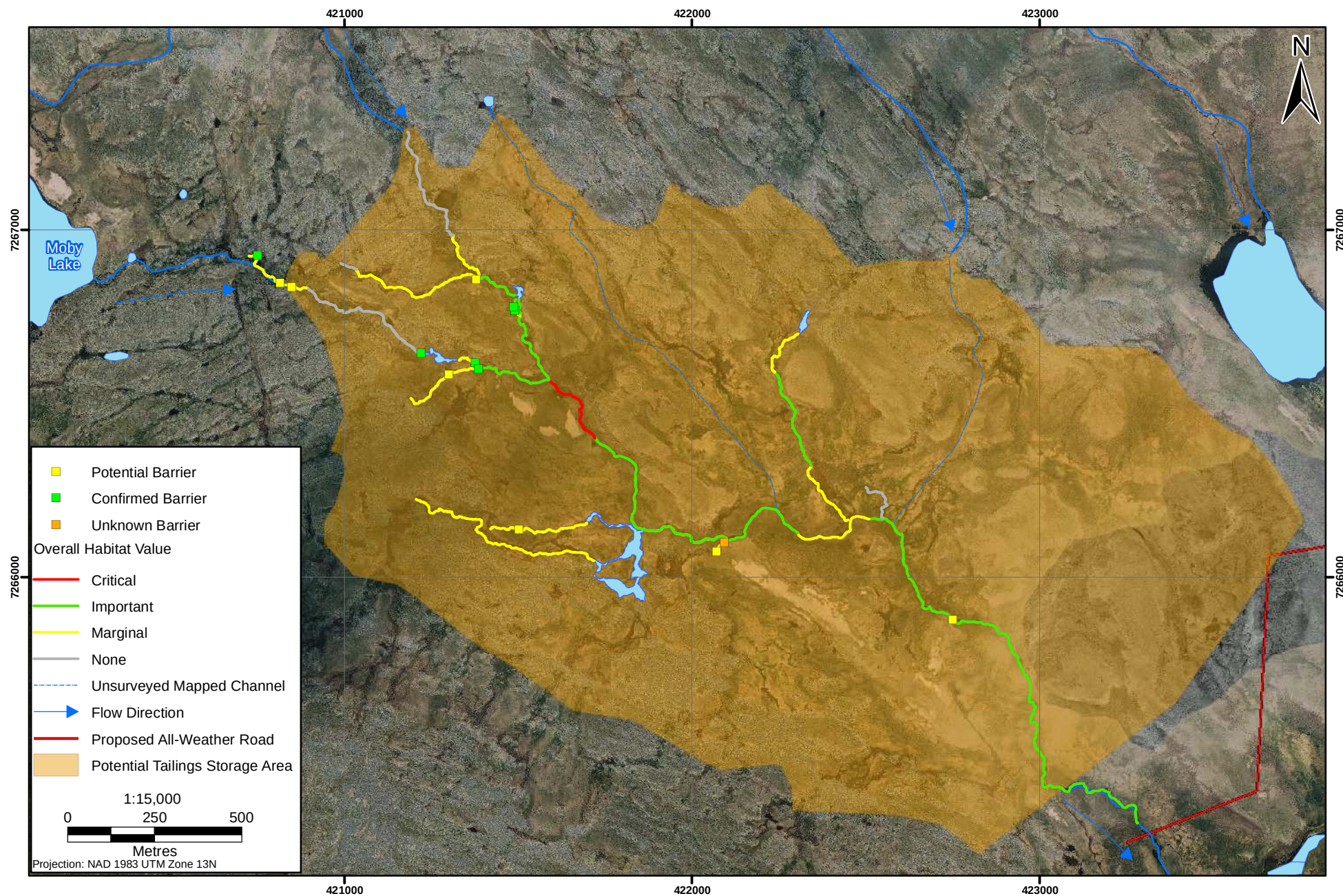
Attribute	Descriptor	Moby Outflow (<i>cont'd</i>)			Tributary 1	Tributary 2			Tributary 2-1
		11	12	13	1	1	2	3	1
Left Bank Height	m	0.63	n/a	0.34	0.21	0.21	0.33	0.24	0.15
Right Bank Height	m	0.80	n/a	0.28	0.18	0.23	0.30	0.19	0.13
Left Bank Stability	0 = unstable, 0.5 = stable, 1.0 = highly stable	0.75	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







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 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.

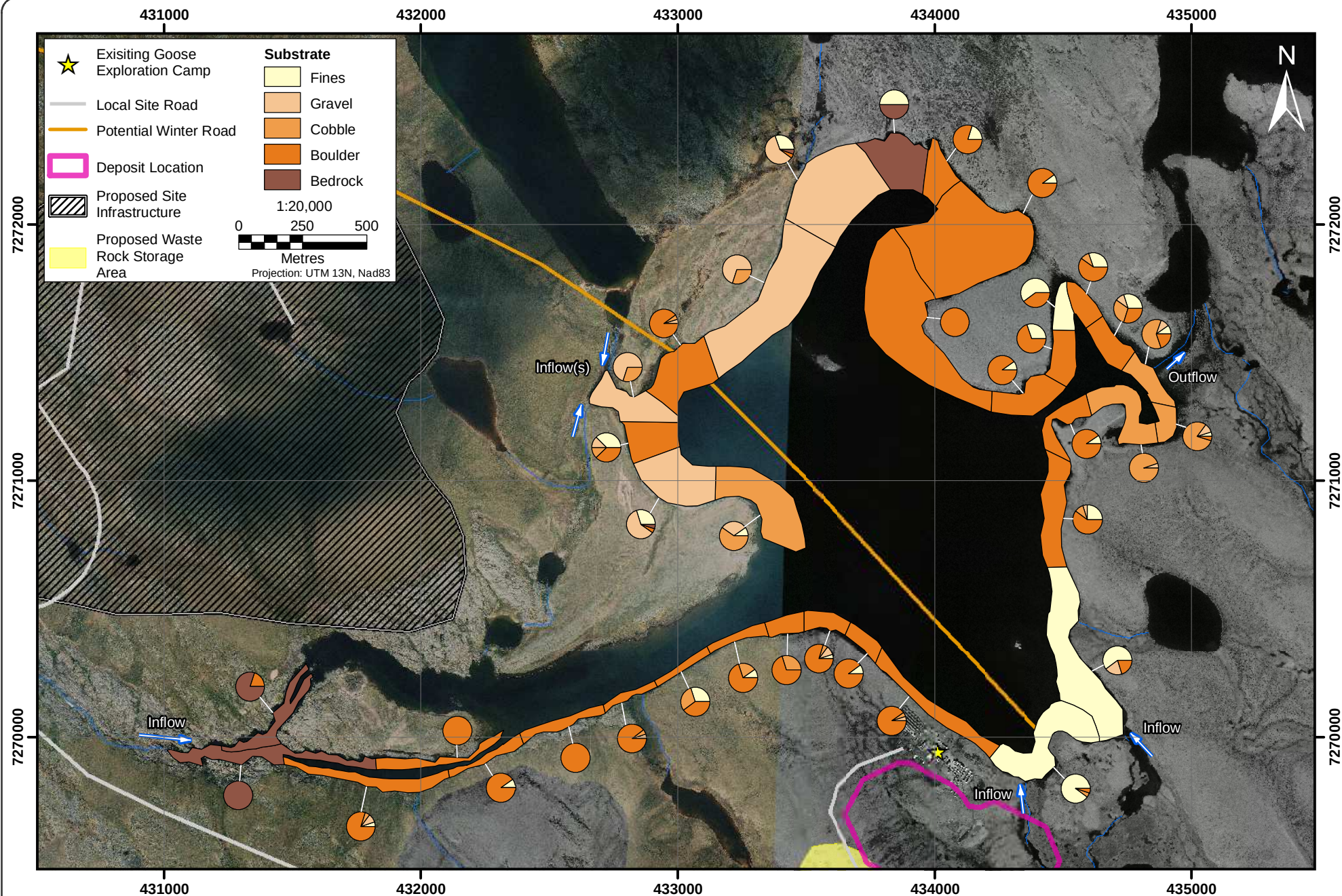




Plate 3.3-3. Bedrock and boulder shoreline in the “gooseneck” area of Goose Lake, looking southwest. July 2012.

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).

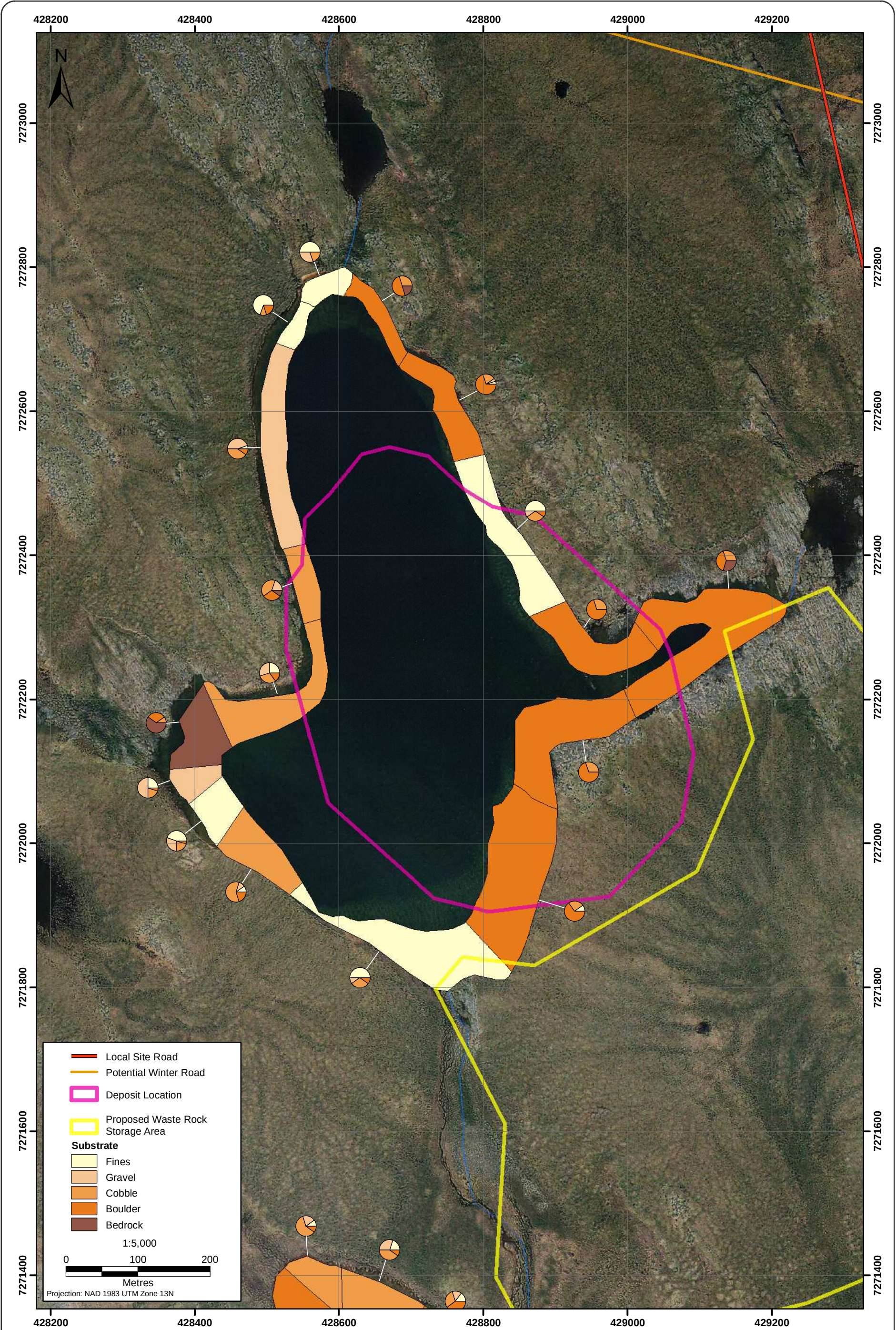


Figure 3.3-2



Shoreline Fish Habitat Substrates Zones, Llama Lake, 2012

Figure 3.3-2

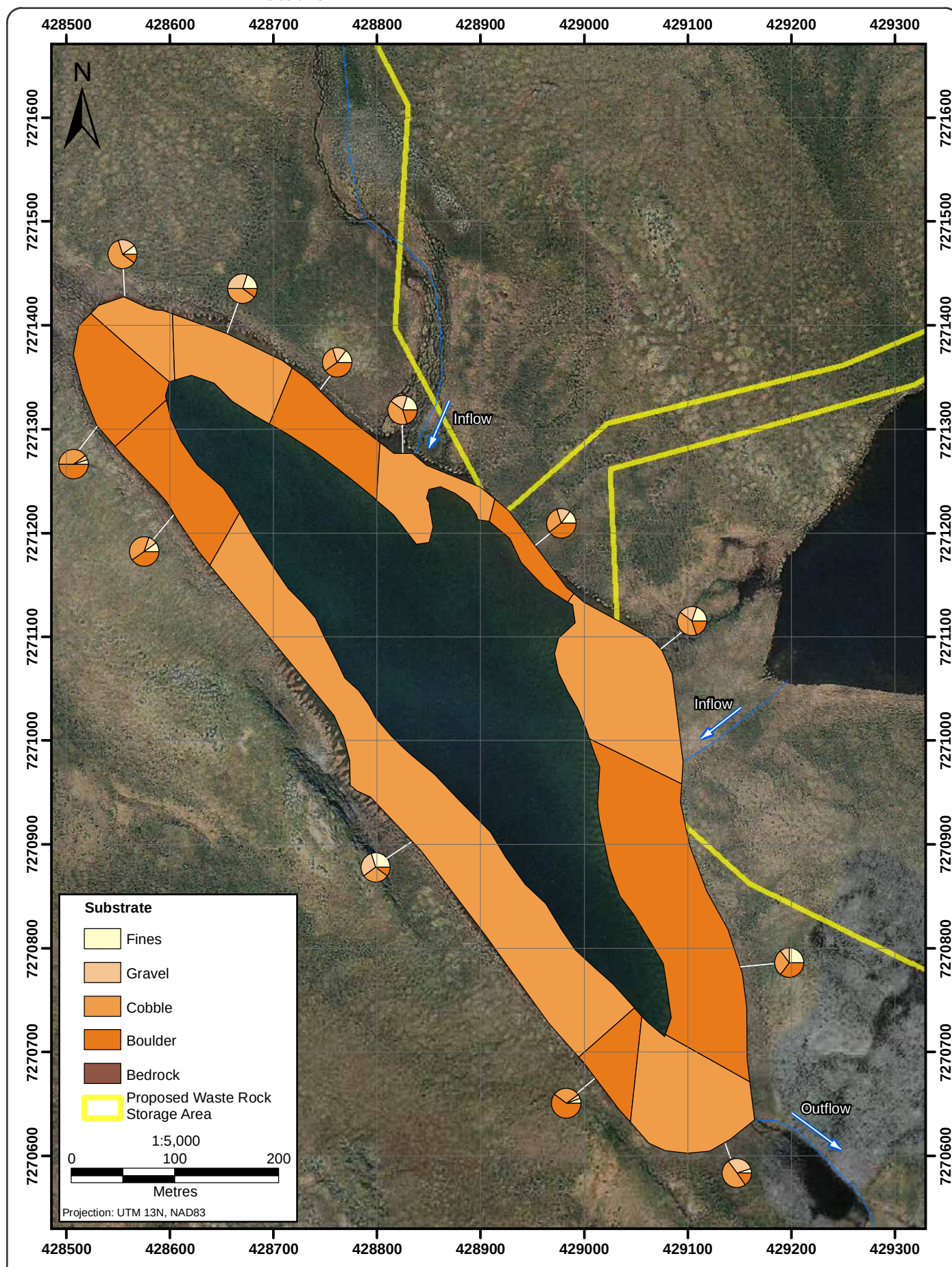




Plate 3.3-4. Boulder-cobble shoreline of Llama Lake with "bays" of finer substrates. July 2012.



Plate 3.3-5. Boulder substrate along the shoreline of Umwelt Lake. July 2012.



Shoreline Fish Habitat Substrates Zones,
Umwelt Lake, 2012

Figure 3.3-3

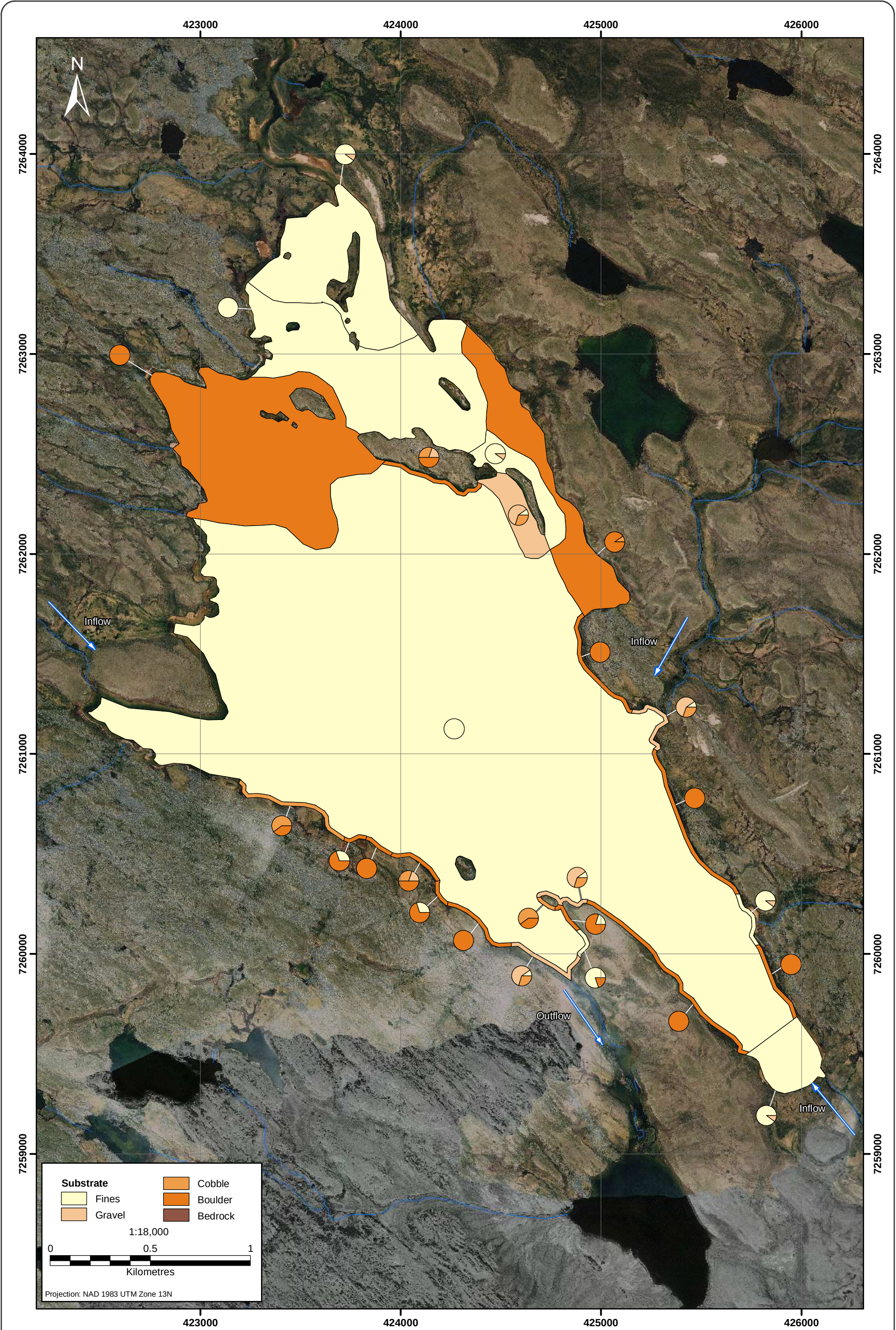




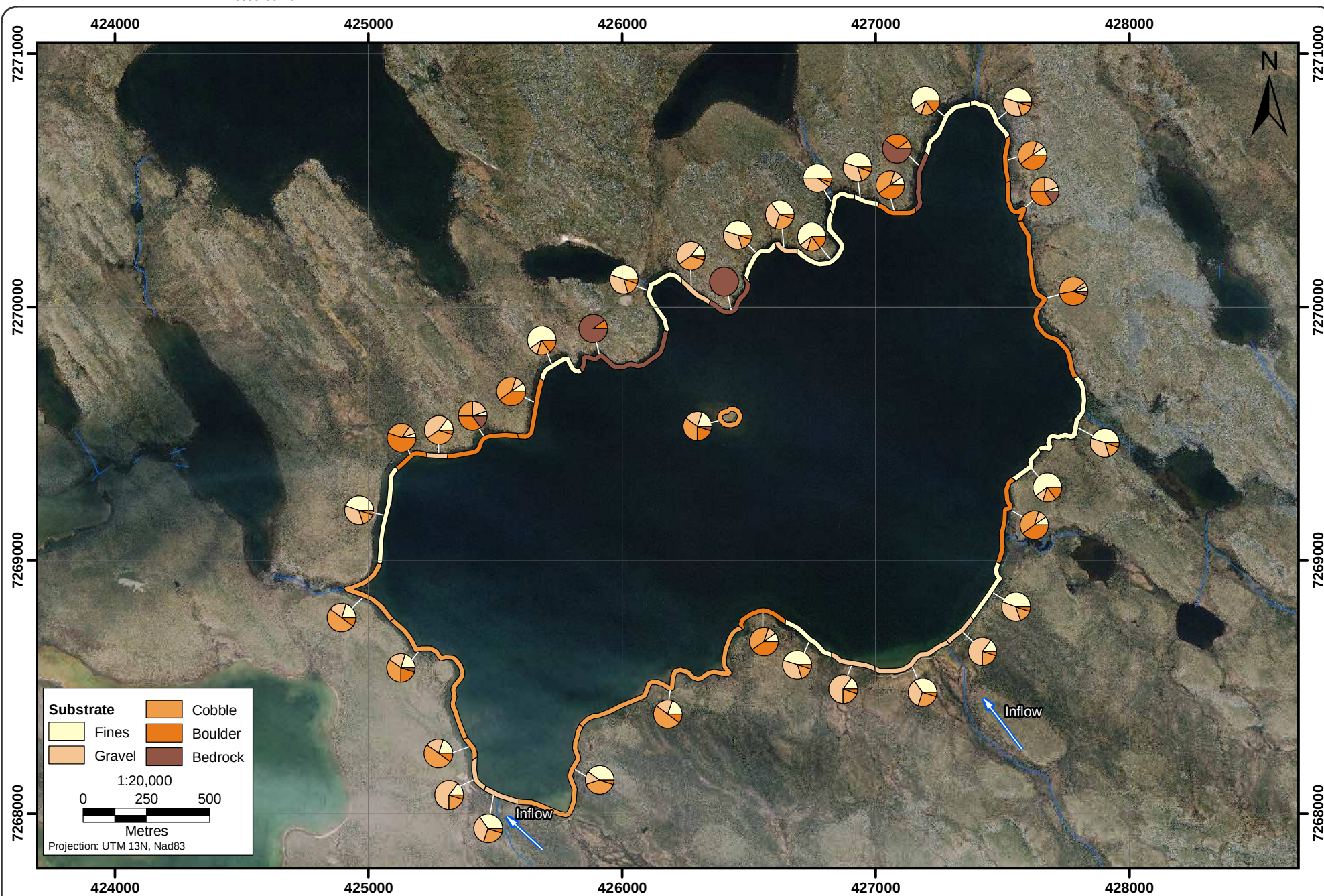
Plate 3.3-6. Sparse moss and emergent vegetation in a sheltered bay of Gander Lake. July 2012.

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.



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.



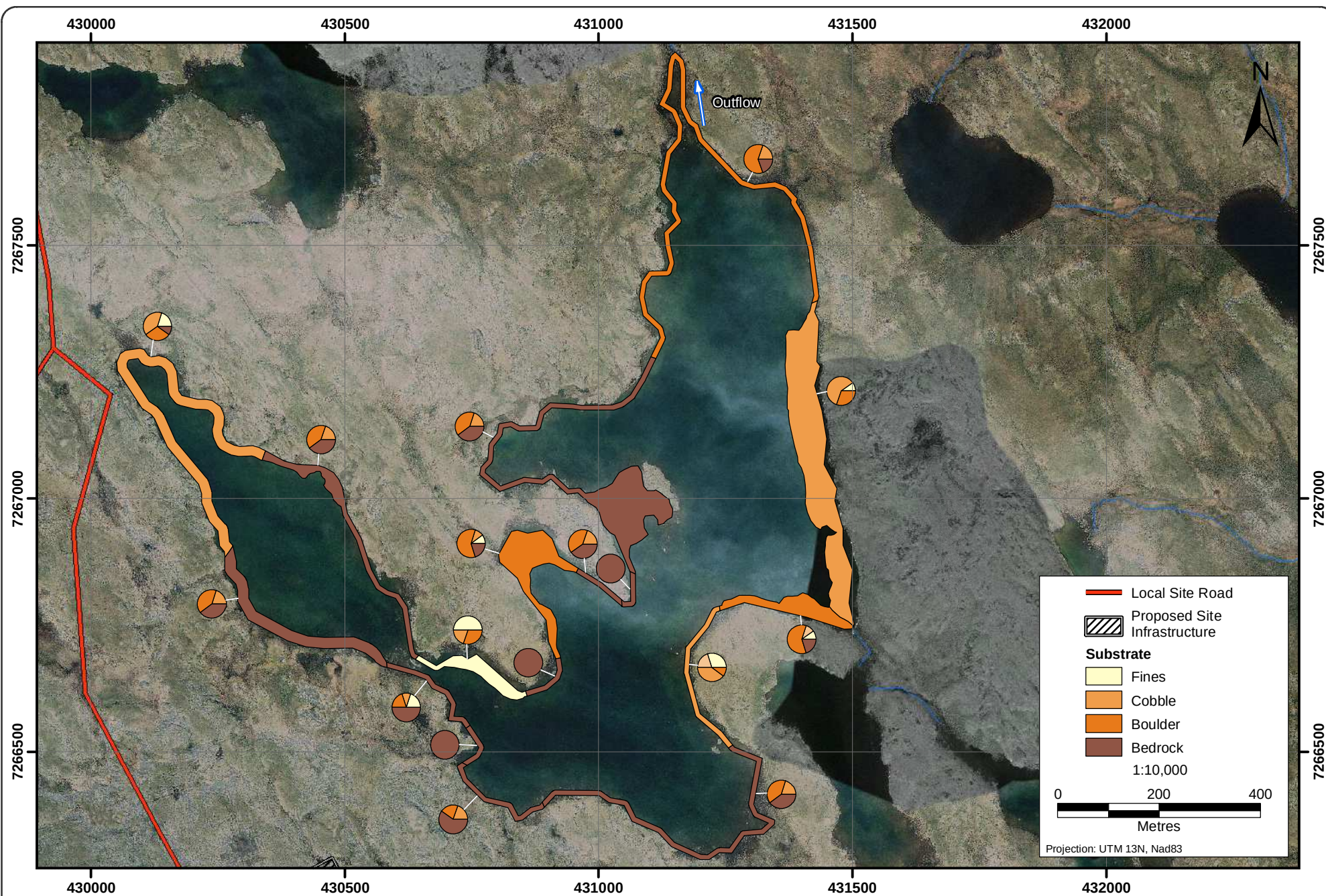
Plate 3.3-8. Boulder-dominated shoreline of Rabbit Lake from the air. August 2012.

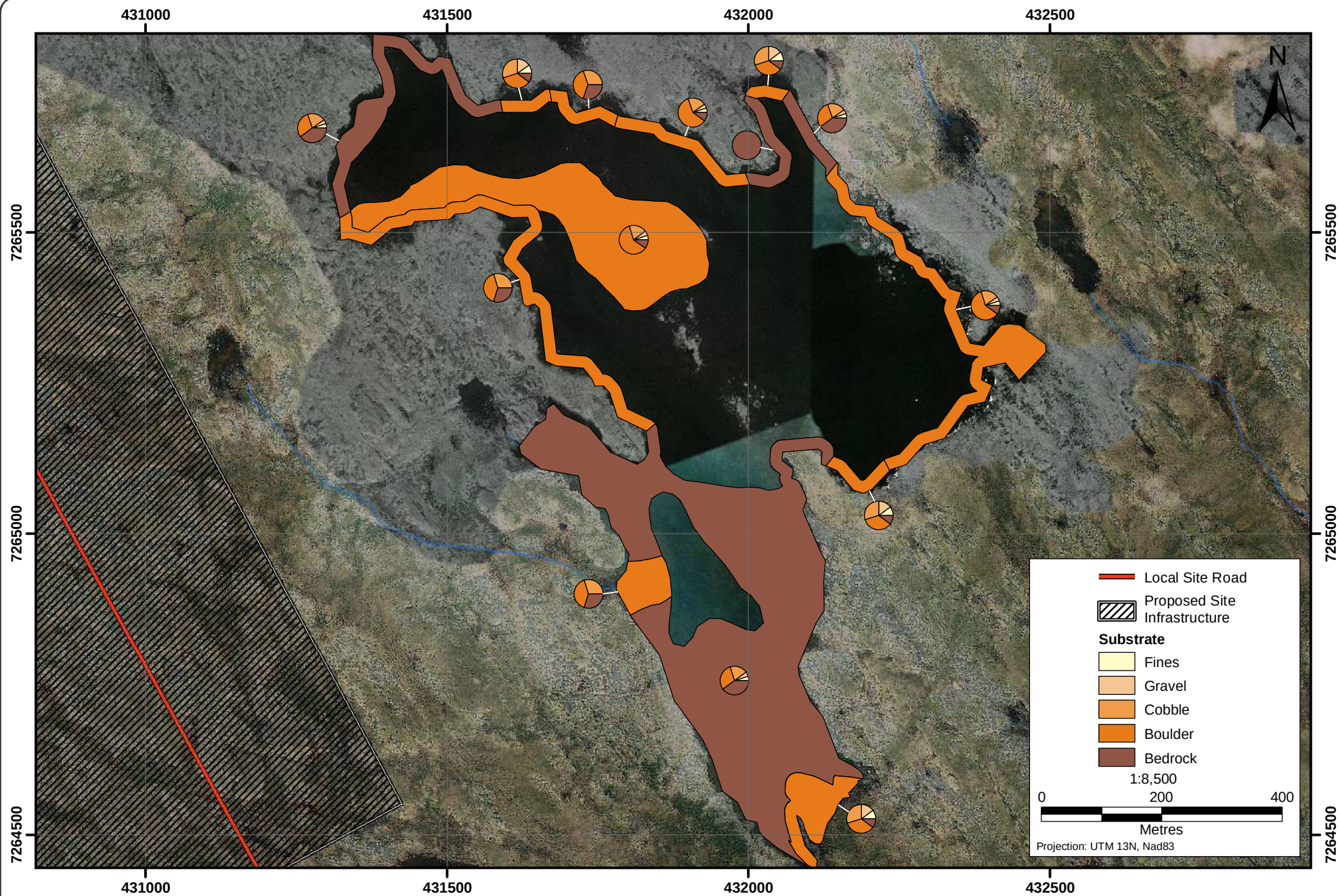
Moby Lake

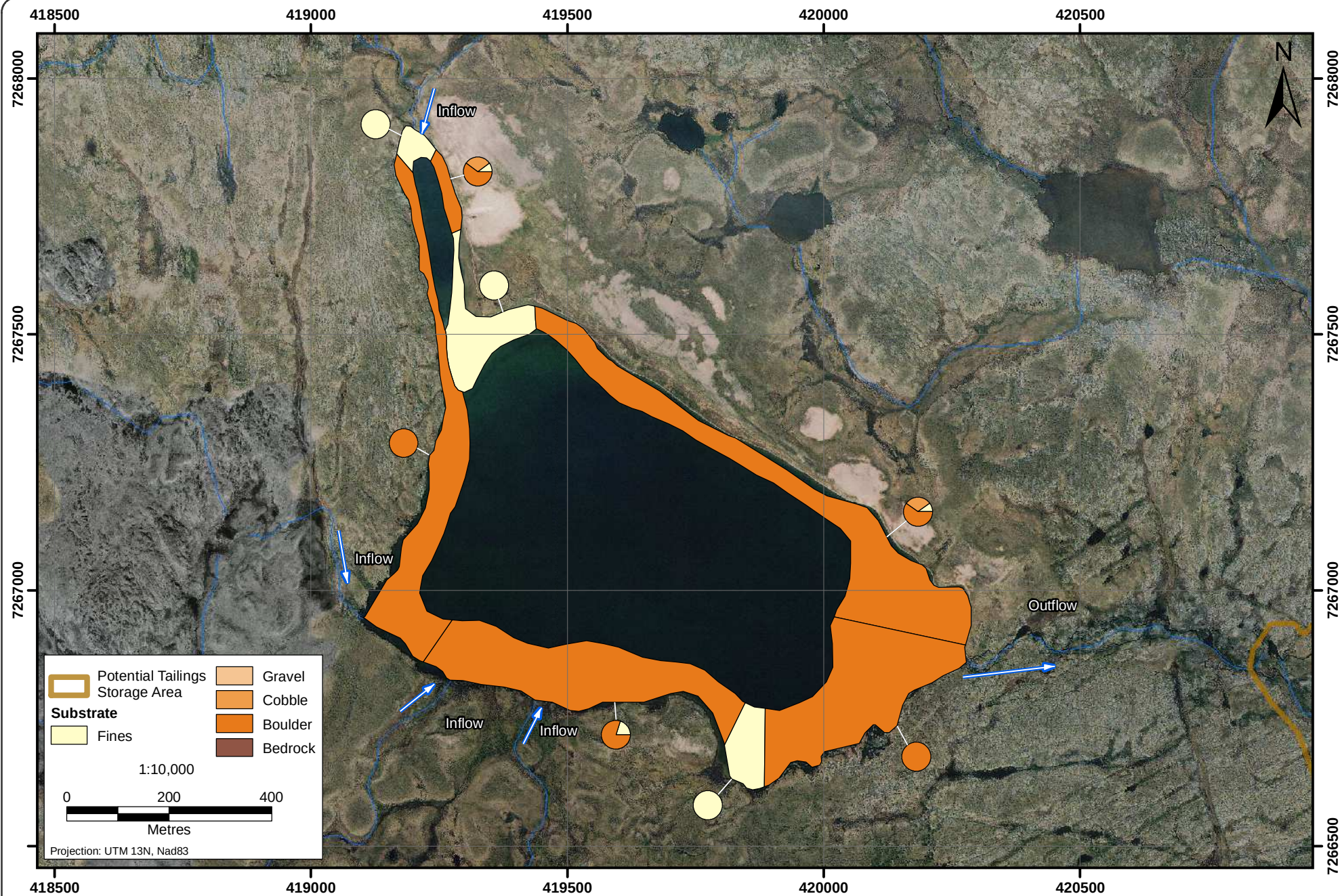
Moby Lake is located in the Moby Watershed. It is a deep lake, with a maximum depth of approximately 12.5 m. Much of the shoreline is dominated by boulder substrate, with fines occurring along the northern shore, as well as near the inflows (Plate 3.3-9, Figure 3.3-8). A large esker dominates the landscape 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.







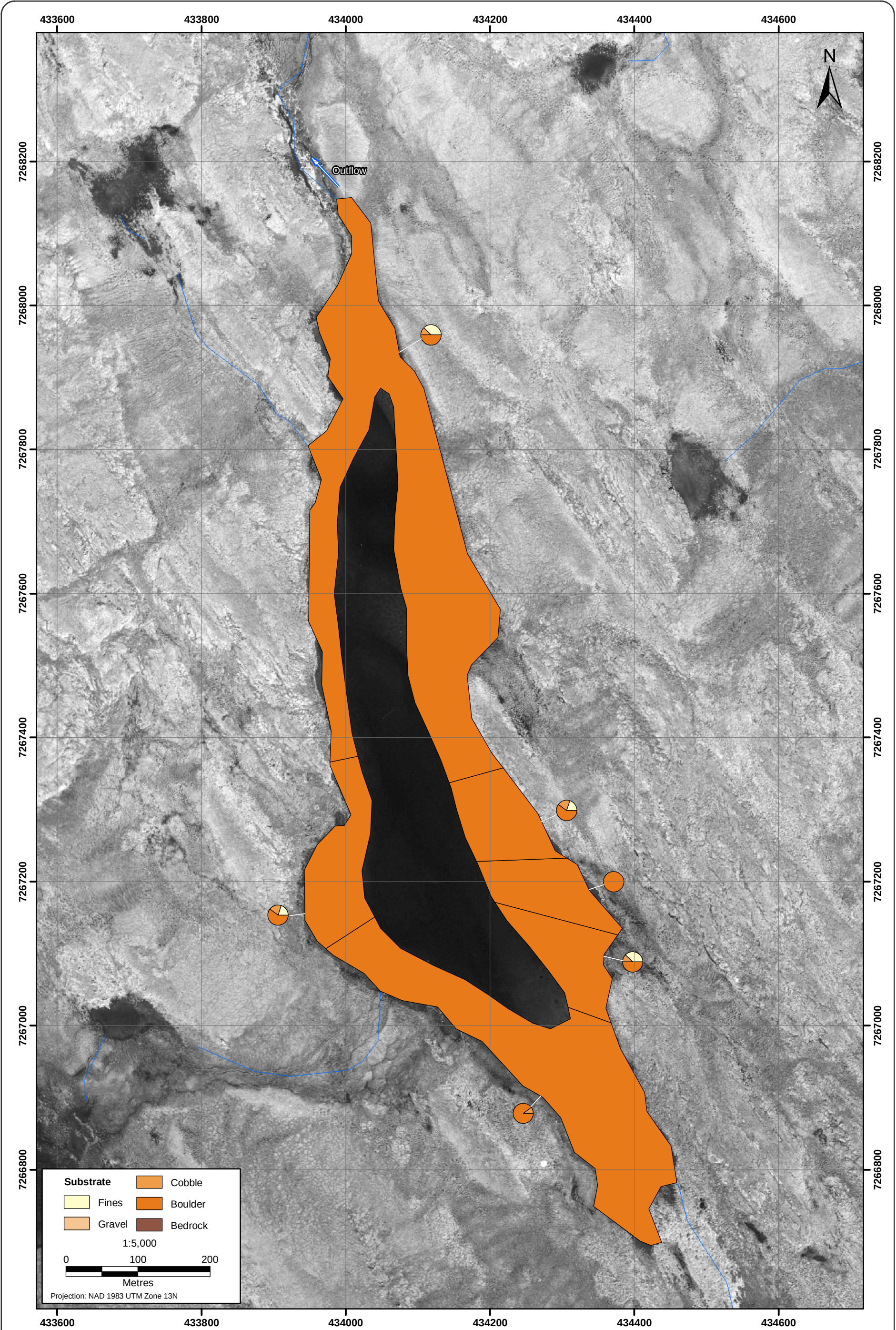




Plate 3.3-9. Boulder-cobble shoreline along the east shore of Moby Lake. July 2012.

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).

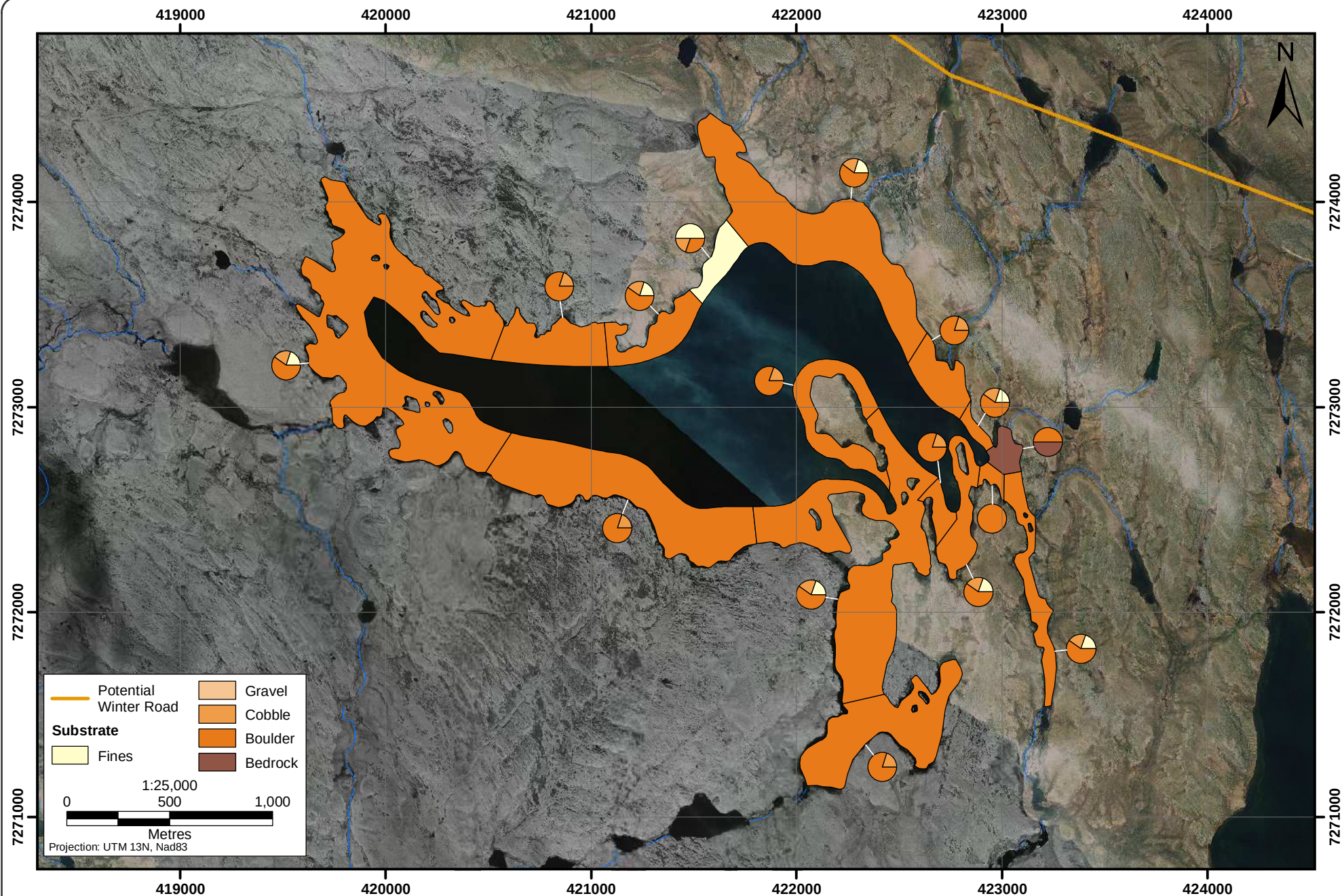
Reference B Lake

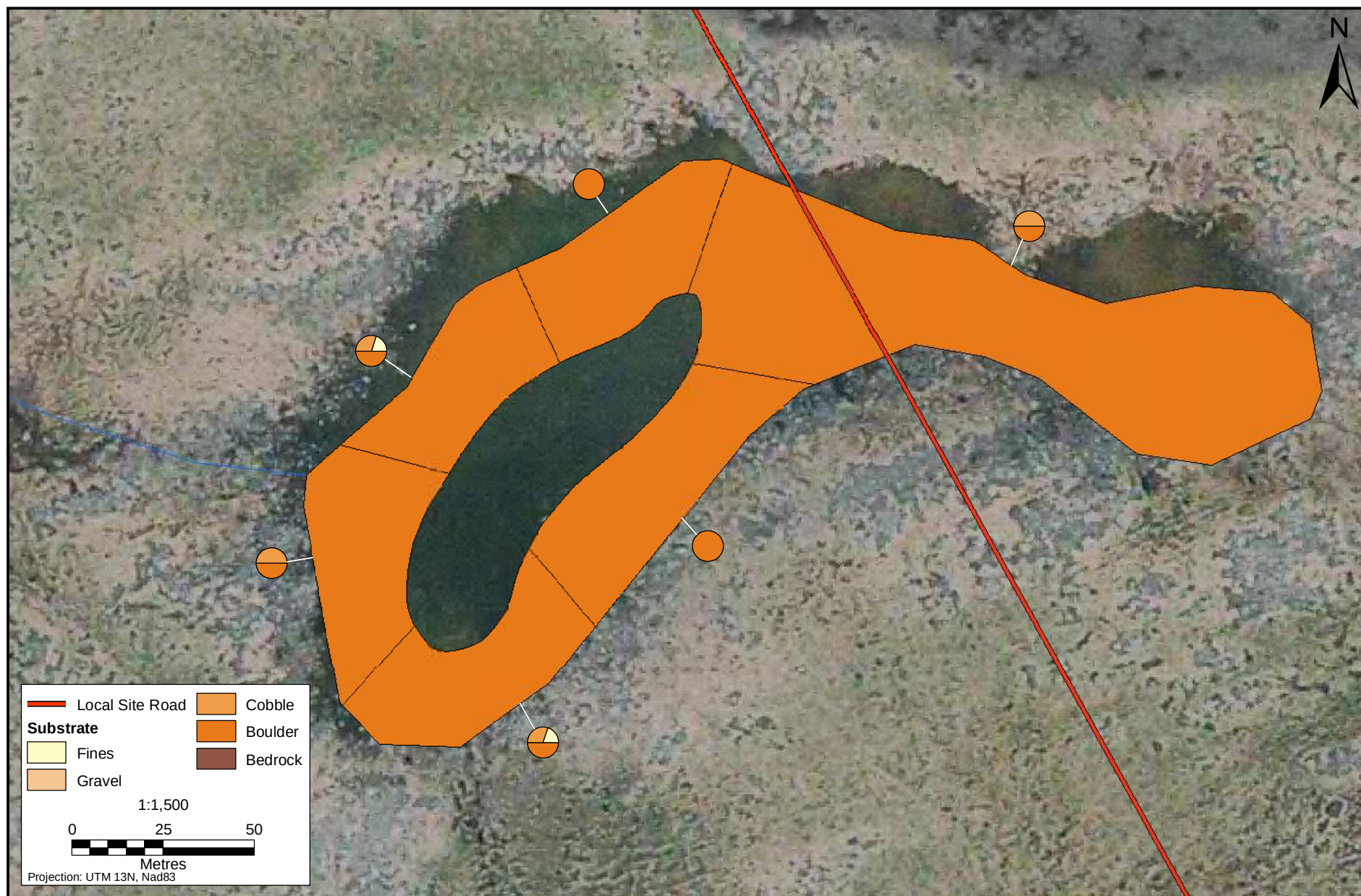
Reference B Lake is located southeast of the Goose area and serves as a reference site. It was also surveyed in 2010, 2011, and 2012. The shoreline is dominated by boulder and cobble substrates, and some sparse moss and vascular aquatic vegetation are present (Plate 3.3-10, Figure 3.3-12). The maximum depth is approximately 5.4 m.

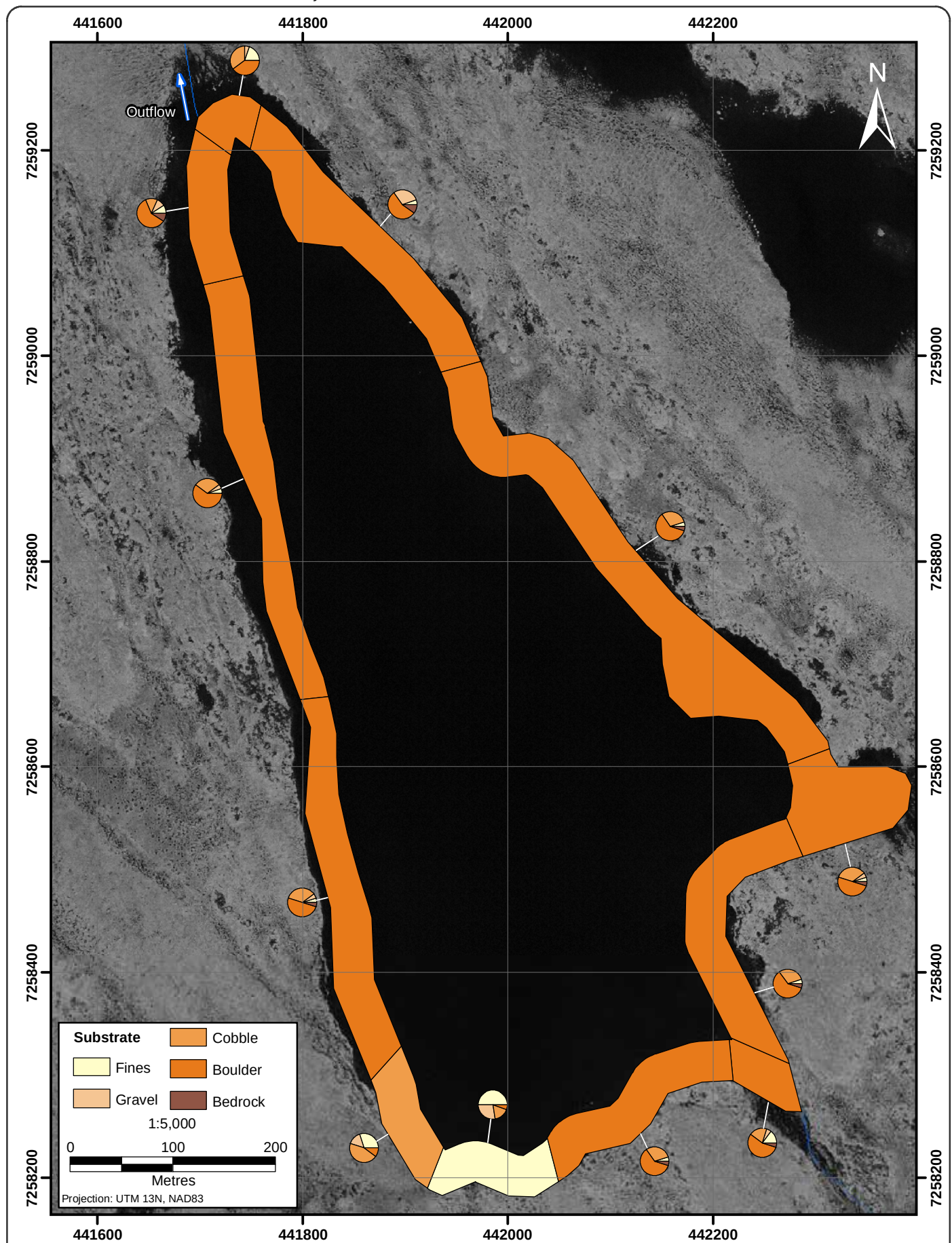
3.3.1.3 George Property

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.







Shoreline Fish Habitat Substrates Zones,
Reference B Lake, 2012

Figure 3.3-12

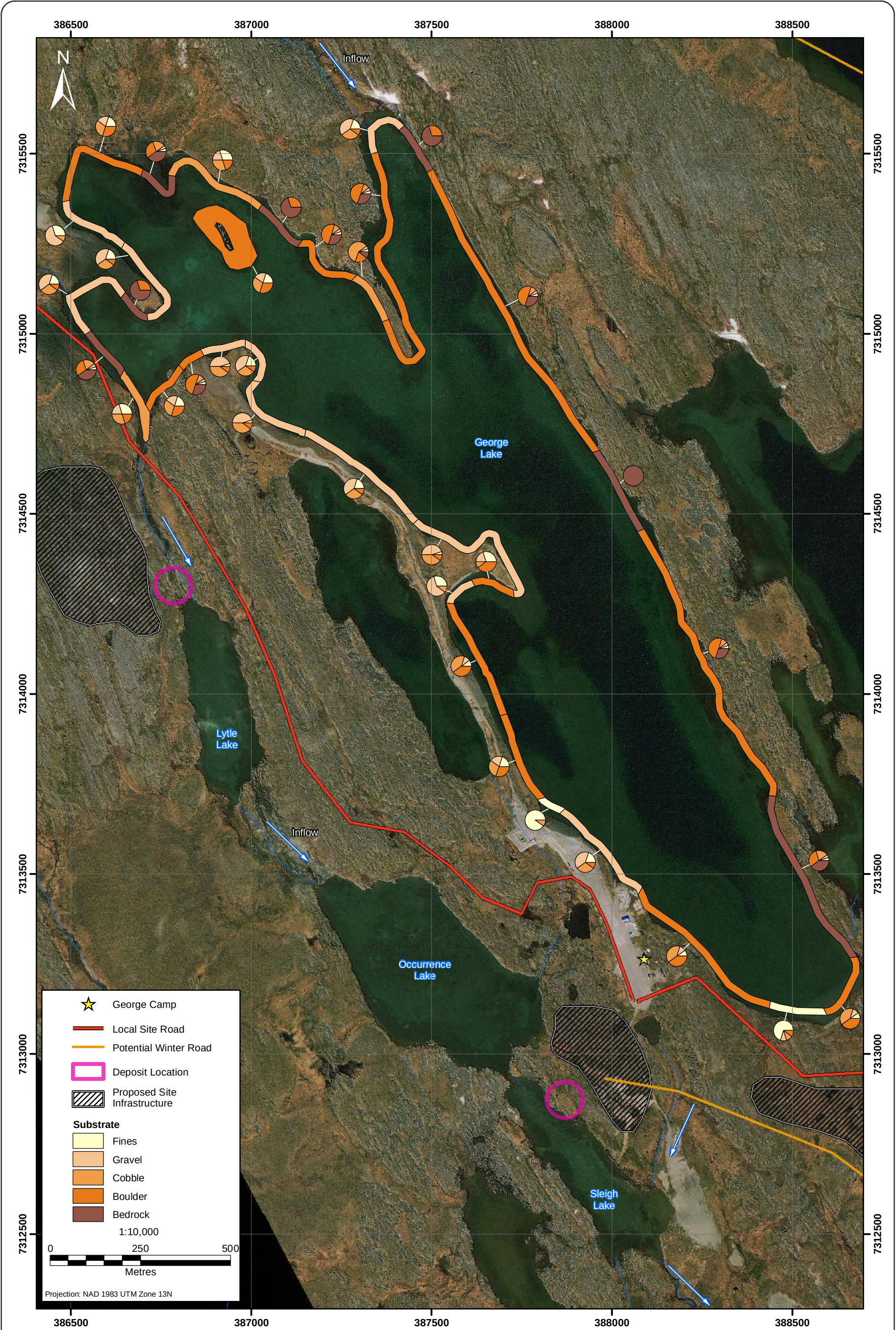




Plate 3.3-10. Boulder-dominated shoreline of Reference B Lake. July 2012.



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

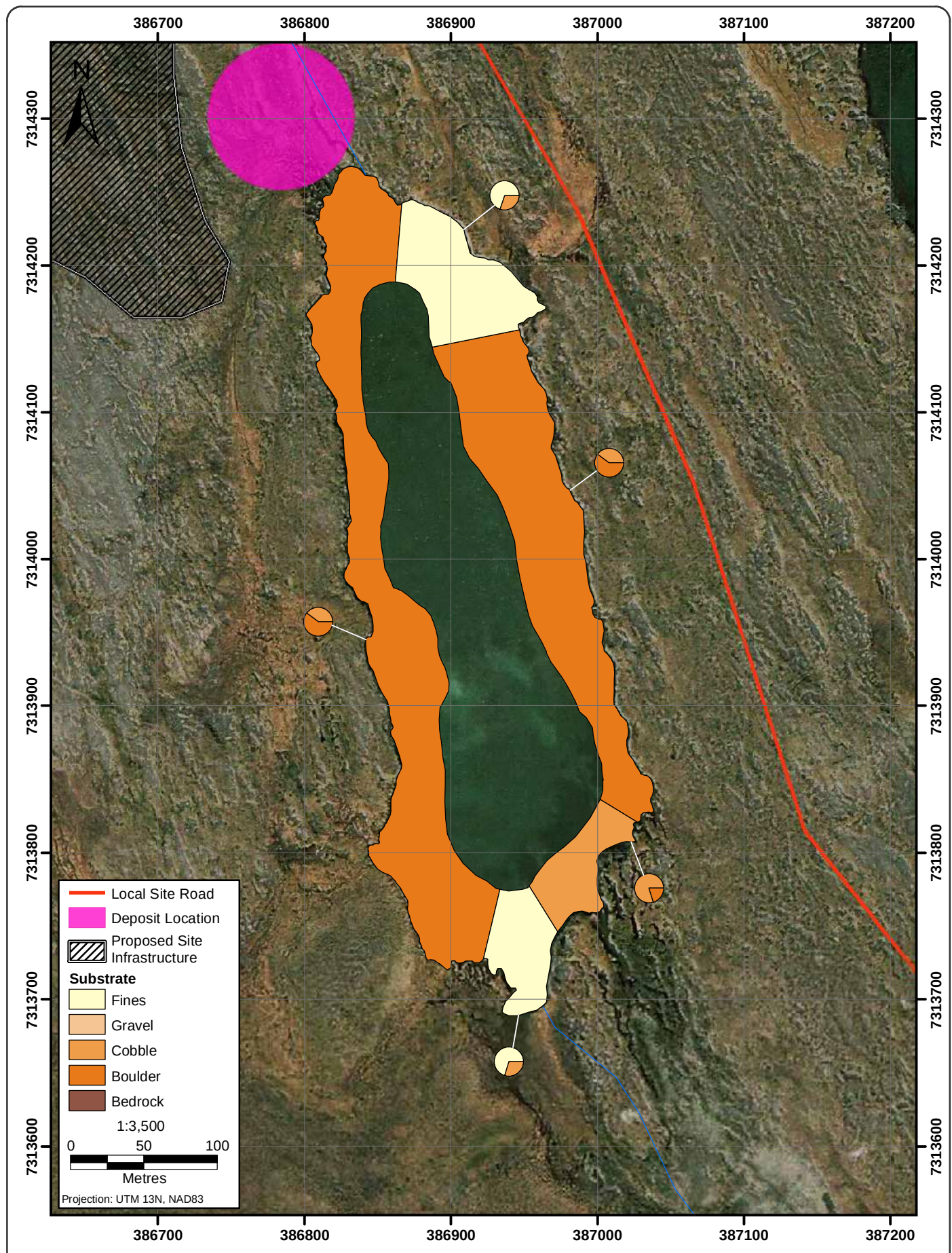
Occurrence Lake is located downstream of Lytle Lake in the George Watershed. It is also a relatively small, shallow lake with a maximum depth of approximately 1.7 m. The shoreline is dominated by boulder and cobble with some sections of bedrock (Plate 3.3-13, Figure 3.3-15). Sparse vascular vegetation 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.

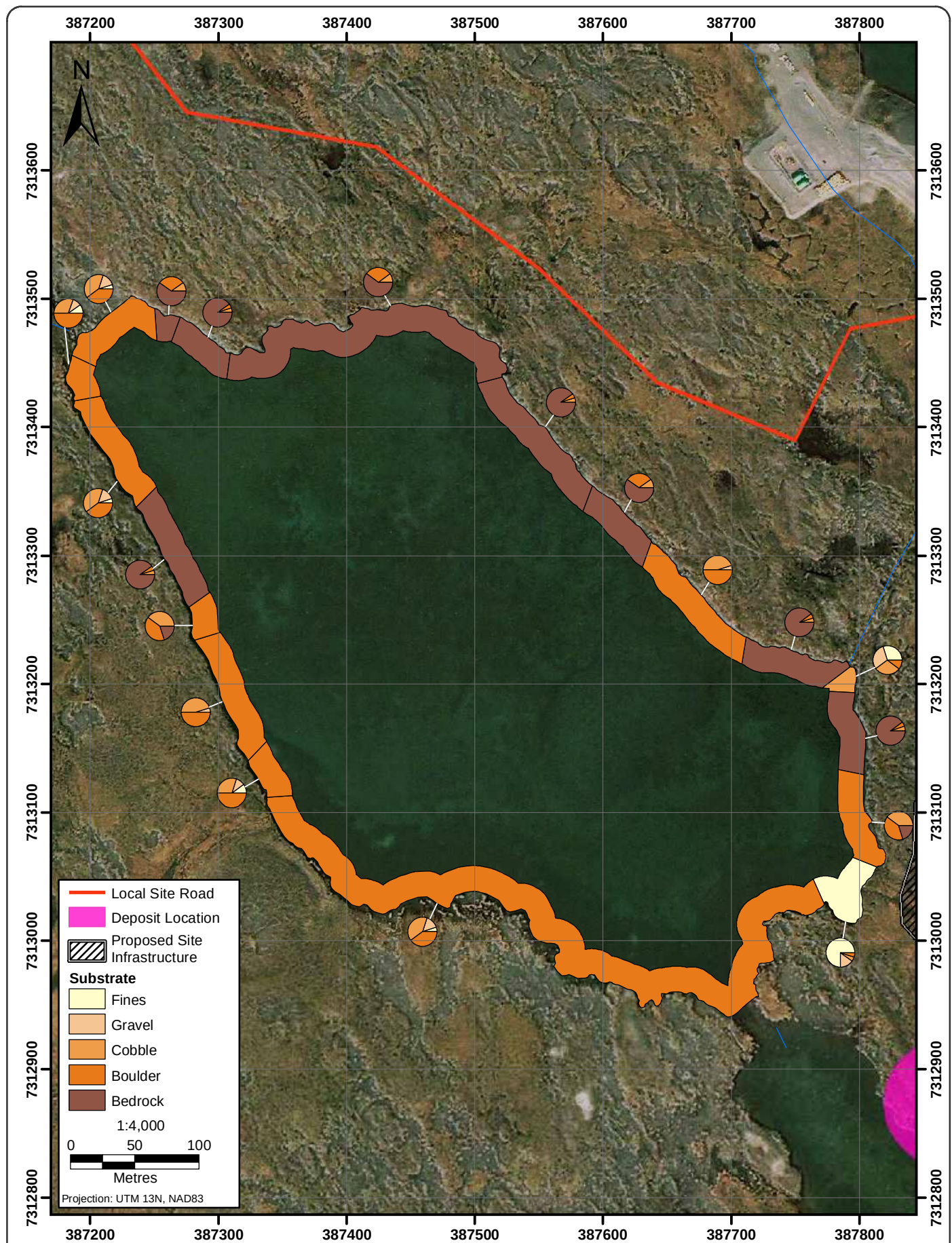
Dragon Lake

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.



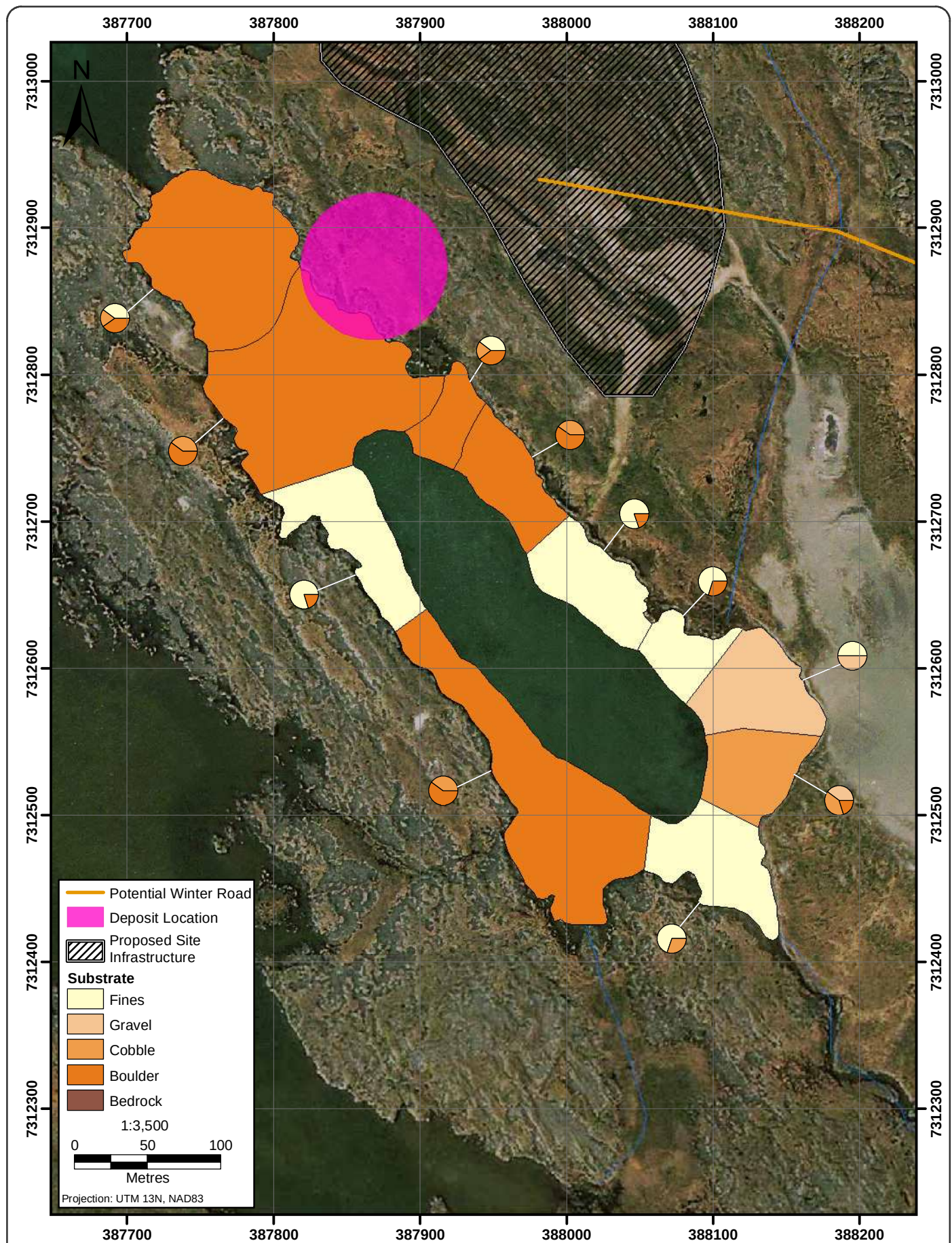
Shoreline Fish Habitat Substrates Zones,
Lytle Lake, 2012

Figure 3.3-14



Shoreline Fish Habitat Substrates Zones,
Occurrence Lake, 2012

Figure 3.3-15



Shoreline Fish Habitat Substrates Zones,
Sleigh Lake, 2012

Figure 3.3-16



Plate 3.3-13. Shoreline of Occurrence Lake, with boulder substrate. August 2012.

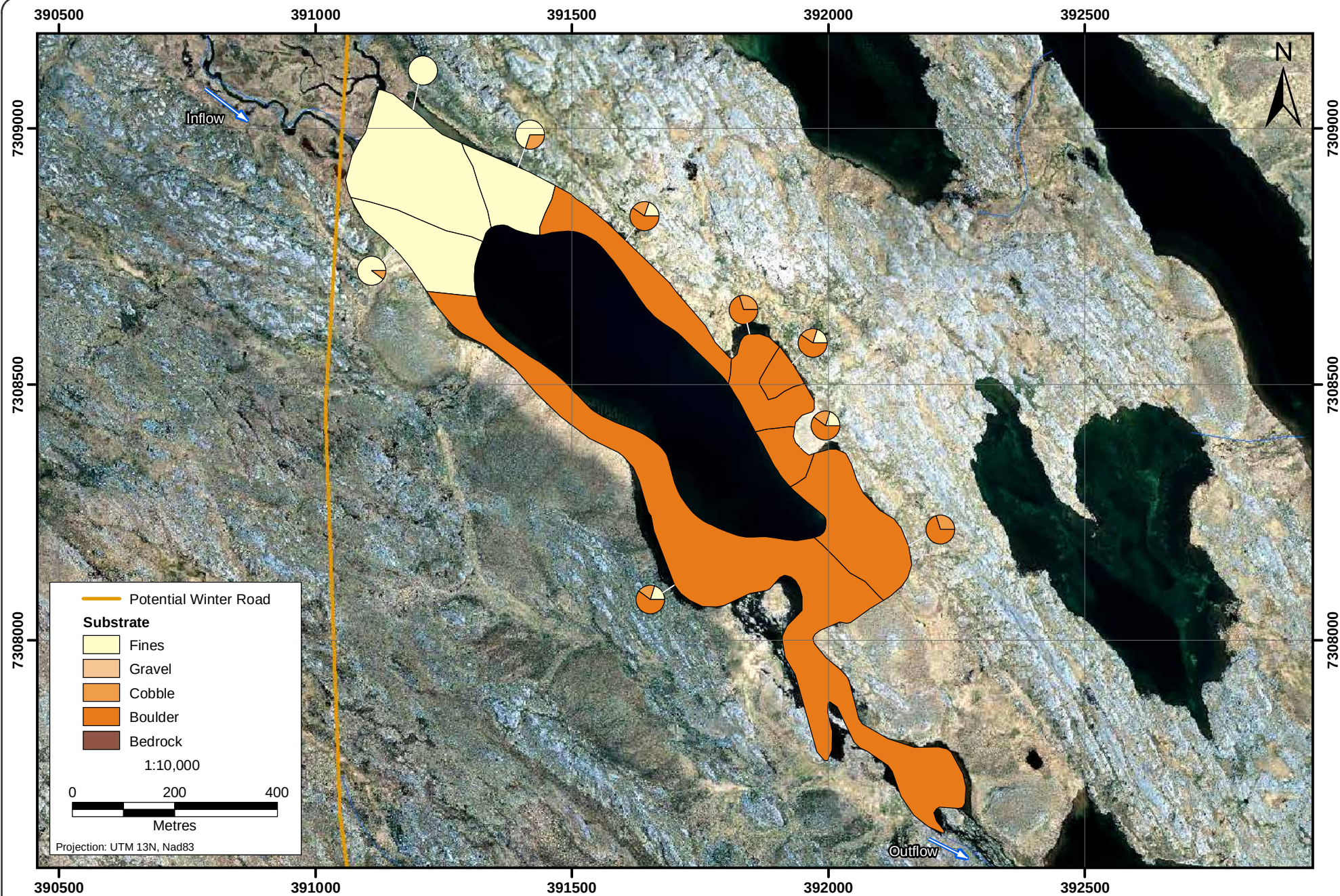
Komatic Lake

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.





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.

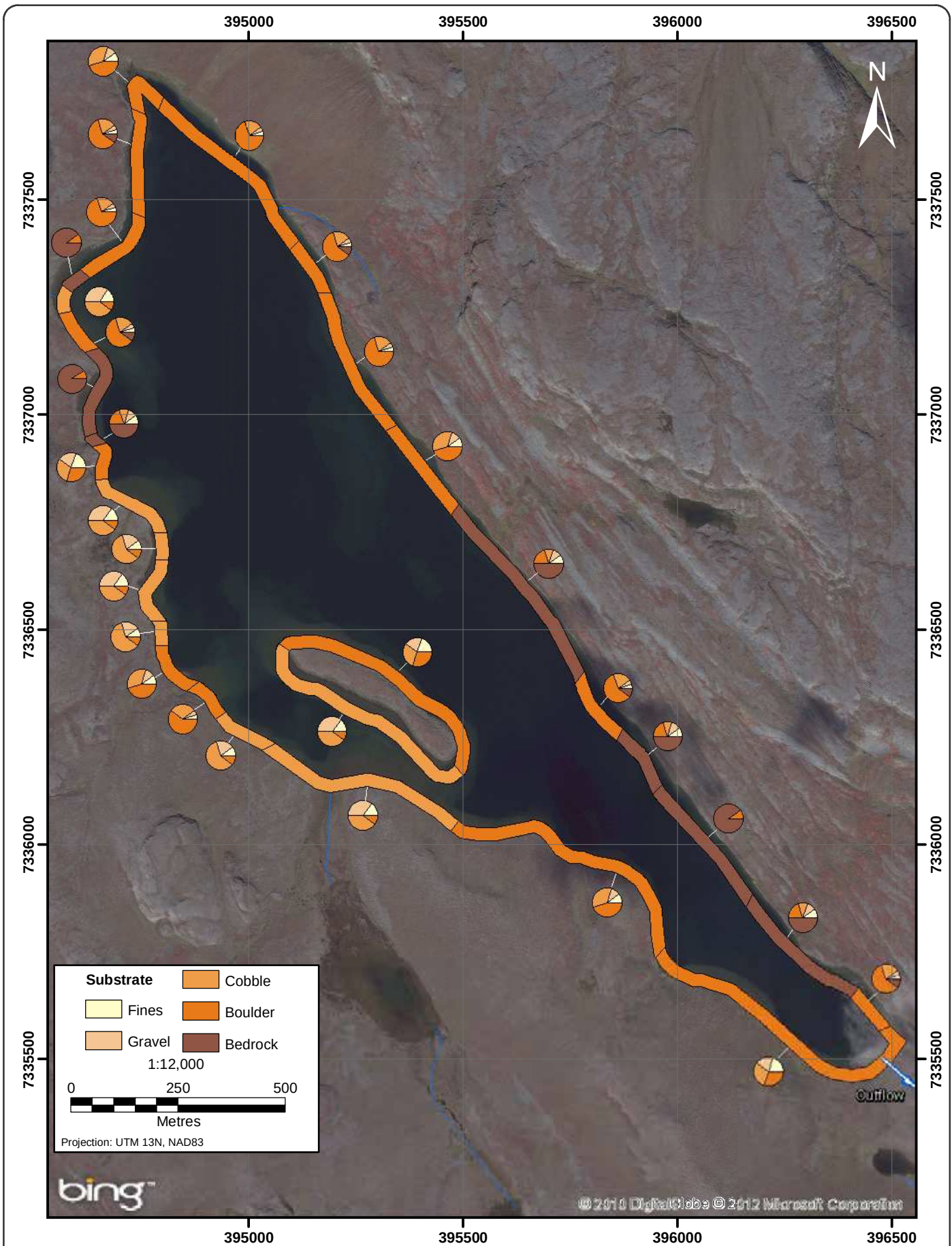


Table 3.3-1. Number of Fish Captured in Surveyed Lakes, 2012

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 m²/h).

Table 3.3-3. Gillnet Standard and Bootstrap CPUE Summary Statistics, 2012

Lake Species		Standard CPUE (No. fish/100 m ² /h)						Bootstrap CPUE (No. fish/100 m ² /h)				
		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)

Lake	Species	Standard CPUE (No. fish/100 m ² /h)						Bootstrap CPUE (No. fish/100 m ² /h)				
		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
	<i>Total</i>	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
	<i>Total</i>	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
	<i>Total</i>	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
	<i>Total</i>	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
	<i>Total</i>	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
	<i>Total</i>	5	1.59	0.50	0.22	1.05	2.25	5	1.59	0.20	1.22	2.01
<i>George Property</i>												
George Lake	Lake trout	6	0.84	1.80	0.73	0.00	4.00	6	0.85	0.67	0.00	2.34
	<i>Total</i>	6	0.84	1.80	0.73	0.00	4.00	6	0.85	0.67	0.00	2.34
Occurrence Lake	<i>Total</i>	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
	<i>Total</i>	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
	<i>Total</i>	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
	<i>Total</i>	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 m² 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 m² to 420 m², 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 m² to 4.5 fish/100 m². 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)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Lake	Species										
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)

Lake	Species	Standard CPUE (no. fish/100 m ²)						Bootstrap CPUE (no. fish/100 m ²)			
		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 m² 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
Umwelt Lake	Round whitefish	9	315.9	88.6	29.5	151.8	413.0	316.4	27.8	257.7	366.1
	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
	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
	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

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	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

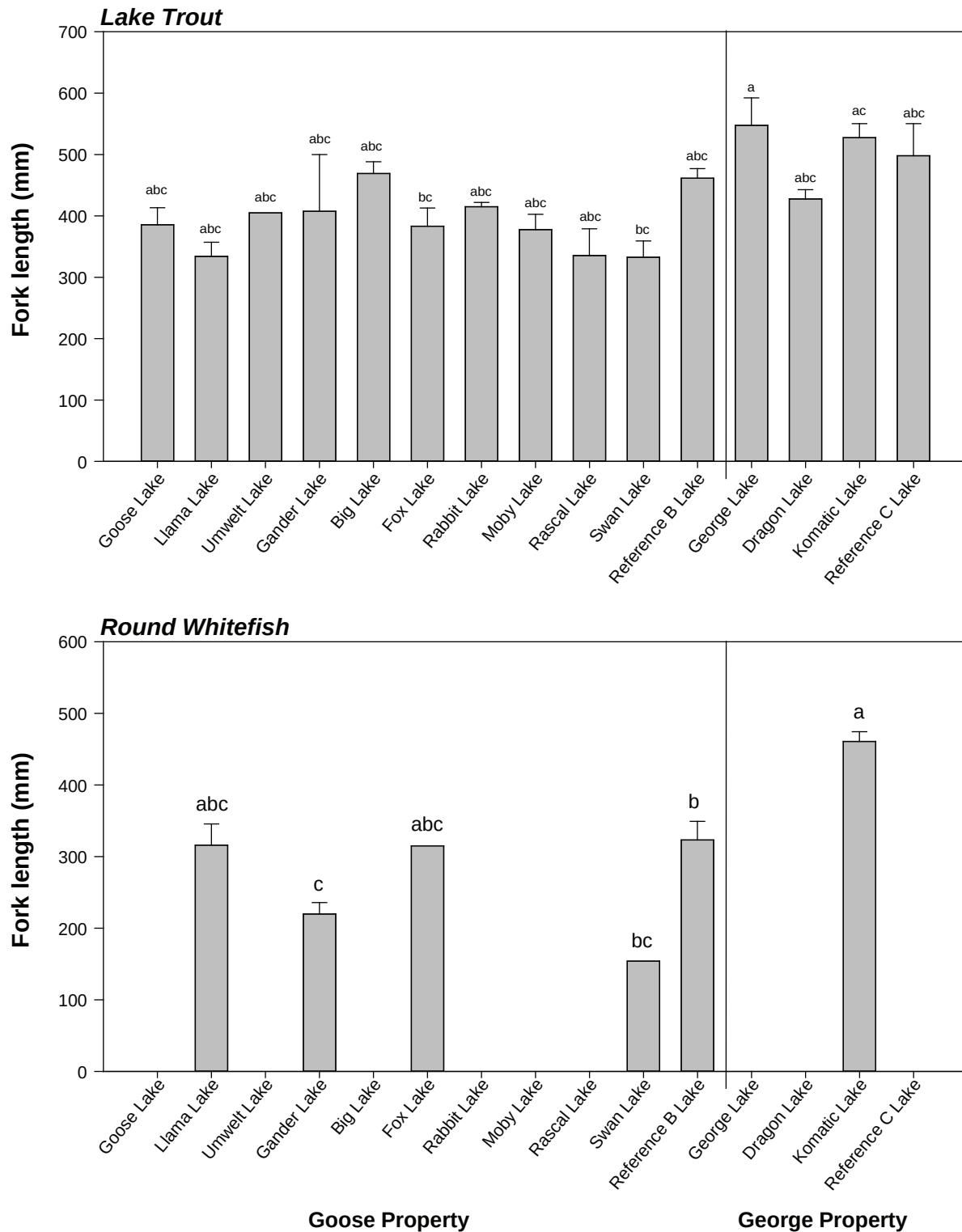
CI = confidence interval (95%)

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

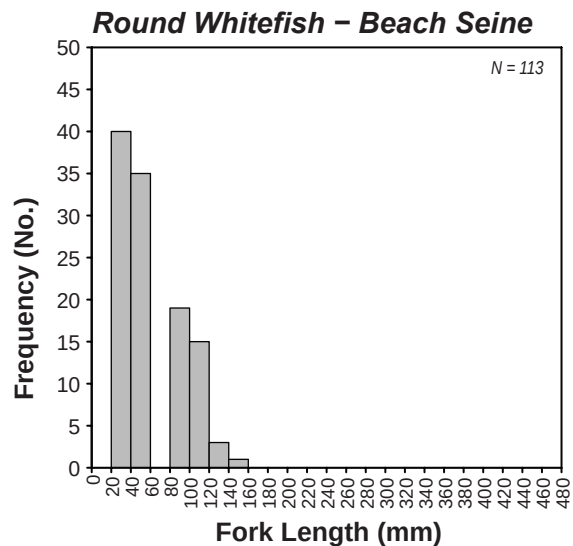
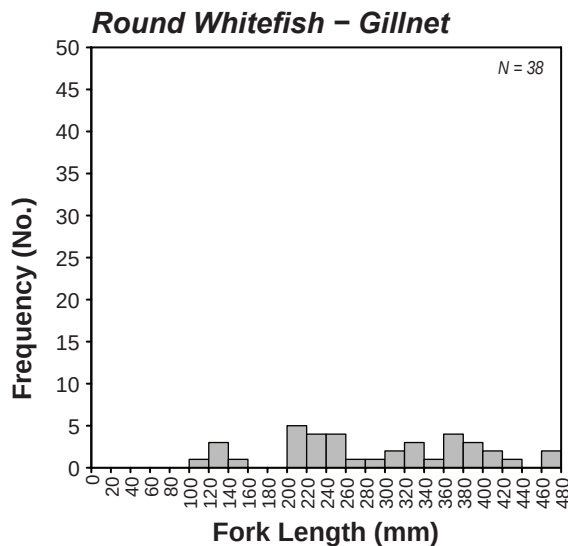
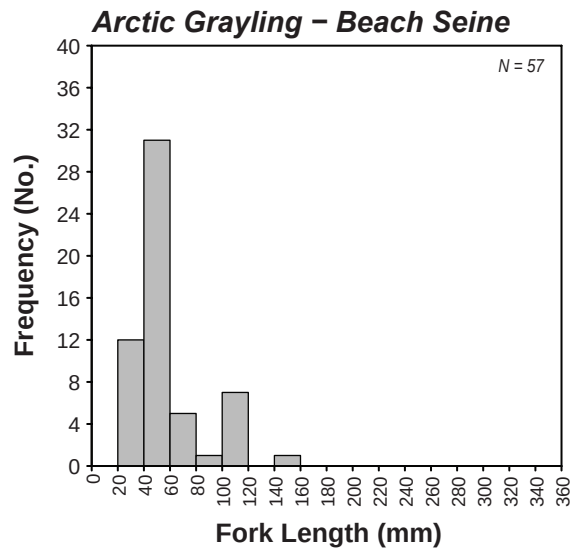
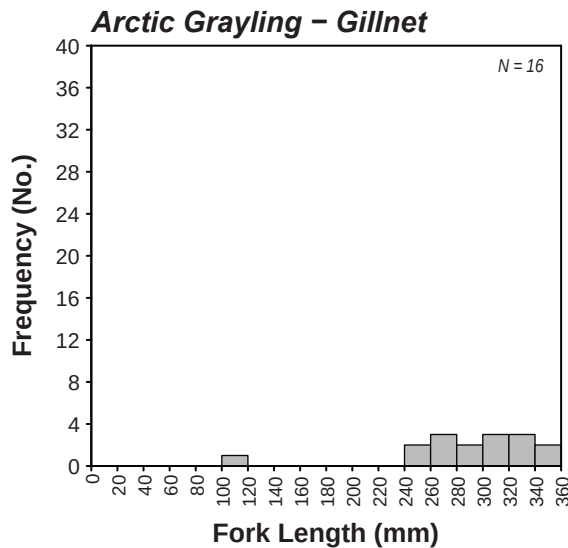
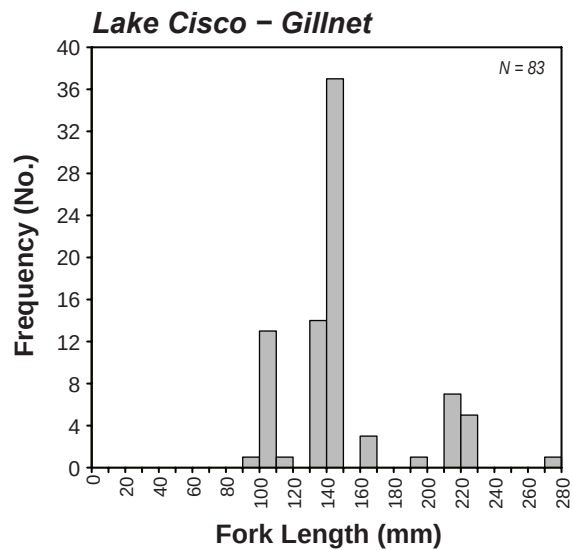
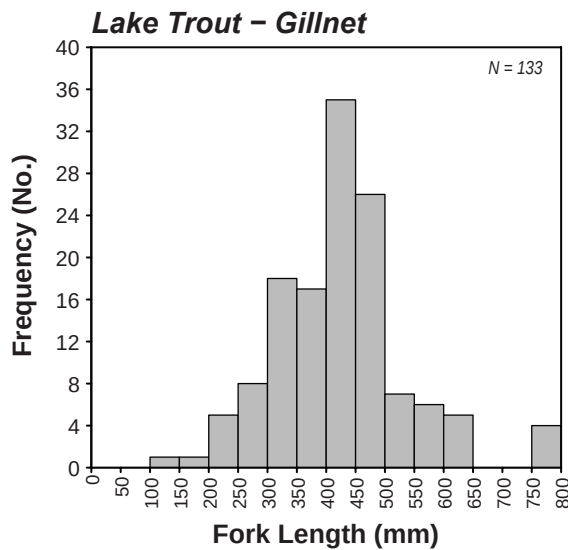
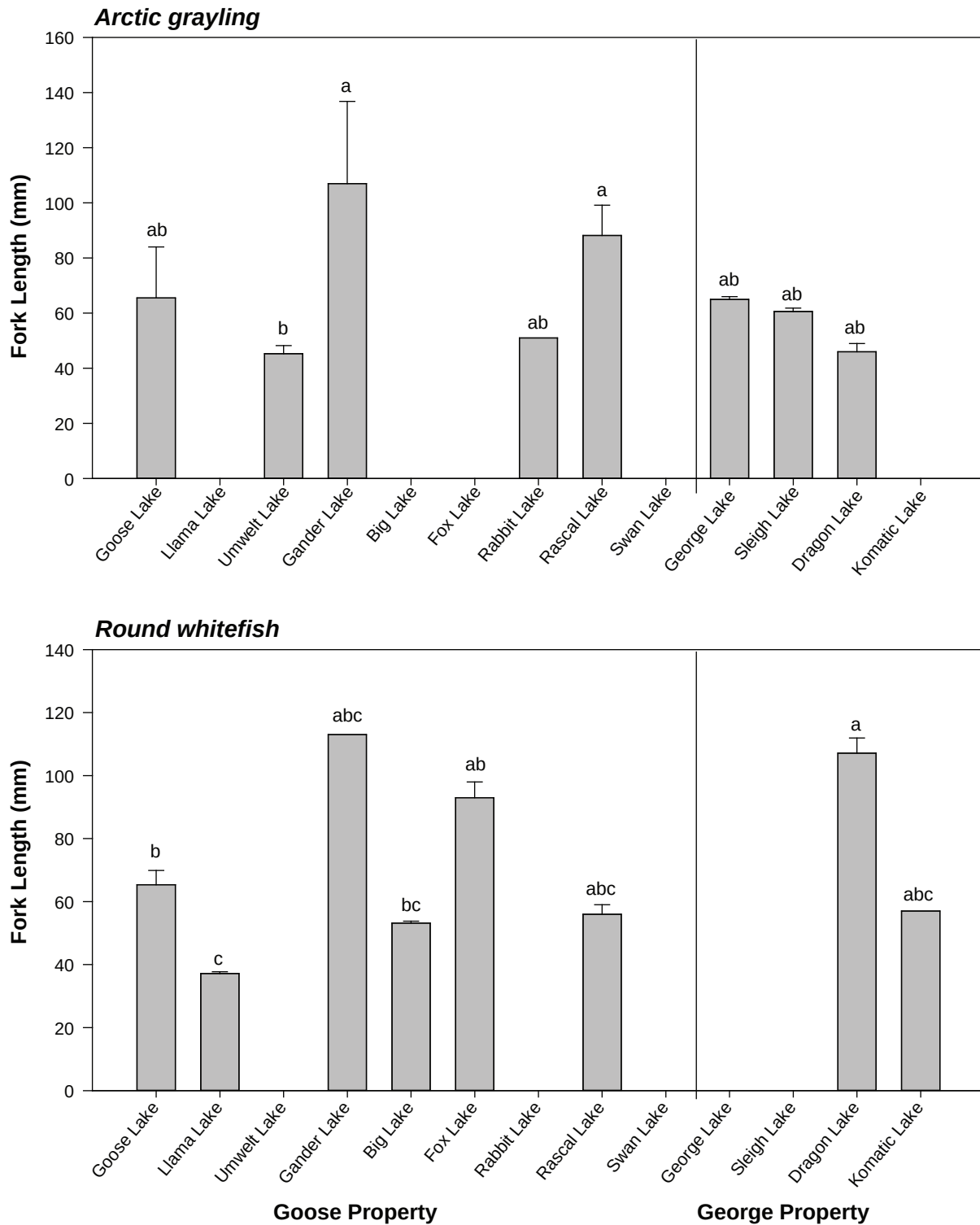


Figure 3.3-21



Notes: Letters indicate significant differences among lakes ($P < 0.05$)
 Errors bars indicate 1 standard error of the mean

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.

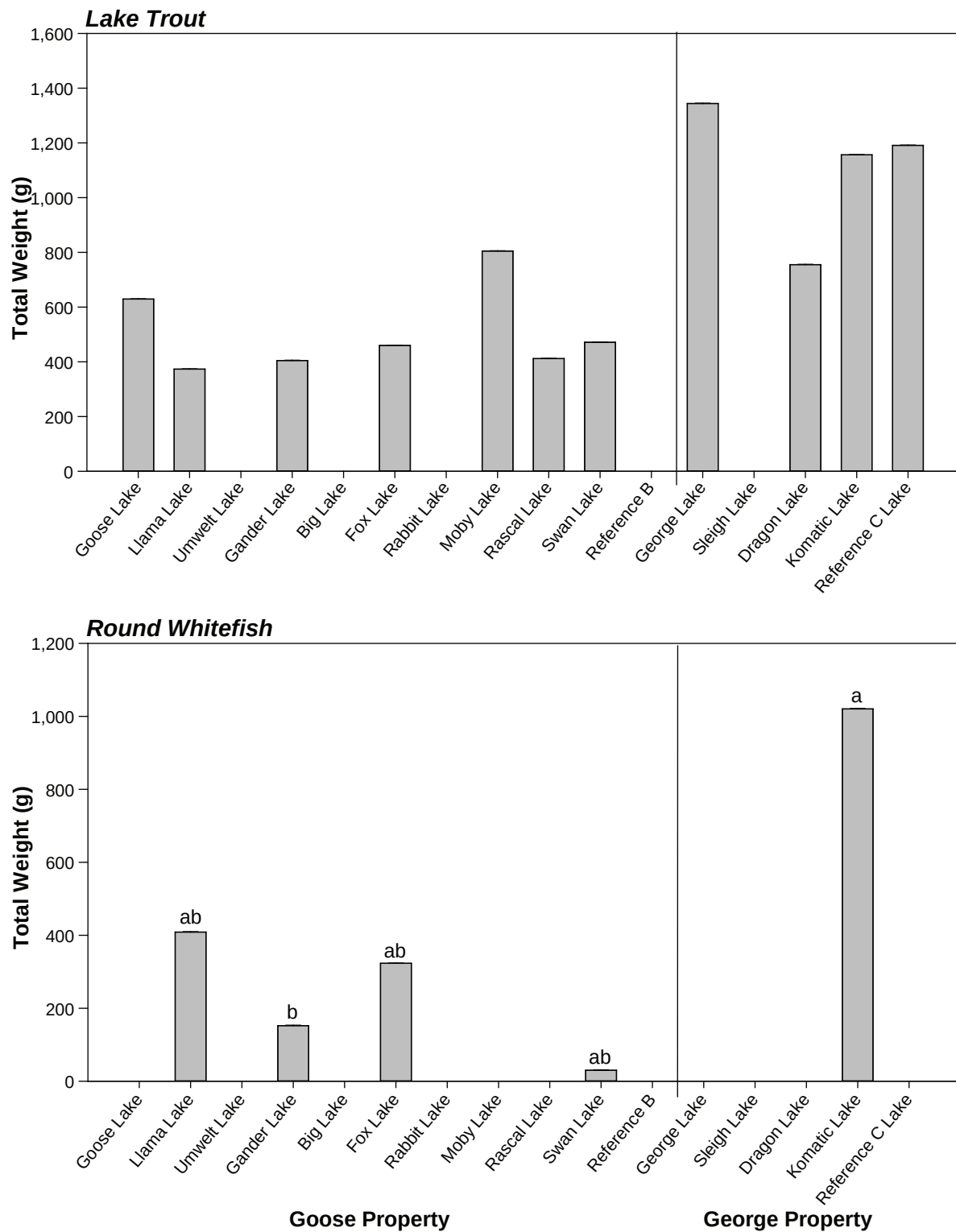
The length-frequency distribution for gillnet-captured round whitefish shows few distinct size classes (Figure 3.3-21). Three faint modes were present at the 120 to 140 mm size class, the 200 to 220 mm size class, and the 360 to 380 mm size class. The length-frequency distribution for beach seined round 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.

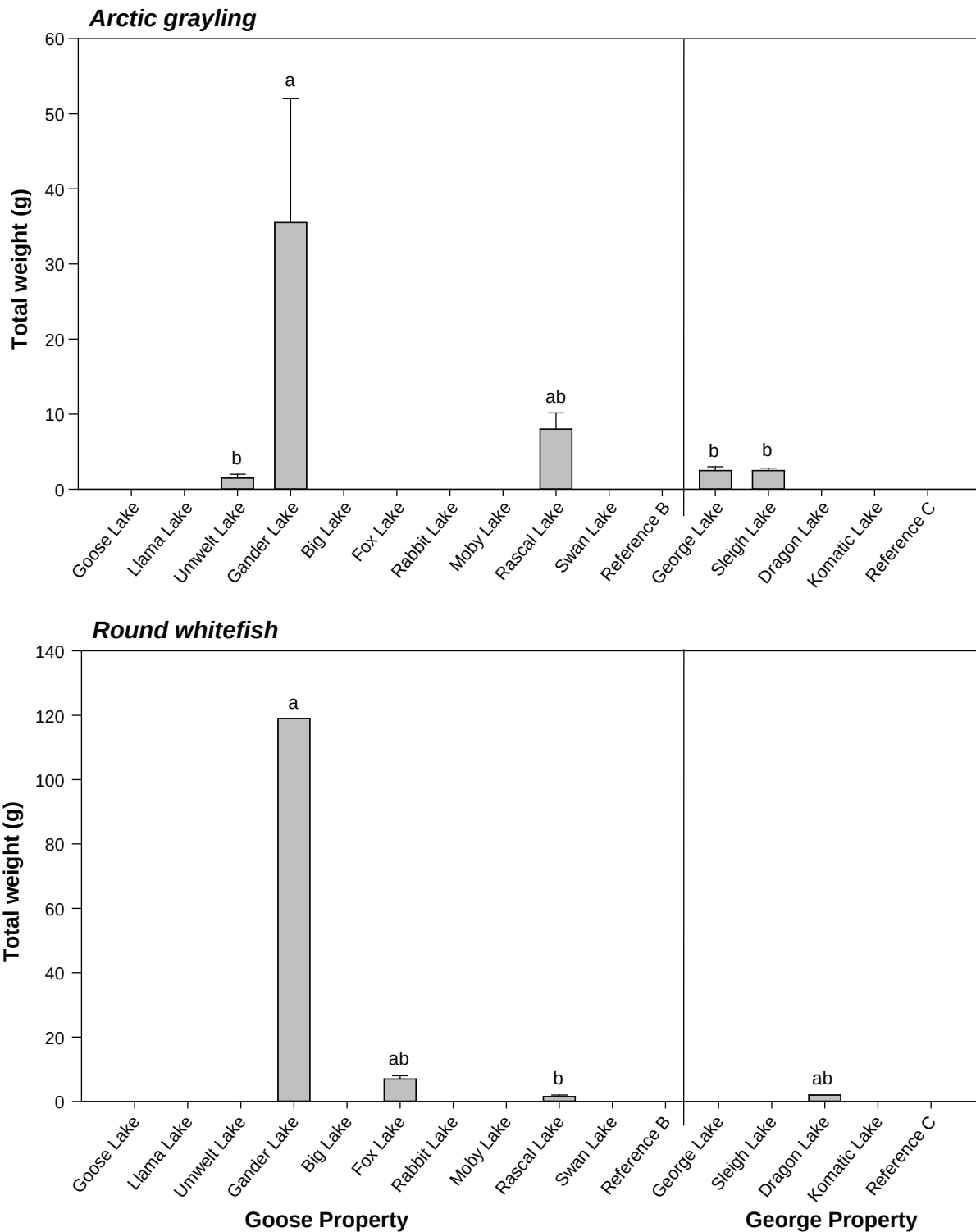
By weight, the largest lake trout were captured by gillnet in Reference C, Komatic and George Lakes (Table 3.3-7). The smallest lake trout by weight were captured in Gander and Llama Lakes. An analysis of lake trout total weight showed that there were significant differences among lakes (ANOVA, $F_{10,88} = 2.31$, $P < 0.05$); 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



Notes: Letters indicate significant differences among lakes ($P < 0.05$)
 Errors bars indicate 1 standard error of the mean

Figure 3.3-24

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

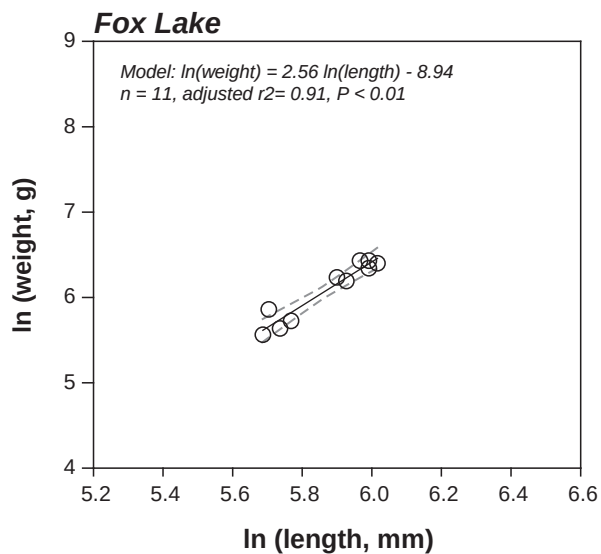
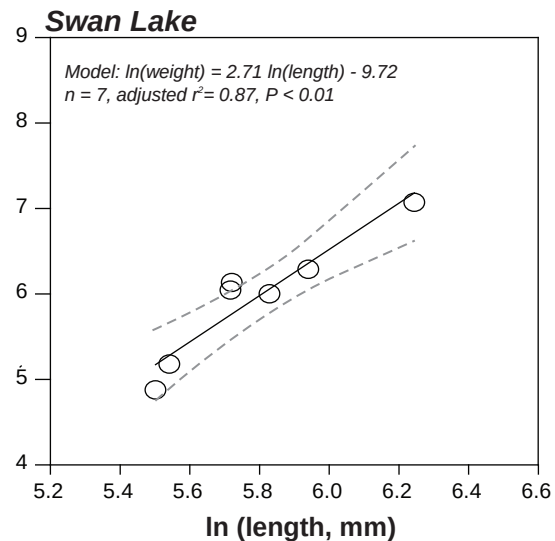
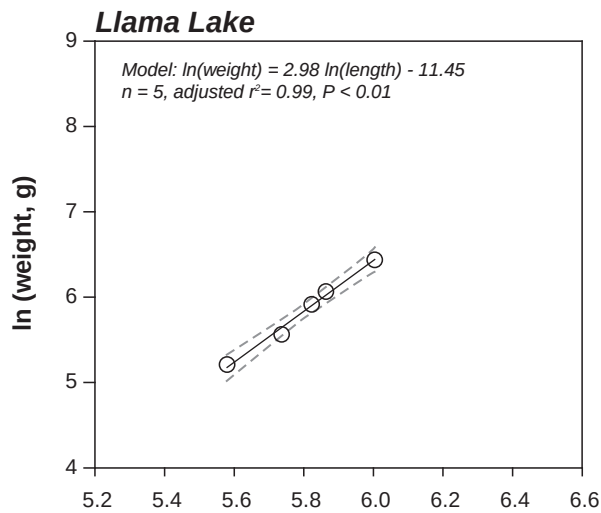
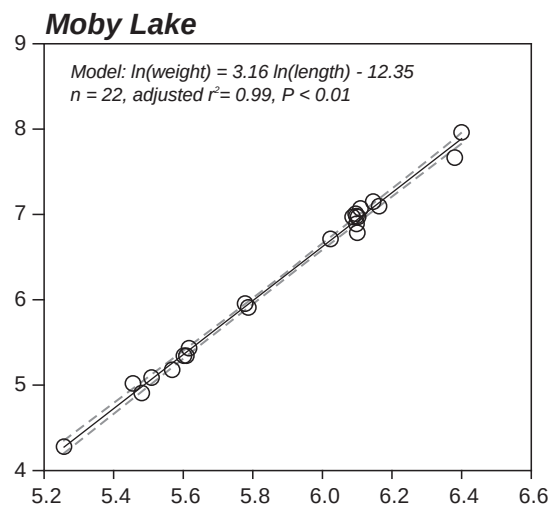
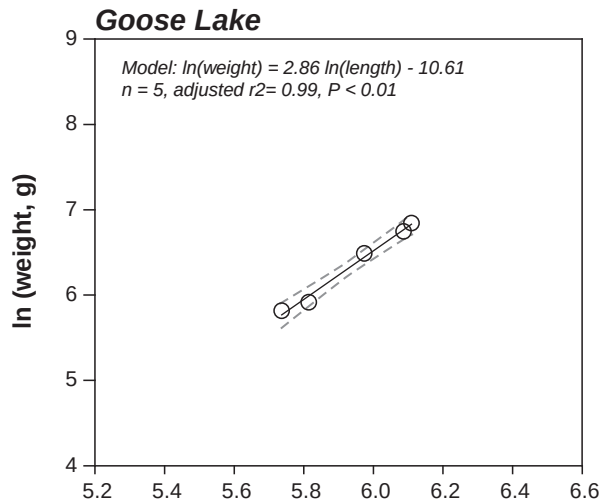
n = sample size (number of fish)

SD = standard deviation

SE = standard error

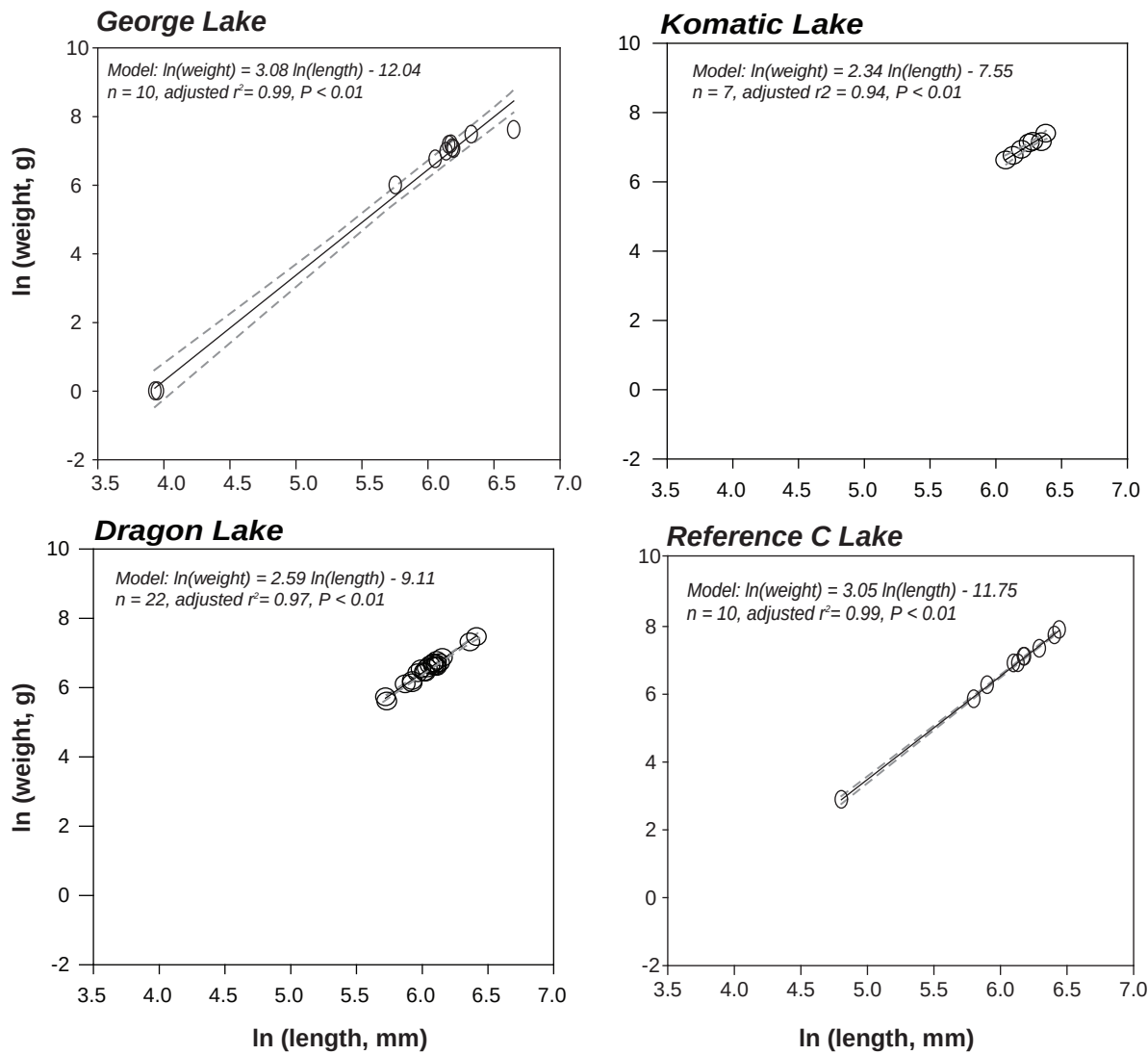
CI = confidence interval (95%)

NA = not applicable due to low sample size

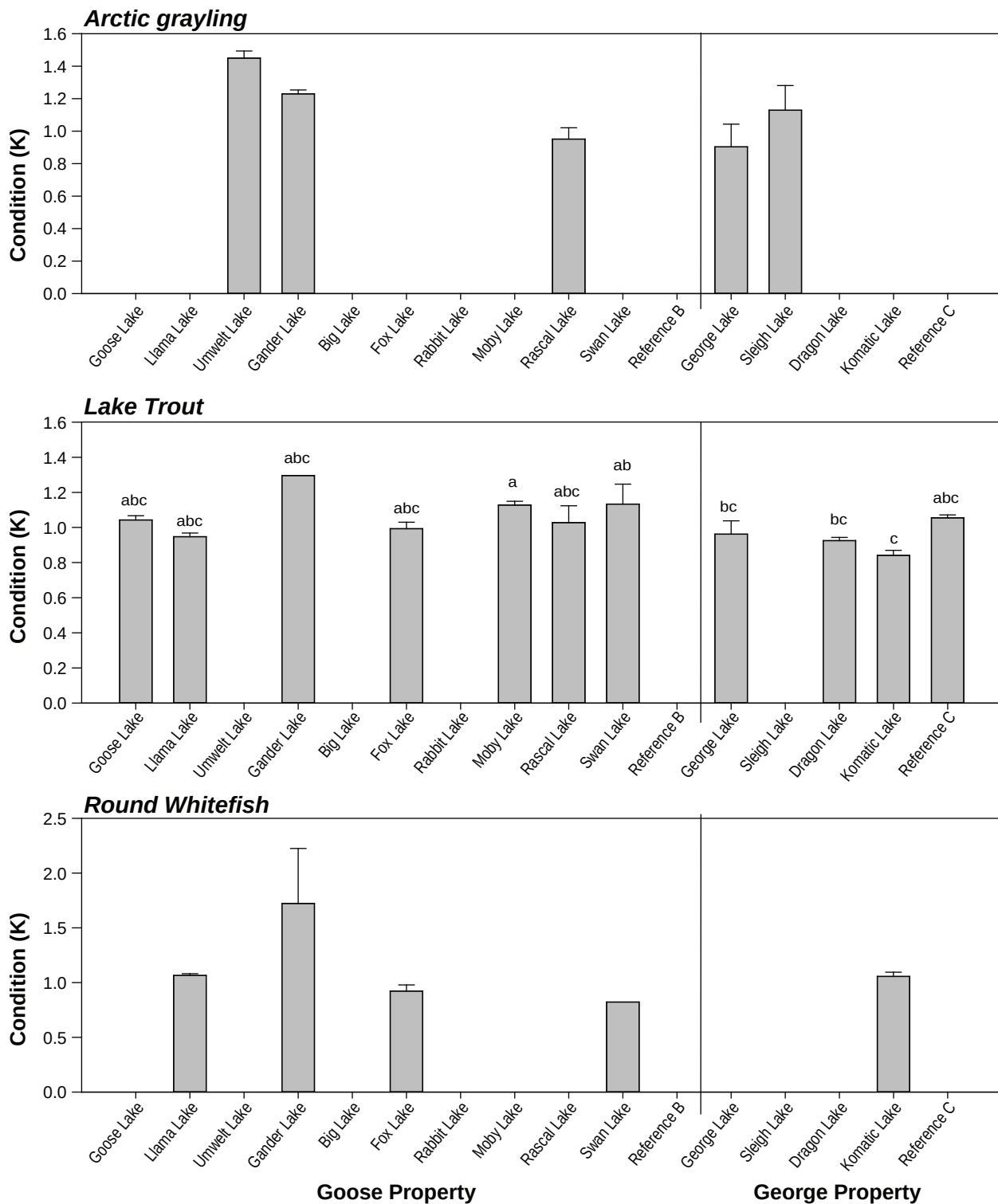


Note: Dashed lines indicate upper and lower 95% confidence intervals

Figure 3.3-25a



Note: Dashed lines indicate upper and lower 95% confidence intervals



Notes: Letters indicate significant differences among lakes ($P < 0.05$)
 Errors bars indicate one standard error of the mean

Figure 3.3-26

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 compare 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.

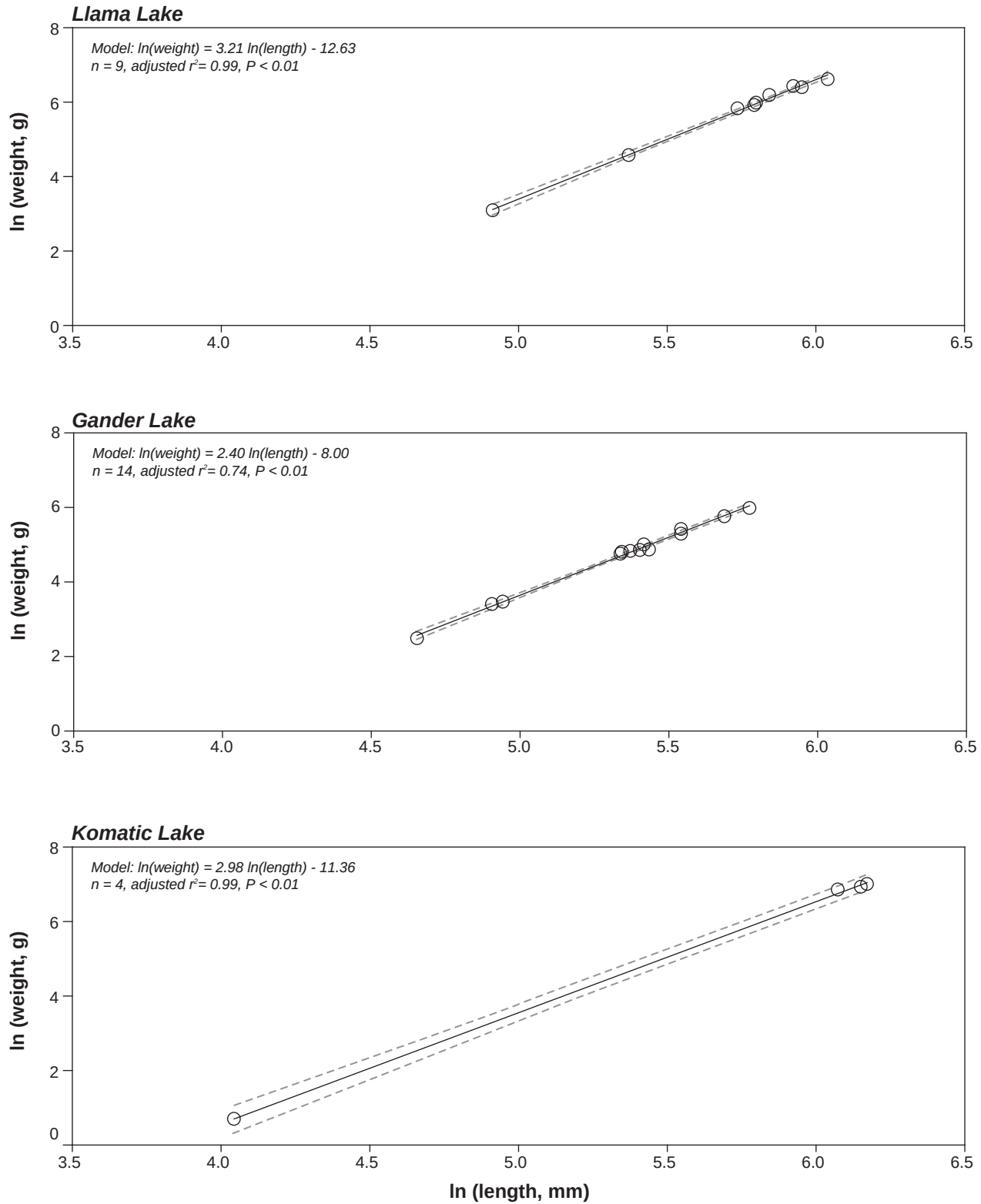
Relationships between liver weight and total weight of round whitefish were compared for fish from Llama Lake. No other lakes could be included due to a scale malfunction that created inaccurate data for Reference B Lake. There was a significant positive correlation between round whitefish total weight and liver weight ($n = 5$, $P < 0.01$) for fish from Llama Lake.

Energy Use

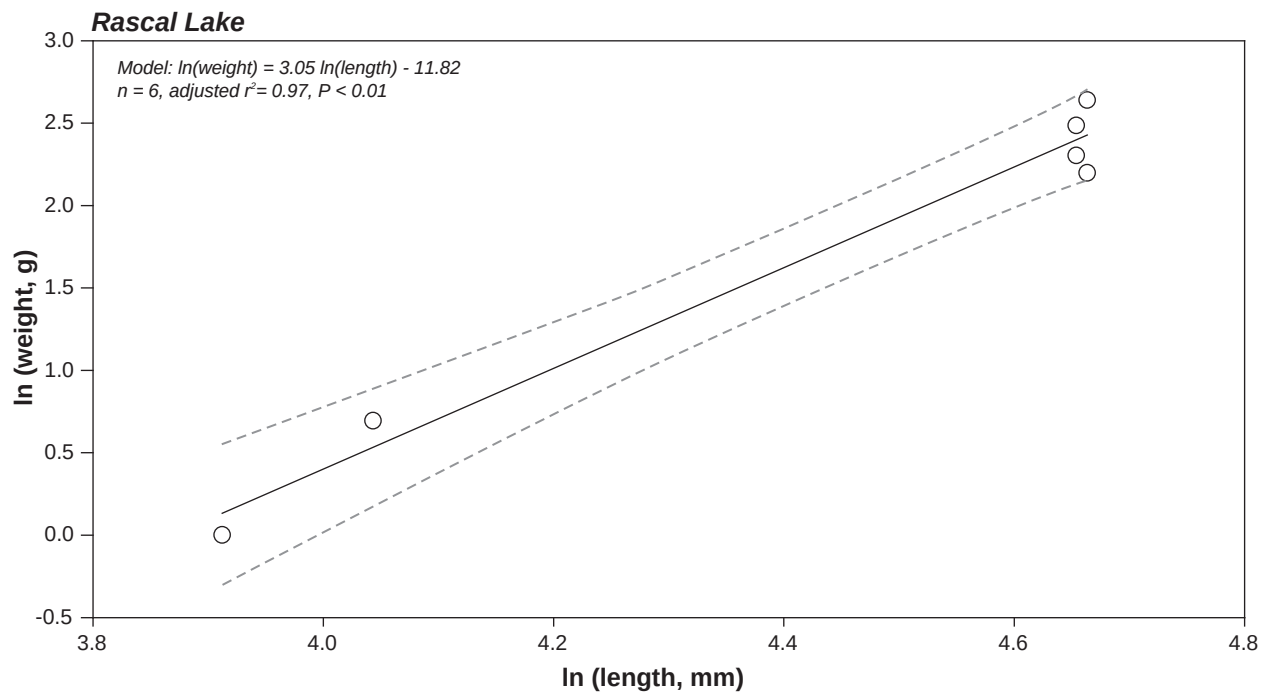
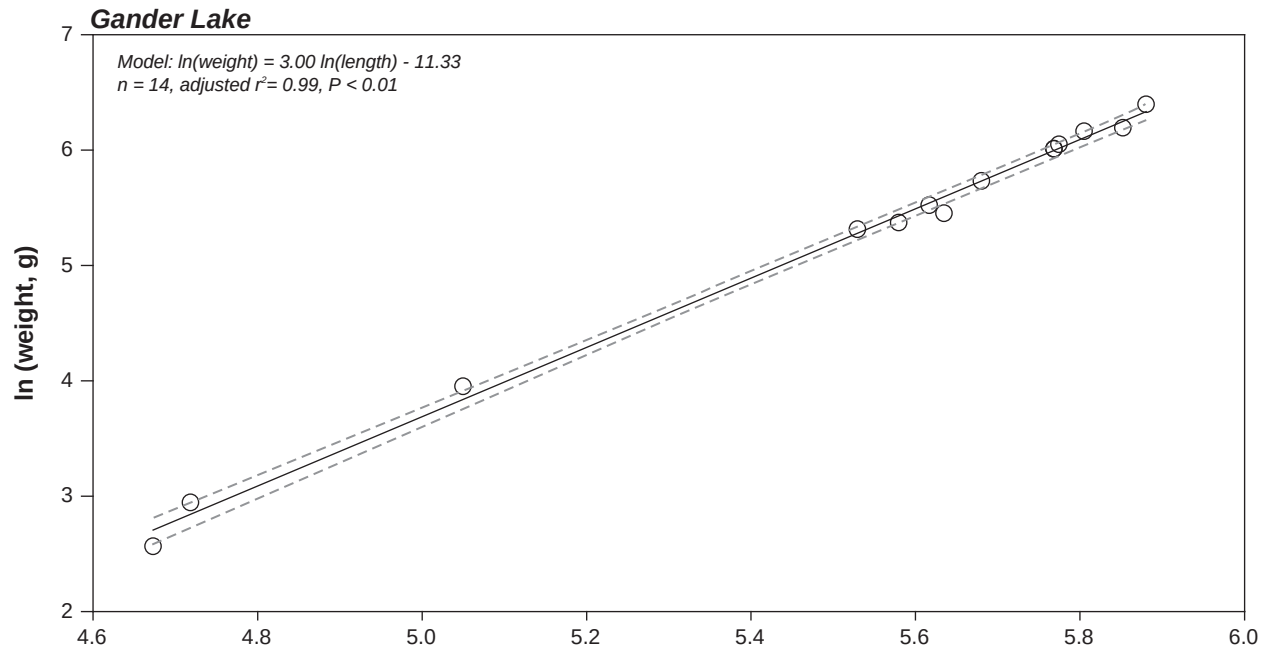
Age-frequency distributions were created for Arctic grayling, lake trout and round whitefish captured in the Back River Project area in 2012 (Figure 3.3-30). Arctic grayling aged in 2012 ranged from 1 to 5 years old, with the majority falling into the 3 and 5-year age classes. Lake trout ranged in age 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.

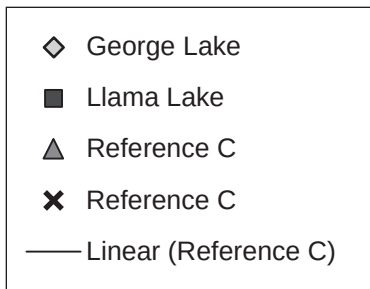
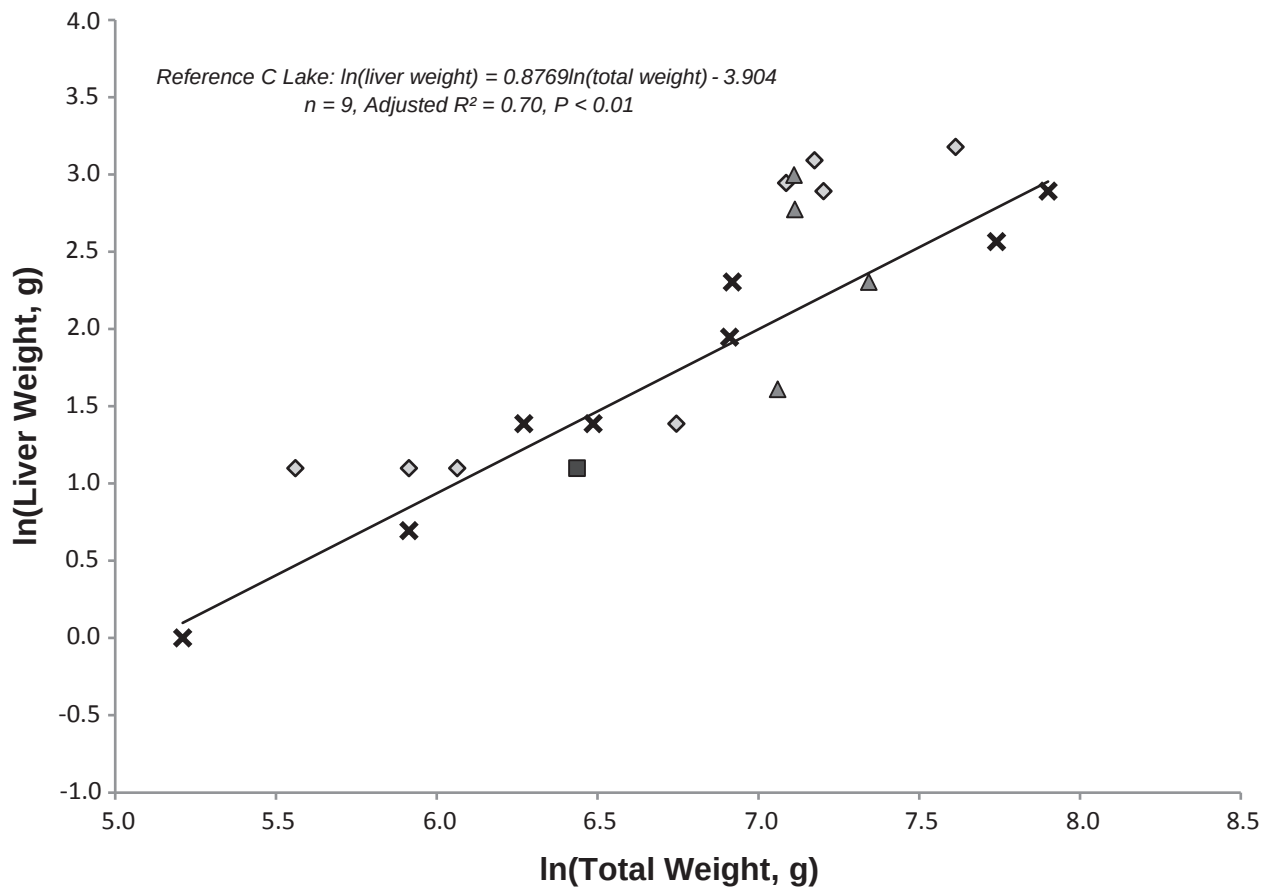
A total of 17 Arctic grayling were aged in the Project area in 2012. The ages of the fish ranged from 1 to 5 years. The modified von Bertalanffy model with t_0 fixed at zero was significant for all parameters ($P < 0.05$), and had the highest Akaike weight (0.66) compared to the other models. This model 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



Note: Dashed lines indicate upper and lower 95% confidence intervals



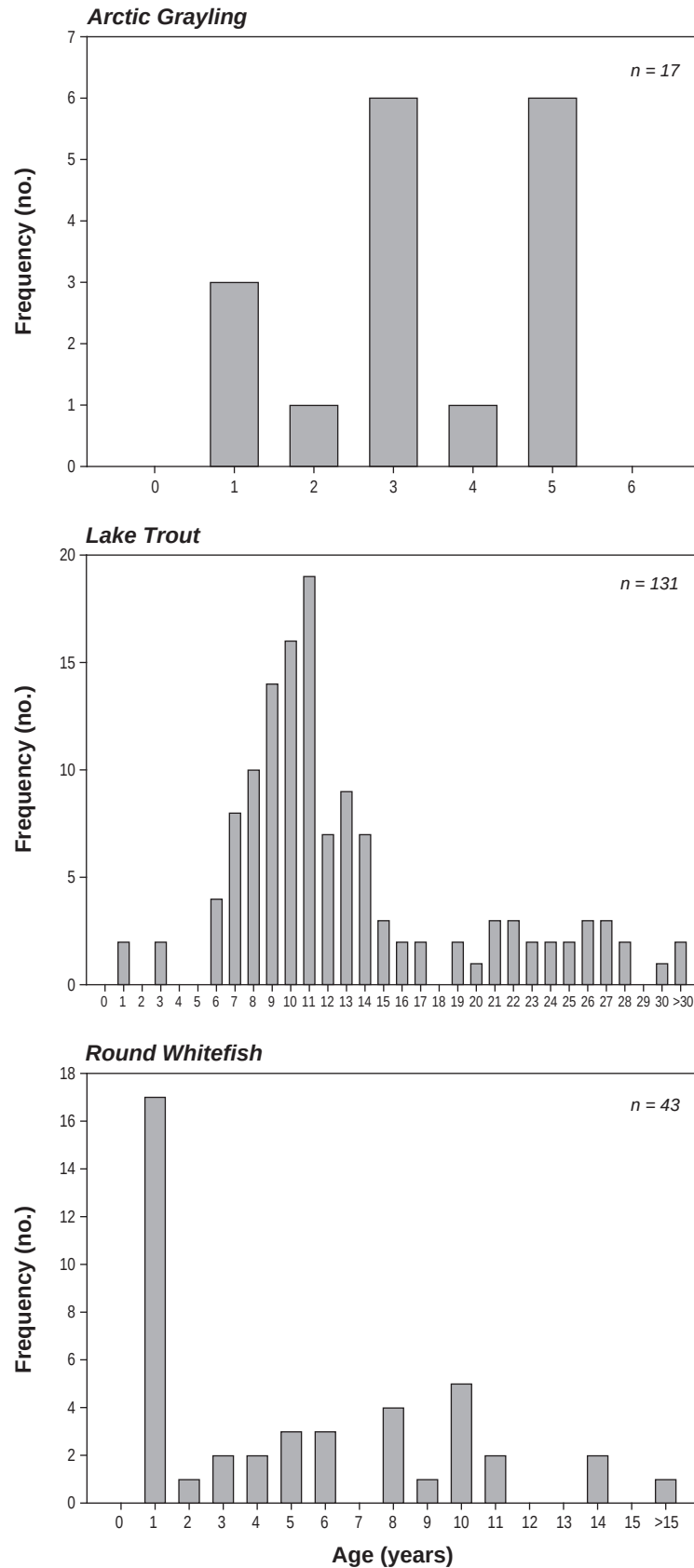
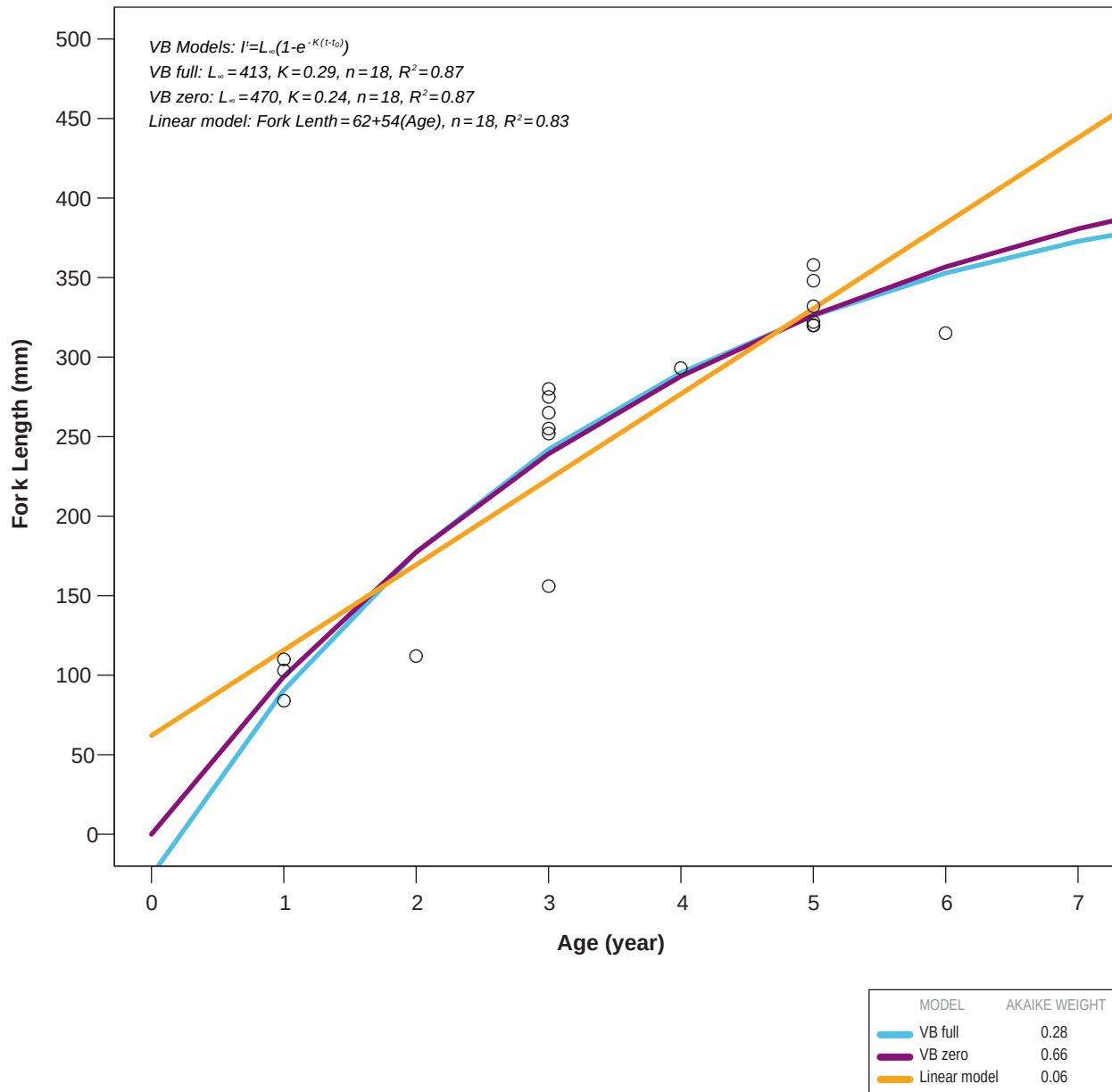
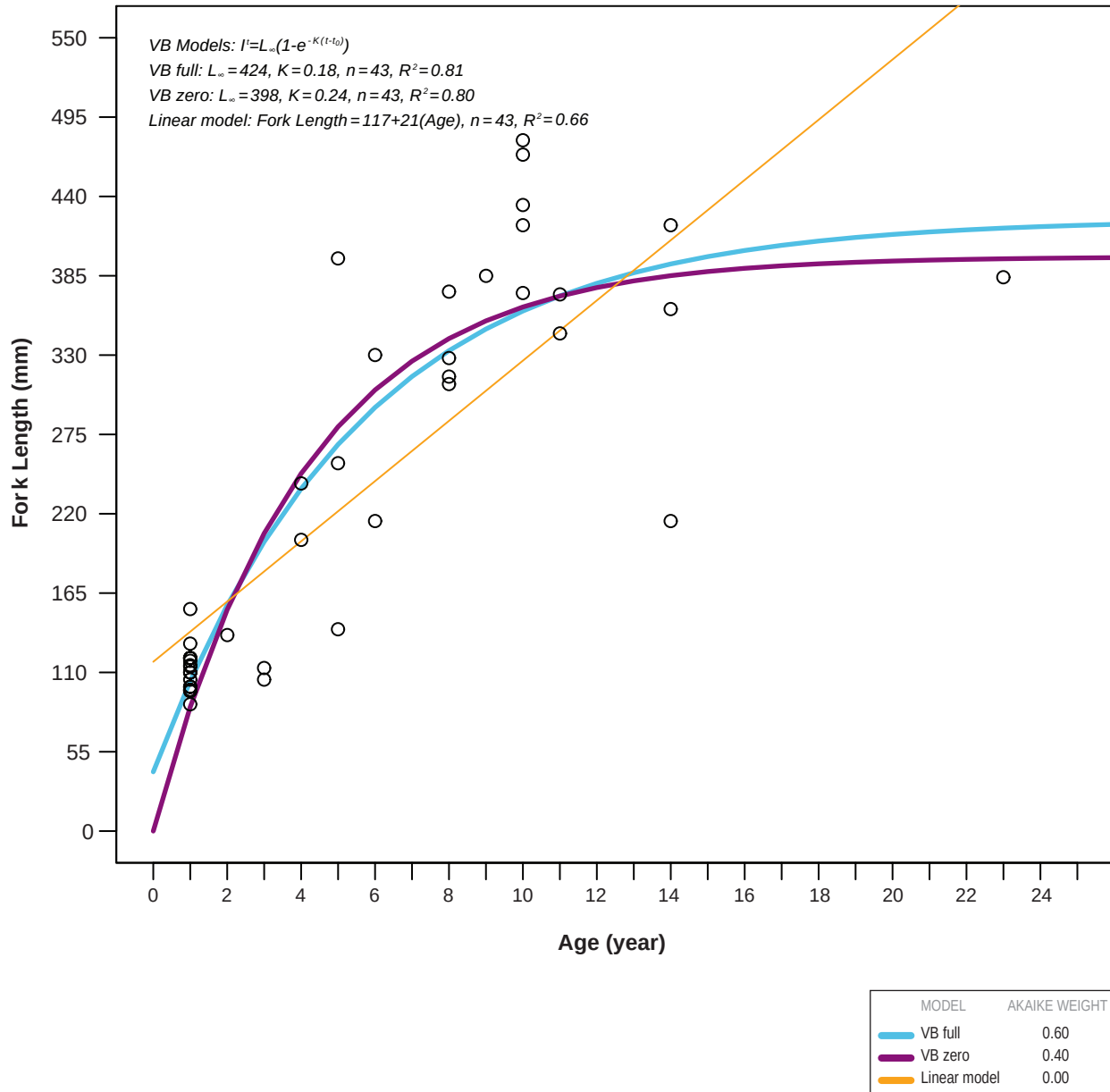
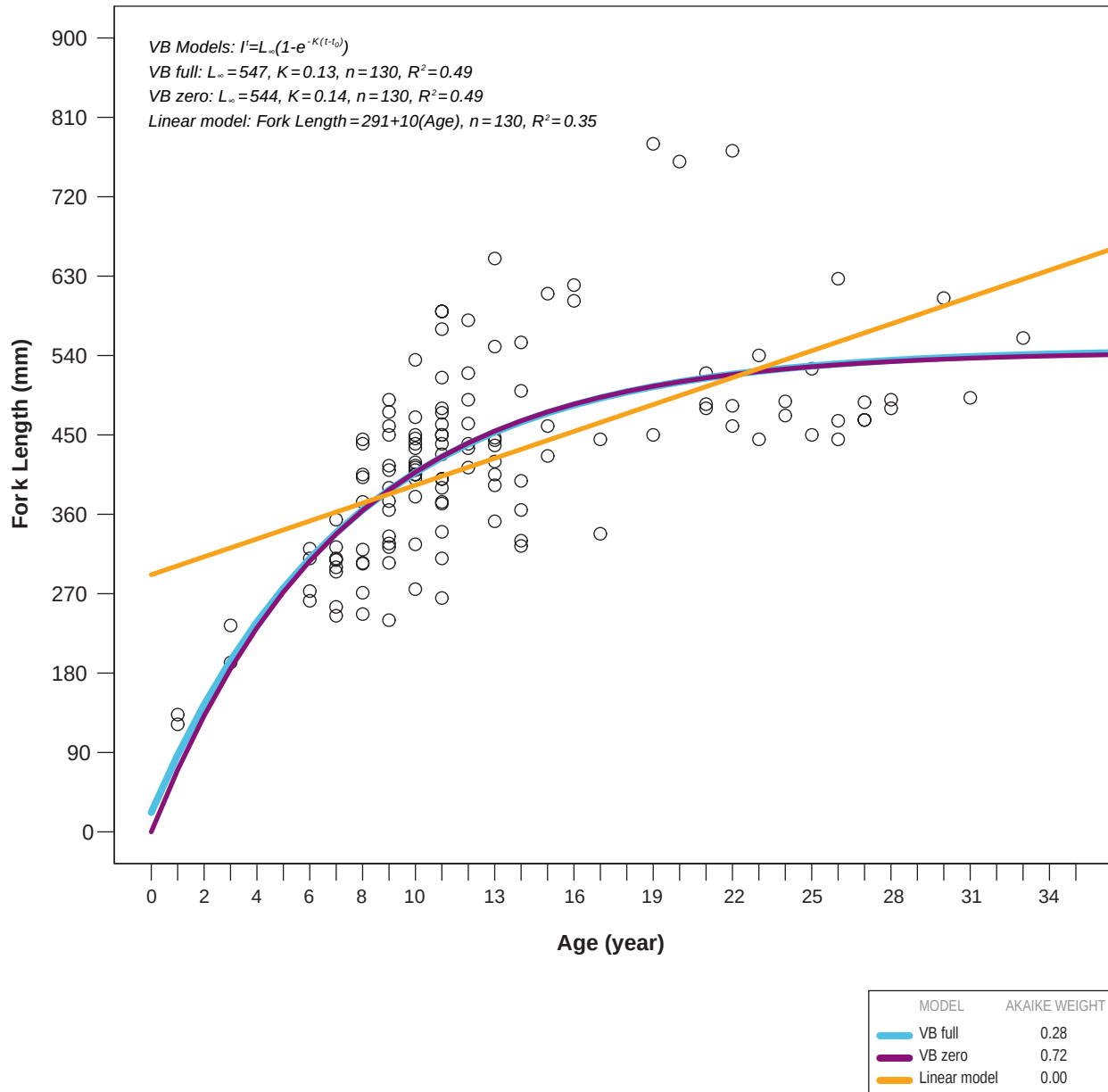


Figure 3.3-30







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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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

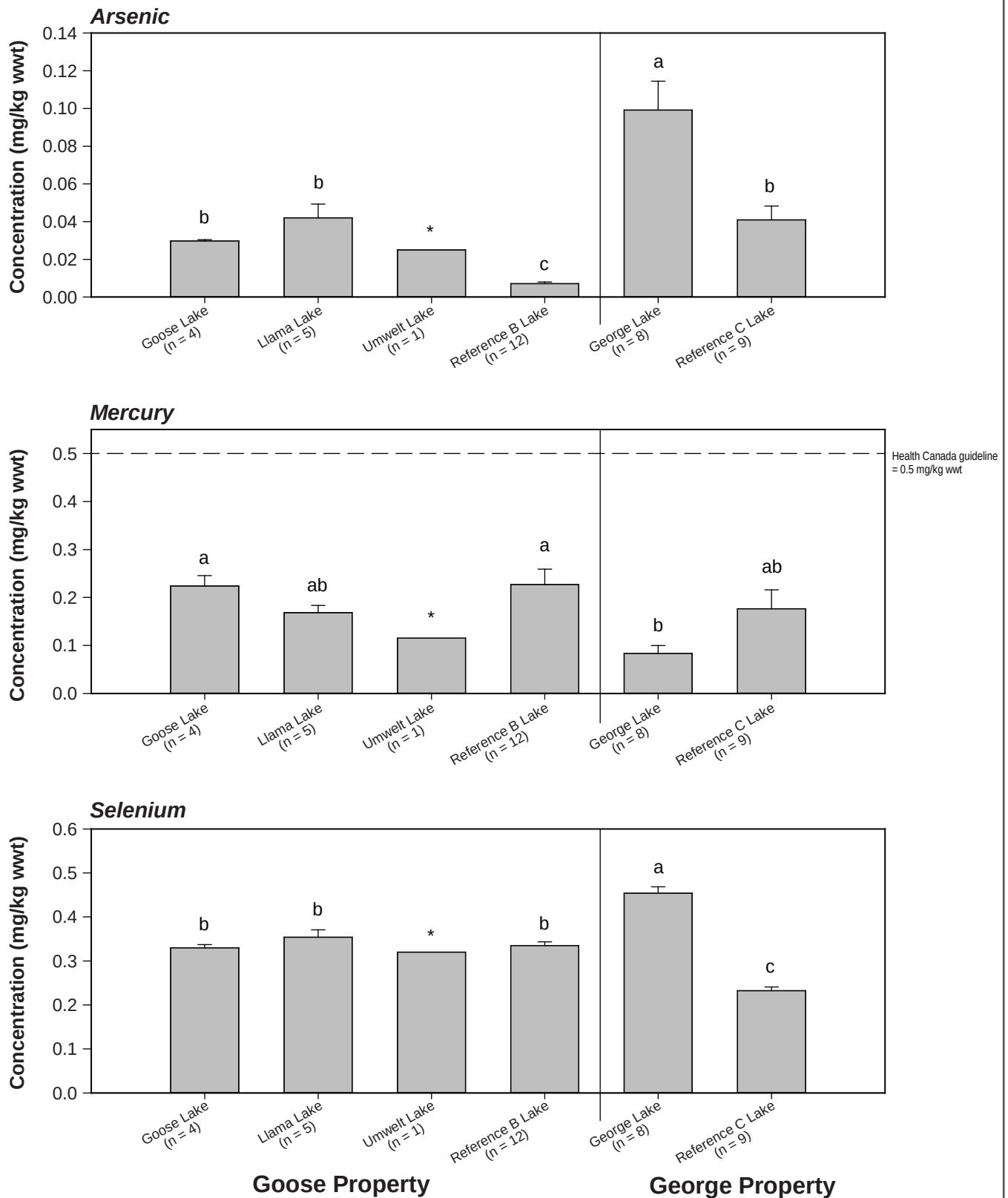
$F_{4,33} = 5.55$, $P < 0.01$). Mercury concentrations in lake trout from all lakes were lower than the Health Canada guideline of 0.50 mg/kg ww for maximum total mercury in fish tissue (CCME 1999; Health Canada 2011). Mercury is the only metal for which Health Canada or CCME guidelines exist for fish 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.

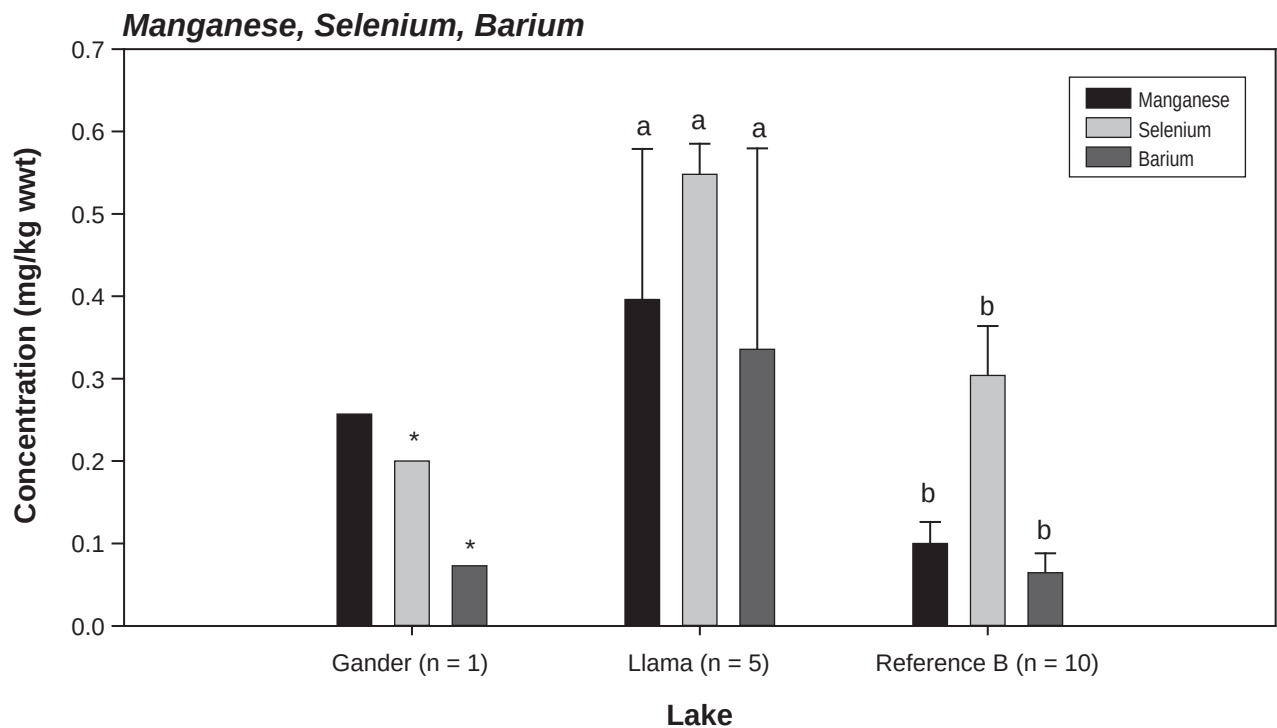
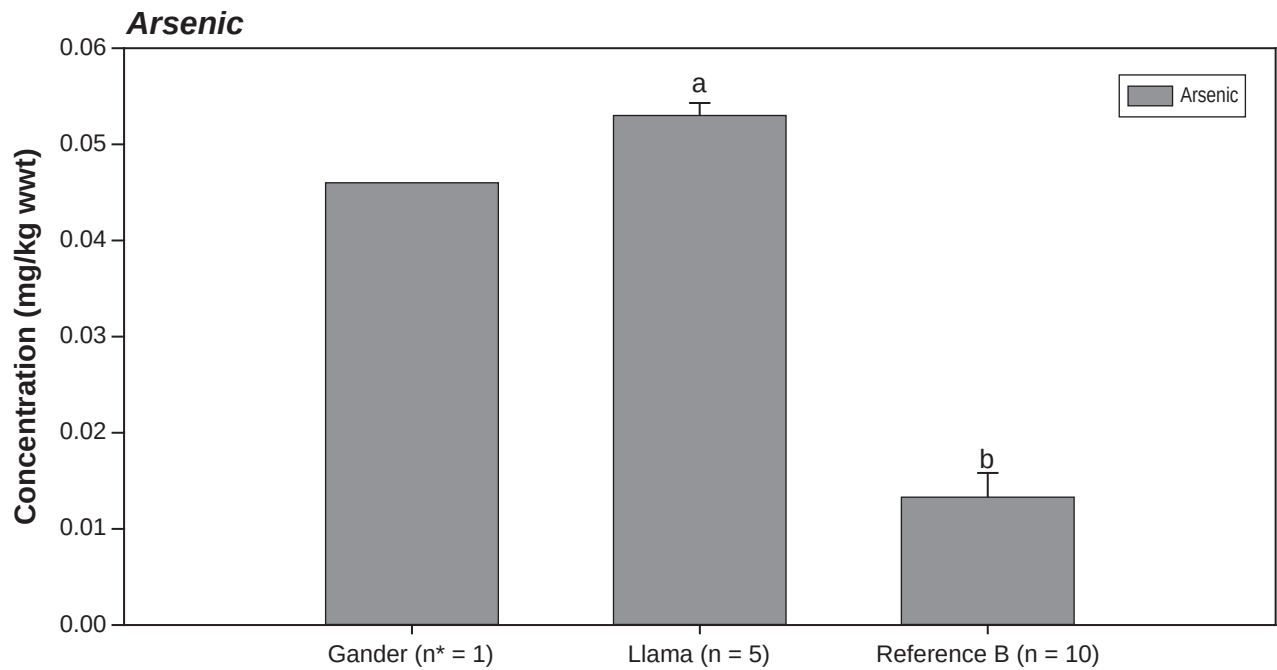
A Pearson product moment correlation analysis indicated that round whitefish fork length was not significantly correlated with the tissue concentration of any metals. Significant differences in round whitefish tissue metal concentrations occurred for arsenic (ANOVA, $F_{1,13} = 24.57$, $P < 0.01$), manganese ($F_{1,13} = 7.39$, $P < 0.05$), 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 ww 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.

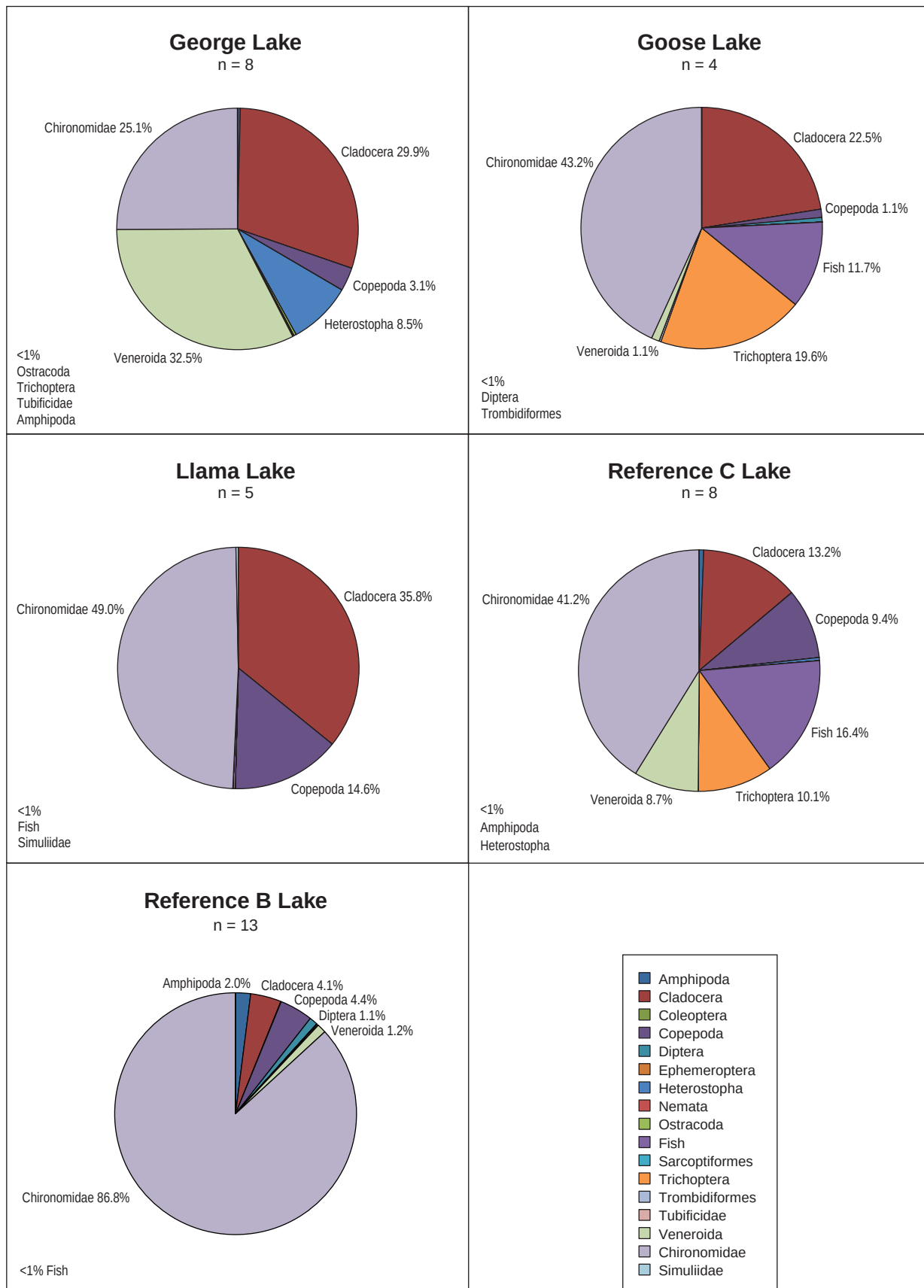


Notes: Error bars indicated standard error of the mean.

* Gander Lake was excluded from statistical analyses because only one fish was analyzed.

Letters indicate significant differences among lakes.

Figure 3.3-35



**Mean Percent Composition (by Number)
of the Stomach Contents of Lake Trout
from the Back River Project Area, 2012**

Figure 3.3-36

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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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 ww	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, *ww* = wet weight

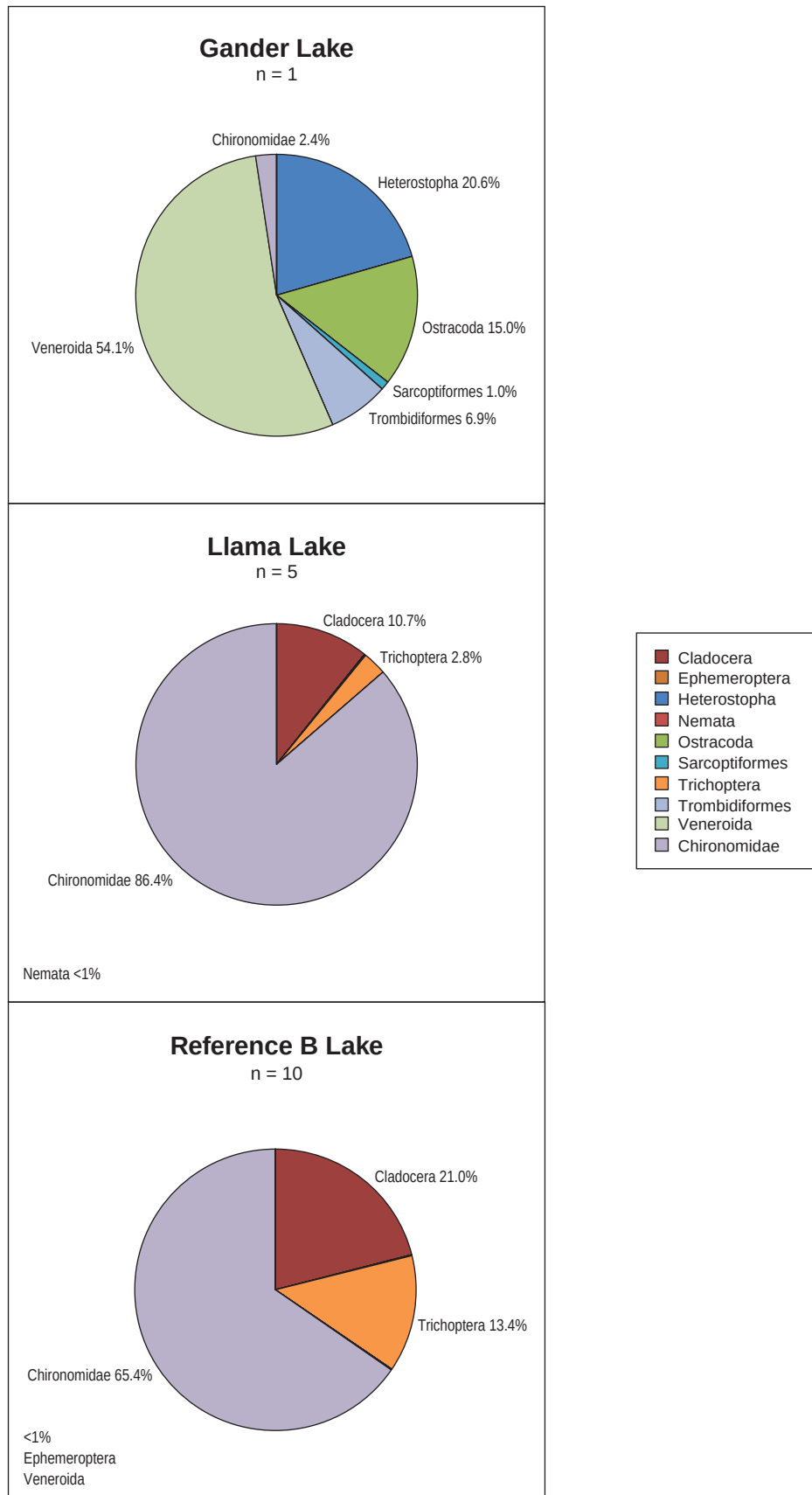


Plate 3.3-24. Zooplankton and bivalves in the stomach contents of an incidental lake trout mortality from Moby Lake.

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 Sarcopiformes). 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, were 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

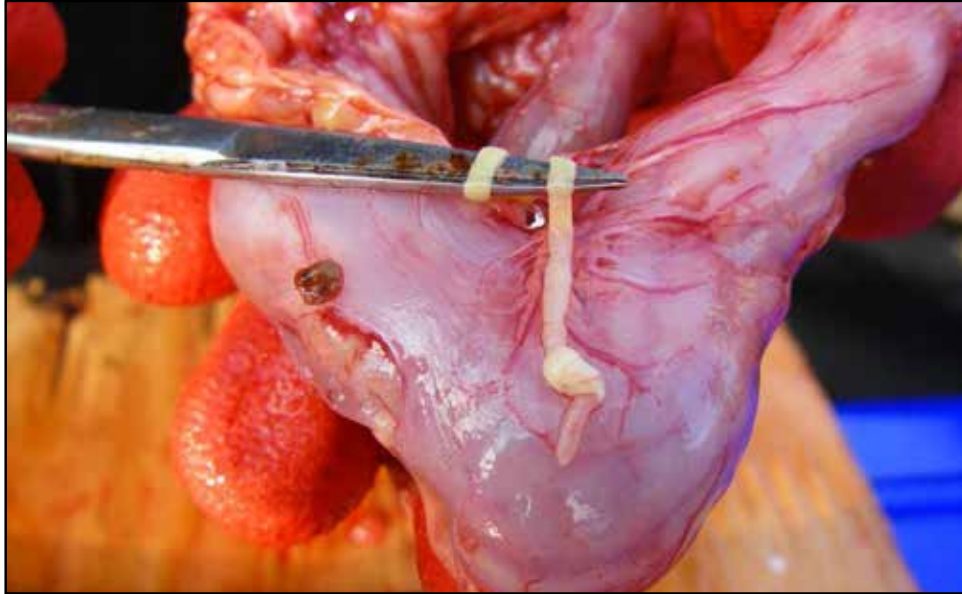


Plate 3.3-25. Tapeworm from the body cavity of a lake trout from George Lake. August 2012.



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

References

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

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

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)
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	-	-

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)
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

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
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	Antler in stream Splits in 3 channels No cover
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	
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	
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	Middle channel
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	No cover
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	

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

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

Turbidity

C = clear

Species Code

ARGR = Arctic grayling

LKTR = Lake trout

SLSC = Slimy sculpin

NNSB = Ninespine stickleback

BB = Burbot

RDWH = Round whitefish

Enclosure

O = open

NFC = No fish caught

- = not collected

Appendix 3.1-3

Individual Fish Data — Streams, 2012

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 Outflow	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

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

KS = Kirsten Seymour
RM = Ryan MacEachern
DE = David Evagalok

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	Pools up to 16 m wide
Moby Outflow	4	0	Poor	Poor	Fair	Marginal	Point/Lateral	Bars at tributary confluence	5.5	6	0.4	0.6	
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	Almost dry, isolated pools
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	
Moby Trib 2	4	0							0	0	0	0	Wide flooding over banks in spring
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	
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	

KS = Kirsten Seymour
 RM = Ryan MacEachern
 DE = David Evagalok

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							

KS = Kirsten Seymour
RM = Ryan MacEachern
DE = David Evagalok

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

KS = Kirsten Seymour
RM = Ryan MacEachern
DE = David Evagalok

Appendix 3.2-2

Fish Habitat Assessment Procedure Data,
Moby Outflow, 2012

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	Pool type	Barrier type
P = pool	S = scour	F = falls
G = glide	D = dam	BF = boulder field
R = riffle		V = velocity barrier
C = cascade	Turbidity	CH = chute
NCD = non-classified drainage	C = clear	NC = no channel
PD = pond		P = permanent
U = undefined section (no banks)		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	0.7			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						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	S	1	0.7			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						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						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	S	1.9	0.7			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						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						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						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						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	S	1.6	0.5			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						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	S	0.8	0.2			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						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						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	S	1.3	0.2			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						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						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						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						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	S	1.1	0.1			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						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						0.3	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 (m²)	Wetted Area (m²)	Proportional Length (%)	Proportional Bankfull Area (%)	Proportional Wetted Area (%)
3000	Trib 2-1	1	S	0.4	0.2			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						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	S	0.4	0.1			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						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	S	0.6	0.3			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						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	S	0.4	0.1			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	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	S	0.5	0.2			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						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						D	0.3	0.05	BF	T	0.1	0.1	0	0	0	10	10	0	0
3050	Trib 4	1	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	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

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

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

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 3.3-2b

Lake Sampling Effort and Species Summary —
Beach Seine, 2012

Appendix 3.3-2b. Lake Sampling Effort and Species Summary – Beach Seine, 2012

Date	Lake	Set #	Time	Samplers	Easting	Northing	Seined		ARGR	LKTR	SLSC	NNSB	RDWH	Total	Comments
							Area (m ²)								
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 help 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		ARGR	LKTR	SLSC	NNSB	RDWH	Total	Comments
							Area (m ²)								
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	Lytte	1	-	JC, JW	386962	7314181	200							0	NFC
8/16/2012	Lytte	2	-	JC, JW	386950	7314193	200							0	NFC
8/16/2012	Lytte	3	-	JC, JW	386917	7314208	200							0	NFC
8/16/2012	Lytte	4	-	JC, JW	386807	7314223	200							0	NFC
8/16/2012	Lytte	5	-	JC, JW	386954	7314185	200							0	NFC
8/16/2012	Lytte	6	-	JC, JW	386948	7314201	200							0	NFC
8/16/2012	Lytte	7	-	JC, JW	386947	7314203	200							0	NFC
8/16/2012	Lytte	8	-	JC, JW	386924	7314207	200							0	NFC
8/16/2012	Lytte	9	-	JC, JW	386962	7313691	200							0	NFC
8/16/2012	Lytte	10	-	JC, JW	386933	7313698	200							0	NFC
8/16/2012	Lytte	11	-	JC, JW	386953	7314187	200							0	NFC
8/16/2012	Lytte	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	ARGR	LKTR	SLSC	NNSB	RDWH	Total	Comments
							Area (m ²)							
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		ARGR	LKTR	SLSC	NNSB	RDWH	Total	Comments
							Area (m ²)								
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

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	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	-	-	-	-	-	B54+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	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	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	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	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	-	-	-	-

<i>KS = Kirsten Seymour</i>	<i>Species</i>	<i>Method</i>	<i>Reproductive Status</i>	<i>Age Taken</i>
<i>LT = Lora Tryon</i>	<i>ARGR = Arctic grayling</i>	<i>GN = gillnet</i>	<i>0 = unknown</i>	<i>S = scale</i>
<i>QS = Quinn Sheppard</i>	<i>LKTR = Lake trout</i>	<i>BS = beach seine</i>	<i>1 = green</i>	<i>F = fin ray</i>
<i>FT = Fraser Tindall</i>	<i>SLSC = Slimy sculpin</i>		<i>2 = maturing</i>	<i>O = otolith</i>
<i>JC = Jason Clarke</i>	<i>NNSB = Ninespine stickleback</i>	<i>Sex</i>	<i>3 = ripe</i>	
<i>JW = Jarvis Williams</i>	<i>BB = Burbot</i>	<i>M = male</i>	<i>4 = running</i>	<i>- = not collected</i>
<i>TS = Tamara Skubovius</i>	<i>RDWH = Round whitefish</i>	<i>F = female</i>	<i>5 = spent</i>	<i>Y = yes</i>
	<i>LKCS = Lake cisco</i>	<i>U = unknown</i>		
	<i>LNSU = Longnose sucker</i>			

Appendix 3.3-4

Tissue Metal Analysis — Raw Data, 2012

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						
	UMWELT LAKE					
Sample ID	REF B RDWH 24	REF B RDWH 25	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							
	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
Sample ID							
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					
	39 RET C LAKE	40 RET C LAKE	41 RET C LAKE	42 RET C LAKE	43 RET C LAKE
Sample ID	LAKE TROUT	LAKE TROUT	LAKE TROUT	LAKE TROUT	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

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 ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Aluminum (Al)-Total	<2.0	<2.0	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Antimony (Sb)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Antimony (Sb)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Arsenic (As)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Arsenic (As)-Total	0.014	0.016	mg/kg ww	9.2	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Barium (Ba)-Total	0.103	0.014	mg/kg ww	152	30	-	-	DUP-H
L1187074-36	Tissue	WG1531912-4	Barium (Ba)-Total	0.014	0.130	mg/kg ww	161	30	-	-	DUP-H
L1187074-12	Tissue	WG1531912-3	Beryllium (Be)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Beryllium (Be)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Bismuth (Bi)-Total	<0.030	<0.030	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Bismuth (Bi)-Total	<0.030	<0.030	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Cadmium (Cd)-Total	<0.0050	<0.0050	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Cadmium (Cd)-Total	<0.0050	<0.0050	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Calcium (Ca)-Total	131	112	mg/kg ww	16	50	-	-	-
L1187074-36	Tissue	WG1531912-4	Calcium (Ca)-Total	118	111	mg/kg ww	6.6	50	-	-	-
L1187074-12	Tissue	WG1531912-3	Chromium (Cr)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Chromium (Cr)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Cobalt (Co)-Total	0.021	<0.020	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Cobalt (Co)-Total	<0.020	<0.020	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Copper (Cu)-Total	0.382	0.228	mg/kg ww	50	30	-	-	DUP-H
L1187074-36	Tissue	WG1531912-4	Copper (Cu)-Total	0.230	0.263	mg/kg ww	13	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Lead (Pb)-Total	0.036	0.022	mg/kg ww	-	-	0.014	0.04	J
L1187074-36	Tissue	WG1531912-4	Lead (Pb)-Total	<0.020	<0.020	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Lithium (Li)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Lithium (Li)-Total	<0.10	<0.10	mg/kg ww	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 ww	1.0	30	-	-	-
L1187074-36	Tissue	WG1531912-4	Magnesium (Mg)-Total	262	261	mg/kg ww	0.3	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Manganese (Mn)-Total	0.129	0.111	mg/kg ww	15	30	-	-	-
L1187074-36	Tissue	WG1531912-4	Manganese (Mn)-Total	0.082	0.079	mg/kg ww	4.7	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Mercury (Hg)-Total	0.139	0.152	mg/kg ww	9.1	30	-	-	-
L1187074-36	Tissue	WG1531912-4	Mercury (Hg)-Total	0.208	0.205	mg/kg ww	1.8	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Molybdenum (Mo)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Molybdenum (Mo)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Nickel (Ni)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Nickel (Ni)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Selenium (Se)-Total	0.38	0.37	mg/kg ww	1.9	30	-	-	-
L1187074-36	Tissue	WG1531912-4	Selenium (Se)-Total	0.36	0.37	mg/kg ww	3.6	30	-	-	-
L1187074-12	Tissue	WG1531912-3	Strontium (Sr)-Total	0.122	0.101	mg/kg ww	19	50	-	-	-
L1187074-36	Tissue	WG1531912-4	Strontium (Sr)-Total	0.111	0.102	mg/kg ww	8.6	50	-	-	-
L1187074-12	Tissue	WG1531912-3	Thallium (Tl)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Thallium (Tl)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Tin (Sn)-Total	<0.050	<0.050	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Tin (Sn)-Total	<0.050	<0.050	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Uranium (U)-Total	<0.0020	<0.0020	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Uranium (U)-Total	<0.0020	<0.0020	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Vanadium (V)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-36	Tissue	WG1531912-4	Vanadium (V)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1187074-12	Tissue	WG1531912-3	Zinc (Zn)-Total	4.18	3.62	mg/kg ww	14	30	-	-	-
L1187074-36	Tissue	WG1531912-4	Zinc (Zn)-Total	4.14	3.97	mg/kg ww	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 ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Antimony (Sb)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Barium (Ba)-Total	<0.010	0.020	mg/kg ww	N/A	30	-	-	DUP-H
L1195853-13	Tissue	WG1541330-3	Beryllium (Be)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Bismuth (Bi)-Total	<0.030	<0.030	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Cadmium (Cd)-Total	<0.0050	<0.0050	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Calcium (Ca)-Total	59.1	48.5	mg/kg ww	20	50	-	-	-
L1195853-13	Tissue	WG1541330-3	Chromium (Cr)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Cobalt (Co)-Total	<0.020	<0.020	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Copper (Cu)-Total	0.524	0.450	mg/kg ww	15	30	-	-	-
L1195853-13	Tissue	WG1541330-3	Lead (Pb)-Total	<0.020	<0.020	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Lithium (Li)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Magnesium (Mg)-Total	270	285	mg/kg ww	5.5	30	-	-	-
L1195853-13	Tissue	WG1541330-3	Manganese (Mn)-Total	0.093	0.099	mg/kg ww	6.2	30	-	-	-
L1195853-13	Tissue	WG1541330-3	Mercury (Hg)-Total	0.430	0.484	mg/kg ww	12	30	-	-	-
L1195853-13	Tissue	WG1541330-3	Molybdenum (Mo)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Nickel (Ni)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Selenium (Se)-Total	0.26	0.26	mg/kg ww	1.6	30	-	-	-
L1195853-13	Tissue	WG1541330-3	Strontium (Sr)-Total	<0.010	<0.010	mg/kg ww	N/A	50	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Thallium (Tl)-Total	<0.010	<0.010	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Tin (Sn)-Total	<0.050	<0.050	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Uranium (U)-Total	<0.0020	<0.0020	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Vanadium (V)-Total	<0.10	<0.10	mg/kg ww	N/A	30	-	-	RPD-NA
L1195853-13	Tissue	WG1541330-3	Zinc (Zn)-Total	3.71	3.61	mg/kg ww	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

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 ww	96.7	70-130	RM-H
Tissue	CRM	Cadmium (Cd)-Total	WG1541330-4	VA-NRC-TORT2	27.7	26.7	mg/kg ww	103.9	70-130	
Tissue	CRM	Chromium (Cr)-Total	WG1541330-4	VA-NRC-TORT2	4.19	0.77	mg/kg ww	544.5	70-130	
Tissue	CRM	Cobalt (Co)-Total	WG1541330-4	VA-NRC-TORT2	0.554	0.510	mg/kg ww	108.7	70-130	
Tissue	CRM	Copper (Cu)-Total	WG1541330-4	VA-NRC-TORT2	103	106	mg/kg ww	96.9	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1541330-4	VA-NRC-TORT2	0.362	0.350	mg/kg ww	0.362	.15-.55	RM-H
Tissue	CRM	Manganese (Mn)-Total	WG1541330-4	VA-NRC-TORT2	12.8	13.6	mg/kg ww	94.1	70-130	
Tissue	CRM	Molybdenum (Mo)-Total	WG1541330-4	VA-NRC-TORT2	0.965	0.950	mg/kg ww	101.5	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1541330-4	VA-NRC-TORT2	4.25	2.50	mg/kg ww	170.0	70-130	
Tissue	CRM	Selenium (Se)-Total	WG1541330-4	VA-NRC-TORT2	5.96	5.63	mg/kg ww	105.8	70-130	
Tissue	CRM	Strontium (Sr)-Total	WG1541330-4	VA-NRC-TORT2	41.5	45.2	mg/kg ww	91.9	70-130	RM-H
Tissue	CRM	Vanadium (V)-Total	WG1541330-4	VA-NRC-TORT2	1.75	1.64	mg/kg ww	1.75	1.14-2.14	
Tissue	CRM	Zinc (Zn)-Total	WG1541330-4	VA-NRC-TORT2	172	180	mg/kg ww	95.8	70-130	
Tissue	CRM	Arsenic (As)-Total	WG1541330-5	VA-NRC-DOLT4	9.46	9.66	mg/kg ww	97.9	70-130	
Tissue	CRM	Cadmium (Cd)-Total	WG1541330-5	VA-NRC-DOLT4	25.1	24.3	mg/kg ww	103.2	70-130	
Tissue	CRM	Calcium (Ca)-Total	WG1541330-5	VA-NRC-DOLT4	644	680	mg/kg ww	94.7	70-130	RM-H
Tissue	CRM	Chromium (Cr)-Total	WG1541330-5	VA-NRC-DOLT4	1.33	1.40	mg/kg ww	94.7	70-130	
Tissue	CRM	Cobalt (Co)-Total	WG1541330-5	VA-NRC-DOLT4	0.230	0.250	mg/kg ww	0.230	.15-.35	
Tissue	CRM	Copper (Cu)-Total	WG1541330-5	VA-NRC-DOLT4	32.7	31.2	mg/kg ww	104.8	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1541330-5	VA-NRC-DOLT4	0.137	0.160	mg/kg ww	85.6	70-130	
Tissue	CRM	Magnesium (Mg)-Total	WG1541330-5	VA-NRC-DOLT4	1340	1500	mg/kg ww	89.4	70-130	RM-H
Tissue	CRM	Molybdenum (Mo)-Total	WG1541330-5	VA-NRC-DOLT4	1.05	1.00	mg/kg ww	105.4	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1541330-5	VA-NRC-DOLT4	1.04	0.97	mg/kg ww	1.04	.47-1.47	
Tissue	CRM	Selenium (Se)-Total	WG1541330-5	VA-NRC-DOLT4	9.14	8.30	mg/kg ww	110.1	70-130	
Tissue	CRM	Strontium (Sr)-Total	WG1541330-5	VA-NRC-DOLT4	5.22	5.50	mg/kg ww	94.9	70-130	
Tissue	CRM	Tin (Sn)-Total	WG1541330-5	VA-NRC-DOLT4	0.142	0.170	mg/kg ww	83.7	70-130	RM-H
Tissue	CRM	Vanadium (V)-Total	WG1541330-5	VA-NRC-DOLT4	0.65	0.60	mg/kg ww	109.1	70-130	
Tissue	CRM	Zinc (Zn)-Total	WG1541330-5	VA-NRC-DOLT4	117	116	mg/kg ww	100.6	70-130	
Tissue	MB	Aluminum (Al)-Total	WG1541330-1		<2.0	<2	mg/kg ww	-	2	RM-H
Tissue	MB	Antimony (Sb)-Total	WG1541330-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1541330-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1541330-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1541330-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1541330-1		<0.030	<0.03	mg/kg ww	-	0.03	RM-H
Tissue	MB	Cadmium (Cd)-Total	WG1541330-1		<0.0050	<0.005	mg/kg ww	-	0.005	
Tissue	MB	Calcium (Ca)-Total	WG1541330-1		<2.0	<2	mg/kg ww	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1541330-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1541330-1		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1541330-1		<0.010	<0.01	mg/kg ww	-	0.01	RM-H
Tissue	MB	Lead (Pb)-Total	WG1541330-1		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1541330-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1541330-1		<1.0	<1	mg/kg ww	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1541330-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Mercury (Hg)-Total	WG1541330-1		<0.0010	<0.001	mg/kg ww	-	0.001	RM-H
Tissue	MB	Molybdenum (Mo)-Total	WG1541330-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Nickel (Ni)-Total	WG1541330-1		<0.10	<0.1	mg/kg ww	-	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 ww	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1541330-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1541330-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1541330-1		<0.050	<0.05	mg/kg ww	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1541330-1		<0.0020	<0.002	mg/kg ww	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1541330-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1541330-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Aluminum (Al)-Total	WG1541330-2		<2.0	<2	mg/kg ww	-	2	
Tissue	MB	Antimony (Sb)-Total	WG1541330-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1541330-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1541330-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1541330-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1541330-2		<0.030	<0.03	mg/kg ww	-	0.03	
Tissue	MB	Cadmium (Cd)-Total	WG1541330-2		<0.0050	<0.005	mg/kg ww	-	0.005	
Tissue	MB	Calcium (Ca)-Total	WG1541330-2		<2.0	<2	mg/kg ww	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1541330-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1541330-2		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1541330-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Lead (Pb)-Total	WG1541330-2		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1541330-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1541330-2		<1.0	<1	mg/kg ww	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1541330-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Mercury (Hg)-Total	WG1541330-2		<0.0010	<0.001	mg/kg ww	-	0.001	
Tissue	MB	Molybdenum (Mo)-Total	WG1541330-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Nickel (Ni)-Total	WG1541330-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Selenium (Se)-Total	WG1541330-2		<0.20	<0.2	mg/kg ww	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1541330-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1541330-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1541330-2		<0.050	<0.05	mg/kg ww	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1541330-2		<0.0020	<0.002	mg/kg ww	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1541330-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1541330-2		<0.10	<0.1	mg/kg ww	-	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 ww	95.3	70-130	
Tissue	CRM	Cadmium (Cd)-Total	WG1531912-5	VA-NRC-TORT2	26.9	26.7	mg/kg ww	100.7	70-130	
Tissue	CRM	Chromium (Cr)-Total	WG1531912-5	VA-NRC-TORT2	0.55	0.77	mg/kg ww	71.6	70-130	
Tissue	CRM	Cobalt (Co)-Total	WG1531912-5	VA-NRC-TORT2	0.490	0.510	mg/kg ww	96.1	70-130	
Tissue	CRM	Copper (Cu)-Total	WG1531912-5	VA-NRC-TORT2	96.0	106	mg/kg ww	90.5	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1531912-5	VA-NRC-TORT2	0.360	0.350	mg/kg ww	0.360	.15-.55	
Tissue	CRM	Manganese (Mn)-Total	WG1531912-5	VA-NRC-TORT2	12.3	13.6	mg/kg ww	90.8	70-130	
Tissue	CRM	Mercury (Hg)-Total	WG1531912-5	VA-NRC-TORT2	0.276	0.270	mg/kg ww	102.2	70-130	
Tissue	CRM	Molybdenum (Mo)-Total	WG1531912-5	VA-NRC-TORT2	0.961	0.950	mg/kg ww	101.2	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1531912-5	VA-NRC-TORT2	2.10	2.50	mg/kg ww	84.2	70-130	
Tissue	CRM	Selenium (Se)-Total	WG1531912-5	VA-NRC-TORT2	5.72	5.63	mg/kg ww	101.6	70-130	
Tissue	CRM	Strontium (Sr)-Total	WG1531912-5	VA-NRC-TORT2	42.4	45.2	mg/kg ww	93.7	70-130	
Tissue	CRM	Vanadium (V)-Total	WG1531912-5	VA-NRC-TORT2	1.72	1.64	mg/kg ww	1.72	1.14-2.14	
Tissue	CRM	Zinc (Zn)-Total	WG1531912-5	VA-NRC-TORT2	172	180	mg/kg ww	95.5	70-130	
Tissue	CRM	Arsenic (As)-Total	WG1531912-6	VA-NRC-DOLT4	9.44	9.66	mg/kg ww	97.7	70-130	
Tissue	CRM	Cadmium (Cd)-Total	WG1531912-6	VA-NRC-DOLT4	25.6	24.3	mg/kg ww	105.4	70-130	
Tissue	CRM	Calcium (Ca)-Total	WG1531912-6	VA-NRC-DOLT4	674	680	mg/kg ww	99.1	70-130	
Tissue	CRM	Chromium (Cr)-Total	WG1531912-6	VA-NRC-DOLT4	1.16	1.40	mg/kg ww	83.0	70-130	
Tissue	CRM	Cobalt (Co)-Total	WG1531912-6	VA-NRC-DOLT4	0.229	0.250	mg/kg ww	0.229	.15-.35	
Tissue	CRM	Copper (Cu)-Total	WG1531912-6	VA-NRC-DOLT4	32.1	31.2	mg/kg ww	102.9	70-130	
Tissue	CRM	Lead (Pb)-Total	WG1531912-6	VA-NRC-DOLT4	0.127	0.160	mg/kg ww	79.2	70-130	
Tissue	CRM	Magnesium (Mg)-Total	WG1531912-6	VA-NRC-DOLT4	1400	1500	mg/kg ww	93.1	70-130	
Tissue	CRM	Mercury (Hg)-Total	WG1531912-6	VA-NRC-DOLT4	2.06	2.58	mg/kg ww	79.8	70-130	
Tissue	CRM	Molybdenum (Mo)-Total	WG1531912-6	VA-NRC-DOLT4	1.12	1.00	mg/kg ww	111.9	70-130	
Tissue	CRM	Nickel (Ni)-Total	WG1531912-6	VA-NRC-DOLT4	0.86	0.97	mg/kg ww	0.86	.47-1.47	
Tissue	CRM	Selenium (Se)-Total	WG1531912-6	VA-NRC-DOLT4	8.93	8.30	mg/kg ww	107.6	70-130	
Tissue	CRM	Strontium (Sr)-Total	WG1531912-6	VA-NRC-DOLT4	5.44	5.50	mg/kg ww	99.0	70-130	
Tissue	CRM	Tin (Sn)-Total	WG1531912-6	VA-NRC-DOLT4	0.132	0.170	mg/kg ww	77.8	70-130	
Tissue	CRM	Vanadium (V)-Total	WG1531912-6	VA-NRC-DOLT4	0.58	0.60	mg/kg ww	96.0	70-130	
Tissue	CRM	Zinc (Zn)-Total	WG1531912-6	VA-NRC-DOLT4	120	116	mg/kg ww	103.2	70-130	
Tissue	MB	Aluminum (Al)-Total	WG1531912-1		<2.0	<2	mg/kg ww	-	2	
Tissue	MB	Antimony (Sb)-Total	WG1531912-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1531912-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1531912-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1531912-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1531912-1		<0.030	<0.03	mg/kg ww	-	0.03	
Tissue	MB	Cadmium (Cd)-Total	WG1531912-1		<0.0050	<0.005	mg/kg ww	-	0.005	
Tissue	MB	Calcium (Ca)-Total	WG1531912-1		<2.0	<2	mg/kg ww	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1531912-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1531912-1		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1531912-1		0.024	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Lead (Pb)-Total	WG1531912-1		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1531912-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1531912-1		<1.0	<1	mg/kg ww	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1531912-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Molybdenum (Mo)-Total	WG1531912-1		<0.010	<0.01	mg/kg ww	-	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 ww	-	0.1	
Tissue	MB	Selenium (Se)-Total	WG1531912-1		<0.20	<0.2	mg/kg ww	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1531912-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1531912-1		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1531912-1		<0.050	<0.05	mg/kg ww	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1531912-1		<0.0020	<0.002	mg/kg ww	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1531912-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1531912-1		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Aluminum (Al)-Total	WG1531912-2		<2.0	<2	mg/kg ww	-	2	
Tissue	MB	Antimony (Sb)-Total	WG1531912-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Arsenic (As)-Total	WG1531912-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Barium (Ba)-Total	WG1531912-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Beryllium (Be)-Total	WG1531912-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Bismuth (Bi)-Total	WG1531912-2		<0.030	<0.03	mg/kg ww	-	0.03	
Tissue	MB	Cadmium (Cd)-Total	WG1531912-2		<0.0050	<0.005	mg/kg ww	-	0.005	
Tissue	MB	Calcium (Ca)-Total	WG1531912-2		<2.0	<2	mg/kg ww	-	2	
Tissue	MB	Chromium (Cr)-Total	WG1531912-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Cobalt (Co)-Total	WG1531912-2		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Copper (Cu)-Total	WG1531912-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Lead (Pb)-Total	WG1531912-2		<0.020	<0.02	mg/kg ww	-	0.02	
Tissue	MB	Lithium (Li)-Total	WG1531912-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Magnesium (Mg)-Total	WG1531912-2		<1.0	<1	mg/kg ww	-	1	
Tissue	MB	Manganese (Mn)-Total	WG1531912-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Molybdenum (Mo)-Total	WG1531912-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Nickel (Ni)-Total	WG1531912-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Selenium (Se)-Total	WG1531912-2		<0.20	<0.2	mg/kg ww	-	0.2	
Tissue	MB	Strontium (Sr)-Total	WG1531912-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Thallium (Tl)-Total	WG1531912-2		<0.010	<0.01	mg/kg ww	-	0.01	
Tissue	MB	Tin (Sn)-Total	WG1531912-2		<0.050	<0.05	mg/kg ww	-	0.05	
Tissue	MB	Uranium (U)-Total	WG1531912-2		<0.0020	<0.002	mg/kg ww	-	0.002	
Tissue	MB	Vanadium (V)-Total	WG1531912-2		<0.10	<0.1	mg/kg ww	-	0.1	
Tissue	MB	Zinc (Zn)-Total	WG1531912-2		<0.10	<0.1	mg/kg ww	-	0.1	

Appendix 3.3-7

Diet Data, 2012

Appendix 3.3-7. Diet Data, 2012



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
<i>Drunella doddsii</i>	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
<i>Rhithrogena sp.</i>	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
<i>Micrasema sp.</i>	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
<i>Grensia praeterita</i>	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
<i>Chironomus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cryptochironomus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dicrotendipes sp.</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Endochironomus sp.</i>	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0
<i>Parachironomus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stictochironomus sp.</i>	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
<i>Corynocera sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Paratanytarsus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Tanytarsus sp.</i>	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
<i>Protanypus</i>	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
<i>Heterotrissocladius sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Parametriocnemus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Psectrocladius sp.</i>	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
<i>Chaetocladius sp.</i>	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
<i>Monodiamesa sp.</i>	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
<u>Ablabesmyia sp.</u>	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
<u>Procladius sp.</u>	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
<u>Daphnia sp.</u>	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
<u>Gammarus sp.</u>	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
<u>Lebertia sp.</u>	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
<u>Pisidium sp.</u>	10	9	20	20	1	14	0	0	37	0	0	0	0	0	0	0
<u>Sphaerium sp.</u>	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: Heterostrophia	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
<u>Valvata sincera</u>	2	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0
<u>Valvata sp.</u>	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
<u>All others</u>	0	0	0	0	0	0	0	0	0	22	0	0	0	4	0	0
<u>No Invertebrates Found</u>	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



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	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
<i>Drunella doddsii</i>	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
<i>Rhithrogena sp.</i>	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
<i>Micrasema sp.</i>	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
<i>Grensia praeterita</i>	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
<i>Chironomus sp.</i>	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	16	0
<i>Cryptochironomus sp.</i>	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dicrotendipes sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Endochironomus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Parachironomus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stictochironomus sp.</i>	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
<i>Corynocera sp.</i>	0	0	8	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0
<i>Paratanytarsus sp.</i>	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Tanytarsus sp.</i>	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
<i>Protanypus</i>	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
<i>Heterotrissocladius sp.</i>	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Parametriochnemus sp.</i>	0	0	28	0	0	90	22	0	0	0	0	0	0	0	0	0	0	0	0
<i>Psectrocladius sp.</i>	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
<i>Chaetocladius sp.</i>	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
<i>Monodiamesa sp.</i>	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
<i>Ablabesmyia sp.</i>	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
<i>Procladius sp.</i>	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
<i>Daphnia sp.</i>	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
<i>Gammarus sp.</i>	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
<i>Lebertia sp.</i>	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
<i>Pisidium sp.</i>	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
<i>Sphaerium sp.</i>	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: Heterostropho	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
<i>Valvata sincera</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Valvata sp.</i>	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
<i>All others</i>	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	8	0	0
<i>No Invertebrates Found</i>	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



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
<i>Drunella dodsii</i>	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
<i>Rhithrogena sp.</i>	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
<i>Micrasema sp.</i>	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
<i>Grensia praeterita</i>	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
<i>Chironomus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cryptochironomus sp.</i>	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0
<i>Dicrotendipes sp.</i>	0	0	0	0	55	0	45	0	0	0	0	0	0	0	0	0	0	0	0
<i>Endochironomus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Parachironomus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Stictochironomus sp.</i>	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
<i>Corynocera sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Paratanytarsus sp.</i>	0	0	0	0	210	75	235	4	1	0	0	0	0	0	0	0	0	0	0
<i>Tanytarsus sp.</i>	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
<i>Protanypus</i>	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
<i>Heterotrissocladius sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Parametrioctenus sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Psectrocladius sp.</i>	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
<i>Chaetocladius sp.</i>	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
<i>Monodiamesa sp.</i>	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
<i>Ablabesmyia sp.</i>	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
<i>Procladius sp.</i>	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
<i>Daphnia sp.</i>	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
<i>Gammarus sp.</i>	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
<i>Lebertia sp.</i>	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
<i>Pisidium sp.</i>	16	0	0	4	0	0	0	0	0	0	0	0	70	0	0	3	1	0	0
<i>Sphaerium sp.</i>	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: Heterostrophia	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
<i>Valvata sincera</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Valvata sp.</i>	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
<i>All others</i>	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	1	6	0	4
<i>No Invertebrates Found</i>	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

Appendix V6-6D

Back River Project: 2013 Freshwater Fish and Fish Habitat Baseline Report

Sabina Gold & Silver Corp.

BACK RIVER PROJECT 2013 Freshwater Fish and Fish Habitat Baseline Report



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March 2014

BACK RIVER PROJECT

2013 FRESHWATER FISH AND FISH HABITAT BASELINE REPORT

March 2014
Project #0194096-0004

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Prepared for:



Sabina Gold & Silver Corp.

Prepared by:



an ERM company

Rescan Environmental Services Ltd., an ERM company
Vancouver, British Columbia

Executive Summary

Executive Summary

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold & Silver Corp. (Sabina) located in the West Kitikmeot region of Nunavut. Exploration programs were run out of both the Goose and George camps in 2013.

The 2013 baseline program was designed to survey fish habitat and community composition in stream, lake, and pond habitats with the potential to be affected by Project development or to support ongoing planning for water management activities or potential fisheries offsetting works.

Goose Potential Development Area

Potential infrastructure within the Goose Potential Development Area (PDA) that was considered during the 2013 fish work included a Tailings Impoundment Area (TIA), two Waste Rock Storage Areas (WRSAs), three open pit locations, a camp/mill location, and connecting local site roads. A total of six road crossing sites, eight streams, eight lakes, and eight ponds were surveyed in 2013.

Three of the six stream crossing sites identified along proposed road routes in the Goose PDA were characterised as important rearing habitat for Arctic Grayling, Slimy Sculpin, Burbot, and Ninespine Stickleback. The remaining three sites crossed dry/intermittently wetted channels or non-channelized wetted areas with no fishery value.

In addition to the six potential road crossings, eight other streams were located adjacent to or within proposed infrastructure. These stream sites were assessed using SHIM methods. Habitat at most of the stream reaches was important to at least one fish life history stage. Most of the surveyed reaches were small, low gradient runs, but a variety of habitats including riffles, pools, and boulder gardens were also identified. Fish barriers were identified in Giraffe Inflow and Wasp Inflow. The natural barrier present at Giraffe Inflow prevents fish from entering the water within the bounds of the potential Tailings Impoundment Area (TIA). Extensive sampling within Giraffe Inflow failed to capture any fish, and the stream is likely non-fish bearing. The fish community at stream sites included Arctic Grayling, Slimy Sculpin, Lake Trout, Burbot, and Ninespine Stickleback, though Arctic Grayling and Slimy Sculpin were the most common species encountered. Spawning and fry surveys indicated that the Rascal-Goose stream, streams intersecting the potential Main Pit, and Gander Pond stream are used by spawning Arctic Grayling and provide critical spawning habitat for Arctic Grayling.

Lake surveys in the Goose PDA included assessments of shoreline and littoral habitat in three lakes, sublittoral habitat surveys in two lakes using hydroacoustic bathymetry and bottom typing, fish community surveys in four lakes, and a Lake Trout spawning survey in Goose Lake. Most lakes were characterised by boulder and cobble-dominated shorelines and sparse aquatic vegetation. Fish communities were sampled at ten lakes using beach seining, gillnetting, minnow trapping, angling, and electrofishing. The lake fish community included: Arctic Grayling, Burbot, Lake Trout, Ninespine Stickleback, Round Whitefish, and Slimy Sculpin. Lake Trout were the most widespread species, but Slimy Sculpin were the most numerous. No fish were captured at Echo Lake, which was determined to be non-fish bearing.

Eight ponds were surveyed in the Goose PDA. Potential fish habitat in Pond 1 and Pond A was quantified using hydroacoustic bathymetry and bottom typing. The fish community compositions of all eight ponds were surveyed using electrofishing. Pond 2 was the only confirmed fish-bearing pond. Three ponds within the potential TIA (Ponds A, A2 and A3) were reconfirmed to be non-fish bearing.

Baseline data on fish survival, energy use and storage, tissue metals, and diet were gathered from Lake Trout and Slimy Sculpin. Slimy Sculpin tissue metals were sampled from four lakes and tissue metal concentrations were below all relevant guidelines. Lake Trout tissue metals were sampled from Giraffe Lake, the lake immediately downstream of the potential TIA. The concentration of most metals in Lake Trout tissue from Giraffe Lake were below relevant guidelines, with the exception of mercury, in which the baseline average concentration was above the Health Canada Guidelines (guideline value 0.50 mg/kg ww, mean concentration 0.58 mg/kg ww).

George Potential Development Area

Potential infrastructure within the George PDA that was considered during the 2013 fish survey included three Waste Rock Storage Areas, an ore stockpile, three open pits, potential other infrastructure including a camp and landfill, and connecting local site roads. A total of four road crossing sites, two streams, and seven lakes were surveyed in 2013.

Four crossing sites were surveyed in the George PDA; two were classified as streams and two were non-classified drainages containing no fish habitat values. The two stream crossings provide important rearing habitat for Arctic Grayling, Lake Trout, and Slimy Sculpin, and George Inflow 2 was identified as critical Arctic Grayling spawning habitat.

In addition to the potential road crossing streams, two other streams in the George PDA were also surveyed. The quality and quantity of fish habitat was characterized in the streams using SHIM methods. No fish were captured in the two streams, although Occurrence Outflow is assumed fish-bearing. George Inflow 1 was determined to be unsuitable for fish habitat due to the high gradient.

Seven lakes were surveyed in the George PDA. Work completed included littoral habitat and littoral substrate surveys in three lakes and fish community sampling using gillnetting, beach seining, angling, and electrofishing at six lakes. The lake fish community included: Arctic Grayling, Burbot, Lake Trout, Ninespine Stickleback, Round Whitefish, and Slimy Sculpin. Although no fish were captured at Lytle Lake, which intersects the proposed Locale 1 Pit, it is connected to fish-bearing water bodies and likely serves as ephemeral fish habitat.

Baseline data on fish survival, energy use and storage, tissue metals, and diet were gathered from Slimy Sculpin. Slimy Sculpin tissue metals from all four lakes exhibited tissue metal concentrations below all relevant guidelines.

Water Management and/or Fisheries Offsetting

Four streams, four lakes, and one pond were sampled to support potential fisheries offsetting projects. Four streams and one pond (Pond E) were located in the Goose and George PDAs. The four lakes were located outside of the Goose and George Properties in the Canyon Lakes area approximately 17 km northeast of the Goose PDA. Sampling details varied based on habitat and the information required, but included at least one of the following methods: SHIM habitat mapping; FHAP habitat assessments; shoreline substrate surveys; and community surveys by angling, electrofishing, gillnetting, and/or minnow trapping. The fish community at potential offsetting locations was similar to that found within the Project footprint, including: Arctic Grayling, Burbot, Lake Trout, Ninespine Stickleback and Slimy Sculpin. Arctic Grayling and Slimy Sculpin were the most common species encountered.

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BACK RIVER PROJECT

2013 FRESHWATER FISH AND FISH HABITAT BASELINE REPORT

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Glossary and Abbreviations

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.

AIC	Akaike Information Criteria
ANOVA	Analysis of variance
BC MOE	British Columbia Ministry of Environment
CPUE	Catch-per-unit-effort
CFDA	<i>Canadian Food and Drug Act</i>
CFIA	Canadian Food Inspection Agency
dB	Decibel
DGPS	Differential Global Positioning System
DL	Detection Limit
Dry/Int.	Dry or intermittent channel
Dwt	Dry weight
EPA	Environmental Protection Agency
FHAP	Fish habitat assessment procedure
GLM	General linear model
GSI	Gonadosomatic Index
HSI	Hepatosomatic Index
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
K	Fulton's Condition Factor
LSA	Local Study Area
MLA	Marine Laydown Area
MMER	Metal Mining Effluent Regulations
NCD	Non-classified Drainage
PDA	Potential Development Area
RIC	Resources Inventory Committee of British Columbia
ROS	Regression on Order Statistics
RSA	Regional Study Area
SHIM	Sensitive Habitat Inventory Mapping
TIA	Tailings Impoundment Area
Wwt	Wet weight
YOY	Young-of-the-year

1. Introduction

1. Introduction

The Back River Project (the Project) is a proposed gold project owned by Sabina Gold & Silver Corp. (Sabina) located in the West Kitikmeot region of Nunavut (Figure 1-1). This report presents the results of the freshwater fish and fish habitat program developed to support the freshwater fish and aquatic habitat portions of the Draft Environmental Impact Statement (Rescan 2013).

The overall objective of the freshwater fish and fish habitat program was to provide required baseline information for the DEIS and to provide information for the freshwater fish and aquatic habitat portions of the DEIS in conjunction with previous Back River baseline reports (Rescan 2010, 2012a, 2012c). The specific objectives of the fish and fish habitat baseline program in 2013 were to:

- 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 Potential Development Areas (PDAs);
- collect baseline tissue metal samples and stomach content samples from fish in lakes in the Goose and George PDAs; and
- collect fish habitat and fish community composition data to support the development of potential fisheries offsetting projects.

Chapter 2 of this report presents the program methods, Chapter 3 the results and discussion, and Chapter 4 contains a brief summary. All raw data collected are included as appendices.

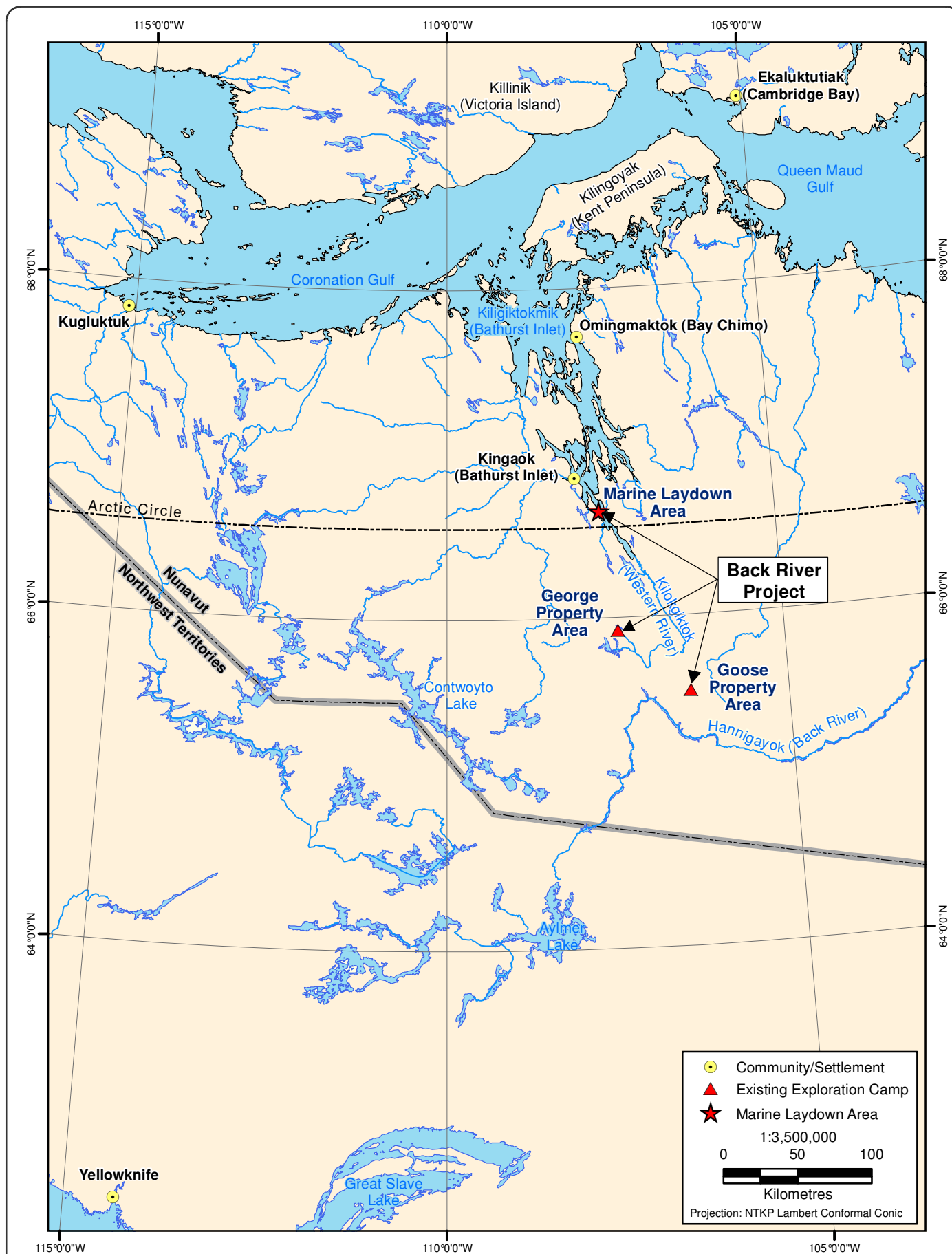


Figure 1-1

2. Methods

2. Methods

2.1 STUDY AREA

Fish habitat and community assessment locations in 2013 were chosen based on their proximity to proposed mine infrastructure or activities within the Potential Development Areas of both the Goose and George Properties. The PDAs included the local sub-watersheds in which infrastructure and activities are proposed (Figure 2.1-1). The LSAs were defined as the immediate sub-watersheds within each Property Area where Project activities and infrastructure may occur. The RSAs included the PDA, the LSA, and additional areas within which there is the potential for indirect or cumulative effects from Project activities. Two lakes which are not expected to experience effects due to Project activities were sampled as reference sites. Work was also conducted in areas that could potentially be used for fisheries offset projects.

The 2013 Fish and Fish Habitat baseline program focused on waterbodies that could be influenced by infrastructure, or activities as described below:

Goose Property Potential Development Area (PDA)

- Haul and access road route:
 - Conduct fish habitat surveys during freshet on streams crossing potential haul and access roads; and
 - Conduct fish community surveys during freshet to identify fish use and community composition in streams with questionable fish-bearing status.
- Streams, Lakes, and Ponds
 - Conduct detailed habitat surveys and fry/spawning surveys on streams that could be affected by development of mine infrastructure and fisheries offsetting, including Giraffe Inflow, Llama Outflow, Umwelt Outflow, and the Goose-Rascal area;
 - Confirm fish-bearing status and assess fish habitat quality in ponds and streams associated with a potential tailings impoundment area (TIA) in the Giraffe Watershed;
 - Collect baseline fish community information on lakes, including Giraffe, Propeller, Wasp, and Echo;
 - Collect fish habitat quality information on lakes, including Giraffe, Propeller, Umwelt, and Wasp;
 - Identify potential Lake Trout (*Salvelinus namaycush*) spawning habitat in Goose and Propeller lakes; and
 - Collect tissue metal data from fish in Giraffe Lake, Goose Lake, Propeller Lake, and Reference B Lake. Metals analyses were conducted on muscle tissue plugs from large-bodied fish (Lake Trout), and whole body concentrations for small-bodied fish (Slimy Sculpin - *Cottus cognatus*).

George Property Potential Development Area (PDA)

- Haul and access road route:
 - Conduct fish habitat surveys during freshet on streams crossing potential haul and access roads; and

- Conduct fish community surveys during freshet to identify fish use and community composition in streams with questionable fish-bearing status.
- Streams, Lakes, and Ponds
 - Conduct detailed habitat surveys and spawning surveys on streams that could be affected by development of mine infrastructure and fisheries offsetting, including George inflow 1, George inflow 2, George outflow, and Occurrence outflow;
 - Collect baseline fish community information on lakes, including Bob, Komatic, Lytle, McCoy, Occurrence, and Reference Q;
 - Collect fish habitat quality information on lakes, including Bob, McCoy, and Reference Q;
 - Collect whole body metal data from Slimy Sculpin in George Lake, Komatic Lake, McCoy Lake, and Reference Q Lake.

Offset Areas

- Conduct fish habitat surveys on streams, lakes, and ponds to collect information to support the design of fisheries offsetting projects; and
- Conduct fish community surveys to identify fish use and community composition in streams, lakes, and ponds with questionable fish-bearing status.

2.2 WATERSHED SETTING

Figure 2.1-1 provides an overview of the Goose and George Property Local Study Area (LSA) locations as well as the Potential Development Areas (PDAs). Further details are provided below.

2.2.1 Goose Property LSA

Sampled streams are located within the Giraffe, Llama, Wolf, Goose, and Propeller sub-watersheds (Figures 2.2-1 and 2.2-2). All five sub-watersheds are components of the larger Queen Maud Gulf-Ellice River Watershed. The Reference B Lake Watershed is located south of the other sampled sites and is in the headwaters of the Back River Watershed.

The Giraffe Watershed is located north of Goose Lake. Wasp Lake discharges south to the smaller Leaf Lake, which discharges south to Giraffe Lake. Numerous small ponds located to the east of the lakes discharge into Wasp Lake and Giraffe Lake through ephemeral or permanent streams. Wasp Inflow discharges water from Pond D into Wasp Lake. Pond A Inflow flows from Pond A1 south to Pond A. Overland flow from Pond A seasonally discharges water into Giraffe Lake Inflow, but there is no connecting stream channel.

The Llama Watershed contains several lakes. Water discharges south from Llama Lake through Llama Outflow to Umwelt Lake, where it converges with water that discharges north from Rabbit Lake and Fox Lake and water that discharges east from a number of unnamed ponds. Umwelt Outflow then flows east to Goose Lake.

Wolf Watershed is a large watershed dominated by Wolf Lake. Numerous lakes and ponds discharge into Wolf Lake. The outflow flows north to Rascal Lake. Rascal Lake discharges north into Gander Pond through the Gander Pond Inflow and into Goose Lake by Gander Pond Outflow and Rascal-Goose stream. The Main Pit streams are fed by overland flow from the Wolf watershed and discharge north into Goose Lake. Echo Lake is located west of Goose-Rascal stream. Echo Lake is a small lake with no inflow that drains north to Goose Lake through an intermittent stream channel. Echo Pond is isolated with no channelized inflow or outflows, located between Echo Lake and Goose-Rascal stream.

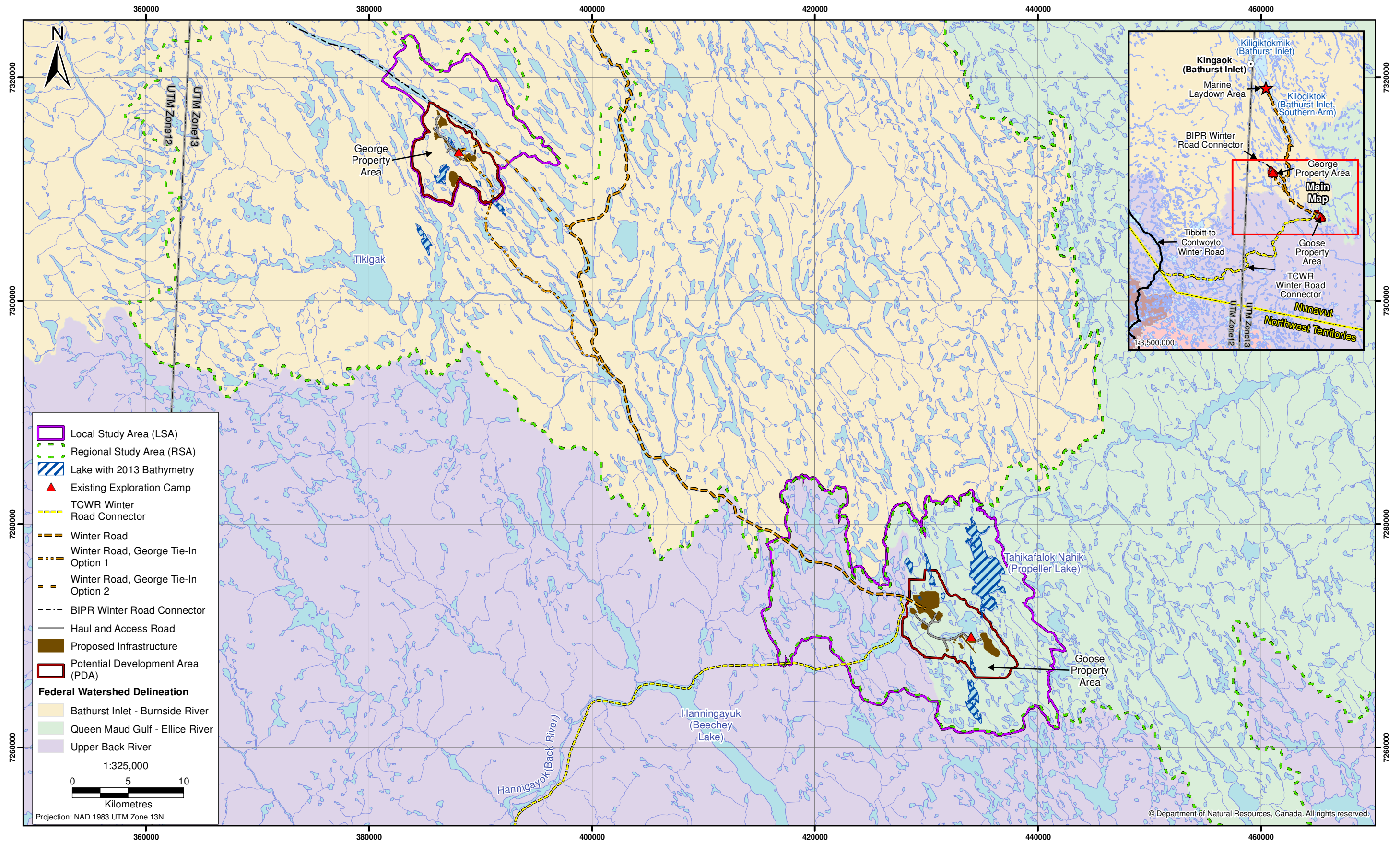
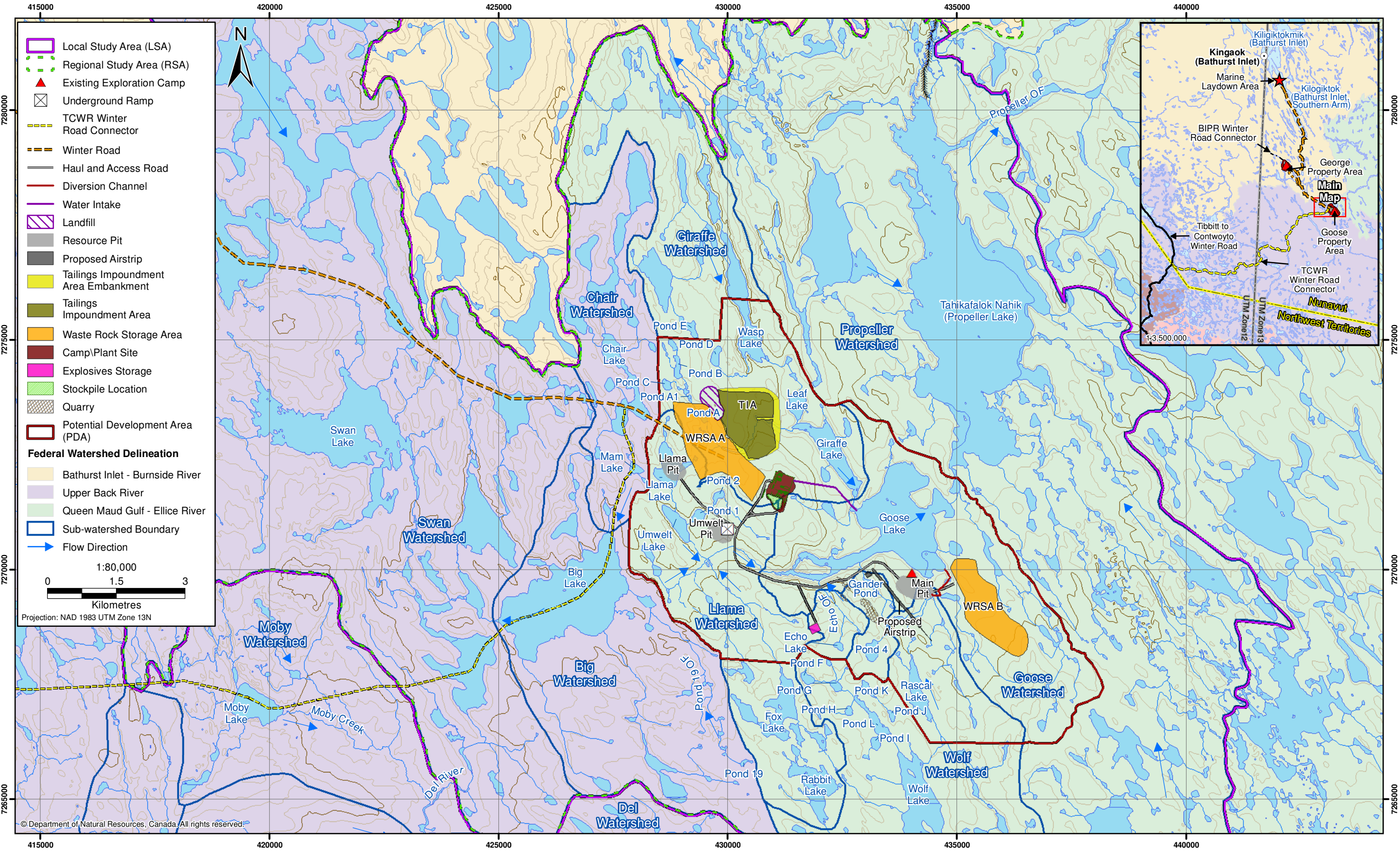


Figure 2.1-1



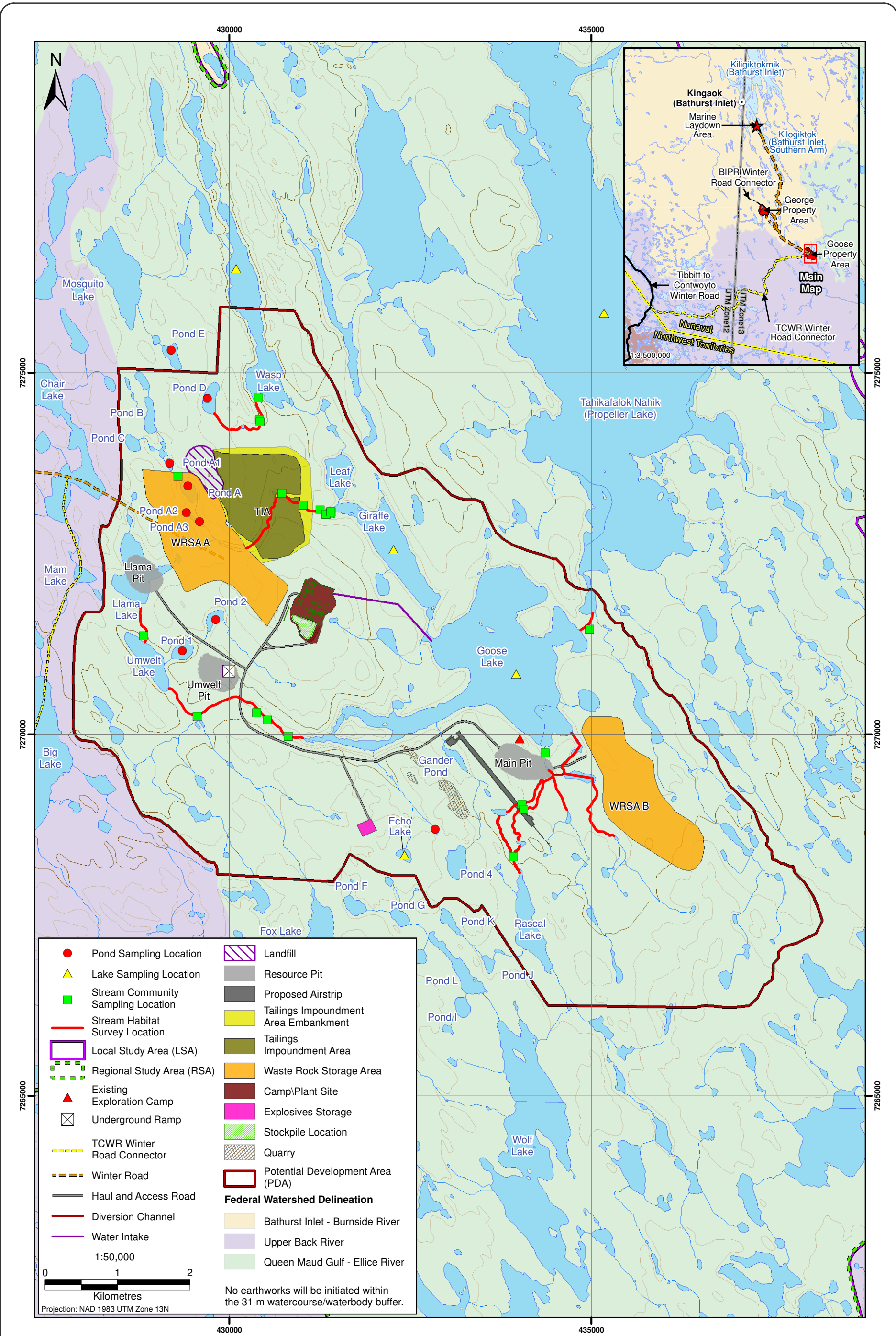


Figure 2.2-2



Goose Property Area Sampling Locations, 2013

Figure 2.2-2



The Goose Watershed consists of Goose Lake and several unnamed ponds and streams that discharge into it. Other inflows to Goose Lake originate in the Giraffe, Llama, and Wolf watersheds. Goose Lake discharges north through Goose-Propeller stream into Propeller Lake.

Propeller Lake is the largest lake in the Propeller Watershed and in the LSA. The watershed contains numerous unnamed lakes, ponds, and streams, all of which discharge into Propeller Lake. Propeller Lake itself discharges north into the Ellice River system.

Reference B Lake Watershed is a small watershed. The single inflow to Reference B Lake is located on the north shoreline of Reference B Lake, where water from an unnamed lake and several unnamed ponds discharges south. Reference B Lake discharges south into other subwatersheds within the Back River Watershed.

2.2.2 George Property LSA

The George Watershed is dominated by George Lake (Figures 2.2-3 and 2.2-4). Small streams collect groundwater from north of George Lake and enter the lake through the George Inflow 1 and George Inflow 2. An additional inflow at the south end of George Lake discharges water from Fold Lake. George Lake discharges into the Dragon Watershed through the George Lake Outflow at the northwest end of the lake.

The George Lake Outflow discharges south into Lytle Lake. The Lytle Lake Outflow discharges into Occurrence Lake. Overland flow enters Occurrence Lake from the east. Occurrence Lake Outflow discharges south to Sleigh Lake. Additional water enters Sleigh Lake from the intermittent Sleigh Lake Inflow from the east of Sleigh Lake and from an unnamed outflow from an unnamed pond west of Sleigh Lake. Sleigh Lake discharges south to Esker Pond. Esker Pond discharges south to Komatic Lake.

2.3 SAMPLING DESIGN

Fish habitat was examined separately according to water body type: streams, lakes, and ponds. Streams flow seasonally or perennially, possess a continuous channel bed that is scoured by water, and contain observable deposits of mineral alluvium (BCMOF 1998). Lakes are open water bodies with maximum water depths greater than 3 metres and with less than 25% of the surface area covered with wetland vegetation. Ponds are any open water body that is lentic (i.e., non-flowing) with a maximum water depth less than 3 metres.

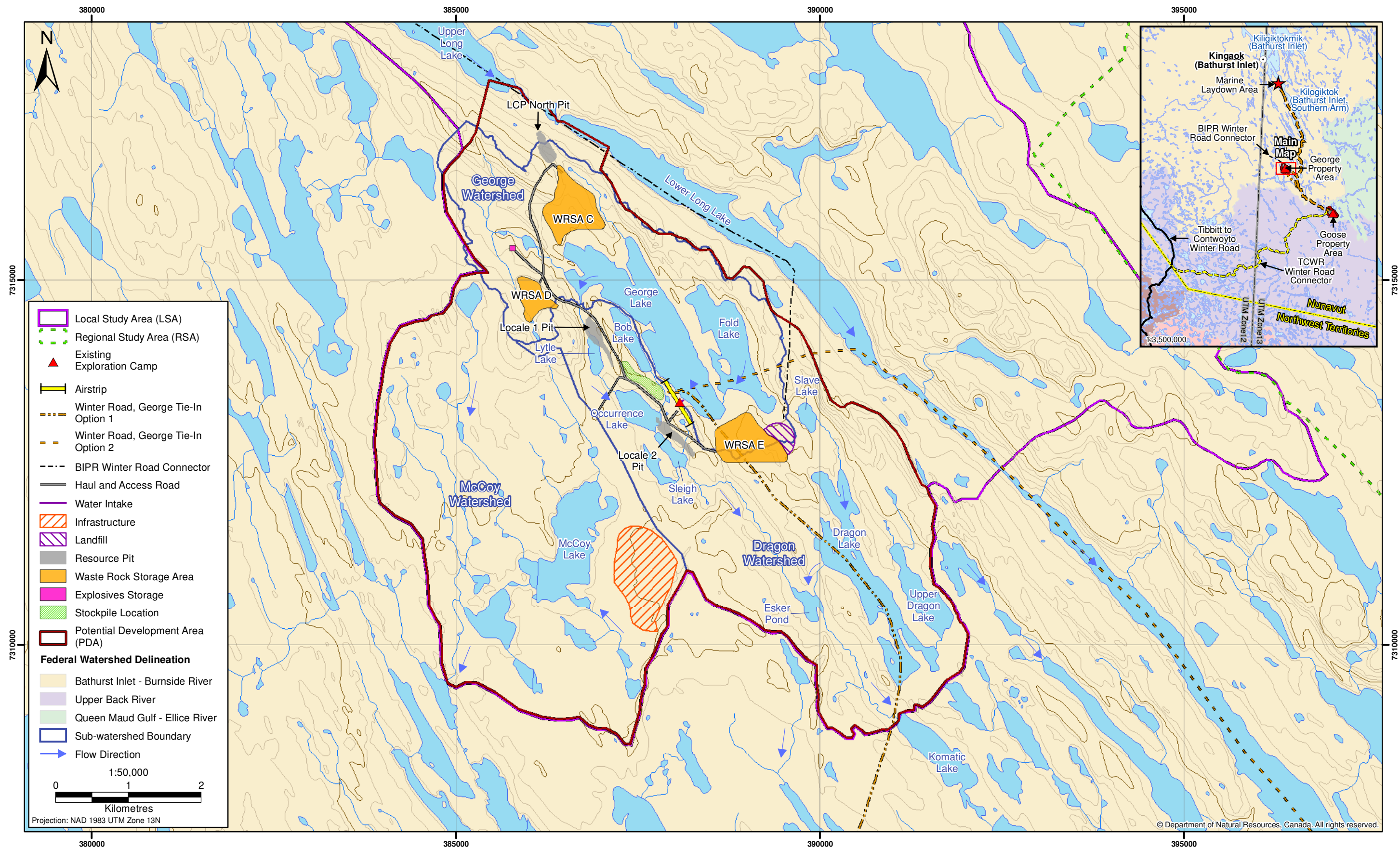
Sites assessed were additionally divided into three categories according to their potential use: haul and access road sites, other streams, lakes, and ponds within the PDAs, and water management and/or fisheries offsetting areas (Tables 2.3-1 to 2.3-3). Haul and access road sites include all streams that cross the proposed haul and access road routes within the Goose and George PDAs. Sampling at haul and access road sites focused on characterizing the fish habitat and fish community at the proposed crossing locations. PDA sites include all other streams, lakes, and ponds with the potential to be affected by the proposed Project infrastructure and activities. As appropriate, fish habitat assessments, fish community surveys, and/or tissue metal sampling were performed according to the *Metal Mining Effluent Regulations* (SOR/2002-222) (MMER) in order for baseline data to be useable and meet any applicable MMER requirements in the future. Potential fisheries offsetting areas include sites where compensation activities may be constructed to offset the effects of potential Project activity on fish habitat or communities. Fish habitat and/or community surveys were conducted at offset sites to determine their suitability for use in offsetting plans. Figure 2.2-2 and Figure 2.2-4 illustrate the location of fish and fish habitat surveys sites.

Table 2.3-1. Fish Sampling Summary for Goose Property PDA, 2013

Habitat Type	Site Name	Name	UTM		Fish Habitat	Bathymetry	Fry Survey	Spawner Survey	Fish Community	SLSC Tissue Metals and Fish Health	LKTR Tissue Metals and Fish Health
			Easting	Northing							
Road Crossings	100		432888	7270063	X						
	101	Gander Pond outflow	432861	7270020	X				X		
	102		431996	7269679	X						
	103	Umwelt outflow	430179	7270435	X						
	105		429653	7271335	X						
	1201	Rascal-Goose	434636	7269618					X		
Other Streams	Various	Giraffe inflow	431254	7273102	X				X		
	810	Goose outflow	434891	7272232	X				X		
	Various	Llama outflow	428819	7271365	X			X	X		
	Various	Main Pit streams	434041	7269033	X		X	X	X		
		Pond A inflow	429292	7273569					X		
	Various	Rascal-Goose	433926	7268876	X			X			
	Various	Umwelt outflow	430762	7270007	X			X	X		
Lakes		Echo Lake	432458	7268422					X		
		Giraffe Lake	432272	7272554	X				X	X	X
		Goose Lake	433897	7270939				X		X	
		Propeller Lake	435433	7275860	X	X			X	X	
		Reference B Lake	441999	7258616						X	
		Umwelt Lake	428901	7271035		X					
		Wasp Lake	430279	7275881	X				X		
Ponds		Pond 1	429188	7271154	X	X			X		
		Pond 2	429699	7271420					X		
		Pond A	429440	7273384	X	X			X		
		Pond A1	429183	7273702					X		
		Pond A2	429400	7273065					X		
		Pond A3	429620	7272974					X		
		Pond D	429680	7274474					X		
		Echo Pond	432821	7268725					X		

SLSC = Slimy Sculpin

LKTR = Lake Trout



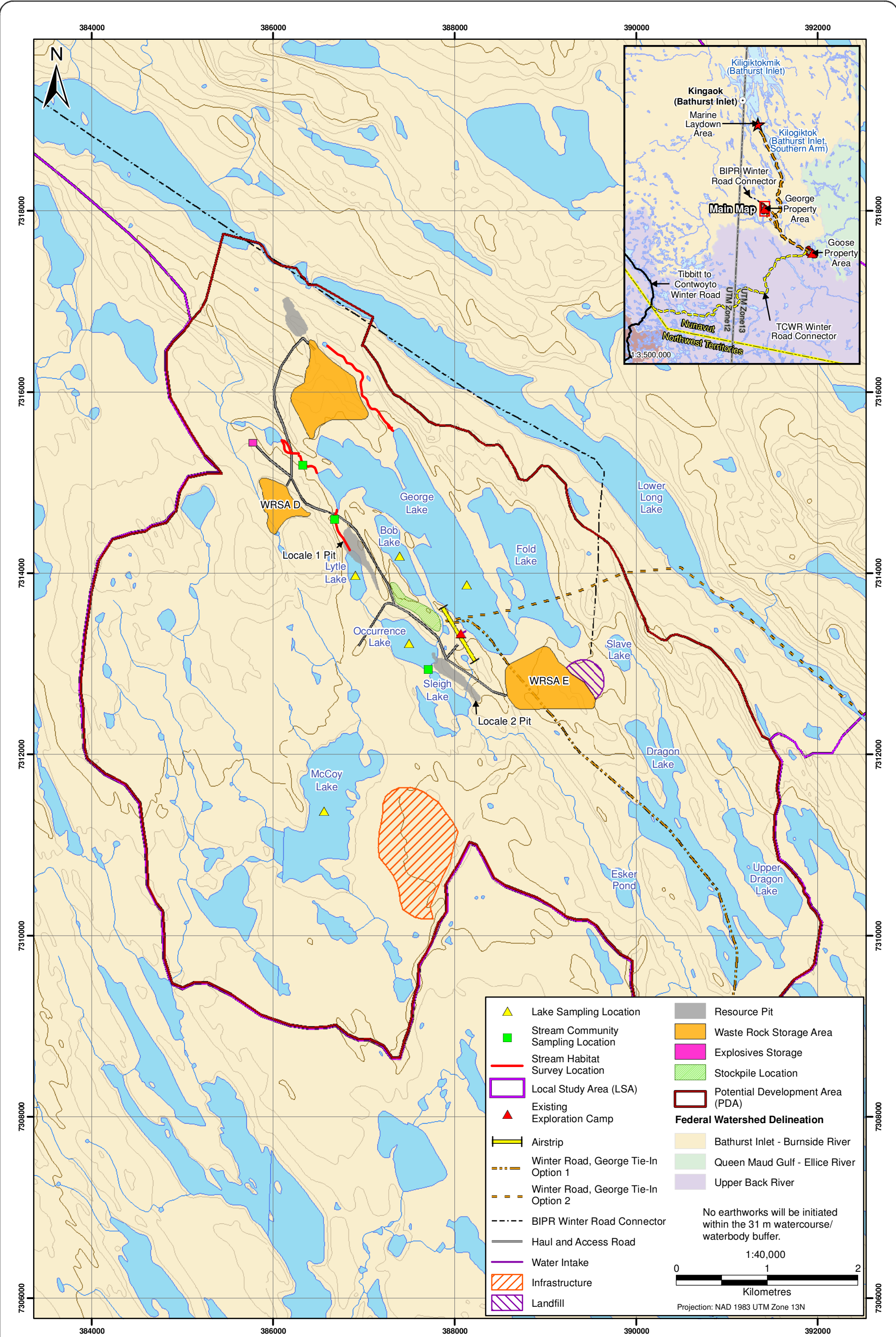


Figure 2.2-4



George Property Area Sampling Locations, 2013

Figure 2.2-4



Table 2.3-2. Fish Sampling Summary for George Property PDA, 2013

Habitat Type	Site Name	Name	UTM		Fish Habitat	Bathymetry	Fry Survey	Spawner Survey	Fish Community	SLSC MMER and Metals
			Easting	Northing						
Road Crossings	400	George inflow 2	386325	7315192	X			X	X	
	401	George outflow	386677	7314593	X				X	
	402		387833	7313275	X					
	405		388162	7312856	X					
Other Streams	400	George inflow 2	386325	7315192	X			X	X	
	800	George inflow 1	387174	7315797	X					
	401	George outflow	386677	7314593	X				X	
	404	Occurrence outflow	387729	7312942	X				X	
Lakes		Bob Lake	387364	7314249	X				X	
		George Lake	387967	7314248						X
		Komatic Lake	391605	7308539					X	X
		Lytle Lake	386921	7313976					X	
		McCoy Lake	386638	7311224	X				X	X
		Occurrence Lake	387498	7313243					X	
		Reference Q Lake	385131	7305202	X				X	X

SLSC = Slimy Sculpin

Table 2.3-3. Summary of Supportive Fish Offsetting Surveys, 2013

Habitat Type	Property	Site Name	Name	Easting	Northing	Fish Habitat	Bathymetry	Fry Survey	Spawner Survey	Fish Community
Stream	Goose	Various	Gander Pond stream	433444	7269401	X		X		X
			Goose - Propeller off-channel	434891	7272232	X			X	X
	George		Long Lake inflow	439472	7286333					X
			McCoy Outflow	385842	7310835	X				X
Lake	Goose		Canyon Lake 5	439089	7287557	X				X
			Canyon Lake 4	438931	7287916	X				
			Canyon Lake 3	438763	7288362	X				X
			Canyon Lake 2	438506	7288944	X				X
Pond	Goose		Pond E	429225	7275046					X

2.4 PDA HAUL AND ACCESS ROAD ROUTE

2.4.1 Fish Habitat

Fish habitat was assessed at sites associated with haul and access roads in the Goose and George PDAs. Habitat surveys took place from June 14 to June 17 and were scheduled to coincide with freshet, the period of maximum stream discharge. The proposed road routes were walked by a crew which surveyed all permanent or ephemeral streams along the route. Stream crossings were assigned a unique identification number.

Where water flowed overland but was not associated with a continuous channel of at least 50 m in length, the site was labeled as a non-classified drainage (NCD). Sites where a channel was identified, but the channel was void of water or contained only unconnected pools were labeled Dry/Intermittent (Dry/Int.). NCD and Dry/Int. sites are not considered fish habitat and were not assessed further. Sites where water flowed through a continuous channel were identified as stream crossings and a fish habitat survey was undertaken.

Fish habitat was surveyed using methods based on the Fish Habitat Assessment Procedures (FHAP) (Johnston and Slaney 1996). At least 100 m of stream length was surveyed at each site, including the habitat 50 m upstream and 50 m downstream of the road crossing. The surveyed reach was divided into individual habitat units that were measured with respect to length, bankfull, and wetted width and depth, stream gradient, substrate composition, residual pool depth, bank stability, bank height, bank vegetation, and instream cover (Table 2.4-1). Barriers to fish migration were also noted and measured where appropriate.

Table 2.4-1. 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 by means of 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%;
- Cascade — high gradient (> 4%) area of turbulent, fast-flowing water; and
- Boulder Garden — a field of rock with no defined channel that may or may not contain open water.

Fish habitat quality for spawning, rearing, and overwintering habitat was based on the habitat preferences of fish, fish presence, and habitat measures. These fish habitats were given a ranking of good, fair, poor or none. From these fish habitat qualities, an overall ranking was determined as either critical, important, marginal, or none. Critical habitat provides fish habitat that is necessary but limited in the area. If critical habitat were removed, fish in that area may not be able to access alternative habitat for that life history stage. Important habitat provides fair or good fish habitat for one or more life history stages. Marginal habitat provides poor or no habitat for all life stages, or contains barriers that limit the accessibility of the habitat to fish. If no habitat is provided for any life stage, the area has no overall habitat quality.

2.4.2 Fish Community

The fish community was surveyed at all crossings not designated NCD, Dry/Int., or (impassable) Boulder Garden (Table 2.2-1). At least 100 m of stream length was surveyed by backpack electrofishing at each site, including the habitat 50 m upstream and 50 m downstream of the road crossing for a minimum of 200 electrofishing seconds. The sections were sampled in a single pass with no use of stop nets because fish presence and species composition, rather than density, was the primary purpose of sampling. Sampling was conducted by one crew leader and one dip netter. The anode ring diameter was 28 cm and the dip net was 21 cm in diameter and contained 3.2 mm mesh. A systematic sweep sampling approach was conducted at each site. Electrofishing effort in seconds and the voltage (V), frequency (Hz), and pulse width (ms) settings were recorded for each site.

Most fish community sampling along the road routes was completed between June 14 and June 17. However, spawning Arctic Grayling (*Thymallus arcticus*) were observed at George Inflow 2, necessitating the postponement of electrofishing activity to protect spawners and eggs. Fish community sampling was conducted at that site on July 10.

2.4.3 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 both fork length (to the nearest 1 mm) and total weight (to the nearest 0.1 g, unless fish were more than 200 g). If external parasites were observed, their presence was recorded. After allowing fish to recover, sampled specimens were released back to the stream from which they were captured.

2.5 OTHER STREAMS, LAKES, AND PONDS

2.5.1 Streams

2.5.1.1 Fish Habitat

Fish habitat sites associated with Project activities or project infrastructure were assessed and mapped, following modified Sensitive Habitat Inventory Mapping (SHIM) methods. 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, up to date, and spatially accurate information about fish habitats and watercourses.

Fish habitat assessments of PDA stream sites in both the Goose and George PDAs were undertaken from June 14 to June 23, 2013.

Streams and wetlands were located in the field and their precise locations were mapped with a differential GPS unit, which collects GPS data at regular intervals. Moving in an upstream direction, a detailed map of the stream channel and associated features such as barriers was created. Streams were divided into reaches characterized by relatively homogenous habitat.

Detailed fish habitat assessments were conducted at representative sites within each reach. Habitat assessment surveys were conducted over at least 100 m of stream 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 greater heterogeneity of habitat units 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 in which the spatial data could be tied to fish habitat data collected in the field. Temperature (°C), pH, and conductivity (µS/cm) were recorded using electronic meters.

Habitat data collected was based on FHAP (Johnston and Slaney 1996). 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 include fish habitat types, substrate composition, and cover for fish. A complete list of the attributes measured is presented in Table 2.4-1 and are further described in Section 2.4-1.

In addition, Arctic streams often have habitat features that don't appear in the southern streams for which FHAP was designed. These include boulder gardens (large fields of rock with no defined channel and often no open water), seepages (wide, poorly defined drainages with pooled and/or overland flow), and ponds (large pools with moderately defined banks). These habitat features were described by a delineation of boundaries using the differential GPS unit, estimates of percent open water, water depth, and description of substrate types or other habitat features as applicable.

2.5.1.2 *Fish Community*

Fish community sampling was conducted at PDA stream sites to determine fish presence and community composition. Fish community sampling in streams within the Goose and George PDAs took place between June 14 and August 15, 2013.

At least 100 m of stream length was surveyed by backpack electrofishing at each site. Streams were electrofished in a single pass with no stop nets, using the methods described for haul and access road crossing streams.

2.5.1.3 *Arctic Grayling Spawning and Fry Surveys*

Spawning surveys for Arctic Grayling were conducted between June 14 and June 23 in the Rascal-Goose and Main Pit streams, Llama Outflow, Umwelt Outflow, and an inflow to George Lake (Figure 2.5-1; Table 2.3-1 and Table 2.3-2). Crews walked the banks of the stream from the downstream end to the upstream end, visually surveying the channel for adult Arctic Grayling. Feeding juveniles and non-breeding adult Arctic Grayling generally prefer streams wider than 6 m and deeper than 1 m, while spawning adult grayling prefer streams that are generally narrower and shallower (Stewart et al. 2007). Adult Arctic Grayling observed in the small, shallow streams included in the spawning surveys were assumed to be potential spawners. The location and number of spawners, as well as additional information (such as stream depth and substrate type) was recorded where adult Arctic Grayling were observed. Adult Arctic Grayling were not captured to minimize the disruption of spawning activities and to prevent inadvertent harm to spawners and fertilized eggs.

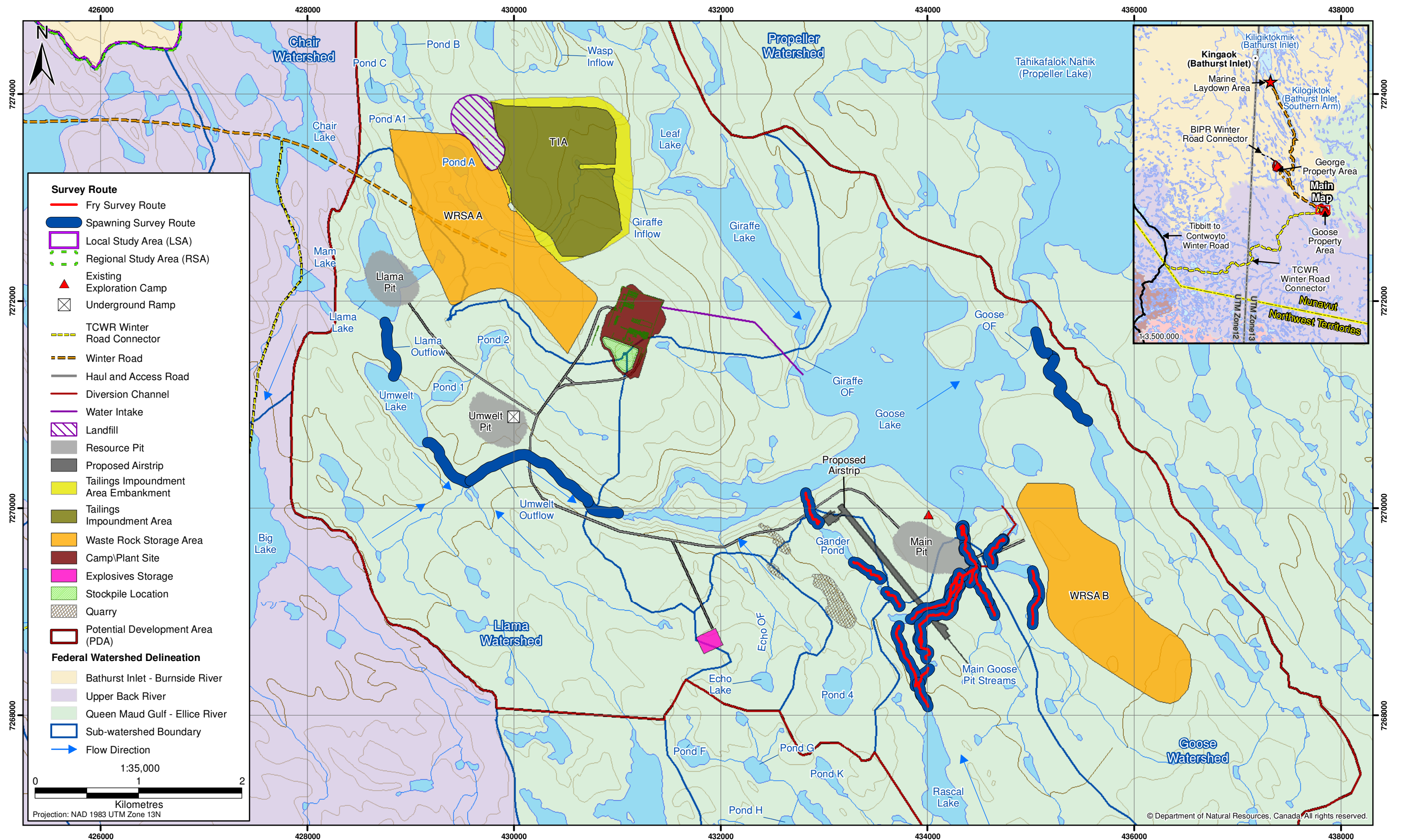


Figure 2.5-1

Arctic Grayling Spawning
and Fry Survey Locations in the
Goose Property Area, 2013

Fry surveys were undertaken in the Rascal-Goose and Main Pit streams on August 11, after fry emergence. Fry survey techniques were similar to spawning surveys. As with spawning surveys, fry surveys were primarily conducted through visual observations to minimize disruption and injury to the newly emerged fry. The location, approximate number, and approximate size of juvenile grayling were recorded. Habitat unit type, dominant substrate, presence of additional species, and presence and type of cover were recorded where juvenile grayling were identified. Arctic Grayling that were smaller than approximately 70 mm were considered to be fry, while those that were larger were considered to be juveniles.

2.5.2 Lakes

2.5.2.1 Fish Habitat

The lakes surveyed for fish habitat and community in the Goose and George PDAs are shown in Figures 2.2-2 and 2.2-4, respectively. Fish habitat was assessed in each lake through a visual survey of the shoreline and littoral zone. The shoreline and littoral zone were grouped into habitat units of relatively homogenous habitat. The substrate of each unit 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 (less than 2 mm diameter), gravel (2 to 64 mm), cobble (64 to 256 mm), boulder (256 to 4,000 mm), and bedrock (greater than 4,000 mm). 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.

Bathymetry and Sublittoral Substrate

Hydroacoustic methods were used to quantify fish habitat in select lakes and ponds in the Goose PDA. A total of two lakes (Propeller and Umwelt) and two ponds (Pond 1 and Pond A) were surveyed. Hydroacoustic techniques were used to collect bottom depth and bottom substrate type data while underwater video surveys were performed to describe and confirm substrate types identified in the acoustic data.

Hydroacoustic surveys were performed by two fish biologists using an aluminum boat with a low-horsepower outboard motor. One biologist ran the hydroacoustic equipment while the other drove the boat and operated a handheld GPS unit recording continuous positional data. Data were collected using a BioSonics MX Aquatic Habitat Echosounder packaged with processing and data visualization software (Visual Habitat MX). The echosounder unit is equipped with a scientific downward looking transducer and is integrated with differential GPS (DGPS).

Sampling was performed by piloting the boat with the hydroacoustic system, at an average speed of 1.4 to 1.9 m/s, along the 1 to 2 m depth periphery of the lake, followed by a single transect at the longest cross-section of the lake, and then parallel cross-lake transects perpendicular to the long transect. The total number of transects performed depended on lake size and geometry. In some cases, supplemental transects (either between or perpendicular to original transects) were performed to capture additional data in areas of interest. Transect information and survey areas specific to each lake/pond are presented in (Table 2.5-1). Certain shallow areas of the lakes/ponds could not be comprehensively sampled because of large boulder areas which did not allow for boat access, and the instrumentation is unreliable at depths of less than 1.5 m. Non-boulder areas were surveyed manually. The specifications of the hydroacoustic collection equipment used during data collection are presented in Table 2.5-2.

Table 2.5-1. Lake/Pond Transect Information and Survey Areas for Hydroacoustic Surveys, Back River Project, 2013

Site	Transect Spacing (m)	Total Survey Area (ha)
Propeller Lake	50 to 300	1,000
Umwelt Lake	10 to 30	10
Pond 1	25 to 30	4.5
Pond A	10 to 20	3.8

Table 2.5-2. Acoustic System Specifications for Collection of Bathymetric and Bottom Type Data, Back River Project, 2013

Category	Variable	Value
Echo sounder	Type	BioSonics MX Aquatic Habitat
Transducer	Type	BioSonics Single Frequency
	Sound frequency	204.8 kHz
	Beam angle	8.5°
	Depth of transducer face	0.18 m
Settings	Transmit pulse duration	0.4 ms
	Receiver sensitivity	- 90 dB
	Maximum data range	100 m
	Time varied gain	30 Log R
	Ping rate	5 Hz
DGPS	Type	WAAS-differential
	Datum	NAD83
Other	Average transecting speed	1.4 to 1.9 m/sec

DGPS = differential global positioning system

Bottom depth was determined from the acoustic data using the Rising Edge Method in Visual Habitat MX software (BioSonics, Inc. 2013, Seattle, Washington). This method analyzes the echo returns from emitted acoustic signals (pings). The first echo return signal that has a higher decibel (dB) value than a specified rising edge threshold is selected as the candidate for the bottom echo. Processing settings used for bottom detection analysis in Visual Habitat MX for each lake/ pond surveyed are listed in Table 2.5-3. Bathymetric contours were interpolated from bottom depth data to create bathymetric maps of the surveyed lakes and ponds.

Acoustic bottom-type data were used in combination with underwater video surveys to create sublittoral substrate maps of the surveyed lakes/ponds. Acoustic bottom-type data were analyzed in Visual Habitat MX. In the bottom-type analysis, 15 analysis features are computed for each ping that provided a bottom echo during the acoustic survey. The analysis features are measures of the hardness and roughness of the bottom signal and are listed with descriptions in Table 2.5-4. The majority of the analysis features are normalized for depth using the median depth of the surveyed area. This is done in order to compensate for any distortion of the bottom echo envelope that occurs at depth and makes bottom signals from echoes at different depths comparable (Moore 2013).

Table 2.5-3. Visual Habitat MX (VHMX) Processing Settings Used to Determine Bottom Depth and Bottom Substrate Types, Back River Project, 2013

Analysis Step	Parameter	Setting			
		Propeller Lake	Umwelt Lake	Pond 1	Pond A
Bottom Detection	Domain	30 Log R	30 Log R	30 Log R	30 Log R
	Rising Edge Threshold	- 45 dB	- 50 dB	- 45 dB	- 60 dB
	Rising Edge Length Criterion	10 cm	1 cm	1 cm	1 cm
	Rising Edge Search Window	100 cm, +/- from previous rising edge	100 cm, +/- from previous rising edge	100 cm, +/- from previous rising edge	100 cm, +/- from previous rising edge
	Rising Edge Min Detection Range	0 m	0 m	0 m	0 m
	Rising Edge Max Detection Range	1,000 m	1,000 m	1,000 m	1,000 m
Bottom Feature Extraction	Bottom Echo - First Part	1 times pulse width	1 times pulse width	1 times pulse width	1 times pulse width
	Bottom Echo - Second Part	3 times pulse width	3 times pulse width	3 times pulse width	3 times pulse width
	Reference Depth	10 m	10 m	10 m	10 m
	Fractal Dimension Threshold	- 60 dB	- 60 dB	- 60 dB	- 60 dB
Bottom Type	Energy Filter width	10 pings	25 pings	25 pings	25 pings
	Energy Filter threshold	75%	75%	75%	75%
Fuzzy Centroid Means Clustering	Number of Clusters	5	3	4	4

Table 2.5-4. Analysis Features Used in Bottom Substrate Type Analysis in Visual Habitat MX

Feature	Number	Description
Fractal Dimension*	1	A measure of the roughness of the bottom signal, measured from the bottom to the point where the bottom echo signal decreases to below the fractal dimension threshold specified in the processing settings.
E1*	1	The energy contained in the first part of the bottom echo, starting at the bottom and extending for the length (in multiples of pulse width) specified in the processing settings
E1	1	The energy contained in the second part of the bottom echo, starting at the end of the first part and extending for the length (in multiples of pulse width) specified in the processing settings
Spectral Moment	12	Computed using the Fast Fournier Transform of the bottom echo (first and second parts; up to 256 samples).

* indicates features that are not normalized for depth

Adapted from Biosonics, Inc. 2013

Once the features of each ping were calculated, pings were grouped into bottom type reports. Each report has an energy filter width (number of pings grouped into the report) and an energy filter threshold (%; minimum bottom echo energy that a ping requires to be included in the report, measured as a percentage of the total energy of all pings in the report). Bottom type reports were 10 pings long (2.8 to 3.8 m long at transecting speed of survey) for Propeller Lake and 25 pings long (7 to 9.5 m long at transecting speed of survey) for Umwelt Lake, Pond 1, and Pond A.

Visual Habitat MX uses fuzzy centroid means clustering to assign each ping possessing the energy filter threshold test to a predetermined number of clusters. The location of cluster centroids was calculated, from the data, to be as dissimilar as possible in Cartesian space. Each bottom type report (i.e., location) was assigned membership to the cluster to which its pings were most frequently assigned. The number of clusters was initially set at three or four and determined through observation during the hydroacoustic survey. The final number of clusters was determined from the video survey described below. The end product is that each ping location is assigned to one cluster representing a bottom substrate type in the survey area.

The types of substrates present in the hydroacoustic survey area were determined by performing an underwater video survey. A Splash Cam Deep Blue Pro Color underwater video camera (Splash Cam) was used to visually assess and take still images of the bottom substrate at video sampling sites. The camera was equipped with a weight and an external light. Images were taken from between 0.2 m and 1.0 m above the substrate and recorded into a digital video recorder. Selection of video sampling sites along the hydroacoustic survey transects was based on a preliminary cluster analysis of the acoustic data, which was conducted in real time and clustered samples into reasonably distinct substrate types. In this way, the more labor-intensive video recordings could be focused on visually validating the most distinctive and uniform substrates according to the hydroacoustic data, where the video and acoustic data could be linked most reliably. The number of clusters in preliminary analysis of the acoustic data was predicted based on visual assessment of the substrates during the hydroacoustic survey (generally 3 or 4). Sampling locations were randomly selected from among bottom type reports in each of the substrate type clusters from the preliminary analysis. Substrate type at the video sampling locations was determined based on visual assessment of estimated grain size and the interaction of the weight with the substrate. Substrate classes identified based on grain size and/or bottom firmness for the surveyed lakes/ponds included fines (less than 2 mm), gravel (2 to 64 mm), cobble (64 to 256 mm), boulder (256 to 4,000 mm) and bedrock (greater than 4,000 mm; Cummins 1962).

The substrate type (from photos and observations) at video sampling locations was compared to the cluster number assigned to the hydroacoustic data collected. The substrate type represented by each cluster was determined based on the dominant substrate identified at video survey locations with that cluster number. The final number of clusters was determined by iterative analysis of the acoustic data with different numbers of clusters (3 or 4) to identify which best represented the substrate types observed in a particular lake/pond. This analysis method is based on both visual/photo and acoustic data, but has limitations due to the subjective nature of assigning substrate types to analysis clusters. Therefore, substrate maps should be interpreted as approximations of the dominant substrate types present in different areas of the lake/pond. Additionally, the hydroacoustic equipment and methods used in this study can be inaccurate on slopes greater than 20°. Therefore, bottom type results from areas with slopes in excess of this gradient should be interpreted with some caution.

2.5.2.2 *Fish Community*

The fish community in selected lakes was sampled using a combination of gillnets and angling in pelagic areas, and beach seines, electrofishing, and minnow traps in shallow littoral 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 45 minutes to minimize fish mortality. If no fish were captured, the set time was increased to maximize the probability of capturing fish. Angling effort was difficult to standardize due to potential differences in lures and gear, casting styles, and levels of experience among anglers, therefore only the total number of fish captured was recorded.

The shallow littoral areas of lakes were primarily sampled by electrofishing and minnow traps. Shorelines were electrofished in a single pass with no stop nets, using the methods and assumptions described for haul and access road crossing sites. Minnow traps consisted of two cylinders of 6.3 mm galvanized metal mesh measuring 42 cm long and 23 cm in diameter with a 2 cm diameter opening. The cylinders were locked together using a clip attached to a rope and buoy. Minnow traps baited with commercial prawn bait were set at depths of 0.5 to 3.0 m along the shoreline and left overnight. Beach seines 9.1 m in length and 1.8 m in height with 6 mm (1/4 inch) mesh were used to sample shallow shoreline areas and beaches of George Lake only, and were not used at other sites due to their low catch efficiency.

Figures 2.5-2 to 2.5-6 show the locations where gillnets and minnow traps were set in each sampled lake in the Goose PDA. Figures 2.5-7 to 2.5-10 show the locations where gillnets and minnow traps were set in each sampled lake in the George PDA.

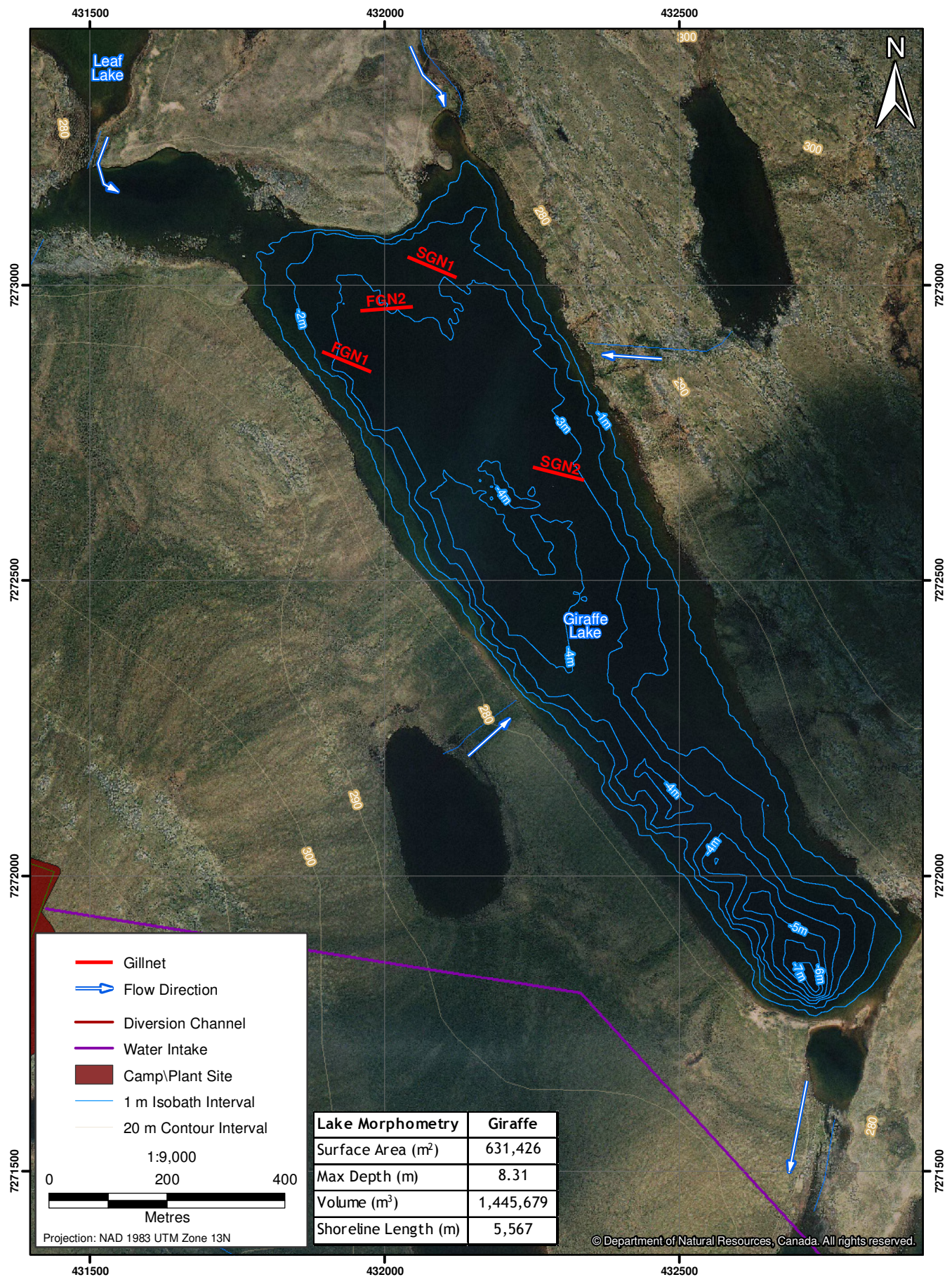
2.5.2.3 *Lake Trout Spawning Survey*

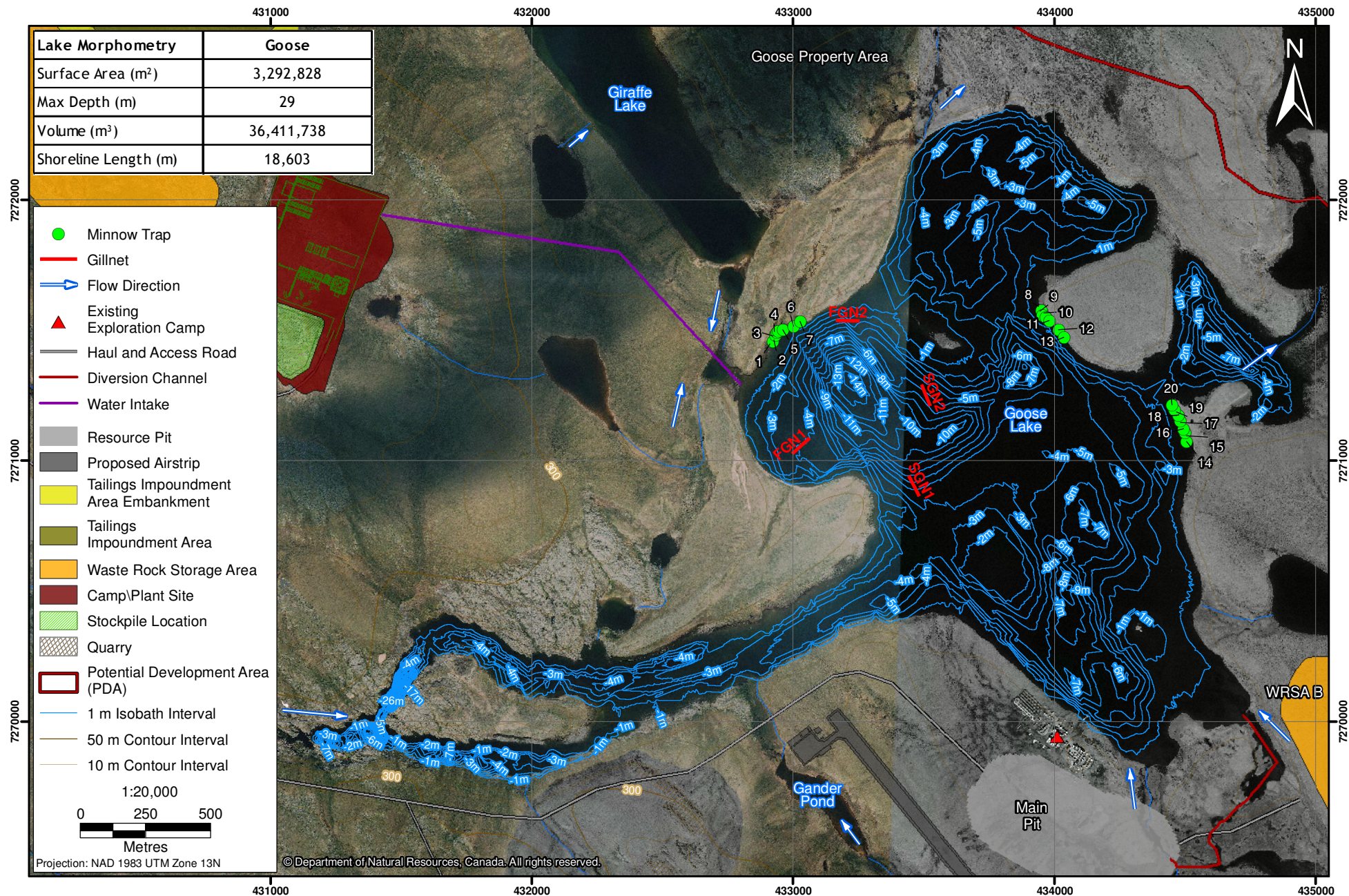
Lake Trout spawning surveys were conducted between September 5 and September 8 on Goose Lake. The edges of the shoreline and shoals were traversed by boat and visually surveyed for adult Lake Trout and substrate suitable for spawning (primarily cobble substrate). The Splash Cam underwater video camera was used to visually assess and take still images of the bottom substrate at suitable spawning sites. The camera was equipped with a weight and an external light. Images were taken from between 0.2 m and 1.0 m above the substrate and recorded into a digital video recorder. Spawning Lake Trout generally prefer cobble, rubble and large gravel substrates (4 to 40 cm; (Fitzsimons 1996), interspersed with boulders and free of any fine materials (Scott and Crossman 1973; Richardson, Reist, and Minns 2001; Birtwell, Samis, and Khan 2005). Spawning grounds are also generally associated with areas affected by wave action and water currents, such as mid-lake islands and shoals, wind-swept points, and shorelines exposed to prevailing winds (Richardson, Reist, and Minns 2001; Birtwell, Samis, and Khan 2005). Adult Lake Trout observed in the shallows of Goose Lake were assumed to be potential spawners. Their location and numbers were recorded, and additional information (such as lake depth and substrate type) was recorded where adult Lake Trout were observed.

Potential areas where Lake Trout may spawn in Propeller Lake were predicted by using the Lake Trout spawning preferences indicated above, and bathymetry and bottom substrate data.

2.5.3 **Ponds**

Fish habitat was qualified and quantified in Pond 1 and Pond A in the Goose PDA (Figure 2.2-2). The shoreline and littoral zone were grouped into habitat units of relatively homogenous habitat. The substrate of each unit 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 (less than 2 mm diameter), gravel (2 to 64 mm), cobble (64 to 256 mm), boulder (256 to 4,000 mm), and bedrock (greater than 4,000 mm). 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. Sublittoral habitat quality and quantity were surveyed using hydroacoustics, as outlined in Section 2.5.2.1.





The fish communities of ponds 1, 2, A, A1, A2, A3, and D, as well as Echo Pond from the Goose PDA were sampled between June 14 and June 20 to confirm the fish-bearing status of these ponds (Figure 2.2-2). Ponds A, A2, and A3 are located within the bounds of the potential TIA. Backpack electrofishers were used to sample the shoreline of the ponds with a minimum of 500 electrofishing seconds of effort expended at small ponds and a minimum of 1000 electrofishing seconds of effort expended at larger ponds. Any fish captured were identified, measured for length, weighed, and released.

No ponds were sampled in the George PDA.

2.5.4 Biology

2.5.4.1 Growth and Health

Each captured fish was identified to species, counted, and measured for fork length (to the nearest 1 mm) and total weight (to the nearest 0.1 g). If external parasites were observed, then their presence was recorded.

A minimum of six scales and/or two pelvic fin rays were collected from fish captured during fish community sampling activities and were analyzed for ageing purposes. Fin rays were used for ageing Lake Trout and Slimy Sculpin. Lake Trout have small scales that are not considered a good measure of age because regeneration of scales provides a high level of uncertainty. Slimy Sculpin do not have scales. Scales were used for aging all other species, with fin rays providing additional quality assurance if necessary. Scales were collected with forceps or a scalpel blade below the posterior margin of the dorsal fin on the left side of the fish. Where pelvic fin rays were used for ageing analysis, two to three rays were collected from each fish with clippers. Otoliths were collected from lethally sampled fish and provided additional ageing information.

Aging structures from each fish were placed on wax paper and kept in an envelope labeled with the site, date, species, and unique sample number and sent to North/South Consultants Inc. (Winnipeg, MB) for analysis. Age was estimated by counting the number of annuli (yearly rings) on each structure. Scales were attached to plastic fiches and annuli were counted with a microfiche reader. Fin rays were air-dried and then mounted in an epoxy medium. Microsections were cut from the fin rays using a saw and mounted on slides for inspection using a compound microscope.

In order to collect baseline tissue metal data and fish health data, 30 to 40 Slimy Sculpin were lethally sampled from four lakes in the Goose PDA (Goose Lake, Propeller Lake, Reference B Lake, and Giraffe Lake) and four lakes in the George PDA (George Lake, Komatic Lake, McCoy Lake, and Reference Q Lake). Lethally sampled fish were euthanized, their livers removed, and any internal parasites removed, counted, and weighed. Methods followed those outlined in MMER guidance documents to ensure compatibility with any future collected information.

Field conditions make it difficult to collect precise measurements of the weight of small tissue samples such as livers, and stored samples rapidly lose water content and may not represent true wet weights. To overcome this, liver weight was determined by measuring dry weight under laboratory controlled settings and then back calculating wet weight using the empirically measured average water content of liver tissue. A subsample of Slimy Sculpin liver samples from Goose Lake were weighed fresh in the field, frozen on dry ice, dried and weighed again to provide an estimate of moisture content. The mean moisture content of livers that were weighed when wet and dry was $77.69 \pm \text{SE } 4.08 \%$. This mean moisture content was used to determine the wet liver weight for all the remaining samples and used for analysis. Collected livers were wrapped in wax paper and frozen on dry ice immediately. Samples were kept on dry ice until dried in a controlled laboratory setting. Once in the laboratory, samples were placed in aluminum weigh boats and weighed to the nearest 0.001 g to provide a total weight. The tissue samples were then placed in a Precision mechanical convection oven at a temperature of 100.3°C for a period of 24 to 36 hrs. Once the tissue samples were dried, they were weighed in the weigh boat to determine the dry weight of the tissue.

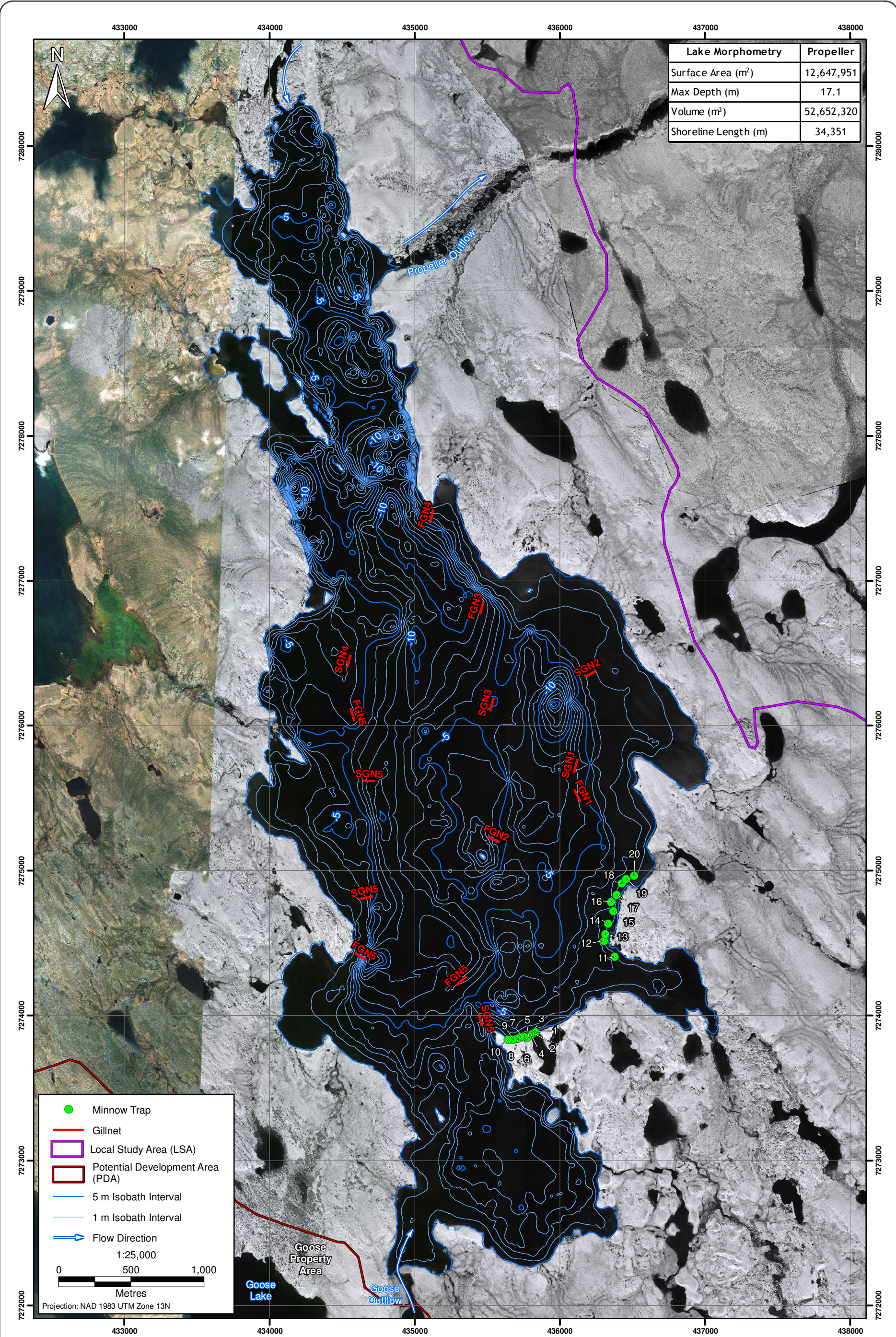


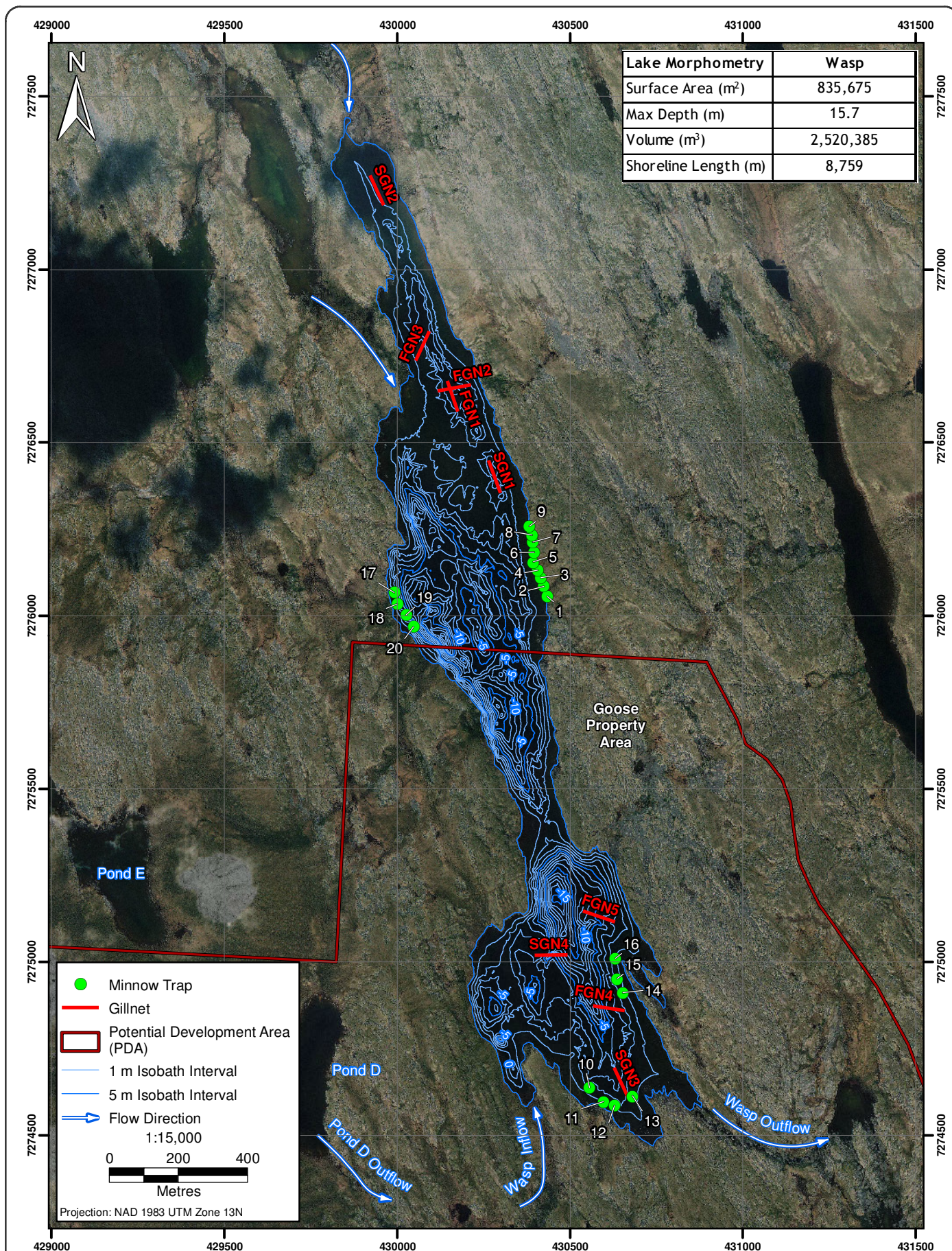
Figure 2.5-4

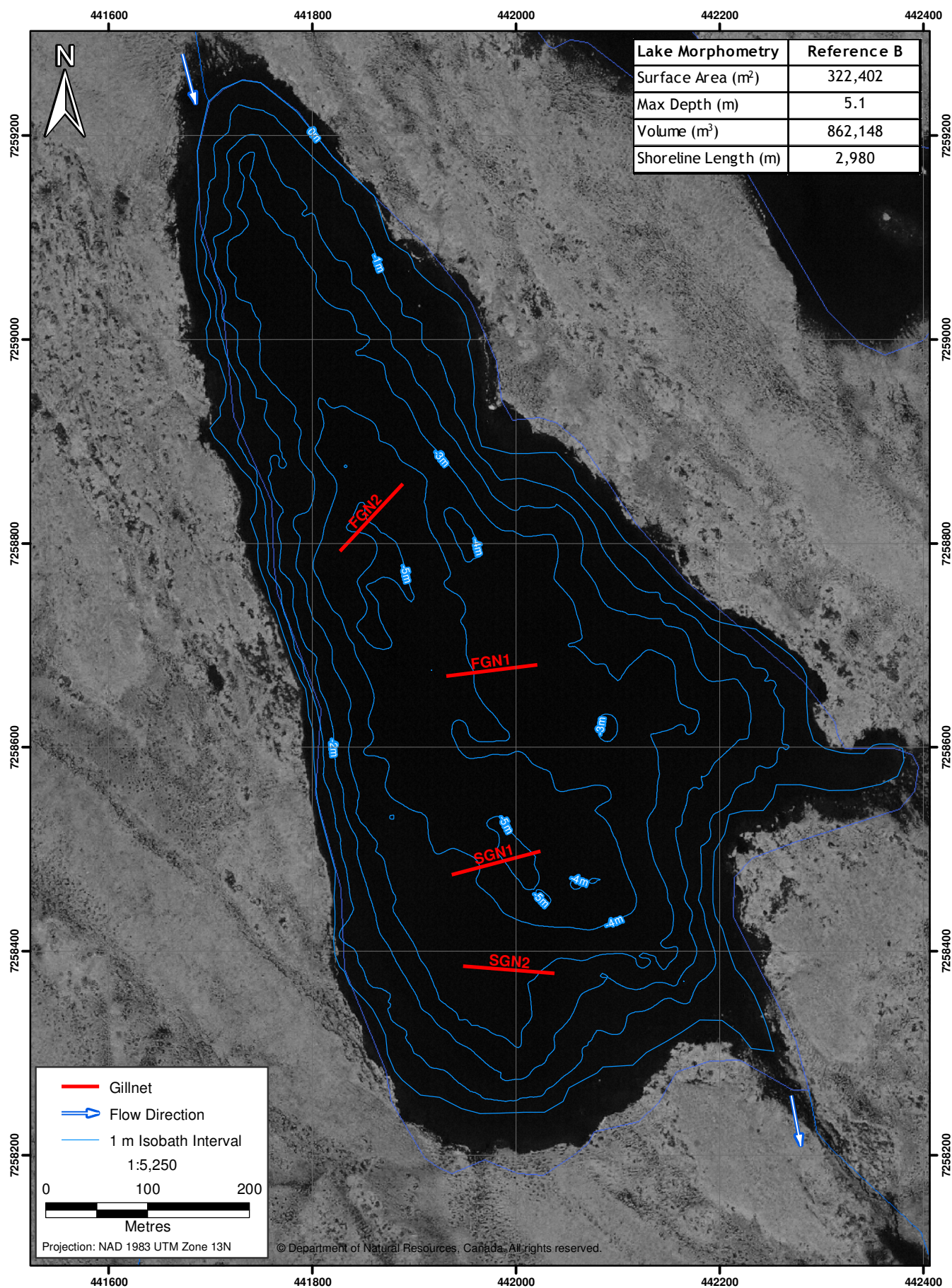


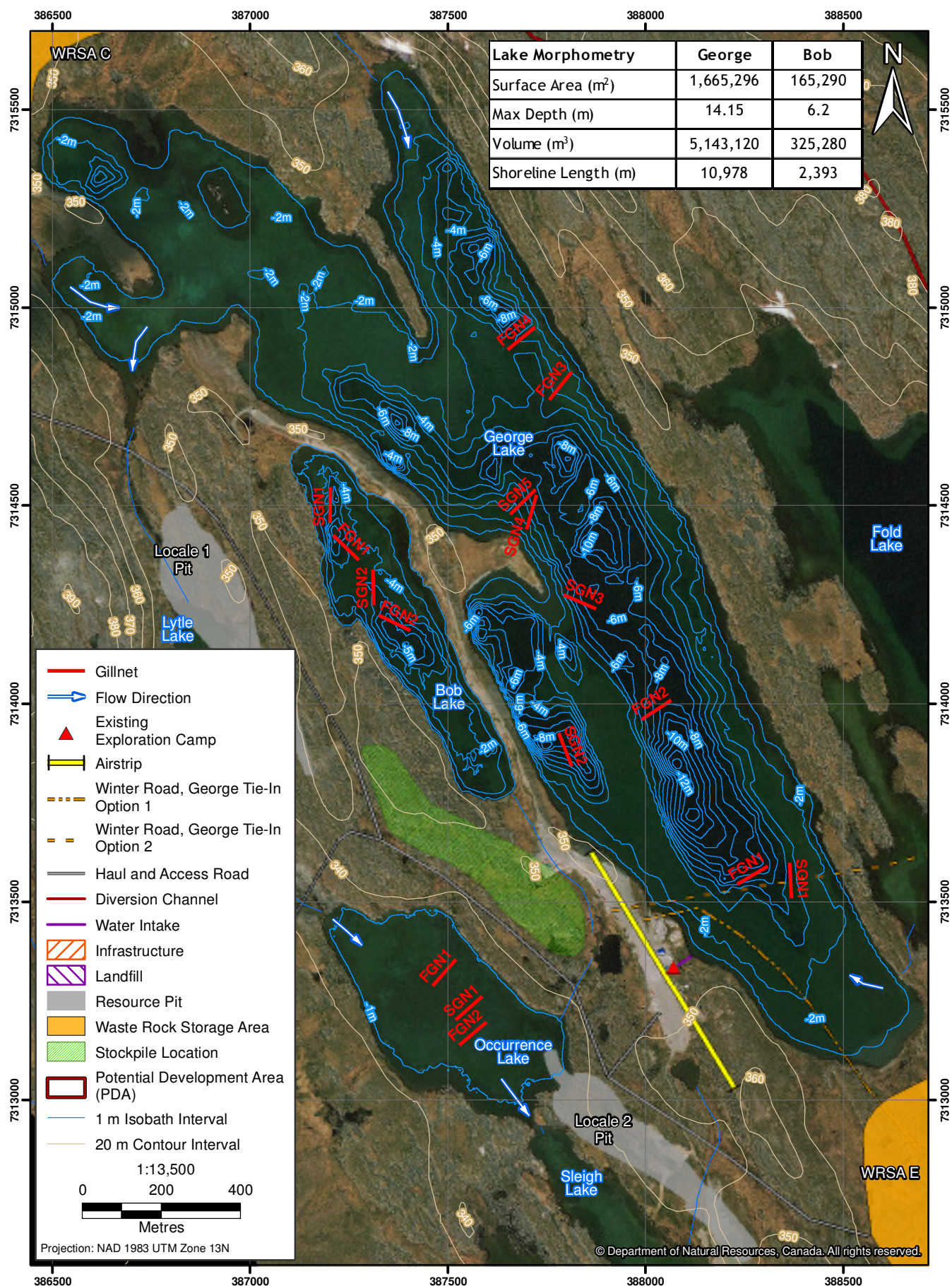
Propeller Lake Fish Community Sampling Locations, 2013

Figure 2.5-4



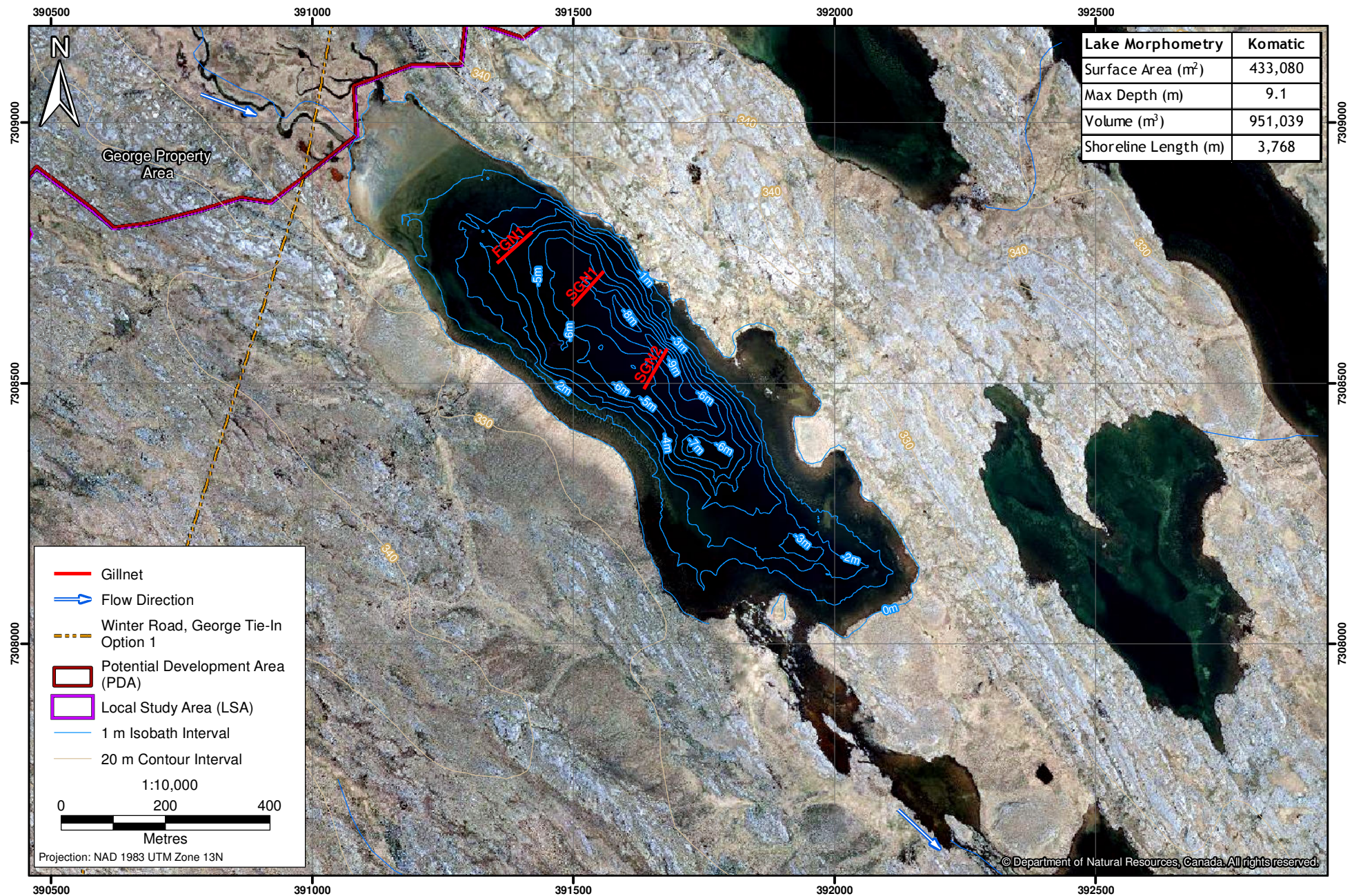






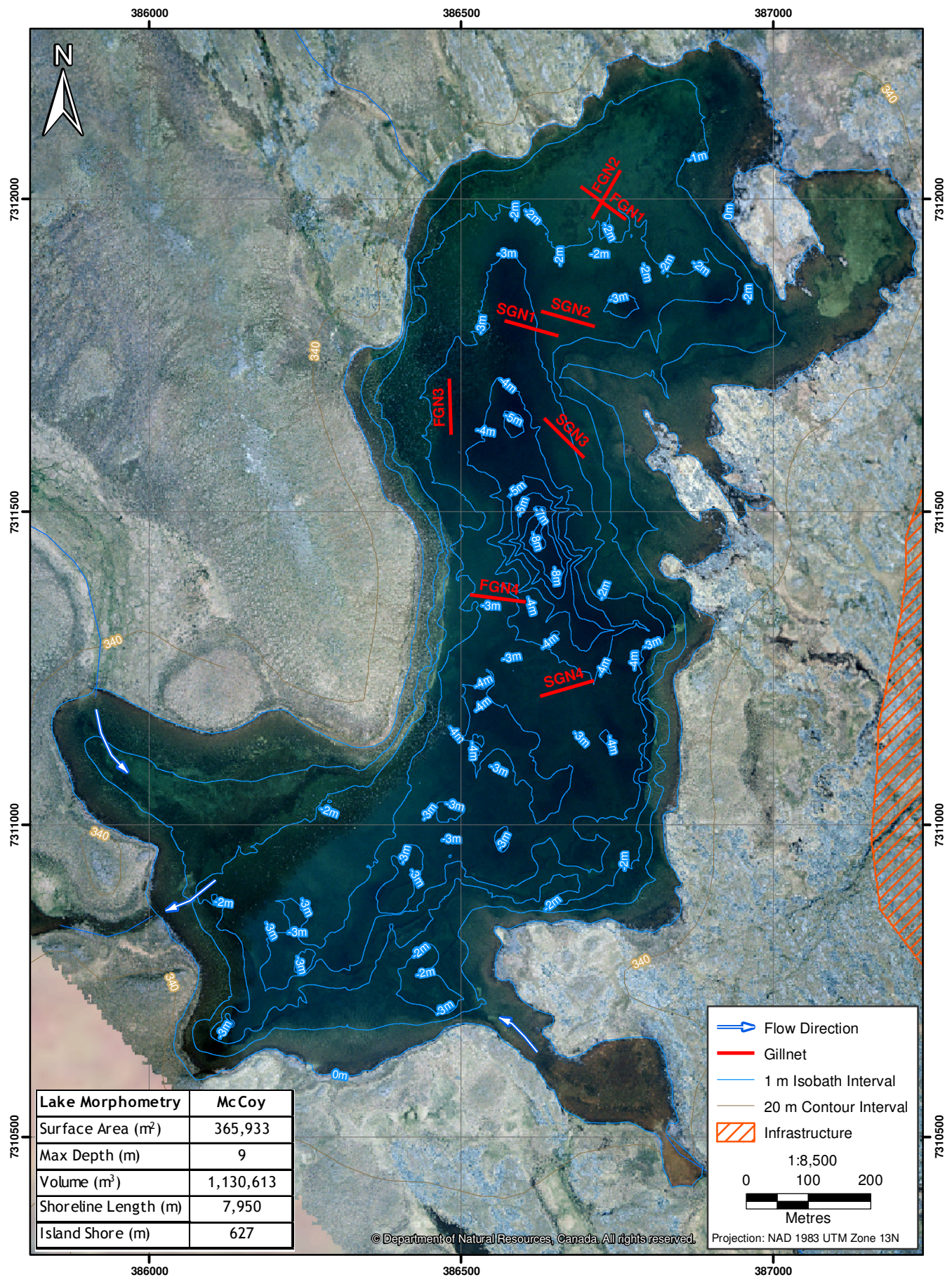
George Lake, Occurrence Lake, and Bob Lake
Gillnet Sampling Locations, 2013

Figure 2.5-7



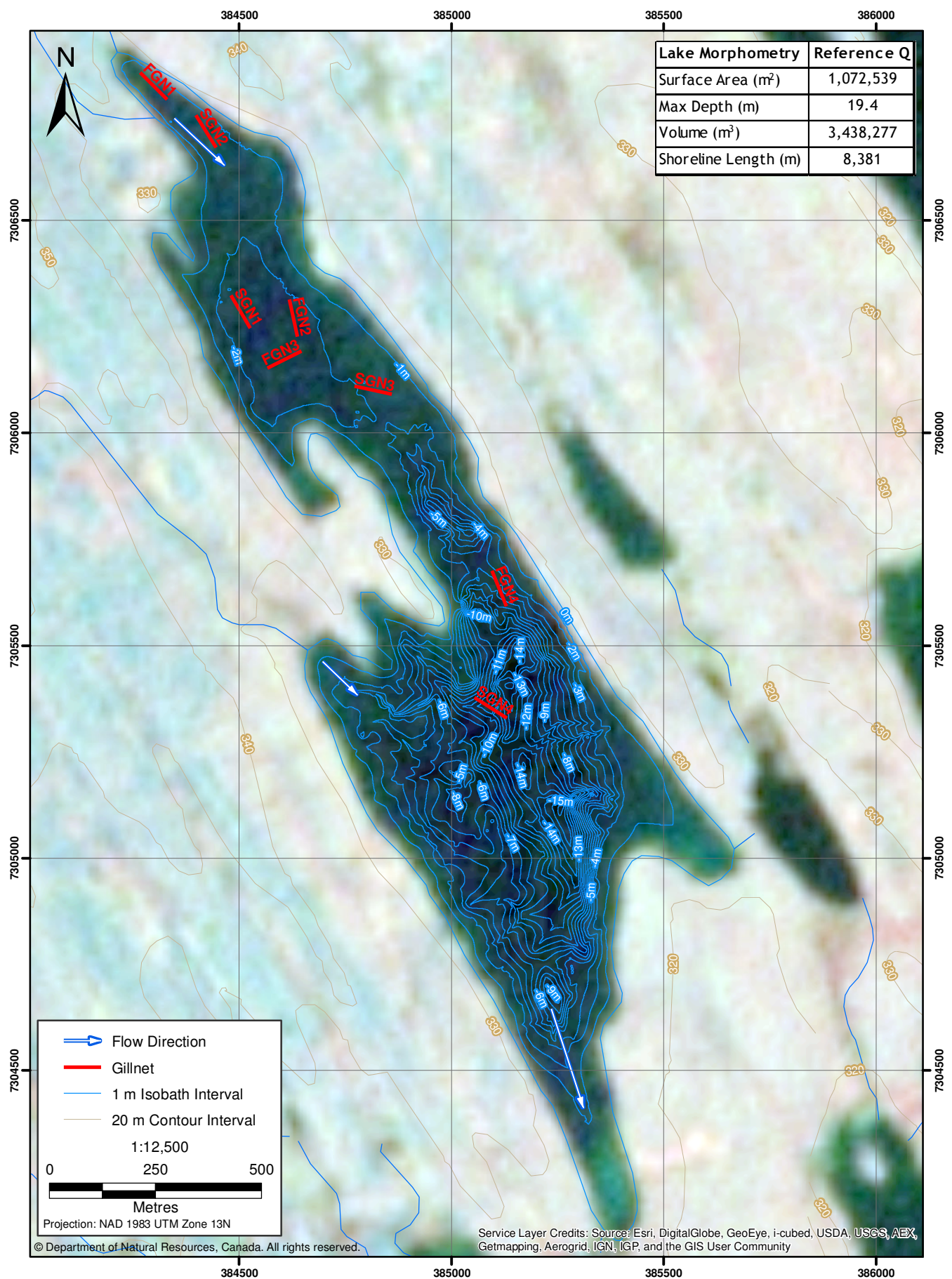
Komatic Lake Gillnet Sampling Locations, 2013

Figure 2.5-8



McCoy Lake Gillnet Sampling Locations, 2013

Figure 2.5-9



Reference Q Lake Gillnet Sampling Locations, 2013

Figure 2.5-10

2.5.4.2 Tissue Metal Concentrations

Fish tissue samples for metal analysis were collected from Slimy Sculpin from the following lakes in the Goose PDA: Goose, Propeller, Reference B, and Giraffe lakes. Lake Trout tissue metal samples were collected from Giraffe Lake. Slimy Sculpin tissue samples were collected for metal analysis from the following lakes in the George PDA: George, Komatic, McCoy, and Reference Q lakes.

Fish tissue samples were collected from eight of the Slimy Sculpin sacrificed for growth and health sampling (see Section 2.5.4.1). After euthanizing each individual using a blunt force to the head, clean dissecting tools were used to remove the head and internal organs. The body was placed in a sterile Whirlpak bag and frozen on dry ice.

All Lake Trout tissue samples were collected using non-lethal biopsy methods. Lake Trout were anaesthetized, and then two to four tissue plugs were removed from the dorsal side of the fish near the dorsal fin using a clean, sterile 4 mm biopsy punch. The skin was removed using a clean scalpel and placed into a sterile Whirlpak bag and immediately frozen on dry ice.

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 (ICP-MS). Mercury concentrations were analyzed by atomic fluorescence spectrophotometry. The 34 metals analyzed and their detection limits are presented in Table 2.5-5.

Table 2.5-5. Fish Tissue Quality Variables and Detection Limits

Parameter	Abbreviation	Detection Limit (mg/kg wwt)	Parameter	Abbreviation	Detection Limit (mg/kg wwt)
Physical Tests			Total Metals (cont'd)		
Moisture		0.10%	Magnesium	Mg	0.40
Total Metals			Manganese	Mn	0.010
Aluminum	Al	1.0	Mercury	Hg	0.0010*
Antimony	Sb	0.0020	Molybdenum	Mo	0.0080
Arsenic	As	0.0060	Nickel	Ni	0.040
Barium	Ba	0.010	Phosphorus	P	2.0
Beryllium	Be	0.0020	Potassium	K	4.0
Bismuth	Bi	0.0020	Rubidium	Rb	0.010
Boron	B	0.20	Selenium	Se	0.020
Cadmium	Cd	0.0020	Strontium	Sr	0.020
Calcium	Ca	4.0	Tellurium	Te	0.0040
Cesium	Cs	0.0010	Thallium	Tl	0.00040
Chromium	Cr	0.040	Tin	Sn	0.020
Cobalt	Co	0.0040	Uranium	U	0.00040
Copper	Cu	0.040	Vanadium	V	0.020
Iron	Fe	1.0	Zinc	Zn	0.20
Lead	Pb	0.010	Zirconium	Zr	0.040
Lithium	Li	0.10			

*Minimum Detection Limit increased to 0.0020 mg/kg wwt for Lake Trout tissue plugs

wwt = wet weight

Note: Lake Trout tissue samples had varying detection limits due to small sample sizes, which are reported in the results - this table presents the minimum detection limit only.

2.5.4.3 *Fecundity*

Slimy Sculpin sacrificed for growth and health assessment were also examined for indicators of fecundity. Sex and maturity were determined by visual examination of the gonads. Maturity classes identified were:

- immature – young individuals with underdeveloped gonads;
- maturing – adult fish in which ovaries and testes have begun to increase in size, individual eggs are distinguishable;
- mature – adult fish in which gonads large and developed, eggs are large and readily distinguishable;
- spawning – eggs or milt are expelled when body cavity is pressed; and
- spent – post-spawning, eggs and sperm totally or almost totally discharged.

All gonads were removed, frozen, and weighed in the lab. As with liver samples, all frozen material was dried in a drying oven set at 100.3°C for 24 to 36 hours. Dried gonads were then weighed to the nearest 0.001 g. A sub-sample of gonad samples from Slimy Sculpin from Goose Lake were weighed fresh in the field, frozen, dried and weighed again to provide a comparison of the techniques. The mean moisture content of gonads that were weighed when wet and dry was $82.53 \pm \text{SE } 3.05\%$. The mean moisture content was then used to determine the wet gonad weight for all the remaining samples and used for analysis.

2.5.4.4 *Diet*

An analysis of diet composition was completed on fish sacrificed for growth and health analyses. Stomachs were removed from dissected fish and preserved in a 10% formalin solution.

The stomach samples were sent to EcoAnalysts, Inc. of Idaho, USA and Biologica Environmental Services Ltd. of Victoria, BC, for identification and enumeration. Each stomach was rinsed with water to remove the preservative. The stomach was carefully slit open and the contents were removed and blotted on filter paper to remove excess moisture. Prey items were identified to the lowest possible taxonomic level and counted.

Stomach contents were grouped by order and major life-history group. This method was used because many taxonomic groups had so few representatives in the diet that obtaining the weight of the group was not possible. Therefore, stomach contents were organized by large taxonomic groups, (e.g., Diptera [minus Chironomidae], Chironomidae, Arachnida, and Oligochaeta). Data were presented by number of individual organisms.

2.6 WATER MANAGEMENT AND/OR FISHERIES OFFSETTING

Several water bodies were sampled to collect information to inform potential fisheries offsetting activities and/or to support water management planning. Further discussion and description of proposed fisheries offsetting projects can be found in the Draft Conceptual Fish Offsetting Plan included in Volume 10 of the Draft Environmental Impact Statement (Rescan 2013). Water bodies included in offset area sampling included streams, lakes, and ponds, each listed in the subsections below. Community sampling methods and assumptions are the same as those outlined for PDA sampling.

2.6.1 Gander Pond Stream

The Gander Pond Stream contains the channel that runs west from Rascal Lake, through an area of ponded water into Gander Pond, and includes the outflow of Gander Pond to Goose Lake (Figure 2.6-1). Sampling in this area included SHIM mapping, fish community sampling, a spawning survey, and a fry survey according to the methods outlined for PDA sites above.

2.6.2 Goose-Propeller Off-channel Area

Stream and off-channel fish habitat east of Goose Lake were surveyed for fish habitat value and fish community (Figure 2.6-1). The area of interest contains the drainage from a long unnamed lake east of Goose Lake to the stream connecting Goose Lake and Propeller Lake. Channelization in this area was intermittent, so habitat was mapped using a differential GPS unit with measurements of wetted width, wetted depth, and other notable habitat information made at points throughout the area. Fish community data was obtained through a combination of visual observations and backpack electrofishing, the methods of which were described in earlier sections.

2.6.3 Lower Long Lake Inflow

Lower Long Lake is a long, narrow lake in the George Property LSA. Fish community sampling was conducted on a tributary east of Lower Long Lake (Figure 2.6-2). Fish were sampled in the stream by use of a backpack electrofisher, and angling was used to capture larger fish in deeper water areas. No biological information beyond species identification was taken because the purpose of sampling was to determine species presence and absence.

2.6.4 McCoy Lake Outflow

McCoy Lake outflow is a short stream reach connecting McCoy Lake to an unnamed lake to the south-west (Figure 2.6-2). Fish habitat information was collected through an FHAP survey conducted on the entire stream length. The method for an FHAP survey is described in Section 2.4.1. Fish within the reach were sampled using a backpack electrofisher. Captured fish were identified to species, measured, weighed, and released.

2.6.5 Canyon Lakes

The Canyon Lakes are a chain of long, narrow, closely situated lakes located approximately 17 km north-east of the Goose PDA. Habitat information was gathered in Canyon Lake 2, Canyon Lake 3, Canyon Lake 4, and Canyon Lake 5 and fish community information was gathered in Canyon Lake 2, Canyon Lake 3, and Canyon Lake 5 (Figure 2.6-3).

The lake habitat was characterized using the methodology outlined for the PDA lakes above. The shoreline and littoral zone were grouped into habitat units of relatively homogenous habitat. The substrate of each unit was recorded as a percent of surface area covered by a type of substrate. 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.

The fish community of the Canyon Lakes and the intervening streams among the lakes was assessed using a combination of electrofishing, angling, gillnetting, and minnow trapping (Figures 2.6-4 through 2.6-6).

2.6.6 Pond E

Pond E is located just outside of the northwestern portion of the Goose PDA, within the LSA, west of Wasp Lake (Figure 2.6-1). The fish habitat and community of Pond E was previously sampled with

minnow traps in 2011. In 2013, the fish community was sampled using a backpack electrofisher to provide additional information on community composition.

2.7 DATA ANALYSIS

2.7.1 Fish Habitat

Fish habitat data collected in streams were based on measurements made over a representative segment of each reach surveyed. Where applicable, habitat characteristics within a reach are reported as the mean of all measurements within that reach. 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.

2.7.2 Fish Community

During fish community sampling, the assumptions of the assessment, according to Johnson et al. (2007), were the following:

- no fish moved in/out of the site or lake during the assessment;
- the rate of fish catch was proportional to abundance;
- capture efficiency was independent of field conditions within each stream, lake, or pond; and
- each minnow trap/gill net was not influenced by the effort and catch of any other trap/net.

Fish community composition was characterized and compared among sites using species presence and calculated 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 (Table 2.7-1). Where less than 10 sampling sets were conducted, CPUE data was bootstrapped to provide additional accuracy to summary statistics.

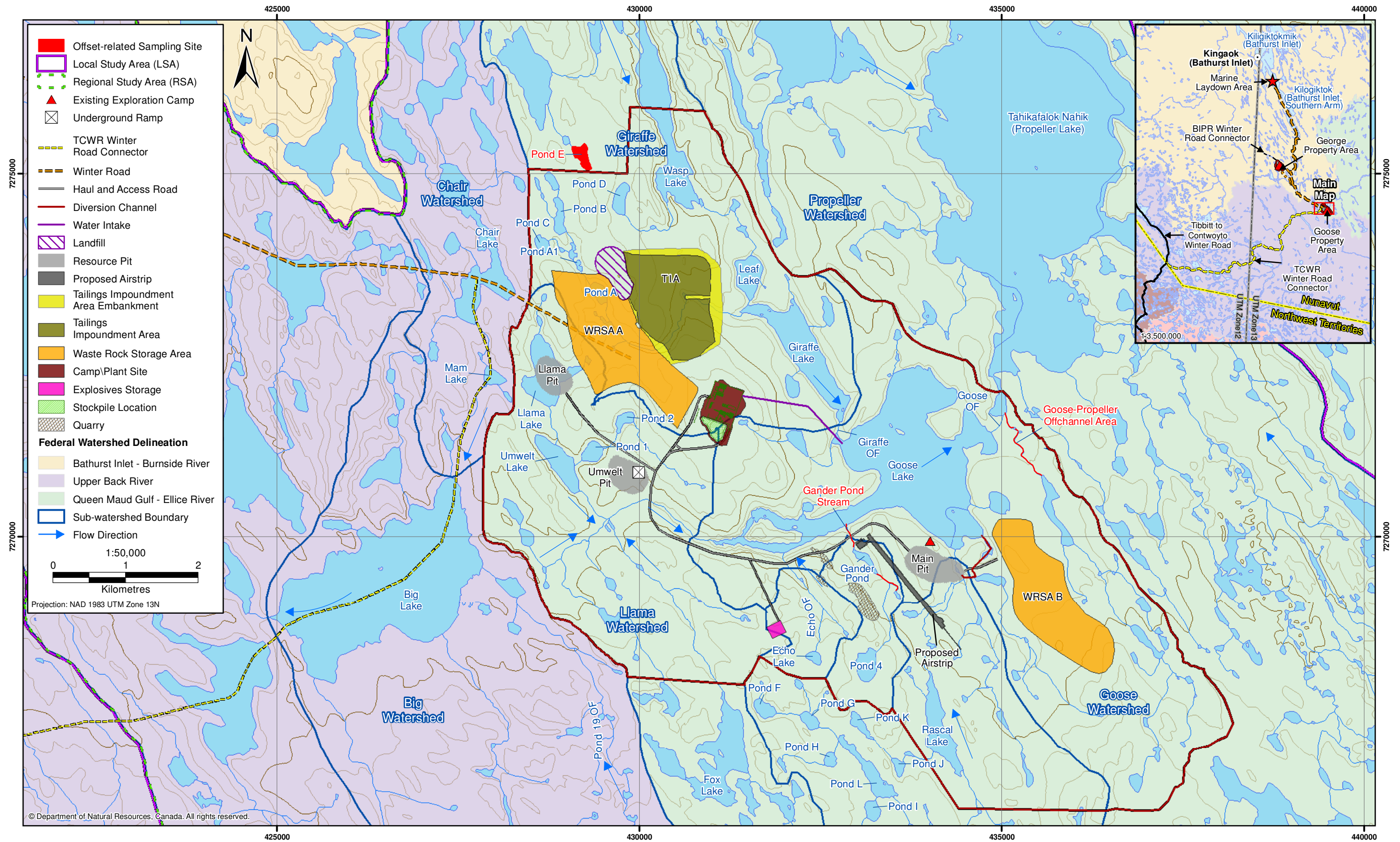
2.7.3 Biology

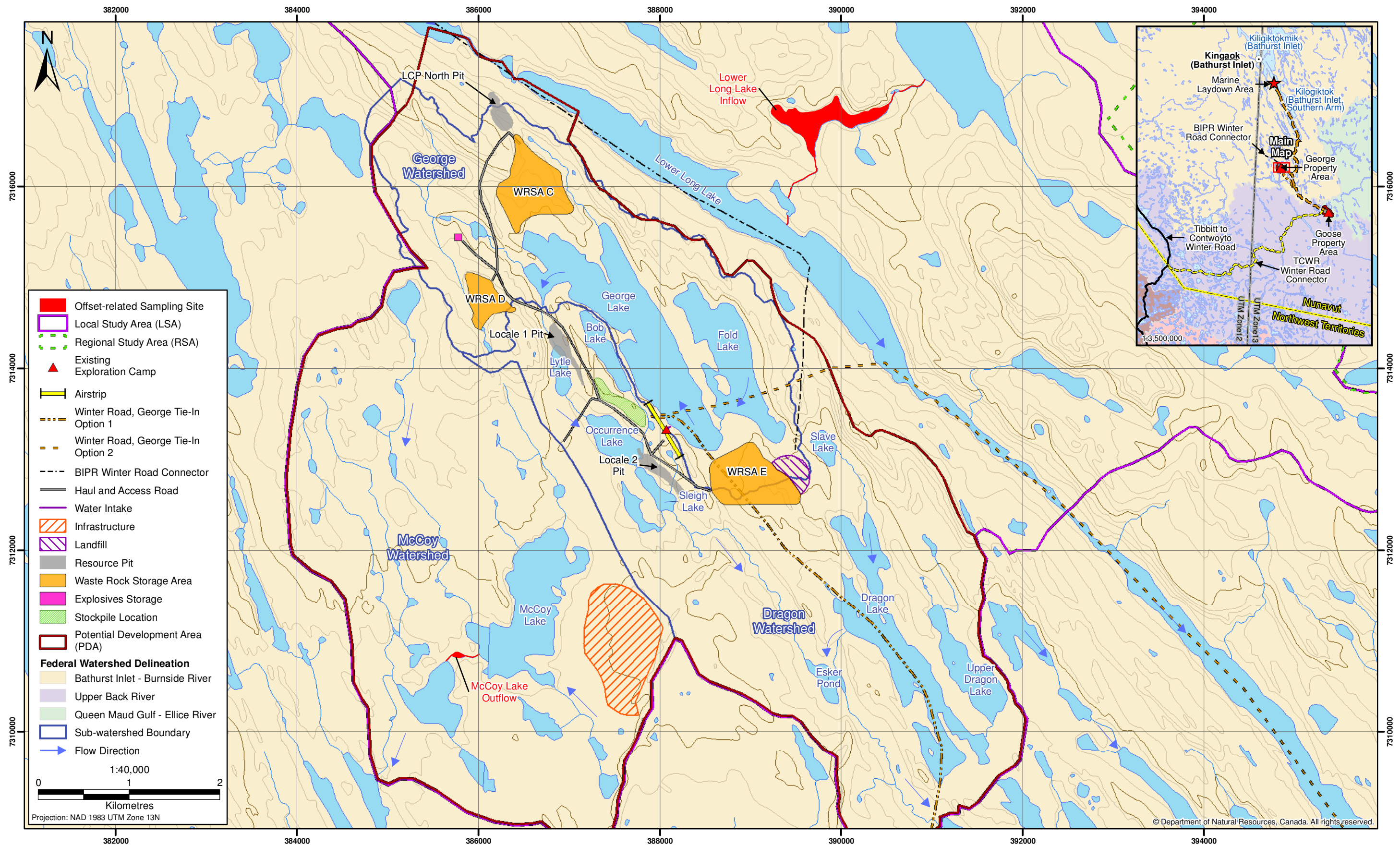
Basic fish measurements such as length and weight were compared for each species among sites. Where fewer than ten samples were collected, data was bootstrapped to provide more accurate summary statistics. Measurements were transformed with natural logarithms to meet assumptions of normality, and data were plotted so that outliers could be identified and addressed by correcting or removing incorrectly recorded or transcribed measurements.

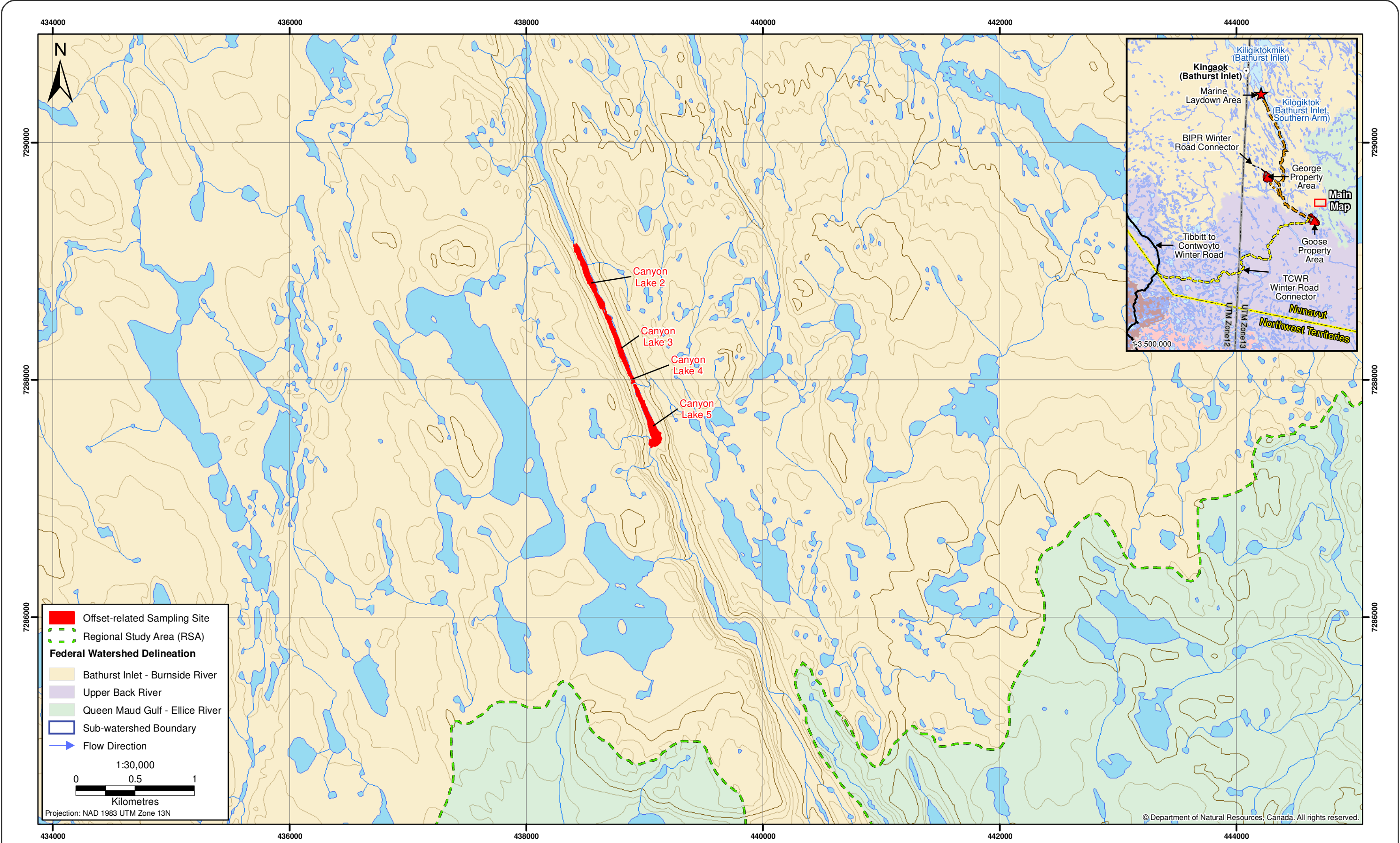
Length- and age-frequency distribution graphs were created to visualize the distribution of these variables for each species at each lake. These graphs provide information about the overall population composition.

Condition is an index of the relative health of fish. Two indices were used to calculate condition: Fulton's condition factor and weight-length regressions. Fulton's condition factor (Fulton's K) was calculated for all fish for which length and weight data were obtained, and was based on the following formula:

$$\text{Fulton's K} = \text{weight (g)} \times 10^5 / \text{fork or total length (mm)}^3$$







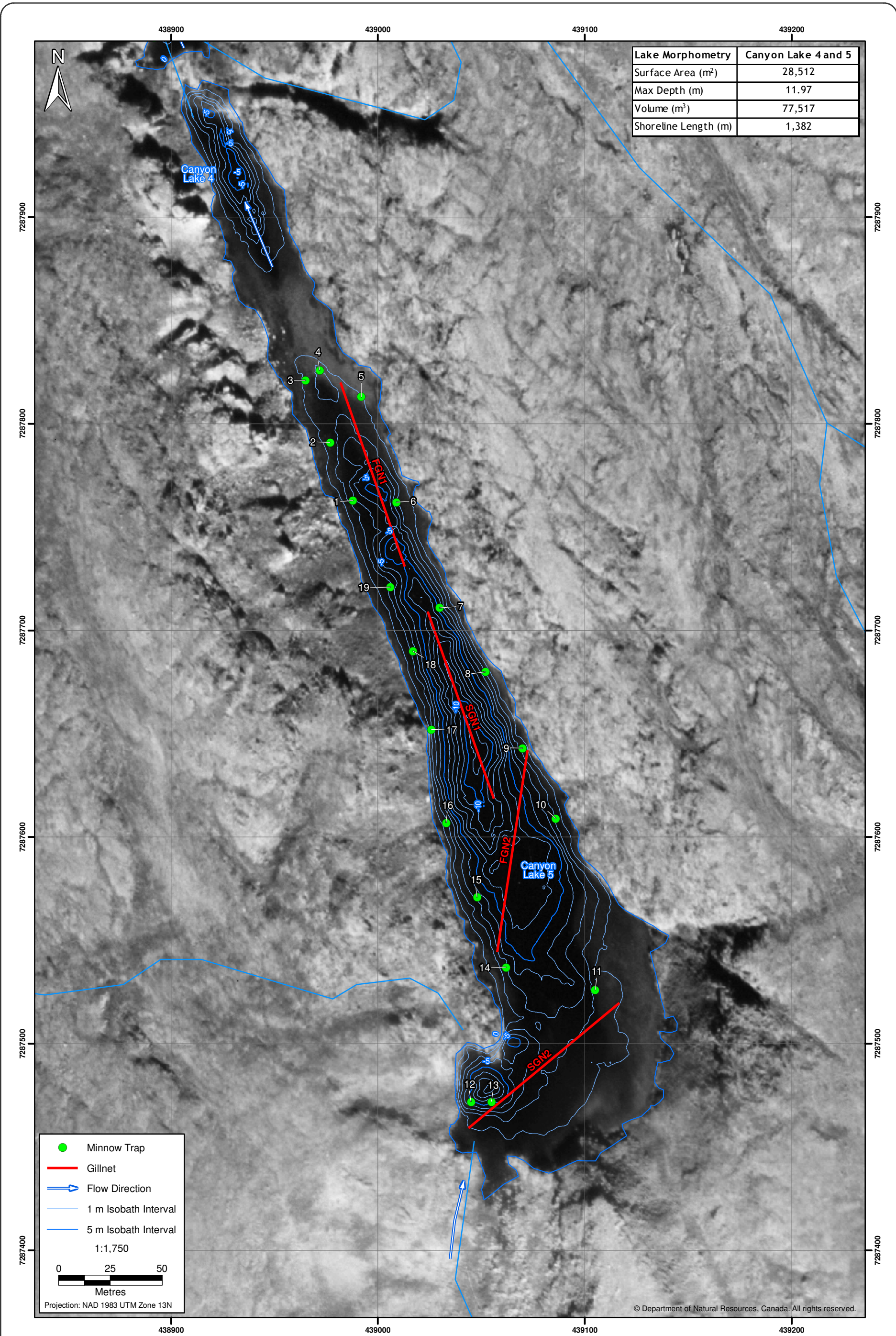


Figure 2.6-4



Canyon Lake 4 and 5 Fish Community Sampling Locations, 2013

Figure 2.6-4



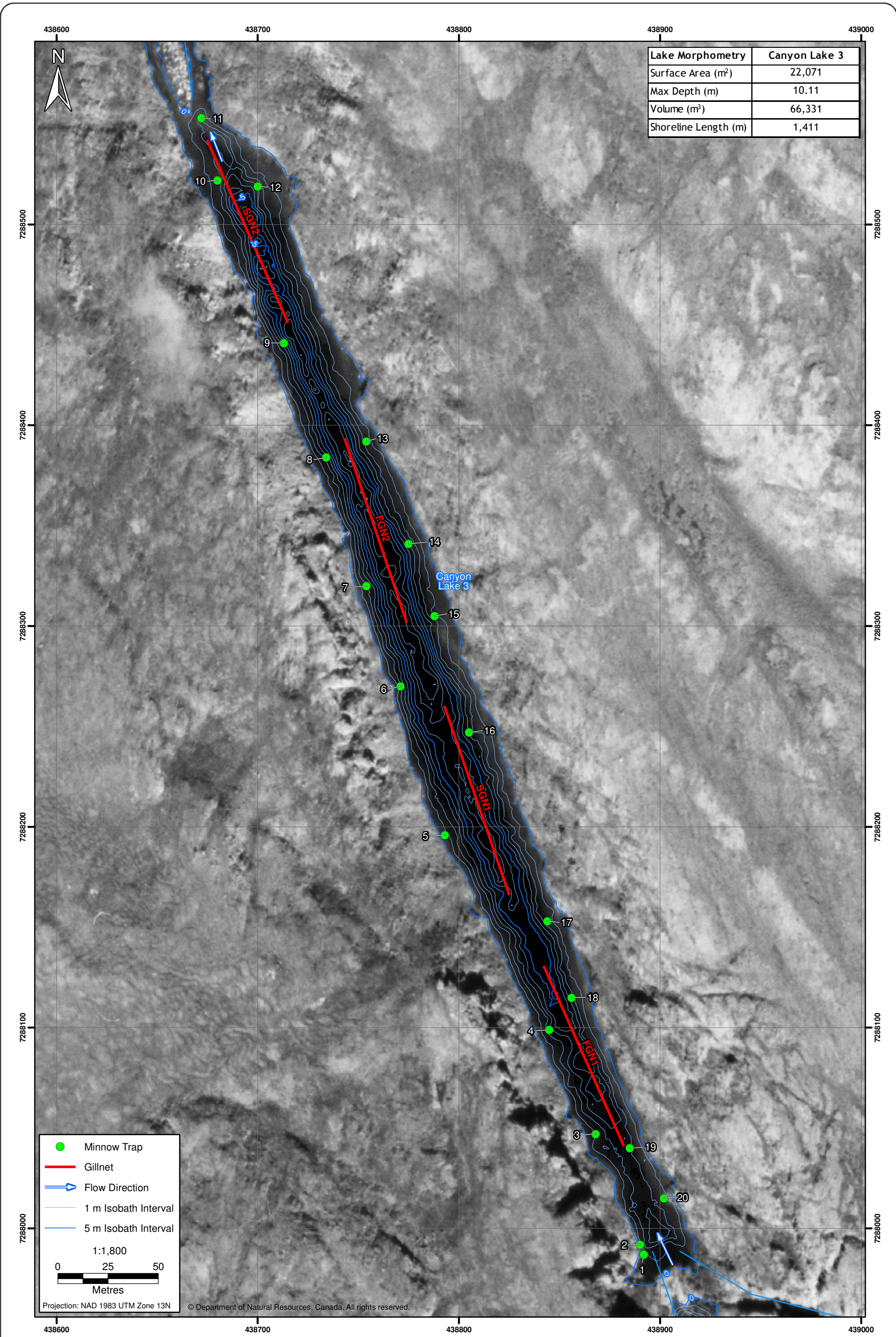


Figure 2.6-5



Canyon Lake 3 Fish Community Sampling Locations, 2013

Figure 2.6-5



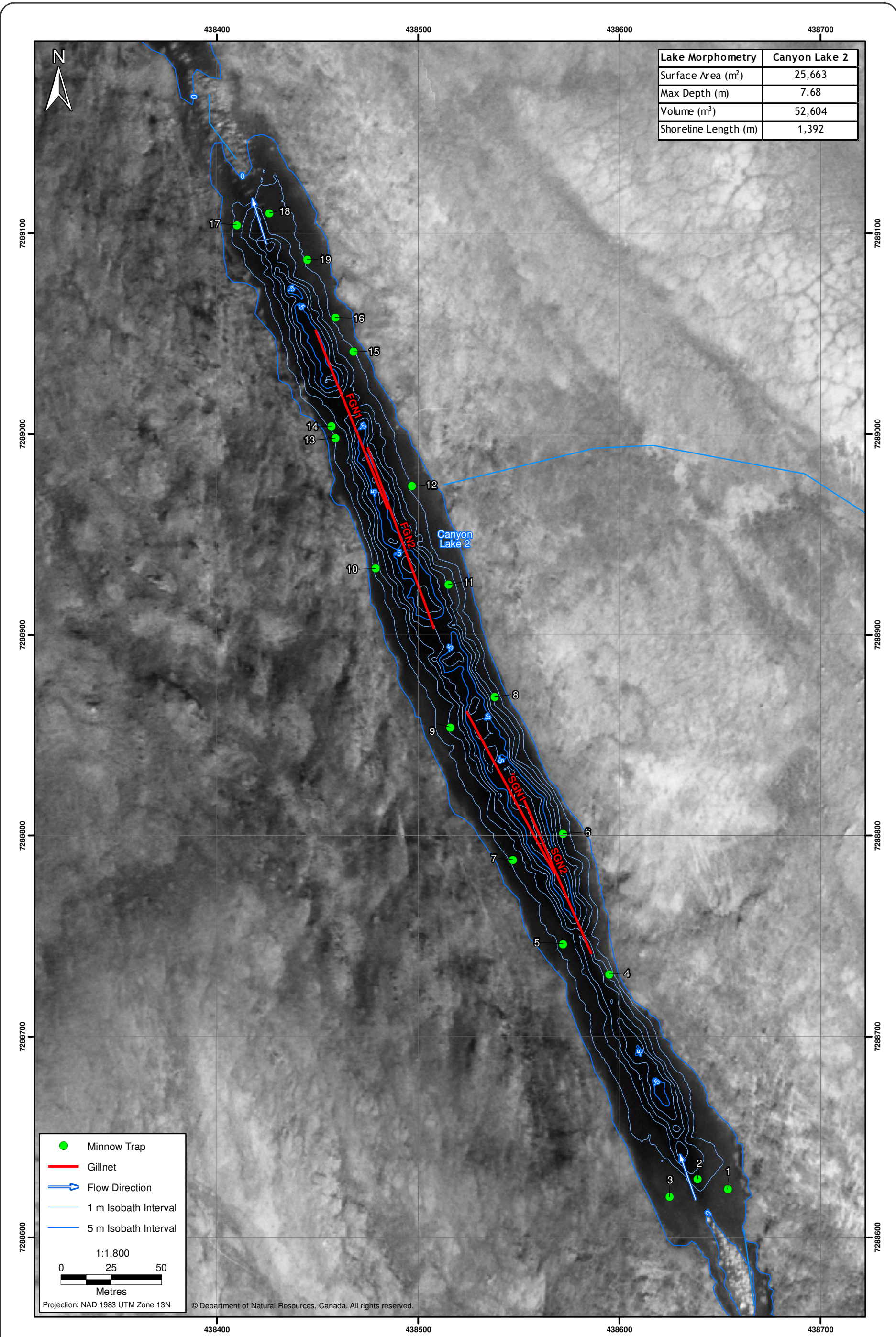


Figure 2.6-6



Canyon Lake 2 Fish Community Sampling Locations, 2013

Figure 2.6-6



Table 2.7-1. Catch-Per-Unit-Effort Calculations Used in Community Summaries

Sampling Gear	CPUE Calculation
Electrofisher	$CPUE = \text{number of fish caught} * [100 / (\text{electrofishing effort, s})]$
Minnow trap	$CPUE = \text{number of fish caught per trap} * [(24 \text{ h} / (\text{set time, h}))]$
Gillnet	$CPUE = \text{number of fish caught per net} * [100 \text{ m}^2 / (\text{total net area, m}^2)] * [1 \text{ h} / (\text{set time, h})]$

CPUE = Catch-per-unit-effort

Comparisons of weight-length regressions are generally considered to be more robust than comparisons of indices such as Fulton's condition factor (Environment Canada 2011). The weight-length relationship was tested using ordinary least-squares regression analyses with natural log transformed weight as the dependent variable and natural log transformed length as the independent variable. A significant regression indicates that there was a strong weight-length relationship. Lack of significance may be due to low sample sizes or variable data (either due to natural variability or measurement error). The equation for the weight-length model is:

$$\ln(\text{weight}) = a + b [\ln(\text{total length})]$$

where weight is in g, total length is in mm, *a* is the y intercept (i.e., weight at length zero), and *b* is the slope of the relationship between weight and length (change in weight with length). Thus, condition or the change in weight with length is equal to the slope of the line in a weight-length regression. Fish captured using different sampling gear were analyzed through separate weight-length regression analyses. The body weight used in all analyses is the total body weight of all fish tissues minus the combined weight of any parasites.

To obtain wet liver weight and wet gonad weight, the mean moisture content was determined from tissue samples were measured wet at the time of dissection and again after tissues were dried. Mean moisture content was used to determine the original wet weight of the other dried samples more precisely than was possible in the field. The equation for obtaining moisture content and wet weights is:

$$\% \text{ moisture} = ((\text{wet weight} - \text{dry weight}) / \text{wet weight}) * 100$$

The wet weight of lethally sampled fish was compared to body weight using ordinary least-squares linear regression.

Liver weight was used as the dependent variable and fish total weight as the independent variable and both variables were natural log transformed. The equation for the liver weight-body weight regression is:

$$\ln(\text{liver weight}) = a + b [\ln(\text{body weight})]$$

The hepatosomatic index (HSI) compares liver size to body weight, as increased liver size is related to available energy reserves and to other health effects such as exposure to toxic substances (Environment Canada 2012). The HSI is calculated as:

$$HSI (\%) = (\text{liver weight, g}) / (\text{body weight, g}) * 100$$

Typically, the same method is also used to examine the relationship between gonad weight (dependent variable) and fish total weight (independent variable), with both variables transformed by natural log. However, as the Slimy Sculpin sampling occurred relatively soon after spawning (sampled in July, while spawning occurs in the spring), gonads were still reduced in most sculpin and maturity was not always obvious. The sample sizes for relative gonad size of mature female and male sculpin in each lake would

be low and, therefore, Gonadosomatic index (GSI) was calculated for both mature and immature fish. In addition, the relative abundance of young-of-year (YOY) fish was reported as an alternative measure of reproductive success according to guidance provided by Environment Canada (Environment Canada 2011).

$$GSI (\%) = \text{gonad weight (g)} / \text{fish weight (g)} * 100$$

The relationship between age and size of each species yields insight into individual growth rate and maximum body length for a population and may be determined using von Bertalanffy growth models. For each species, three models are examined: a standard von Bertalanffy model, a modified von Bertalanffy model with the age at which length equals zero (t_0) fixed at zero, and a linear regression length-age 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 (mm) at age t (years), L_{∞} is the length (mm) that the fish would attain if it were allowed to grow for an infinitely long time (otherwise known as asymptotic length), K is a growth constant (year^{-1}), and t_0 is the age (years) at which length equals zero.

The equation for the modified von Bertalanffy model is:

$$L_t = L_{\infty}(1 - e^{(-K(t))})$$

Weighted Akaike Information Criteria (wAIC) values are presented for each model to compare the goodness of fit of each model to the data. The model with the highest wAIC is the model that best fits the data. If either the von Bertalanffy or the modified von Bertalanffy models were the best fit, the estimated L_{∞} (asymptotic length) and K (instantaneous growth rate) were reported. If the linear model was the best fit, the respective F value was reported along with the growth rate (the slope parameter, b , of the linear equation). Growth models were only estimated for datasets containing at least 15 fish, as model reliability declines sharply with fewer samples.

2.7.3.1 Tissue Metal Concentrations

Fish fork length was compared among lakes using an analysis of variance (ANOVA). If the results indicated a significant relationship between fish size and lake, a general linear model (GLM) was used to obtain the slopes of the metal concentration - fork length relationships and compare among lakes. If there was no significant relationship between fork length and lake, then fish size was not accounted for when comparing among lakes.

Some metals concentrations were below detection limits (DLs). For some of the tissue metals concentrations, particularly for Lake Trout tissue plugs, detection limits were raised where there was insufficient tissue or when analyte was detected in the method blanks. To avoid bias arising from multiple DLs and to provide a robust estimate of mean metal concentrations, Regression on Order Statistics (ROS) was used following the recommendations by Helsel (2005) rather than substituting with a static number (such as half of the DL). The data were first examined for the proportion of the sample below the analytical DL. If a single lake was found to have between 0 and 60% of data below DL, ROS regression was used to estimate the mean ($\pm$ SE) metal concentration. ROS regression was implemented in the NADA package in R. If greater than 60% of data were below the DL, that lake was excluded from analysis due to insufficient data above the DL to obtain a reasonable estimate of mean and variance.

Table 2.7-2 presents the available tissue metal guidelines related to human health.

Table 2.7-2. Fish Tissue Guidelines

Variable	Source	Guideline Value
Arsenic	CFIA 2011	3.5 mg/kg ww
Mercury	CFDA; Health Canada 2012	0.5 mg/kg ww

Notes: CFDA = Canadian Food and Drug Act, CFIA = Canadian Food Inspection Agency

ww = wet weight, dw = dry weight

2.8 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance and quality control was implemented throughout 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 were being conducted in a standardized manner. Field scales were calibrated prior to the beginning of the field trip and were kept free of excess water and sediment and regularly tared to maintain accuracy while in use. Laboratory scales used to weigh livers and gonads were calibrated at the beginning of each weighing session.

Quality assurance was provided for aging data by analyzing multiple structures from some individual fish and comparing the age estimates derived from those structures. Additional quality assurance for fish ageing was provided by North/South Consultants by re-analyzing structures with a different analyst to test the precision of the estimates. The resulting confidence in the ages provided were generally fair to poor, and the associated analyses using age should be interpreted with caution.

The process of weighing dried gonads and livers, then calculating dry weights from average moisture content introduces a source of uncertainty to the measurements. The resulting indices and analyses provide useful fish health information but should be taken as estimations.

Fish tissue samples were collected in the field using clean tools to reduce the transfer of materials among fish. Tissue samples were subjected to quality control analyses in the lab as well with replicated samples being analyzed to test for relative percent differences, and reference material tests and laboratory blanks to ensure the accuracy of the metal concentrations. The results of quality control analyses conducted in the lab are presented in Table 2.8-1.

Table 2.8-1. Tests of Variability of Fish Tissue Metal Concentrations

Quality Control Test	Qualifier	Number of Incidences	Percent
Replicates	None	93	53.1
	DUP-H	30	17.1
	RPD-NA	52	29.7
	Total	175	100
Reference Material	None	111	100
	Total	111	100
Laboratory Blanks	None	308	99.7
	MB-LOR	1	0.3
	Total	309	100

RPD-NA = Relative Percent Difference Not Available due to one or both values being less than the detection limit

DUP-H = Duplicate results outside of ALS data quality objectives due to sample heterogeneity

MB-LOR = Method Blank exceeds ALS data quality objectives. Limits of Reporting have been adjusted for samples with positive hits below five times blank level.

None = No qualifier, results fell within ALS data quality objectives.

Upon entry of the data into databases, the data were 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.

3. Results and Discussion

3. Results and Discussion

3.1 FISH-BEARING STATUS OF POTENTIAL DEVELOPMENT AREAS

3.1.1 Goose Property Potential Development Area

Habitat and fish community sampling conducted in 2013 confirmed the fish-bearing status of select streams, lakes, and ponds in the Goose PDA. Figure 3.1-1 summarizes the known fish-bearing and non-fish bearing status of waterbodies in the Goose PDA as supported by 2013 sampling results, as well as previous baseline results (Rescan 2010, 2012a, 2012c).

Fish were captured at every lake sampled in the Goose PDA in 2013, with the exception of Echo Lake. Echo Lake has been sampled extensively, with sampling conducted over multiple years, and as a result it has been confirmed non-fish bearing. Further details regarding the fish habitat and sampling in Echo Lake can be found in Section 3.5.

Giraffe Inflow, Pond A inflow, and portions of Goose Inflow are believed, due to the presence of barriers and the results of the sampling conducted, to be non-fish bearing. Descriptions of the fish barriers are provided in Section 3.3.1 and details regarding sampling are provided in Section 3.3.1.2. All other sampled streams are confirmed or assumed to be fish-bearing.

Many of the ponds in the Goose PDA are shallow and do not provide overwintering habitat. Ponds with no passable inflows or outflows through which fish could access overwintering habitat cannot provide fish habitat. Pond 2, Pond A, Pond A1, Pond B, and Pond E are confirmed non-fish bearing as a result of the lack of overwintering habitat and through multiple years of sampling. Detailed descriptions of pond habitat and sampling effort are provided in Section 3.5.

All waterbodies within the proposed footprint of the TIA and WRSAs were confirmed to be non-fish bearing by the 2013 survey, as well as by previous baseline results (Rescan 2010, 2012a, 2012c).

3.1.2 George Property Potential Development Area

All waterbodies within the proposed footprint of the WRSAs were confirmed to be non-fish bearing by the 2013 survey, as well as by previous baseline results (Rescan 2010, 2012a, 2012c).

George Inflow 1, at the north-east end of George Lake, was evaluated for fish-bearing potential. The morphology of the stream, including high gradient and intermittent channelization, make fish use unlikely. An additional barrier to fish passage and a low pH also result in unsuitable habitat for fish. As a result, George Inflow 1 is not considered fish-bearing (Figure 3.1-2).

The stream section south of site 400 (George Inflow 2) potentially covered by WRSA D (Figure 3.1-2) was evaluated for fish habitat by aerial survey on June 17, 2013. This section of land showed no signs of channelization and no open surface water was observed. Consequently, the section of stream under the area potentially covered by WRSA D is considered unsuitable as fish habitat and non-fish bearing.

3.2 HAUL AND ACCESS ROAD STREAMS

3.2.1 Goose Property PDA

3.2.1.1 Fish Habitat

A total of six road crossings were identified in the Goose PDA. The full habitat assessments and site photographs are presented in Appendix 3.2-1.

Four of the crossings are associated with continuous, channelized streams (Table 3.2-1). The streams ranged in bankfull width from 1.2 m to 85.9 m and represent a range of habitat types from cascades to pools and boulder gardens. Sites 101 and 102 are small streams with a mix of sand, gravel, cobble and boulder substrates (Table 3.2-2). They have no barriers to fish movement, frequent pools, and provide moderate levels of instream cover from pools, boulder cover, and vegetation, thus providing good potential spawning and rearing habitat, and have an important overall habitat value (Table 3.2-3 and Table 3.2-4).

Site 103 is a wide boulder garden area with frequent barriers to fish movement and large substrate, providing poor rearing habitat and no spawning habitat for a marginal overall habitat value. Site 1201 is a small stream with fine organic substrate is within reach 1 of Rascal-Goose stream (see Section 3.3.1 for more details), providing unsuitable substrate for spawning and poor rearing habitat due to limited cover, and thus a marginal overall habitat value.

Site 100 was characterized as a Dry/Intermittent crossing. While the presence of a defined cobble channel suggests past water flow, during 2013 freshet it was mostly dewatered with only a few unconnected pools of standing water. Site 105 in the Goose PDA marks the location where the proposed road route crosses an area of overland flow categorized as NCD. The water flows overland through vegetation without forming a channel. Both of these sites do not provide any spawning, rearing or overwintering fish habitat.

3.2.1.2 Fish Community

Species Composition

Four fish species were captured or observed in surveyed streams along proposed road routes in the Goose PDA: Arctic Grayling, Burbot (*Lota lota*; Plate 3.2-1), Ninespine Stickleback (*Pungitius pungitius*; Plate 3.2-2), and Slimy Sculpin (Plate 3.2-3). Appendix 3.2-2 presents the sampling effort and catch summary. Appendix 3.2-3 presents the individual fish data.

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 rear in lakes, to which they return after spawning (Hubert et al. 1985). Both adults and juveniles overwinter in larger rivers and lakes downstream of the spawning areas (Stewart et al. 2007).

Burbot generally inhabit deep waters in lakes; however, they migrate into 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 deep water areas of lakes.

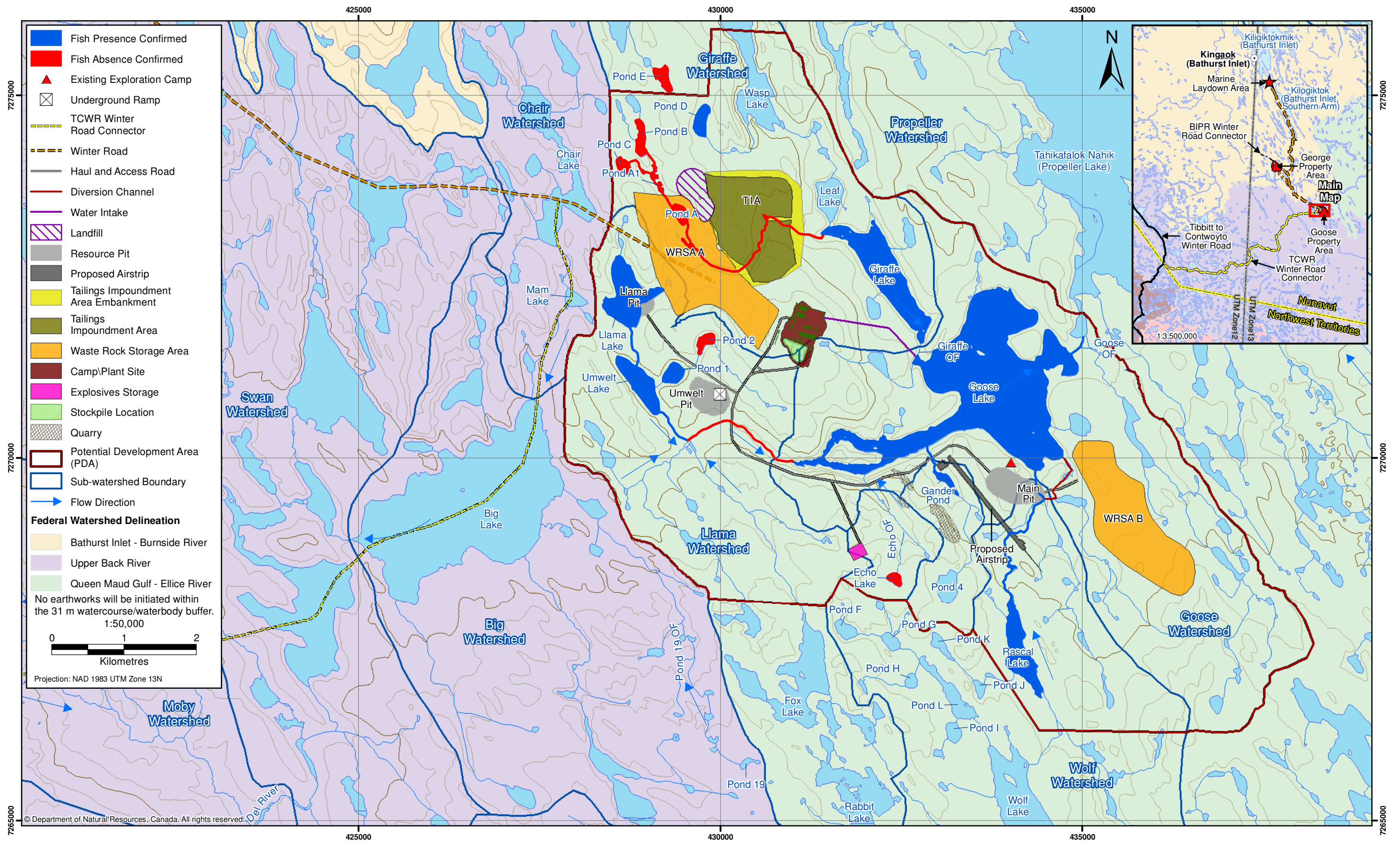


Figure 3.1-1

Fish Presence / Absence at Goose
Property Area, 2013

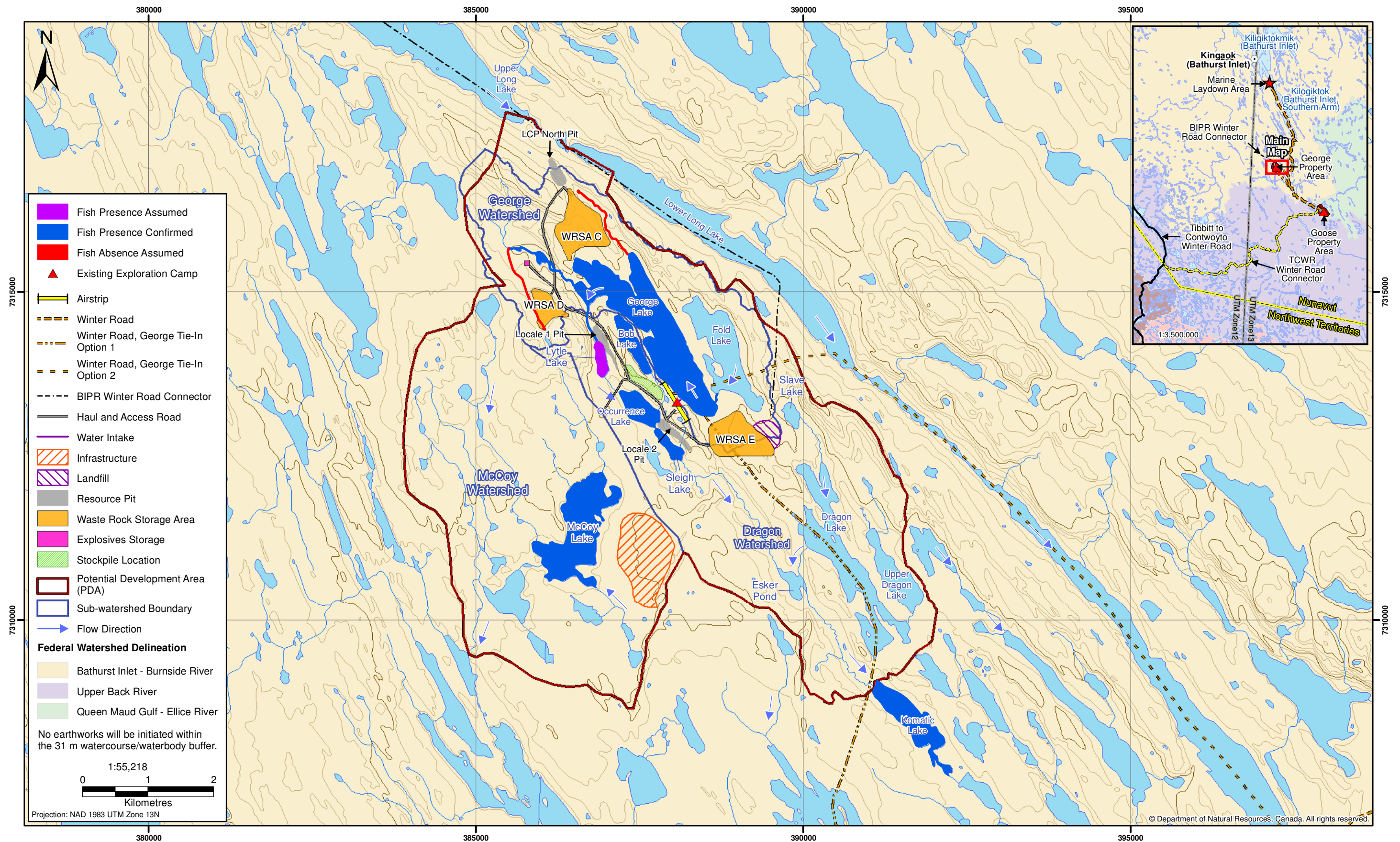


Figure 3.1-2

Fish Presence / Absence at George Property Area, 2013

Table 3.2-1. Weighted Channel Characteristics of Road Crossing Sites in the Goose PDA, 2013

Site	Cascade (%)	Riffle (%)	Glide (%)	Pool (%)	Boulder Garden (%)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)
100						Dry/Int.				
101	9	17	43	30	0	2	0.33	0.33	2.5	2.5
102	0	0	85	15	0	3	0.16	0.24	1.0	1.2
103	0	0	31	18	51	2	0.37	0.90	75.8	85.9
105						NCD				
1201	0	0	100	0	0	0	1.1	.7	3.5	3.0

Dry/Int. = dry or intermittently wetted stream channel

NCD = non-classified drainage

Table 3.2-2. Weighted Substrate Composition of Road Crossing Sites in the Goose PDA, 2013

Site	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)
100				Dry/Int.
101	42	16	25	17
102	14	28	32	26
103	0	0	23	77
105				NCD
1201	80	10	10	0

Dry/Int. = dry or intermittently wetted stream channel

NCD = non-classified drainage

Table 3.2-3. Pool and Barrier Characteristics of Road Crossing Sites in the Goose PDA, 2013

Site	Pools (No.)	Average Max. Depth (m)	Average Crest Depth (m)	Residual Depth (m)	Barriers (No.)	Barrier Type
100			Dry/Int.		1	Dry Channel
101	3	0.53	0.18	0.35	0	-
102	3	0.27	0.08	0.19	0	-
103	2	0.80	0.47	0.33	5	Boulder Garden
105			NCD			
1201	0	-	-	-	0	-

Dry/Int. = dry or intermittently wetted stream channel

NCD = non-classified drainage

No. = number

Dashes indicate data not available

Table 3.2-4. Weighted Instream Cover Composition of Road Crossing Sites in the Goose PDA, 2013

Site	Pool (%)	Boulder (%)	Instream Vegetation (%)	Overhanging Vegetation (%)	Undercut Bank (%)	Large Woody Debris (%)	Small Woody Debris (%)	Canopy Cover (%)
100				Dry/Int.				
101	16	9	3	1	1	0	0	0
102	2	4	6	0	0	0	0	0
103	5	21	1	4	0	0	0	0
105				NCD				
1201	3		5	2				

Dry/Int. = dry or intermittently wetted stream channel

NCD = non-classified drainage



Plate 3.2-1. Burbot captured at Gander Pond Outflow (Site 101), June 19, 2013.



Plate 3.2-2. Ninespine Stickleback captured at Gander Pond Outflow (Site 101), June 19, 2013.



Plate 3.2-3. Slimy Sculpin captured at Gander Pond Outflow (Site 101), June 19, 2013.

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 and are found at a wide range of depths (Scott and Crossman 1973). It is not known if sticklebacks or sculpins undertake migrations to overwintering habitat.

CPUE

Fish were captured by electrofishing in all of the streams sampled, excluding Dry/Int. and NCD crossings. Electrofishing CPUE was 1.89 fish/100 s at Site 1201 and 2.05 fish/100 s at Site 101 (Gander Pond outflow; Table 3.2-5). Ninespine Stickleback were the only species found at the Gander Pond outflow, while Arctic Grayling, Burbot, Ninespine Stickleback, and Slimy Sculpin were found at Site 101.

3.2.1.3 *Biology*

Table 3.2-6 presents the mean fork length, total weight, and condition of fish species captured in surveyed streams at road crossings at the Goose PDA in 2013.

The single Arctic Grayling captured at Site 101 was 77 mm in length and weighed 9.1 g. The condition factor was 1.99 g/mm³, above normal values for salmonid fishes. This was a higher condition than seen elsewhere in the area and may be a potential measurement error due to excess water on the scale when measuring very small fish.

Mean Slimy Sculpin length at Site 101 was 55 mm. Mean total weight for sculpins was 1.2 g at Site 101. Mean condition factor was 0.87 g/mm³.

At Site 101, mean stickleback length was 46 mm, mean weight was 0.7 g, and mean condition was 0.66 g/mm³. At site 1201, mean stickleback length was 28 mm.

3.2.2 **George Property PDA**

3.2.2.1 *Fish Habitat*

A total of four road crossings were identified in the George PDA. The full habitat assessments and site photographs are presented in Appendix 3.2-1.

Two of the crossings are associated with continuous, channelized streams (Table 3.2-7). Site 400 (George Inflow 2) was a small stream with frequent pools, undercut banks, and sandy substrate interspersed with cobble. Although mostly sandy, the cobble provided good spawning habitat for grayling (Table 3.2-8). The pools and undercut banks provided good rearing habitat (Table 3.2-9 and Table 3.2-10). Site 400 was overall an important habitat. Site 401 was larger (7.93 m bankfull width) with boulder and cobble substrate, providing good spawning habitat as well as a slower moving section that was considered fair rearing habitat, for an important overall habitat value. Neither Site 400 nor Site 401 contained barriers to fish movement within the surveyed reach.

Sites 402 and 405 in the George PDA were categorized as NCD, and did not provide any fish habitat.

3.2.2.2 *Fish Community*

Species Composition

Three fish species were captured or observed in surveyed streams along proposed road routes in the George PDA: Arctic Grayling, Lake Trout (Plate 3.2-4), and Slimy Sculpin. Appendix 3.2-2 presents the sampling effort and catch summary. Appendix 3.2-3 presents the individual fish data.

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 rear in lakes, to which they return after spawning (Hubert et al. 1985). Both adults and juveniles overwinter in larger rivers and lakes downstream of the spawning areas (Stewart et al. 2007).

Table 3.2-5. Summary of Electrofishing CPUE and Visual Observations of Fish in Surveyed Streams at Goose PDA Road Crossings, 2013

Site Name	Electro-fishing Effort(s)	Electrofishing (no. of fish captured)						Electrofishing CPUE (Fish/100 s)	Visual Observation		
		Arctic Grayling	Burbot	Lake Trout	Ninespine Stickleback	Slimy Sculpin	Total		Arctic Grayling	Unknown Species	Total
Goose Property											
101	831	1	1	-	14	1	17	2.05	-	1	1
1201	106	-	-	-	2	-	2	1.89	-	-	-

CPUE = Catch-per-unit-effort

Dashes indicate no fish were caught

Table 3.2-6. Summary of Mean Fork Length, Total Weight and Condition of Fish Captured in Surveyed Streams at Goose PDA Road Crossings, 2013

Site	Species	n	Fork Length (mm)					Bootstrap Fork Length (mm)			
			Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
101	Arctic Grayling	1	77	-	-	77	77	-	-	-	-
	Burbot	1	95	-	-	95	95	-	-	-	-
	Ninespine Stickleback	14	46	6	2	36	55	-	-	-	-
	Slimy Sculpin	1	50	-	-	50	50	-	-	-	-
1201	Ninespine Stickleback	2	28	3	2	26	30	28	1	26	30
		n	Total Weight (g)					Bootstrap Total Weight (g)			
			Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
101	Arctic Grayling	1	9.1	-	-	9.1	9.1	-	-	-	-
	Burbot	1	8.1	-	-	8.1	8.1	-	-	-	-
	Ninespine Stickleback	14	0.7	0.2	0.1	0.3	1.0	-	-	-	-
	Slimy Sculpin	1	1.2	-	-	1.2	1.2	-	-	-	-
		n	Condition (g/mm ³)					Bootstrap Condition (g/mm ³)			
			Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
101	Arctic Grayling	1	1.99	-	-	1.99	1.99	-	-	-	-
	Burbot	1	0.94	-	-	0.94	0.94	-	-	-	-
	Ninespine Stickleback	14	0.66	0.18	0.05	0.44	0.99	-	-	-	-
	Slimy Sculpin	1	0.96	-	-	0.96	0.96	-	-	-	-

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate not applicable

Table 3.2-7. Weighted Channel Characteristics of Road Crossing Sites in the George PDA, 2013

Site	Cascade (%)	Riffle (%)	Glide (%)	Pool (%)	Boulder Garden (%)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)
400						0				
401	0	40	60	0	0	1	0.40	0.32	8.02	7.93
402						NCD				
405						NCD				

NCD = non-classified drainage

Table 3.2-8. Weighted Substrate Composition of Road Crossing Sites in the George PDA, 2013

Site	Sand (%)	Gravel (%)	Cobble (%)	Boulder (%)
400			82	
401	17	0	38	45
402			NCD	
405			NCD	

NCD = non-classified drainage

Table 3.2-9. Pool and Barrier Characteristics of Road Crossing Sites in the George PDA, 2013

Site	Pools (No.)	Average Max. Depth (m)	Average Crest Depth (m)	Residual Depth (m)	Barriers (No.)	Barrier Type
400			5		0.98	0.35
401	0	-	-	-	0	-
402			NCD		1	No Channel
405			NCD		1	No Channel

NCD = non-classified drainage

No. = number

Dashes indicate data not available

Table 3.2-10. Weighted Instream Cover Composition of Road Crossing Sites in the Goose PDA, 2013

Site	Pool (%)	Boulder (%)	Instream Vegetation (%)	Overhanging Vegetation (%)	Undercut Bank (%)	Large Woody Debris (%)	Small Woody Debris (%)	Canopy Cover (%)
400				5				
401	0	33	6	0	3	0	0	0
402				NCD				
405				NCD				

Dry/Int. = dry or intermittently wetted stream channel

NCD = non-classified drainage



Plate 3.2-4. Juvenile Lake Trout captured at Lytle - George (Site 401), June 17, 2013.

Lake Trout spend little time in streams and rivers, and instead spend most of their life cycle in lakes. Streams and rivers are most often used as migration corridors between lakes; however, and in the Arctic Lake Trout have been known to use fluvial habitat more extensively (Scott and Crossman 1973). In the Project LSA, most Lake Trout captured in streams were near the inlets or outlets of lakes.

Ninespine Sticklebacks were captured in small streams and shallow lake margins with abundant instream vegetation and slow to moderate current.

CPUE

Fish were captured by electrofishing at both of the streams sampled, but not at NCD crossings. Electrofishing CPUE was 0.72 fish/100 s at Site 400 and 0.21 fish/100 s at Site 101 (Gander Pond outflow; Table 3.2-11). Lake Trout was the only species found at Site 401, while Arctic Grayling, Lake Trout, and Slimy Sculpin were found at Site 400.

During the Arctic Grayling spawning survey at Site 400, a total of 17 adult and 6 juvenile grayling were observed (Figure 3.2-1). Grayling were primarily holding in deep pools (Plate 3.2-5), as well as under undercut banks. The high number of adult grayling observed indicates that the stream likely provides important spawning habitat.

3.2.2.3 *Biology*

Table 3.2-12 presents the mean fork length, total weight, and condition of fish species captured in surveyed streams at road crossings at the George PDA in 2013.

The Arctic Grayling captured at George Inflow 2 had a mean fork length of 29 mm and a mean weight of 0.3 g. The mean condition factor was 1.26 g/mm³, within the normal range for salmonid fishes.

Mean Slimy Sculpin length at George Outflow was 70 mm. Mean total weight for sculpins was 3.1 g. Mean condition factor was 1.02 g/mm³.

Table 3.2-11. Summary of Electrofishing CPUE and Visual Observations of Fish in Surveyed Streams at George PDA Road Crossings, 2013

Site Name	Electro-fishing Effort(s)	Electrofishing (no. of fish captured)						Electrofishing CPUE (Fish/100 s)	Visual Observation		
		Arctic Grayling	Burbot	Lake Trout	Ninespine Stickleback	Slimy Sculpin	Total		Arctic Grayling	Unknown Species	Total
400 (June)	244	-	-	-	-	-	0	0.00	6	-	6
400 (July)	977	4	-	1	-	2	7	0.72	-	-	-
401	473	-	-	1	-	-	1	0.21	-	-	-

CPUE = Catch-per-unit-effort

Dashes indicate no fish were caught

Table 3.2-12. Summary of Mean Fork Length, Total Weight and Condition of Fish Captured in Surveyed Streams at George PDA Road Crossings, 2013

Site	Species	n	Fork Length (mm)					Bootstrap Fork Length (mm)			
			Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
400	Arctic Grayling	4	29	1	1	28	31	29	1	28	31
	Lake Trout	1	132	-	-	132	132	-	-	-	-
	Slimy Sculpin	2	70	11	8	62	77	70	5	62	77
401	Lake Trout	1	191	-	-	191	191	-	-	-	-
		n	Total Weight (g)					Bootstrap Total Weight (g)			
			Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
400	Arctic Grayling	4	0.3	0.1	0.1	0.2	0.5	0.3	0.1	0.2	0.5
	Lake Trout	1	26.9	-	-	26.9	26.9	-	-	-	-
	Slimy Sculpin	2	3.1	1.5	1.1	2.1	4.1	3.1	0.7	2.0	4.1
401	Lake Trout	1	71.0	-	-	71.0	71.0	-	-	-	-
		n	Condition (g/mm ³)					Bootstrap Condition (g/mm ³)			
			Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
400	Arctic Grayling	4	1.26	0.32	0.16	0.94	1.64	1.26	0.14	0.99	1.57
	Lake Trout	1	1.17	-	-	1.17	1.17	-	-	-	-
	Slimy Sculpin	2	0.87	0.04	0.03	0.84	0.90	0.87	0.02	0.84	0.90
401	Lake Trout	1	1.02	-	-	1.02	1.02	-	-	-	-

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate not applicable

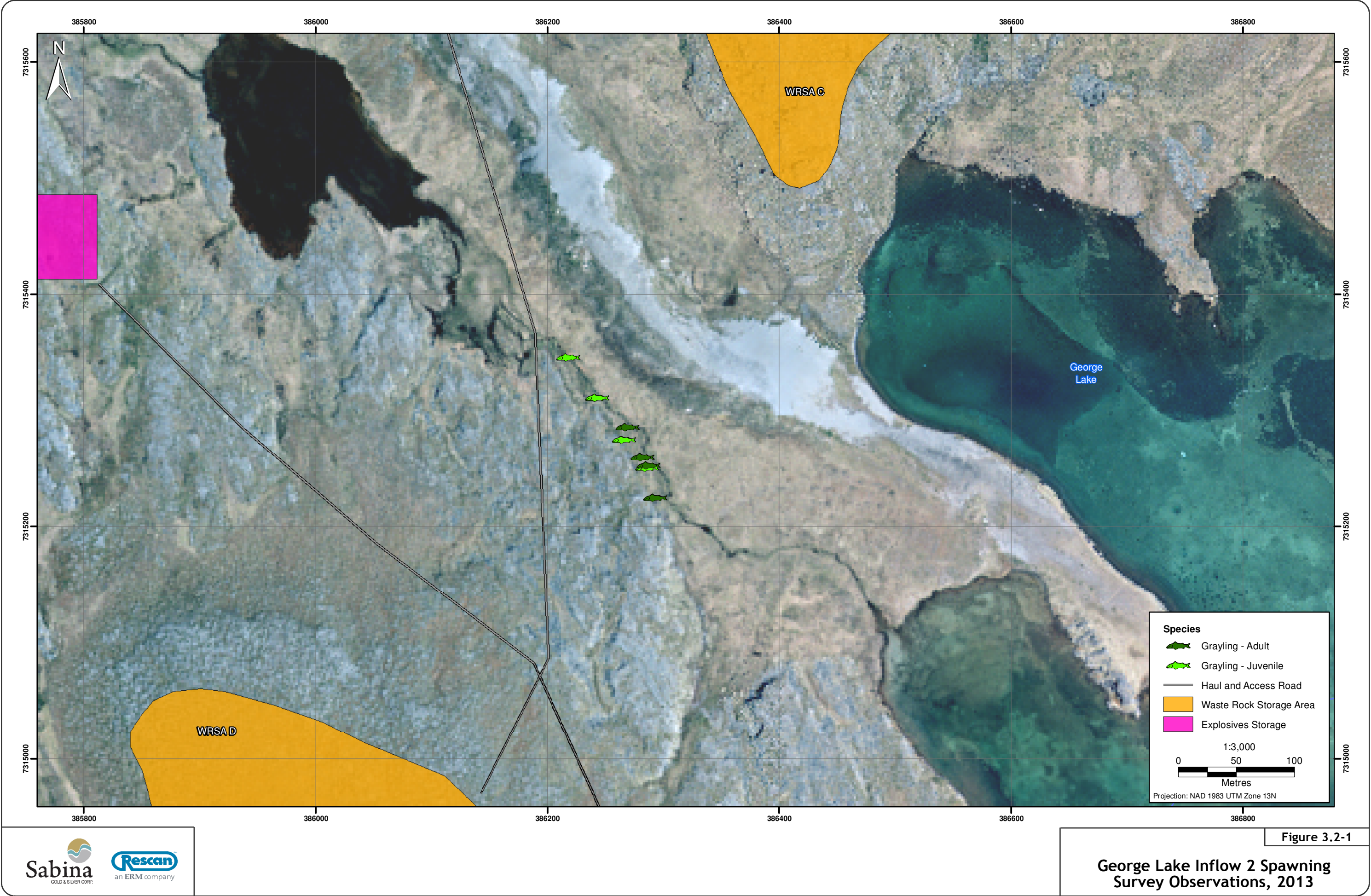




Plate 3.2-5. Spawning Arctic Grayling holding in a deep pool in George Inflow 2 in the George Property PDA, June 17, 2013.

At Site 400, the single Lake Trout captured was 132 mm in length, weighed 26.9 g, and had a condition factor of 1.17 g/mm³. At George Outflow, the single Lake Trout captured was 191 mm in length, weighed 71.0 g, and had a condition factor of 1.02 g/mm³. Both Lake Trout had condition factors within the normal range for salmonid fishes.

3.3 OTHER STREAMS

3.3.1 Goose Property PDA

3.3.1.1 Fish Habitat

In addition to the road crossing stream sites, eight streams were sampled in the Goose Property PDA. Appendix 3.3-1 shows the fish habitat data for each site. Appendix 3.3-2 shows the detailed habitat data collected from a subset of sites.

Rascal-Goose

There are seven reaches that form the Rascal-Goose stream, starting from the downstream end of Rascal-Goose stream where it discharges into Goose Lake and moving upstream towards Rascal Lake (Figure 3.3-1). Figure 3.3-1 also shows the Main Pit stream reaches which are in the same area but do not form the main Rascal-Goose stream. Reach 1 of the Rascal-Goose stream is comprised entirely of run habitat. The channel is relatively narrow (1.5 m bankfull width), braided, and at the time of the survey had overtopped the banks, creating additional off-channel habitat (Table 3.3-1). The substrate of Reach 1 is a mix of gravel, cobble, and boulder (Table 3.3-2; Plate 3.3-1). The low gradient, moderate instream cover and abundant gravel provide good spawning and rearing habitat, and as a result the reach is considered important fish habitat.

Table 3.3-1. Characteristics of Rascal-Goose Stream Reaches, 2013

Attribute	Units	Rascal-Goose Stream						
		Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7
Site number	n/a	300	301	302	305	306	307	308
Morphology	n/a	Run	Run	Riffle	Riffle	Run	Riffle	Boulder Garden
Secondary Habitat	n/a	Braided	OCH	OCH	Braided	-	-	Braided
Reach Length	m	385.9	257.6	536.9	806.0	545.0	313.7	740.6
Mean Gradient	%	1.0	0.0	1.0	1.0	0.0	4.0	1.0
Mean Bankfull Width	m	1.5	18.0	2.5	3.7	7.1	8.0	17.0
Mean Wetted Width	m	2.0	20.0	2.5	5.1	13.5	10.0	17.4
Mean Bankfull Depth	m	0.35	0.35	0.20	0.25	0.32	0.20	0.19
Mean Wetted Depth	m	0.35	0.60	0.20	0.30	0.35	0.25	0.19
Bankfull area	m ²	579	4,637	1,342	2,982	3,870	2,510	12,590
Spawning	n/a	Good	None	Poor	Fair	None	None	Fair
Overwintering	n/a	None	None	None	None	None	None	None
Rearing	n/a	Good	Fair	Fair	Fair	Poor	Fair	Good
Overall	n/a	Important	Important	Important	Important	Marginal	Important	Important

Braided = braided channel morphology

OCH = off-channel habitat

n/a = not applicable

Dashes indicate data not available



Plate 3.3-1. Braided channels with mixed cobble, gravel, and boulder substrate at Reach 1 of Rascal-Goose Stream, June 16, 2013.

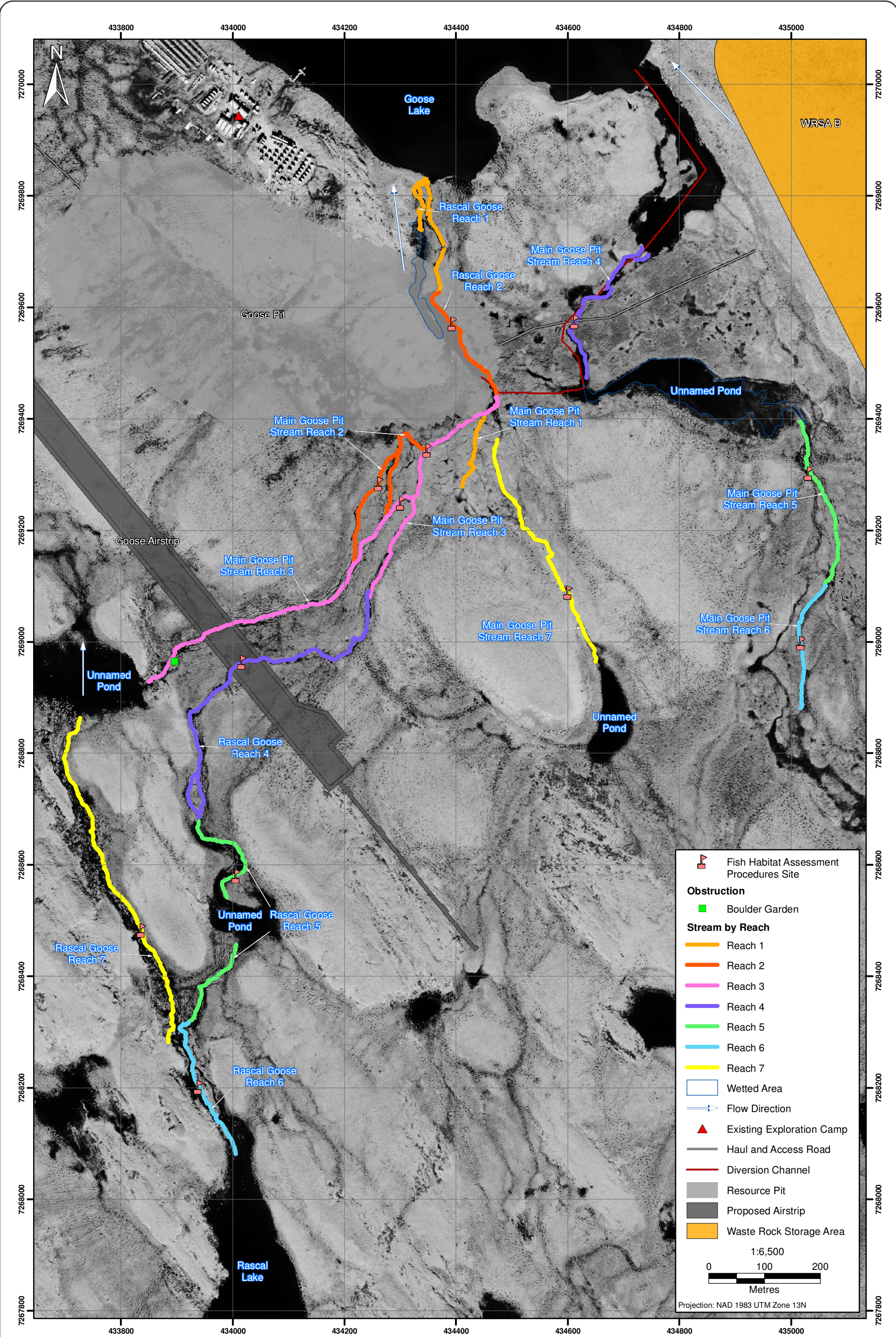


Figure 3.3-1

 **Rascal-Goose and Main Goose Pit Stream Reaches and Survey Sites, 2013**

Table 3.3-2. Weighted Mean Habitat Characteristics of Rascal-Goose Stream Reaches, 2013

Attribute	Units	Rascal-Goose Stream						
		Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Reach 7
Site number	n/a	300	301	302	305	306	307	308
Organics	%	5	98	0	0	0	4	0
Fine	%	0	0	0	0	60	0	0
Gravel	%	30	2	0	10	10	0	0
Cobble	%	40	0	75	60	20	3	20
Boulder	%	25	0	25	30	10	82	80
Bedrock	%	0	0	0	0	0	11	0
Compaction	n/a	Medium	Medium	Low	Medium	Medium	High	Medium
Bank Stability	n/a	Unstable	Unstable	Unstable	Unstable	Unstable	Stable	Unstable
Bank Substrate	n/a	Fines	Fines	Fines	Fines	Fines	Boulder	Fines
Pool	%	2	0	0	0	0	3	0
Boulder	%	0	3	2	2	1	7	20
Instream Vegetation	%	2	0	1	1	1	0	0
Overhead Vegetation	%	0	0	0	0	0	0	0
Undercut Bank	%	1	2	3	0	0	0	0
Total Cover	%	5	5	6	2	2	9	20
Number of Pools	no.	0	0	0	0	0	1	0
Mean Maximum Pool Depth	m	-	-	-	-	-	1.0	-
Mean Crest Depth	m	-	-	-	-	-	0.3	-
Residual Pool Depth	m	-	-	-	-	-	0.7	-
Riffle	no.	0	0	1	1	0	1	0
Pool	no.	0	0	0	0	0	1	0
Run	no.	1	1	0	0	1	1	0
Cascade	no.	0	0	0	0	0	0	0
Boulder Garden	no.	0	0	0	0	0	0	1
Other	no.	0	0	0	0	0	0	0

n/a = not applicable

Dashes indicate data not available

No. = number

At the time of the survey, the wetted width at Reach 2 was wider than the bankfull width by 2 m, creating off-channel habitat in flooded areas beyond the stream banks (Plate 3.3-2). The channel is wide (18.0 m bankfull width) and low gradient. Fine organic sediments are the primary substrate type. Fine substrates are deleterious to fish species that lay eggs on the stream bed as fine sediments can smother fish eggs. As a result of the substrate composition, no suitable spawning habitat was identified at Reach 2. Rearing habitat in Reach 2 is of fair quality, and overall the reach is identified as important fish habitat.

A large temporarily flooded area was observed to the west of Reach 2, running roughly parallel to the stream reach. The wetted area is comprised of ponded overland flow that drains from the west and discharges into Reach 1 (Plate 3.3-3). While likely ephemeral as evidenced by the presence of rooted terrestrial vegetation throughout the wetted area, small unidentified fish were observed within the 3,422 m² wetted area, suggesting that it provides seasonal fish habitat.



Plate 3.3-2. Off-channel habitat was present in wetted areas outside the bankfull width at Reach 2 of Rascal-Goose Stream, June 16, 2013.



Plate 3.3-3. Ephemeral fish habitat at a flooded area west of Reach 2 of Rascal-Goose Stream, June 16, 2013.

Reach 3 is comprised entirely of riffle habitat with limited braiding (Plate 3.3-4). Boulder and cobble substrates dominate within the shallow (0.2 m bankfull depth) channel. Substrate compaction is low and there is a moderate amount of instream cover provided by boulders and undercut banks, providing fair habitat for rearing fish. Overall, the reach is important fish habitat.



Plate 3.3-4. Upstream view of riffle habitat at Reach 3 of Rascal-Goose Stream, June 16, 2013.

Reach 4 is differentiated from Reach 3 by greater width (bankfull width = 3.7 m) and the presence of multiple braided channels (Plate 3.3-5). Reach 4 is the longest reach in the Rascal-Goose Stream (806 m) and comprises 22% of the stream's total length. As with Reach 3, Reach 4 is composed entirely of riffle habitat with cobble as the primary substrate type. Reach 4 contains pockets of gravel that provide fair spawning habitat and contains some instream cover from boulders that provides fair rearing habitat. The reach is characterized as important fish habitat overall.

Reach 5 encompasses the inflow and outflow of a small unnamed pond downstream of Rascal Lake. The low gradient in Reach 5 (0% slope) results in a greater retention of fines within the channel (Plate 3.3-6). Reach 5 contains little instream cover for rearing fish (poor rearing habitat) and the presence of 60% fines in the substrate results in a lack of suitable fish spawning habitat. Overall, the reach provides marginal quality fish habitat, although the pond may provide higher quality rearing habitat due to the cover provided by the deeper water.

Reach 6 is the outflow of Rascal Lake. Reach 6 is relatively heterogeneous compared to other reaches, as it contains riffle, pool, and run habitat (Plate 3.3-7). Boulders are the primary substrate type and it is the only reach of Rascal-Goose Stream to contain bedrock. The single pool in Reach 6 is deep, with a residual pool depth of 0.7 m and may provide higher quality rearing habitat. Otherwise, the quality of the rearing habitat is characterized as fair due to the high channel gradient (4%), and the large substrate size results in the absence of any observed spawning habitat. The reach is characterized as important fish habitat overall.



Plate 3.3-5. Braiding at Reach 4 of Rascal-Goose Stream, June 16, 2013.



Plate 3.3-6. Low gradient channel at Reach 5 of Rascal-Goose Stream, June 16, 2013.



Plate 3.3-7. Riffle and pool habitat at Reach 6 of Rascal-Goose Stream, June 16, 2013.

While the majority of water from Reach 6 discharges north-east into Reach 5, some discharges north-west into Reach 7, instead. Reach 7 runs approximately parallel to and west of Reach 5. Reach 7 is comprised of boulder garden habitat with open water (Plate 3.3-8). The channel is wide (17.0 m bankfull width) but shallow (0.19 bankfull depth). The reach may become seasonally impassable to fish during low flow periods due to the abundance of large, closely packed boulders. Rearing habitat in Reach 7 is of good quality, and the reach is considered important overall fish habitat.



Plate 3.3-8. Boulder-dominated substrate at Reach 7 of Rascal-Goose Stream, June 16, 2013.

Main Pit Streams

There are seven reaches that form the Main Pit streams, which are an assortment of tributaries that flow into the Rascal-Goose stream or Goose Lake within the main pit area (Figure 3.3-1). The seven reaches are not consecutive reaches of a single stream, but rather several streams in close proximity with similar habitat characteristics which will be grouped together for the purposes of this report. Reach 1 of the Main Pit streams is a side channel to Rascal-Goose Stream. It collects overland flow from west of Rascal-Goose stream and flows north to discharge into Reach 3 of Rascal-Goose Stream. It is intermittently channelized, and in between channelized sections the water flows over land through rooted vegetation and grasses (Plate 3.3-9). Where a channel is present it is very narrow (bankfull width = 0.1 m) and shallow (bankfull depth = 0.04; Table 3.3-3). Instream vegetation covers 70% of the bankfull area and the substrate is comprised entirely of organic fines (Table 3.3-4). Although there is abundant instream vegetation, poor connectivity of the channel results in poor rearing habitat, and the presence of 100% organics in the substrate results in a lack of suitable fish spawning habitat. Overall, the reach provides marginal quality fish habitat.



Plate 3.3-9. Intermittent channelization at Reach 1 of the Main Pit streams, June 16, 2013.

Reach 2 of the Main Pit streams discharges into Reach 3 of Rascal-Goose stream from the west. The morphology is composed entirely of riffle habitat with no secondary habitat present. Cobble substrates are dominant and the moderately abundant instream cover is primarily provided by boulders (Plate 3.3-10). It provides good quality rearing and spawning habitat from the abundant cover and major presence of cobble substrate. Given the limited quantity of good spawning habitat in the Goose Lake watershed, the presence and accessibility of such habitat results in the categorization of Reach 2 as critical fish habitat.

Table 3.3-3. Characteristics of Main Pit Streams Reaches, 2013

Attribute	Units	Goose Pit Streams						
		1	2	3	4	5	6	7
Site	n/a	-	303	304	500	501	502	503
Morphology	n/a	Side channel	Riffle	Run	Run	Run	Run	Run
Secondary Habitat	n/a	Int.	-	Braided	OCH	Braided	OCH	Braided
Reach Length	m	163.4	466.6	223.9	249.9	363.9	250.0	494.5
Mean Gradient	%	0.0	1.0	2.0	1.0	1.5	1.5	0.5
Mean Bankfull Width	m	0.1	2.5	5.0	2.0	2.3	0.7	0.2
Mean Wetted Width	m	0.2	2.5	5.0	3.5	3.7	2.1	0.6
Mean Bankfull Depth	m	0.04	0.20	0.31	1.10	0.10	0.08	0.10
Mean Wetted Depth	m	0.07	0.22	0.30	0.70	0.12	0.13	0.70
Bankfull area	m ²	16	1,166	1,119	499	836	175	74
Spawning	n/a	None	Good	Fair	Poor	Good	None	None
Overwintering	n/a	None	None	None	None	None	None	None
Rearing	n/a	Poor	Good	Good	Good	Good	Poor	Poor
Overall	n/a	Marginal	Critical	Important	Important	Critical	Marginal	Marginal

Braided = braided channel morphology

Int. = intermittent channelization

OCH = off-channel habitat

n/a = not applicable

Dashes indicate data not available

Table 3.3-4. Weighted Mean Habitat Characteristics of Main Pit Streams Reaches, 2013

Attribute	Units	Goose Pit Streams						
		1	2	3	4	5	6	7
Site	n/a	-	303	304	500	501	502	503
Organics	%	100	0	0	80	23	0	75
Fine	%	0	0	15	0	0	90	0
Gravel	%	0	0	0	10	42	5	0
Cobble	%	0	80	29	10	21	5	25
Boulder	%	0	20	26	0	14	0	0
Bedrock	%	0	0	0	0	0	0	0
Compaction	n/a	High	Medium	Medium	High	High	High	High
Bank Stability	n/a	Unstable	Unstable	Unstable	Stable	Unstable	Unstable	Unstable
Bank Substrate	n/a	Fines	Fines	Fines	Fines	Fines	Fines	Fines
Number of Pools	no.	0	0	0	0	0	0	0
Mean Maximum Pool Depth	m	-	-	-	-	-	-	-
Mean Crest Depth	m	-	-	-	-	-	-	-
Mean Residual Depth	m	-	-	-	-	-	-	-
Pool	%	0	0	0	2	2	0	0
Boulder	%	0	8	3	0	0	0	0
Instream Vegetation	%	70	2	3	5	4	40	30

(continued)

Table 3.3-4. Weighted Mean Habitat Characteristics of Main Pit Streams Reaches, 2013 (completed)

Attribute	Units	Goose Pit Streams						
		1	2	3	4	5	6	7
Overhanging Vegetation	%	0	0	0	0	0	10	0
Undercut Bank	%	0	0	2	3	2	0	5
Total Cover	%	70	10	8	10	8	50	35
Riffle	no.	0	1	1	0	1	1	0
Pool	no.	10	0	0	0	0	0	0
Run	no.	90	0	2	1	2	0	1
Cascade	no.	0	0	0	0	0	0	0
Boulder Garden	no.	0	0	0	0	0	0	0
Other	no.	0	0	0	0	0	0	0

n/a = not applicable

Dashes indicate data not available

No. = number



Plate 3.3-10. Instream boulders provide cover at Reach 2 of the Main Pit streams, June 16, 2013.

Reach 3 of the Main Pit streams is an outflow from an unnamed pond west of Rascal-Goose Stream and discharges into Reach 2 of the Main Pit streams and into Reach 3 of Rascal-Goose Stream. It contains riffle and run habitat units. It is larger than the other Main Pit streams (bankfull width = 5.0 m). It is important fish habitat, as it provides good rearing habitat and fair quality spawning habitat. A boulder garden creates a possible fish barrier at the upstream end of the reach (Plate 3.3-11).



Plate 3.3-11. A boulder garden at the upstream end of Reach 3 of the Main Pit streams forms a potential barrier to fish passage, June 16, 2013.

Reach 4 is located east of the Rascal-Goose stream. It discharges into a narrow embayment of Goose Lake. Reach 4 is a moderate gradient run. The bankfull width and depth are highly variable (Plate 3.3-12). At the time of the survey it had flooded beyond the 1.5 m bankfull width and as a result there was abundant off-channel habitat. The substrate is primarily fine organic matter with areas of gravel and cobble. The reach has poor potential as spawning habitat due to the abundance of fine sediments, but it contains good quality rearing habitat and is overall important fish habitat.



Plate 3.3-12. Variable stream widths and off-channel habitat at Reach 4 of the Main Pit streams, June 18, 2013.

Upstream of Reach 4 there is a large (18,800 m²) pond. At the time of the survey the pond was very shallow (maximum depth = 0.6 m) but satellite imagery and the presence of saturated, unvegetated fluvial sediments beyond the shoreline suggests that the pond size and depth may be greater at other times (Plate 3.3-13).



Plate 3.3-13. Saturated fluvial sediments on the shoreline suggest that the pond upstream of Main Pit Goose Stream Reach 4 may at times cover a greater area, June 18, 2013.

Reach 5 is located upstream of the pond, to the east of Goose-Rascal stream. The stream channel of Reach 5 is wide (bankfull width = 2.3 m), shallow (bankfull depth = 0.10 m) and braided. Both riffle and run units are present. Reach 5 contains moderate amounts of gravel substrate and instream cover, creating good spawning and rearing habitat (Plate 3.3-14). With the limited areas of good spawning habitat, the reach provides overall critical fish habitat.



Plate 3.3-14. Potential spawning gravels at Reach 5 of the Main Pit streams, June 18, 2013.

Reach 6 is located upstream of Reach 5. It is primarily differentiated from Reach 6 by its narrower width (bankfull width = 0.7 m) and the dominance of fine sediments in the substrate. The wetted width in this reach was greater than the bankfull width at the time of the survey, resulting in the formation of off-channel habitat where the surface water flowed through the surrounding grasses (Plate 3.3-15). Although there is abundant instream vegetation in the form of overhanging vegetation, poor connectivity of the channel results in poor rearing habitat. No spawning habitat was identified within the reach, and the overall habitat quality is marginal.



Plate 3.3-15. Off-channel habitat and intermittent channel at Reach 6 of the Main Pit streams, June 18, 2013.

Reach 7 of the Main Pit streams connects a small pond east of Rascal-Goose Stream to Reach 2 of Rascal Goose Stream. The channel is narrow (bankfull width = 0.2 m) and shallow (bankfull depth = 0.10 m), although the wetted width and wetted depth were greater than bankfull widths and depths at the time of the survey. The reach is braided with primarily fine sediment substrates and abundant cover in the form of instream vegetation (Plate 3.3-16). Overall the fish habitat is marginal, as there is no identified spawning habitat and the rearing habitat is poor due to the small size of the channel.

Umwelt Outflow

There are seven reaches that form the Umwelt Outflow, starting from the downstream end of Umwelt Outflow where it discharges into Goose Lake and moving upstream towards Umwelt Lake (Figure 3.3-2). Reach 1 of Umwelt Lake Outflow is directly upstream of Goose Lake. This reach is wide (bankfull width = 35.0) and deep (bankfull depth = 1.5 m) with vertical bedrock walls (Table 3.3-5 and Table 3.3-6). Habitat in the reach is provided by boulders, which are the dominant substrate (Plate 3.3-17). Pockets of water greater than 2 m in depth may provide fair quality overwintering habitat, while the abundant instream cover and low gradient provide good quality rearing habitat. The habitat in Reach 1 is characterized as important fish habitat. A short cascade at the upstream end of the reach is not likely a barrier to fish migration, but may impede the upstream migration of small fish.



Plate 3.3-16. Reach 7 of the Main Pit Streams was small with abundant instream vegetation, June 18, 2013.



Plate 3.3-17. A view of Reach 1 of Umwelt Outflow from upstream, June 15, 2013.

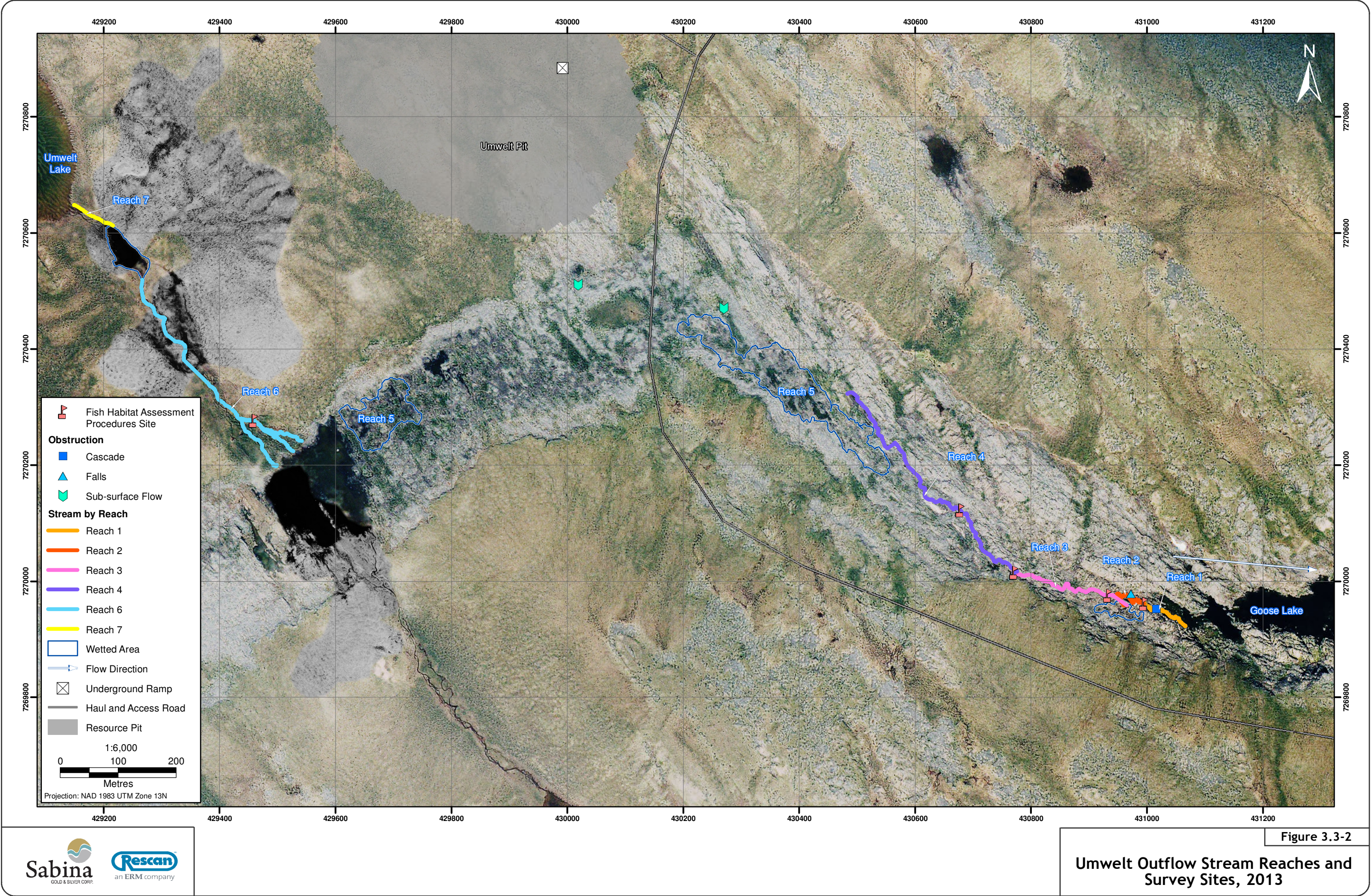


Table 3.3-5. Characteristics of Umwelt Outflow Stream Reaches, 2013

Attribute	Units	Umwelt Outflow						
		1	2	3	4	5	6	7
Site	n/a	205	206	207	208	103, 104	209	-
Morphology	n/a	Run	Cascade	Riffle	Run	BG	Run	Run
Secondary Habitat	n/a	-	-	-	-	-	Braided, OCH	OCH
Reach Length	m	156.3	177.25	284.3	582	-	471.6	79.2
Mean Gradient	%	0.5	6.0	2.0	0.5	1.0	2.0	0.0
Mean Bankfull Width	m	35.0	8.0	6.0	18.0	-	4.0	12.0
Mean Wetted Width	m	35.0	6.0	4.0	15.0	-	12.1	15.0
Mean Bankfull Depth	m	1.50	0.30	0.55	0.55	-	0.31	0.14
Mean Wetted Depth	m	1.50	0.25	0.50	0.51	-	0.28	0.14
Bankfull area	m ²	5,471	1,418	1,706	10,476	8,905	1,886	950
Spawning	n/a	None	Poor	Poor	None	None	Good	Fair
Overwintering	n/a	Fair	None	None	None	None	None	None
Rearing	n/a	Good	Poor	Good	Poor	Fair	Good	Good
Overall	n/a	Important	Marginal	Important	Marginal	Important	Important	Important

BG = boulder garden

Braided = braided channel morphology

OCH = off-channel habitat

n/a = not applicable

Dashes indicate data not available

Table 3.3-6. Weighted Mean Habitat Characteristics of Umwelt Outflow Stream Reaches, 2013

Attribute	Units	Umwelt Outflow						
		1	2	3	4	5	6	7
Organics	%	0	0	0	0	0	0	35
Fine	%	0	0	0	0	0	2	35
Gravel	%	0	4	4	0	0	3	20
Cobble	%	10	11	34	0	10	60	10
Boulder	%	70	37	59	39	80	35	0
Bedrock	%	20	49	4	61	10	0	0
Compaction	n/a	Low	Low	Low	Low	Low	Medium	High
Bank Stability	n/a	Stable	Stable	Stable	Stable	Stable	Unstable	Stable
Bank Substrate	n/a	Bedrock	Bedrock	Boulder	Bedrock	Boulder	Fines	Fines
Number of Pools	no.	0	0	0	2	-	0	0
Mean Maximum Pool Depth	m	-	-	-	0.68	-	-	-
Mean Crest Depth	m	-	-	-	0.21	-	-	-
Mean Residual Depth	m	-	-	-	0.47	-	-	-
Pool	%	0	0	0	2	20	0	0
Boulder	%	30	10	40	17	30	6	1
Instream Vegetation	%	0	0	0	2	0	2	6

(continued)

Table 3.3-6. Weighted Mean Habitat Characteristics of Umwelt Outflow Stream Reaches, 2013 (completed)

Attribute	Units	Umwelt Outflow						
		1	2	3	4	5	6	7
Overhanging Vegetation	%	0	0	0	0	0	2	3
Undercut Bank	%	0	0	0	0	0	0	0
Total Cover	%	30	10	40	20	50	10	10
Riffle	no.	0	1	1	0	0	0	0
Pool	no.	0	0	0	2	0	0	0
Run	no.	1	0	1	1	0	1	1
Cascade	no.	0	1	0	0	0	0	0
Boulder Garden	no.	0	0	1	0	1	0	0
Other	no.	0	0	0	0	0	0	0

n/a = not applicable

Dashes indicate data not available

No. = number

Cascade and riffle habitat characterize the majority of Reach 2. The reach gradient is high (6% slope), and the reach is of marginal habitat quality for fish due to the presence of a cascade barrier and thus poor rearing and spawning habitat. Subsurface flow and boulder and bedrock substrate prevent the formation of scour pools or other morphological features that could aid fish in the navigation of the 3.8 m high cascade, and as a result it forms a barrier to fish passage (Plate 3.3-18). An off-channel wetted area south of Reach 2 is unconnected to the stream channel downstream of the cascade and does not provide a route for fish passage.



Plate 3.3-18. Boulders and bedrock formations obscure the water where the change in elevation marks the barrier to fish passage at Reach 2 of Umwelt Outflow, June 15, 2013.

The habitat in Reach 3 is heterogeneous and includes riffle, run, and boulder garden habitat units (Plate 3.3-19). Boulder and cobble are the dominate substrate types and boulders provide abundant instream cover. The channel is relatively deep (bankfull depth = 0.55 m). Spawning habitat is of poor quality due to the large substrate size. The abundance of instream cover and moderate gradient provide good rearing habitat and overall important fish habitat.



Plate 3.3-19. Riffle and glide habitat at Reach 3 of Umwelt Outflow, June 15, 2013.

Reach 4 is wide (bankfull width = 18.0 m), and provides fair rearing habitat and overall marginal fish habitat. While boulder substrates provide instream cover, they may also impede fish movement through shallow areas of the channel. The majority of the reach is typified by shallow, boulder-filled runs between which there are several pools with bedrock substrate and sparse instream cover (Plate 3.3-20).

Upstream of Reach 4, Umwelt Outflow flows through a large, wetted boulder garden area that comprises Reach 5 of Umwelt Outflow (Plate 3.3-21). The wetted area covers approximately 8,905 m² and contains approximately 50% open water and 50% boulder islands, bedrock outcrops, and other non-wetted features. There is no distinct channel in this area and little to no observable flow of water, and as such some habitat summary measurements such as bankfull widths and depths were not applicable. The abundant instream cover from boulders and pools, with little flow provides fair rearing habitat, and an important overall habitat quality. The upstream end of this area is bounded by an area where all water flow is subsurface, creating an impassable barrier to fish.

Reach 6 is the primary inflow to an unnamed pond upstream of Reach 5. The reach is extensively braided, especially at the downstream end of the reach. At the time of the survey, water levels were high and the wetted width was more than double the bankfull width (wetted width = 12.1 m; bankfull width = 4.0 m). The flooded area created additional instream cover where it flowed through vegetated areas (Plate 3.3-22). Cobble and boulder are the primary substrate types, however pockets of gravel provide good potential spawning habitat. The moderate gradient and instream cover provide good rearing habitat. The overall habitat is valued as important. The upstream end of Reach 6 is bounded by an unnamed shallow pond with primarily fine organic substrates and little fish cover. The wetted area of the pond is 3,201 m².



Plate 3.3-20. Run with boulder substrate and pool with bedrock substrate in Reach 4 of Umwelt Outflow, June 15, 2013.



Plate 3.3-21. Non-channelized wetted area upstream of Reach 4 of Umwelt Outflow, June 15, 2013.



Plate 3.3-22. Off-channel habitat at Reach 6 of Umwelt Outflow, June 15, 2013.

Reach 7 discharges from Umwelt Lake into the unnamed pond. It is a shorter reach (79.2 m) with fair spawning habitat and good rearing habitat. The overall habitat quality is important. The substrate is a combination of organic fine sediment, sand, and gravel (Plate 3.3-23). Instream cover was provided by instream vegetation in flooded areas outside the banks.



Plate 3.3-23. Small pockets of spawning gravel at Reach 7 of Umwelt Outflow, June 15, 2013.

Llama Outflow

There are two reaches that form the Llama Outflow, starting from the downstream end of Llama Outflow where it discharges into Umwelt Lake and moving upstream towards Llama Lake (Figure 3.3-3). Reach 1 of Llama Outflow is immediately upstream of Umwelt Lake (Plate 3.3-24). It is a narrow reach (bankfull width = 0.7 m), although at the time of the survey the water had flooded over the banks and was providing off-channel habitat (wetted width = 3.1 m; Table 3.3-7 and Table 3.3-8). The substrate is primarily cobble and boulder, which provides abundant instream cover and good habitat for rearing fish. The spawning habitat is of fair quality and the reach contains important overall fish habitat.



Plate 3.3-24. Reach 1 of Llama Outflow upstream of Umwelt Lake, June 18, 2013.

Reach 2 of Llama Outflow is of moderate size (bankfull width = 2.9 m) and is shallow (bankfull depth = 0.13 m). The substrate is a mixture of fines, gravel, cobble, and boulder, with appropriate-sized substrate to provide good grayling spawning habitat in some microhabitat units (Plate 3.3-25). The habitat is also of good quality for rearing. Good spawning habitat is not common in the Llama and Umwelt area, and as a result the good spawning habitat in Llama Outflow is of critical value.

Giraffe Inflow

There are five reaches that form the Giraffe Inflow, starting from the downstream end of Giraffe Inflow where it discharges into Giraffe Lake and moving upstream (Figure 3.3-4). Directly upstream of Giraffe Lake, Reach 1 of Giraffe Inflow consists of boulder garden morphology with only intermittent areas of open water between which water flows subsurface (Table 3.3-9). Although off-channel habitat and other types of non-channelized wetted areas are frequent within Reach 1, there is no continuous wetted area that could provide potential fish passage upstream of Giraffe Lake and thus no fish habitat is present (Plate 3.3-26). Where surface water is present, deep pools are a frequent habitat type, although some riffle habitat was also identified (Table 3.3-10).

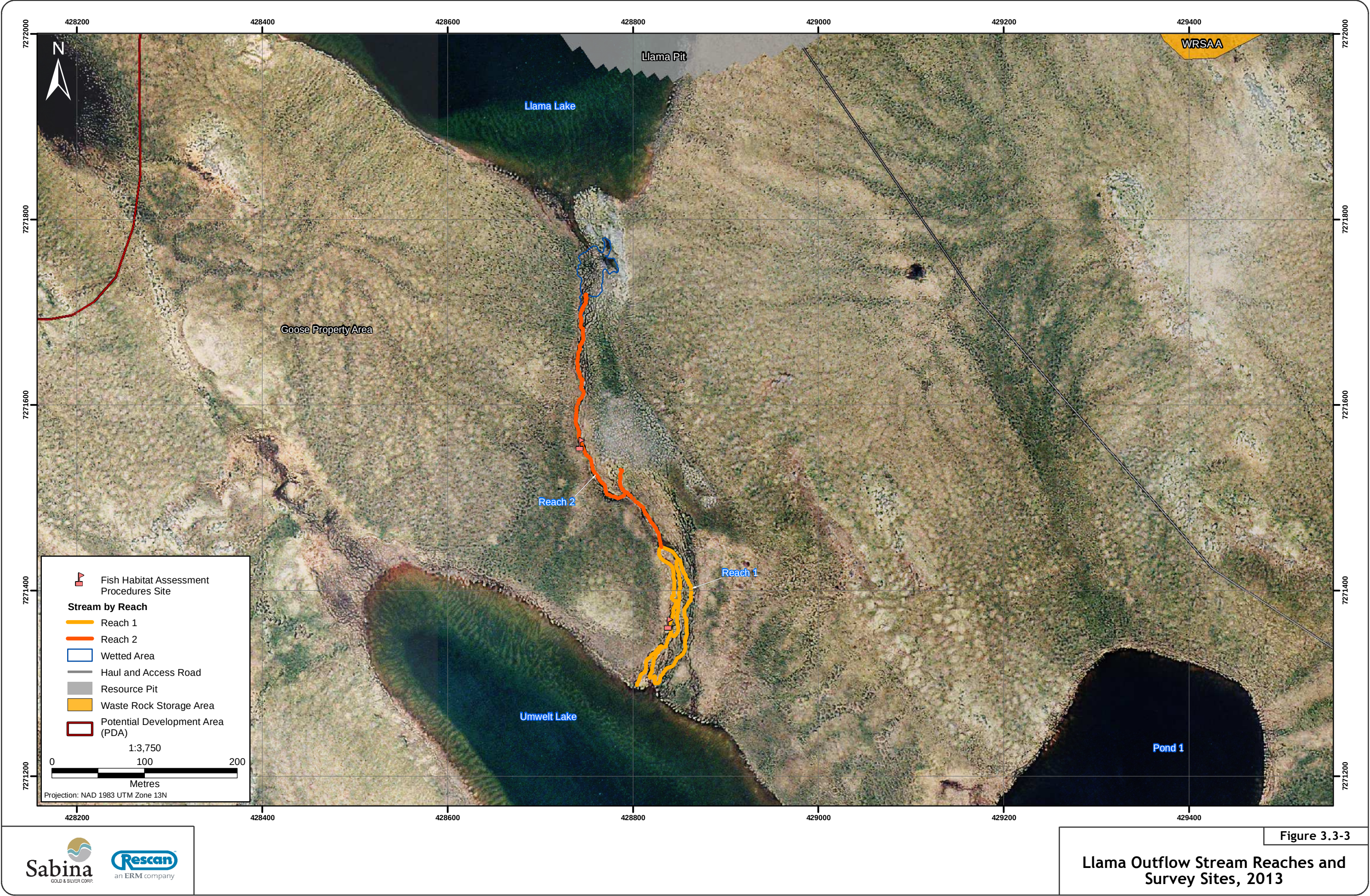


Table 3.3-7. Characteristics of Llama Outflow Stream Reaches, 2013

Attribute	Units	Llama Outflow	
		1	2
Site	n/a	505	506
Morphology	n/a	Run	Run
Secondary Habitat	n/a	Braided with OCH	-
Reach Length	m	160	276.4
Mean Gradient	%	1.0	1.0
Mean Bankfull Width	m	0.7	2.9
Mean Wetted Width	m	3.1	3.1
Mean Bankfull Depth	m	0.09	0.13
Mean Wetted Depth	m	0.14	0.13
Bankfull area	m ²	117	802
Spawning	n/a	Fair	Good
Overwintering	n/a	None	None
Rearing	n/a	Good	Good
Overall	n/a	Important	Important

Braided = braided channel morphology

OCH = off-channel habitat

n/a = not applicable

Dashes indicate data not available

Table 3.3-8. Weighted Mean Habitat Characteristics of Llama Outflow Stream Reaches, 2013

Attribute	Units	Llama Outflow	
		1	2
Organics	%	0	0
Fine	%	0	5
Gravel	%	0	10
Cobble	%	70	65
Boulder	%	30	20
Bedrock	%	0	0
Compaction	n/a	Medium	Medium
Bank Stability	n/a	Stable	Stable
Bank Substrate	n/a	Cobble	Cobble
Number of Pools	no.	0	0
Mean Maximum Pool Depth	m	-	-
Mean Crest Depth	m	-	-
Mean Residual Depth	m	-	-
Pool	%	0	0
Boulder	%	30	5
Instream Vegetation	%	0	2
Overhanging Vegetation	%	0	0

(continued)

Table 3.3-8. Weighted Mean Habitat Characteristics of Llama Outflow Stream Reaches, 2013 (completed)

Attribute	Units	Llama Outflow	
		1	2
Undercut Bank	%	0	1
Total Cover	%	30	8
Riffle	no.	0	0
Pool	no.	0	0
Run	no.	1	1
Cascade	no.	0	0
Boulder Garden	no.	0	0
Other	no.	0	0

n/a = not applicable

Dashes indicate data not available

No. = number



Plate 3.3-25. Mixed substrate types in Reach 2 of Llama Outflow, June 18, 2013.

Reach 2 is a long (383.6 m) deep (1.2 m maximum depth) pool-riffle complex located upstream of the barriers identified in Reach 1. Boulder and bedrock are the dominant substrate types (Plate 3.3-27). The gradient is low. Rearing habitat is of fair quality, but no spawning or overwintering habitat was identified within the reach. Habitat in Reach 2 has no value to fish populations due to barriers upstream and downstream preventing movement in or out of the reach.

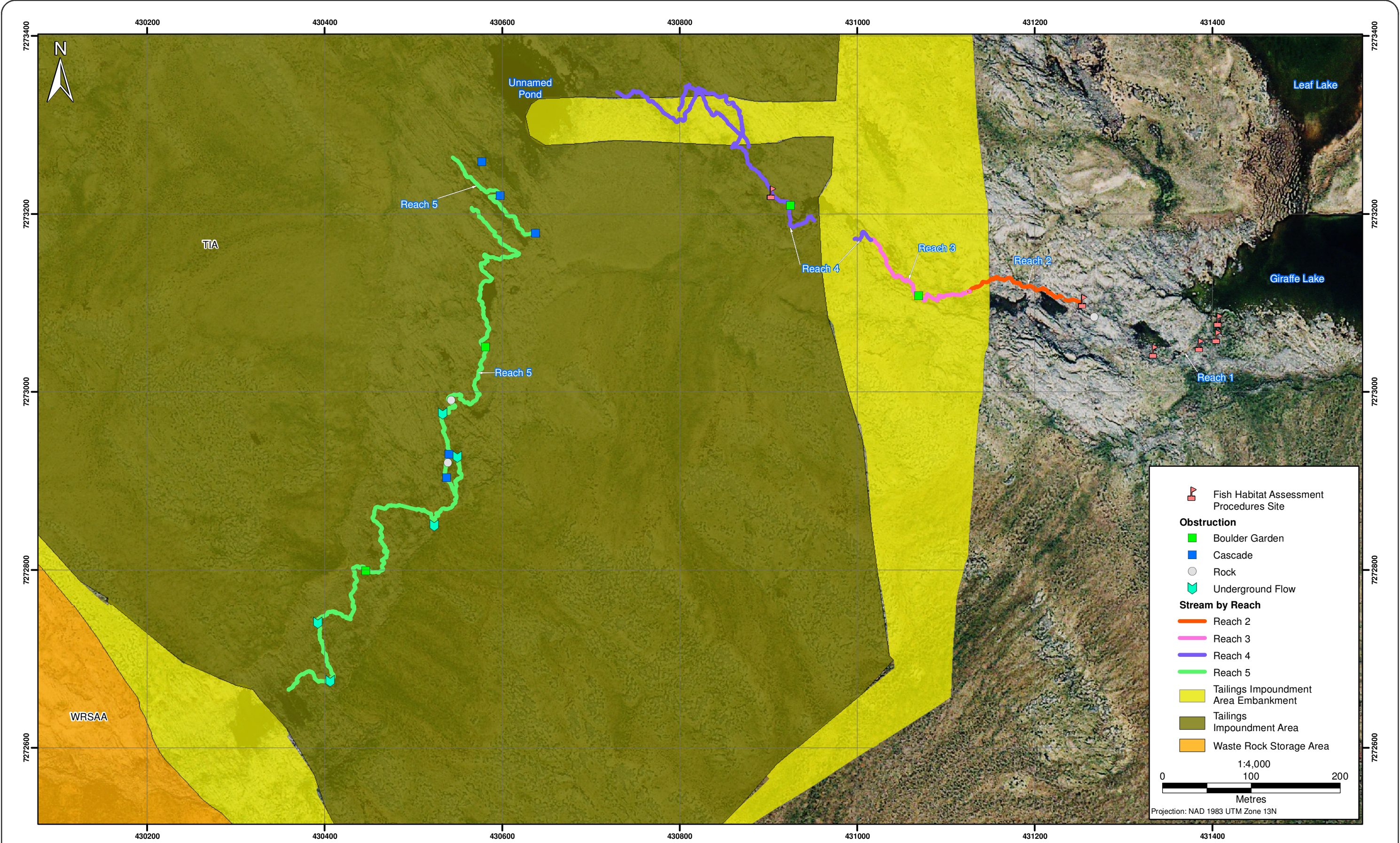


Table 3.3-9. Characteristics of Giraffe Inflow Stream Reaches

Attribute	Units	Giraffe Inflow				
		1	2	3	4	5
Site	n/a	210, 211, 212, 213	200	201	203	-
Morphology	n/a	Boulder Garden	Pool	Boulder Garden	Riffle	Riffle
Secondary Habitat	n/a	OCH	OCH	Intermittent channel	OCH, incoming seeps	Braided, incoming seeps
Reach Length	m	-	383.6	663.6	103.8	522.7
Mean Gradient	%	0.5	0.0	1.0	1.0	2.5
Mean Bankfull Width	m	11.6	9.0	1.0	10.0	10.0
Mean Wetted Width	m	11.4	15.0	1.0	8.0	9.0
Mean Bankfull Depth	m	0.36	0.80	0.15	0.35	0.35
Mean Wetted Depth	m	0.51	1.00	0.15	0.31	0.30
Bankfull area	m ²	-	3,452	630	1,038	5,227
Spawning	n/a	None	None	None	None*	None*
Overwintering	n/a	None	None	None	None	None*
Rearing	n/a	None	None*	None*	None*	None*
Overall	n/a	None	None*	None*	None*	None*

Braided = braided channel morphology

OCH = off-channel habitat

n/a = not applicable

Dashes indicate data not available

** Lack of habitat a consequence of fish access to reach, not habitat characteristics*



Plate 3.3-26. Fish access upstream of the deep pool (left) is prevented by rocks and subsurface flow forming a barrier (right), Reach 1, Giraffe Inflow, June 14, 2013.

Table 3.3-10. Weighted Mean Habitat Characteristics of Giraffe Inflow Stream Reaches, 2013

Attribute	Units	Giraffe Inflow				
		1	2	3	4	5
Organics	%	0	0	0	0	0
Fine	%	3	5	2	0	0
Gravel	%	4	0	8	10	2
Cobble	%	10	20	38	40	35
Boulder	%	68	40	38	40	35
Bedrock	%	13	35	14	10	28
Compaction	n/a	-	Low	Low	Low	Low
Bank Stability	n/a	Stable	Stable	Stable	Stable	Stable
Bank Substrate	n/a	-	Bedrock	Boulder	Boulder	Bedrock
Number of Pools	no.	2	1	1	0	0
Mean Maximum Pool Depth	m	1.00	1.20	0.68	-	-
Mean Crest Depth	m	0.15	-	0.10	-	-
Mean Residual Depth	m	0.85	-	0.58	-	-
Pool	%	0	4	1	0	0
Boulder	%	19	19	16	10	15
Instream Vegetation	%	3	3	0	0	0
Overhanging Vegetation	%	15	0	2	10	10
Undercut Bank	%	4	0	0	0	0
Total Cover	%	30	25	20	20	25
Riffle	no.	2	0	0	1	-
Pool	no.	2	1	1	0	-
Run	no.	1	0	1	0	-
Cascade	no.	0	0	0	0	-
Boulder Garden	no.	3	0	0	0	-
Other	no.	0	0	0	0	-

n/a = not applicable

Dashes indicate data not available

No. = number

Reach 3 is a boulder garden with intermittent channelization (Plate 3.3-28). An impassable boulder garden located mid-reach prevents potential fish passage through the reach. Instream and bank substrates are dominated by boulder and cobble. The open water areas are characterized by pool and riffle morphology. Pools and riffles are created due to bedrock formations, and there is little evidence of streambed scour influencing stream morphology. Habitat in Reach 3 has no value to fish populations due to barriers preventing movement into and within the reach.

Reach 4 is primarily riffle habitat. There is abundant off-channel habitat and several locations where groundwater seeps enter the main channel. As in Reaches 1 through 3, boulder and cobble are the dominant substrate types, but in Reach 4 there are pockets of gravel that provide potential, though poor-quality, spawning habitat. Instream boulders and overhanging vegetation from small shrubs provide instream cover, and the potential as rearing habitat is fair. Habitat in Reach 4 has no value to fish populations due to barriers upstream and downstream preventing movement in or out of the reach. Approximately 80 m upstream of the downstream end of the reach, a shallow boulder garden forms a fish barrier preventing fish movement into the reach from downstream (Plate 3.3-29).

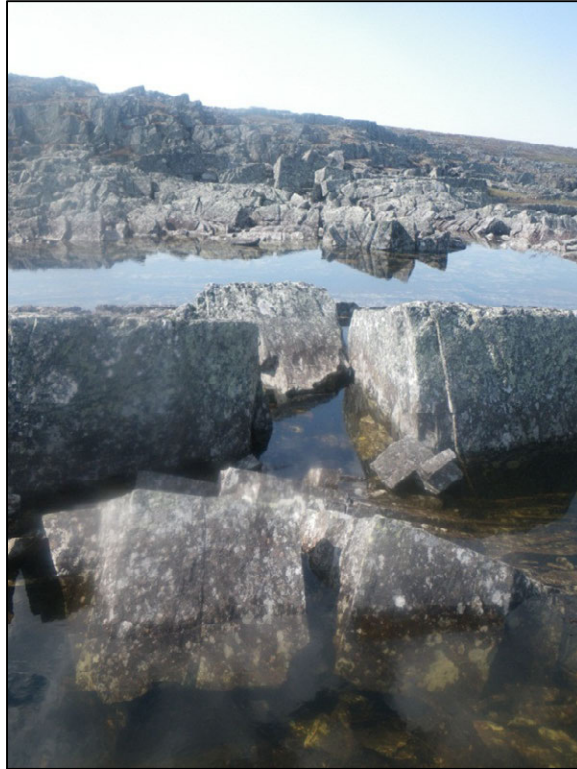


Plate 3.3-27. Large boulder and bedrock substrate at Reach 2 of Giraffe Inflow, June 14, 2013.



Plate 3.3-28. Intermittent channelization at Reach 3 of Giraffe Inflow, June 19, 2013.



Plate 3.3-29. Boulder garden fish barrier at Reach 4 of Giraffe Inflow, June 14, 2013.

An unnamed pond is located upstream of Reach 4. The majority of the pond shoreline is unvegetated boulders and bedrock. The shoreline is complex, with embayments and bedrock protrusions (Plate 3.3-30). The depth of the pond is unknown, and therefore its suitability as overwintering habitat could not be determined.

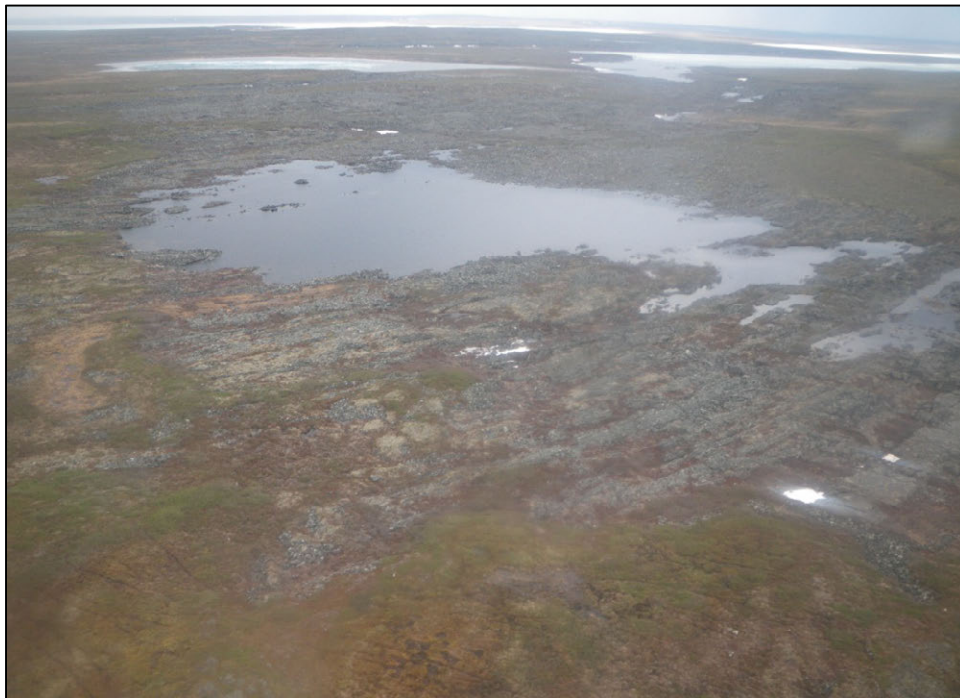


Plate 3.3-30. Pond between Reaches 4 and 5 of Giraffe Inflow, June 14, 2013.

Reach 5 is an inlet to the unnamed pond. This reach is characterized by intermittent and braided channelization and frequent barriers to fish passage (Plate 3.3-31). Cascades, boulder gardens, areas of underground flow, and rock barriers were all identified in this reach for a total of 14 permanent barriers, with many additional seasonal or partial barriers to fish passage. There is no fish habitat due to the barriers to fish passage.



Plate 3.3-31. One of multiple barriers to fish passage at Reach 5 of Giraffe Inflow, June 19, 2013.

Water volume decreases at the upstream end of Reach 5 (Plate 3.3-32). Water in Reach 5 is sourced from several seeps where overland flow with no identifiable stream channels discharge into Giraffe Inflow. These non-channelized drainages are shallow and temporary and do not provide fish habitat. They were not mapped.

Wasp Inflow

There are two reaches that form the Wasp Inflow, starting from the downstream end of Wasp Inflow where it discharges into Wasp Lake and moving upstream (Figure 3.3-5). Reach 1 of Wasp Inflow discharges directly into Wasp Lake. Reach 1 is a boulder garden with a continuous, braided wetted channel (Table 3.3-11). The channel is small (bankfull width = 1.2 m) and shallow (bankfull depth = 0.8 m; wetted depth = 0.1 m; Table 3.3-12). Fine sediments are the dominant substrate type, although occasional highly embedded boulders added habitat complexity and instream cover. Four barriers to fish passage were identified: two cascades and two impassable boulder garden areas (Plate 3.3-33). Spawning habitat is poor quality due to the high percentage of fine substrates, and rearing habitat is of fair quality. Overall, the habitat is of marginal value.

An unnamed pond was identified upstream of Reach 1. The pond is 0.4 m in depth, with no discernible outflow (Plate 3.3-34). The pond shoreline is irregular, creating embayments and small projections of non-wetted land. The substrate is entirely fine organic sediment. The wetted area of the pond is 1,811 m².



Plate 3.3-32. Aerial view of the non-channelized drainage upstream of Reach 5 of Giraffe Inflow, June 14, 2013.

Table 3.3-11. Characteristics of Wasp Inflow Stream Reaches, 2013

Attribute	Units	Wasp Inflow	
		1	2
Site	n/a	215	214, 600
Morphology	n/a	Boulder Garden	Standing water
Secondary Habitat	n/a	Braided	Intermittent channel
Reach Length	m	608.86	1110.6
Mean Gradient	%	2.0	1.0
Mean Bankfull Width	m	1.2	0.5
Mean Wetted Width	m	1.0	0.5
Mean Bankfull Depth	m	0.80	0.10
Mean Wetted Depth	m	0.10	0.10
Bankfull area	m ²	731	555
Spawning	n/a	Poor	None
Overwintering	n/a	None	None
Rearing	n/a	Fair	Poor
Overall	n/a	Marginal	Marginal

Braided = braided channel morphology

n/a = not applicable

Dashes indicate data not available

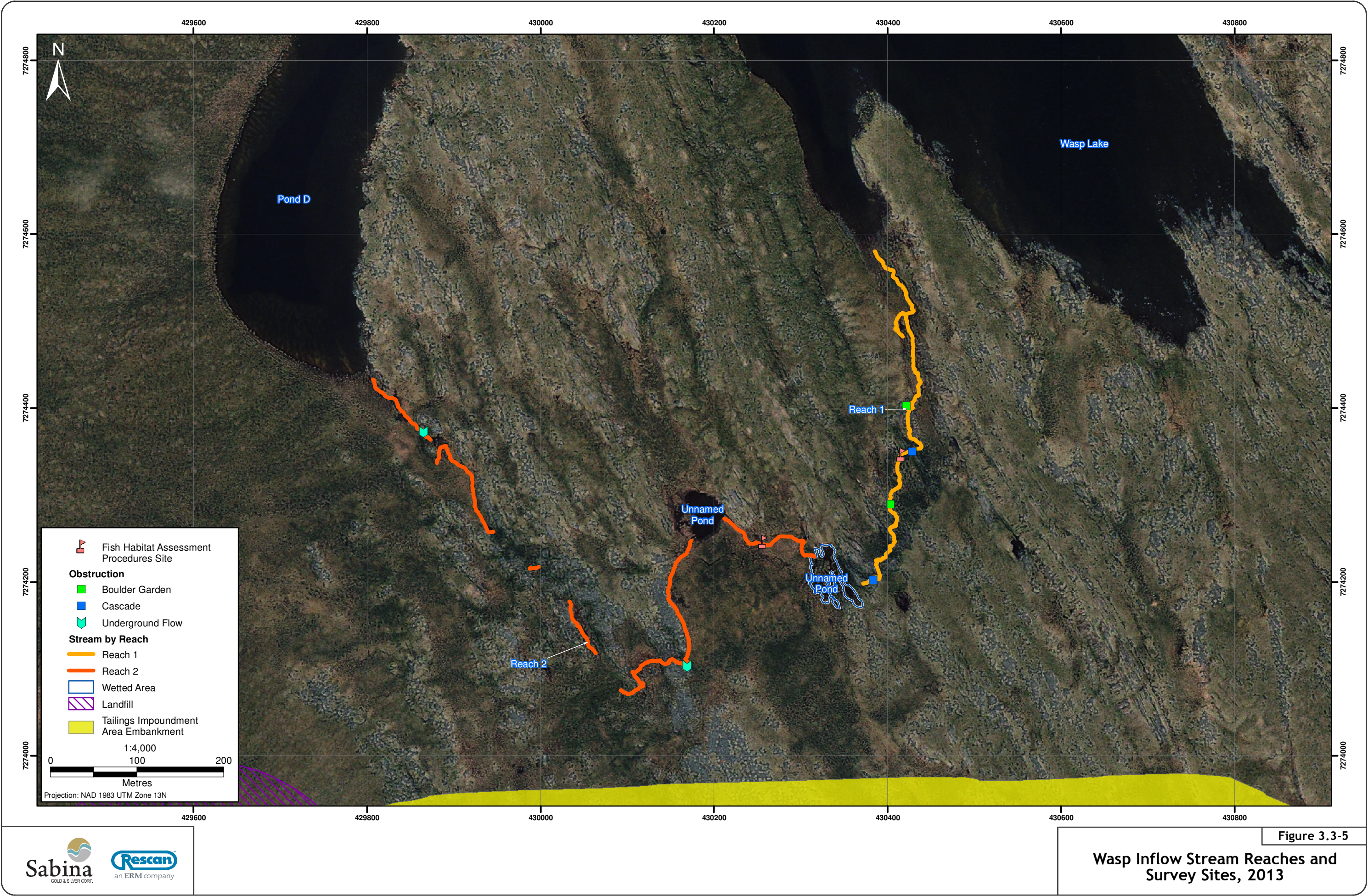


Figure 3.3-5

Wasp Inflow Stream Reaches and Survey Sites, 2013

Table 3.3-12. Weighted Mean Habitat Characteristics of Wasp Inflow Stream Reaches, 2013

Attribute	Units	Wasp Inflow	
		1	2
Organics	%	42	20
Fine	%	20	0
Gravel	%	8	10
Cobble	%	8	55
Boulder	%	22	15
Bedrock	%	0	0
Compaction	n/a	High	High
Bank Stability	n/a	Stable	Unstable
Bank Substrate	n/a	Bedrock	Fines
Number of Pools	no.	1	0
Mean Maximum Pool Depth	m	-	-
Mean Crest Depth	m	-	-
Mean Residual Depth	m	-	-
Pool	%	0	0
Boulder	%	11	2
Instream Vegetation	%	8	3
Overhanging Vegetation	%	8	0
Undercut Bank	%	2	0
Total Cover	%	30	5
Riffle	no.	0	0
Pool	no.	1	0
Run	no.	5	1
Cascade	no.	0	0
Boulder Garden	no.	0	0
Other	no.	0	0

n/a = not applicable

Dashes indicate data not available

No. = number

Reach 2 is the inflow to the unnamed pond. Reach 2 is formed of unconnected units of shallow standing water (bankfull depth = 0.1 m). In between units of surface water, water flows or seeps underground and could not be mapped. The substrate is comprised of boulders and cobbles embedded in fine sediment. The habitat value is marginal due to the lack of connectivity within the reach (Plate 3.3-35). Reach 2 contains another shallow, unnamed pond with fine organic substrate.

Goose Outflow

The outflow to Goose Lake is comprised of a single reach connecting Goose Lake and Propeller Lake (Figure 3.3-6). The reach contains only two habitat units, both characterized by run morphology (Table 3.3-13). The two habitat units are separated by a wide pond. The stream channel is wide (bankfull width = 40.0 m) but shallow (bankfull depth = 0.2 m; Table 3.3-14). Cobble and boulder are the dominant substrate types, and within the channel numerous clusters of boulders support small islands of vegetation and create a complex channel with instream cover (Plate 3.3-36). Rearing habitat among these small islands is of good quality. Pockets of gravel substrate provide fair quality spawning habitat. Overall, habitat in Goose Outflow is important to fish populations.



Plate 3.3-33. The first barrier to fish passage at Reach 1 of Wasp Inflow is a boulder garden, June 19, 2013.



Plate 3.3-34. Downstream end of the unnamed pond upstream of Reach 1 of Wasp Inflow, with no visible surface outflow, June 19, 2013.



Plate 3.3-35. Reach 2 of Wasp Inflow has no flow and low connectivity, June 19, 2013.

Table 3.3-13. Characteristics of Goose Outflow Stream Reaches, 2013

Attribute	Units	Goose Outflow 1
Site	n/a	814
Morphology	n/a	Run
Secondary Habitat	n/a	-
Reach Length	m	577.8
Mean Gradient	%	40.0
Mean Bankfull Width	m	40.0
Mean Wetted Width	m	1.0
Mean Bankfull Depth	m	0.2
Mean Wetted Depth	m	0.2
Bankfull area	m ²	23,112
Spawning	n/a	Fair
Overwintering	n/a	None
Rearing	n/a	Good
Overall	n/a	Important

n/a = not applicable

Dashes indicate data not available

Table 3.3-14. Weighted Mean Habitat Characteristics of Goose Outflow Stream Reaches, 2013

Attribute	Units	Goose Outflow 1
Organics	%	0.0
Fine	%	5.0
Gravel	%	15.0
Cobble	%	55.0
Boulder	%	25.0
Bedrock	%	0.0
Compaction	n/a	Low
Bank Stability	n/a	Stable
Bank Substrate	n/a	Cobble
Number of Pools	no.	0
Mean Maximum Pool Depth	m	-
Mean Crest Depth	m	-
Mean Residual Depth	m	-
Pool	%	0
Boulder	%	5
Instream Vegetation	%	1
Overhanging Vegetation	%	1
Undercut Bank	%	0
Total Cover	%	0
Riffle	no.	0
Pool	no.	0
Run	no.	1
Cascade	no.	0
Boulder Garden	no.	0
Other	no.	0

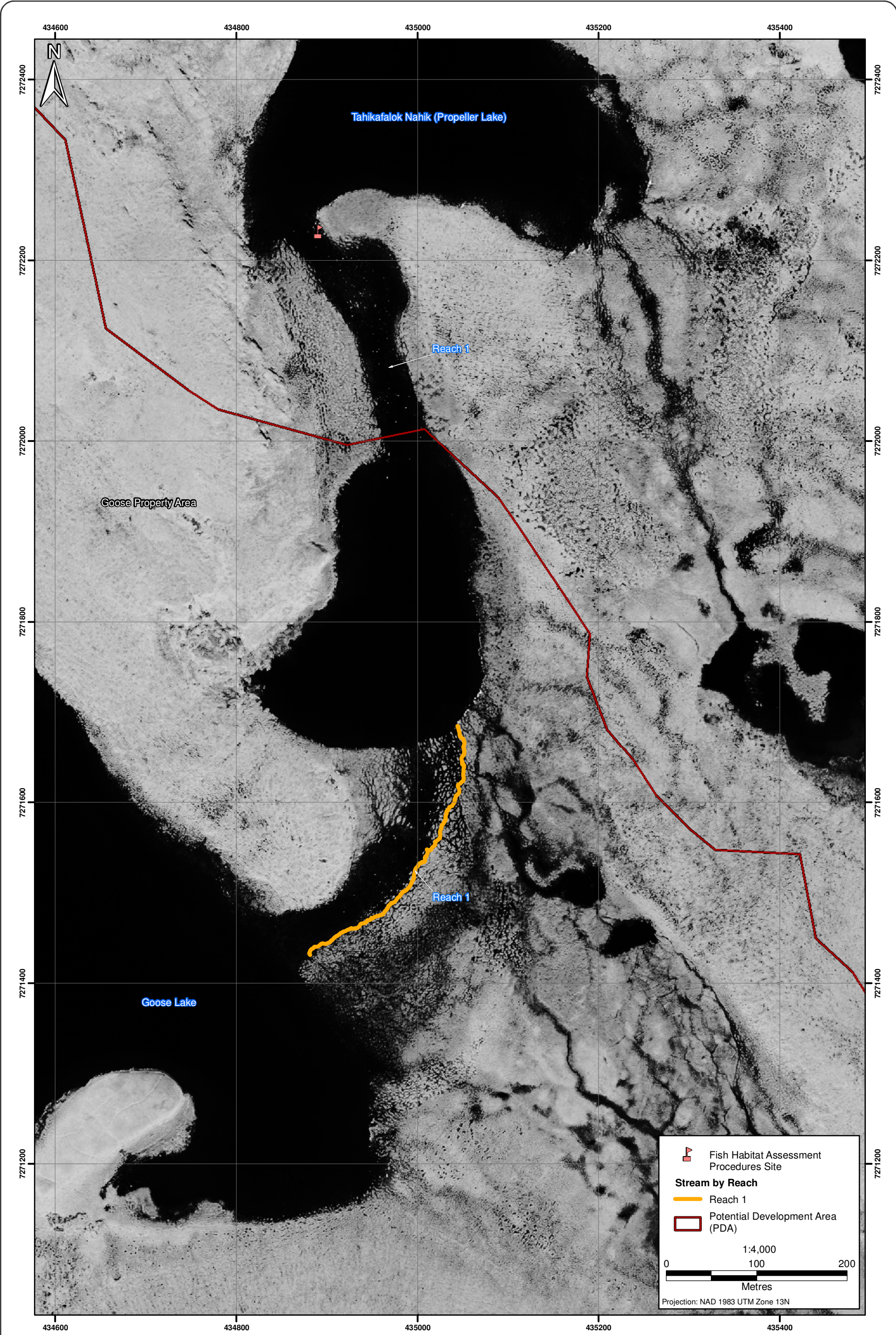
n/a = not applicable

Dashes indicate data not available

No. = number



Plate 3.3-36. Aerial view of the downstream end of Goose Outflow, looking north towards Propeller Lake, June 20, 2013.



3.3.1.2 Fish Community

Species Composition

Four fish species were captured or observed in surveyed PDA streams in 2013: Arctic Grayling (Plate 3.3-37), Ninespine Stickleback, Round Whitefish, and Slimy Sculpin. Appendix 3.3-3 presents the sampling effort and catch summary. Appendix 3.3-4 presents the individual fish data. Table 3.3-15 presents the life history periodicity for species captured in the Goose PDA in 2013. Section 3.2.1.2 describes the life history and general stream habitat use information pertaining to Arctic Grayling, Ninespine Stickleback, and Slimy Sculpin. Streams are not generally considered Round Whitefish habitat, and no information is available regarding their stream habitat use patterns.



Plate 3.3-37. Juvenile Arctic Grayling captured at Llama outflow, June 18, 2013.

CPUE

Fish were captured by electrofishing in three of six streams sampled (Table 3.3-16). No fish were captured in the Giraffe Inflow although a single Slimy Sculpin was observed in Giraffe Lake at the mouth of the inlet. Fish barriers were identified near the mouth of the stream, upstream of the single fish observation, and additional barriers were identified throughout the upstream reaches. The frequent barriers prevent fish from moving downstream or upstream from Giraffe Inflow to overwintering habitat. No fish were captured despite 1,385 seconds of electrofishing effort in 2013, and suitable habitat was not available for all life stages, Giraffe Inflow is likely non-fish bearing.

No fish were captured in the inflow to Pond A.

A total of 688 seconds of electrofishing effort in Umwelt Outflow did not result in the capture of any fish. A fish barrier at the upstream end of Reach 1 prevents fish from migrating into the upstream reaches, and the channel is impassable to fish moving downstream into Reaches 2 through 5 due to a long section of subsurface flow at the downstream end of Reach 6. There is no overwintering habitat in Reaches 2 through 5, and these reaches are likely non-fish bearing. Reach 1, Reach 6, and Reach 7 are assumed fish bearing, due to their connectivity to fish bearing water bodies.

Table 3.3-15. Fish Life History Periodicity Table for Species Captured in the Project Area, 2013

Species	Life stage	Habitat	Month											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arctic Grayling	Spawning	Streams/Rivers												
	Hatching	Streams/Rivers												
	Fry rearing/migration	Streams/Rivers												
	Rearing/overwintering	Rivers/Lakes												
	Adult migration	Streams/Rivers												
Lake Trout	Spawning	Lakes												
	Hatching	Lakes												
	Fry emergence	Lakes												
	Rearing/overwintering	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												
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.

* Limited data known about the life history of the Slimy Sculpin in the Arctic.

Table 3.3-16. Summary of Electrofishing CPUE and Visual Observations of Fish in Potential Development Area Streams, 2013

Site Name	Electro-fishing Effort(s)	Electrofishing (No. of Fish Captured)					Electrofishing	Visual Observation	
		Arctic Grayling	Ninespine Stickleback	Round Whitefish	Slimy Sculpin	Total	CPUE (Fish/100 s)	Slimy Sculpin	Total
Giraffe inflow	1,384	-	-	-	-	0	0	1	1
Llama outflow	895	2	2	-	2	6	0.67	-	-
Main Pit streams	959	31	2	1	18	52	5.42	-	-
Pond A inflow	104	-	-	-	-	0	0	-	-
Umwelt outflow	688	-	-	-	-	0	0	-	-
Wasp Lake inflow	478	1	-	-	1	2	0.42	2	2

CPUE = Catch-per-unit-effort

Dashes indicate no fish caught

Among the sites where fish were captured, electrofishing CPUE ranged from 0.42 fish/100 s at Wasp Lake Inflow to 5.42 fish/100 s at the Main Pit streams. Arctic Grayling and Slimy Sculpin were the most widespread species in surveyed streams. Arctic Grayling were also the most abundant species. Species diversity was greatest in the Main Pit streams, with four species and a total of 52 fish captured. The second most diverse stream was Llama Lake Outflow in which 3 species and a total of 6 fish were captured.

Arctic Grayling Spawning and Fry Surveys

Spawning surveys were conducted on the Main Pit streams (Rascal-Goose area; Figure 3.3-7), and the Llama-Goose streams. Appendix 3.3-5 shows the detailed results of the spawning surveys.

During the spawning survey of the Main Pit streams, Arctic Grayling, Slimy Sculpin, and fish of unidentified species were observed (Figure 3.3-8). A total of 9 adults and 16 juvenile grayling were observed throughout the streams. Some of the adults were holding over gravel substrate, at typical spawning habitat. Other adults were observed at cobble-boulder riffles, which is not typical spawning habitat although it is similar to spawning habitat occasionally reported for northern populations (McPhail, 2007). Most observed spawners were found at streams west of the main Rascal-Goose channel.

No fish were observed at Umwelt Outflow. Two fish, one juvenile Arctic Grayling and one Slimy Sculpin, were observed at Llama Outflow (Figure 3.3-9). The absence of observed Arctic Grayling spawners may indicate that these streams are not used by spawning grayling; however, the presence of juvenile Arctic Grayling in the system indicates that spawning is occurring in the system, and as no other suitable spawning habitat has been identified, it must be assumed that these streams may be used by spawning grayling. Grayling have been known to spawn over a wide variety of substrates and will spawn in less suitable habitat including fine sediments if there are no alternatives.

Fry surveys were undertaken on the Main Pit streams. Appendix 3.3-6 shows the detailed results of the fry surveys. Three species were identified (Arctic Grayling, Slimy Sculpin, and Ninespine Stickleback) as well as unidentified fish in the Main Pit streams (Figure 3.3-10). A total of 1,656 Arctic Grayling fry were seen throughout the streams, with 1,122 fry found in Rascal-Goose stream (Plate 3.3-38). Along the main Rascal-Goose stream, the majority of the fry were found in pools or large ponds with boulder/cobble substrate. A total of 22 juvenile (between 70 and 120 mm) grayling were observed in the Main Pit streams. Of the other species, 237 Ninespine Stickleback, 7 Slimy Sculpin, and 4 unidentified fish were observed. The Main Pit streams provide high quality habitat for rearing Arctic Grayling fry.

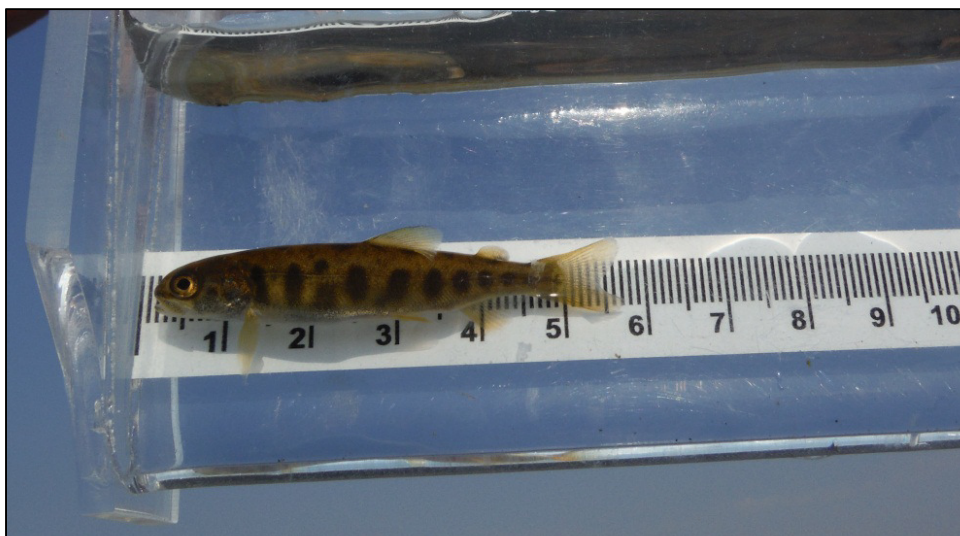


Plate 3.3-38. Arctic Grayling fry in Main Pit streams, August 12, 2013.

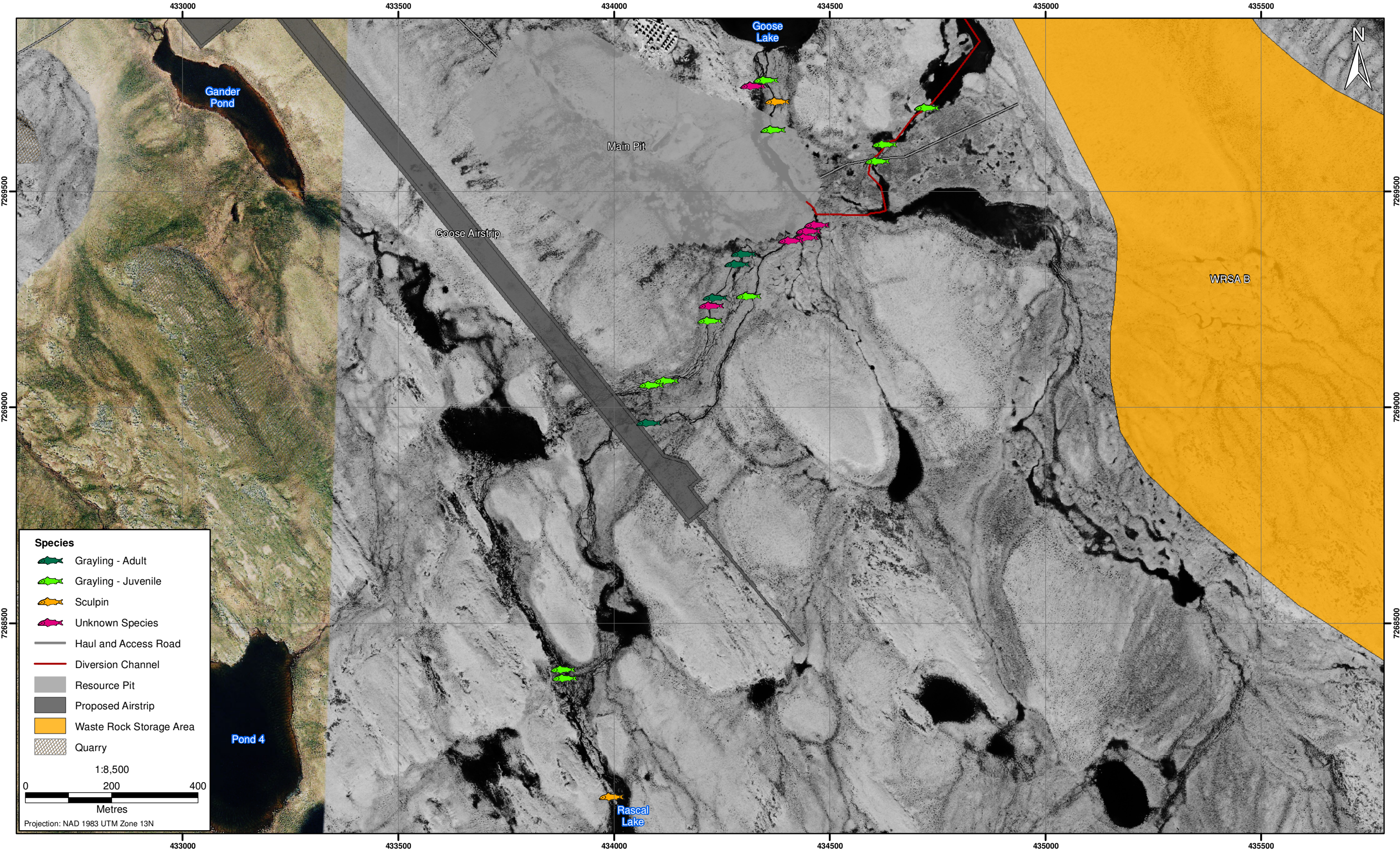
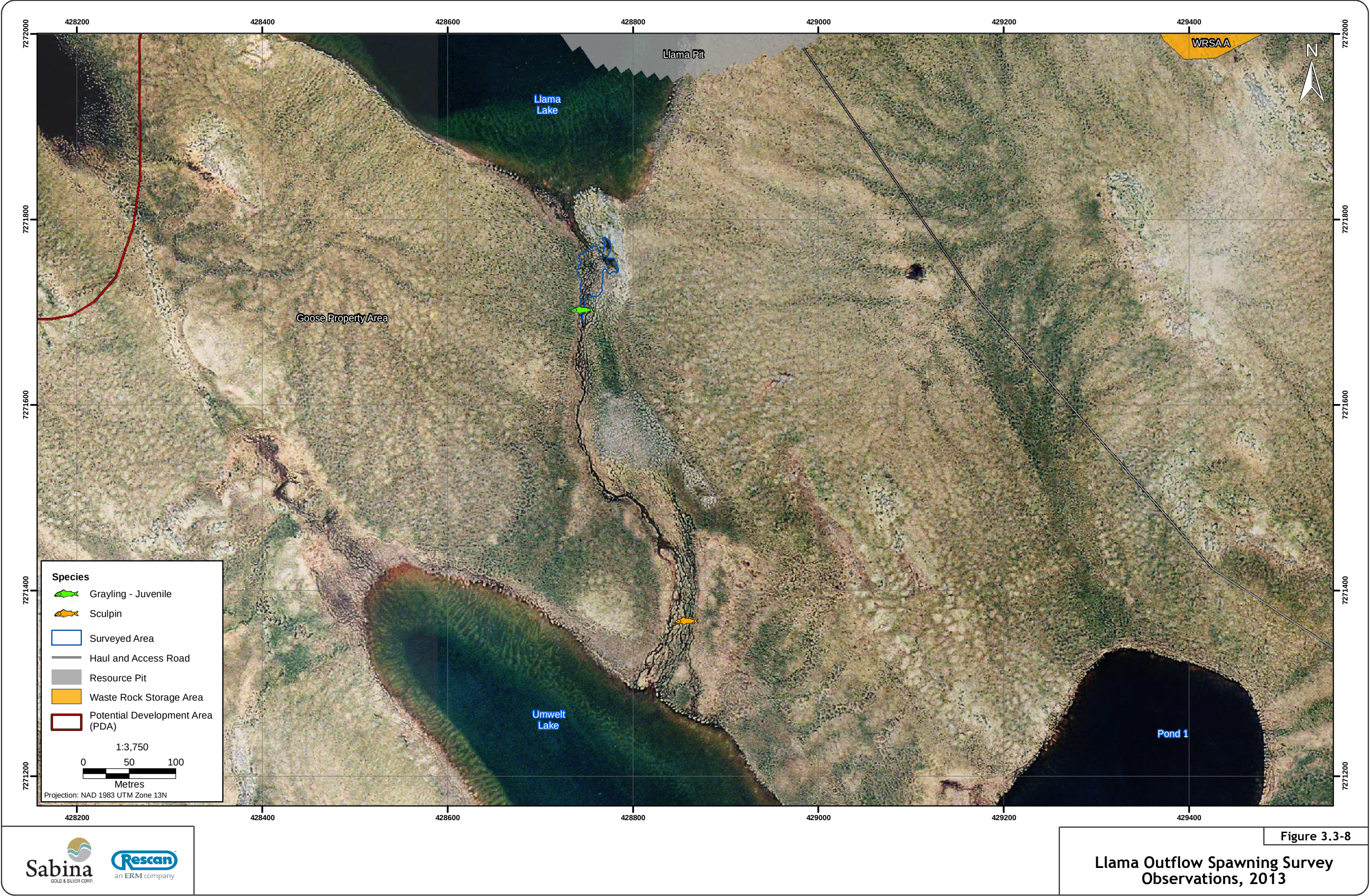


Figure 3.3-7

Rascal-Goose and Main Goose Pit Streams
Spawning Survey Observations, 2013



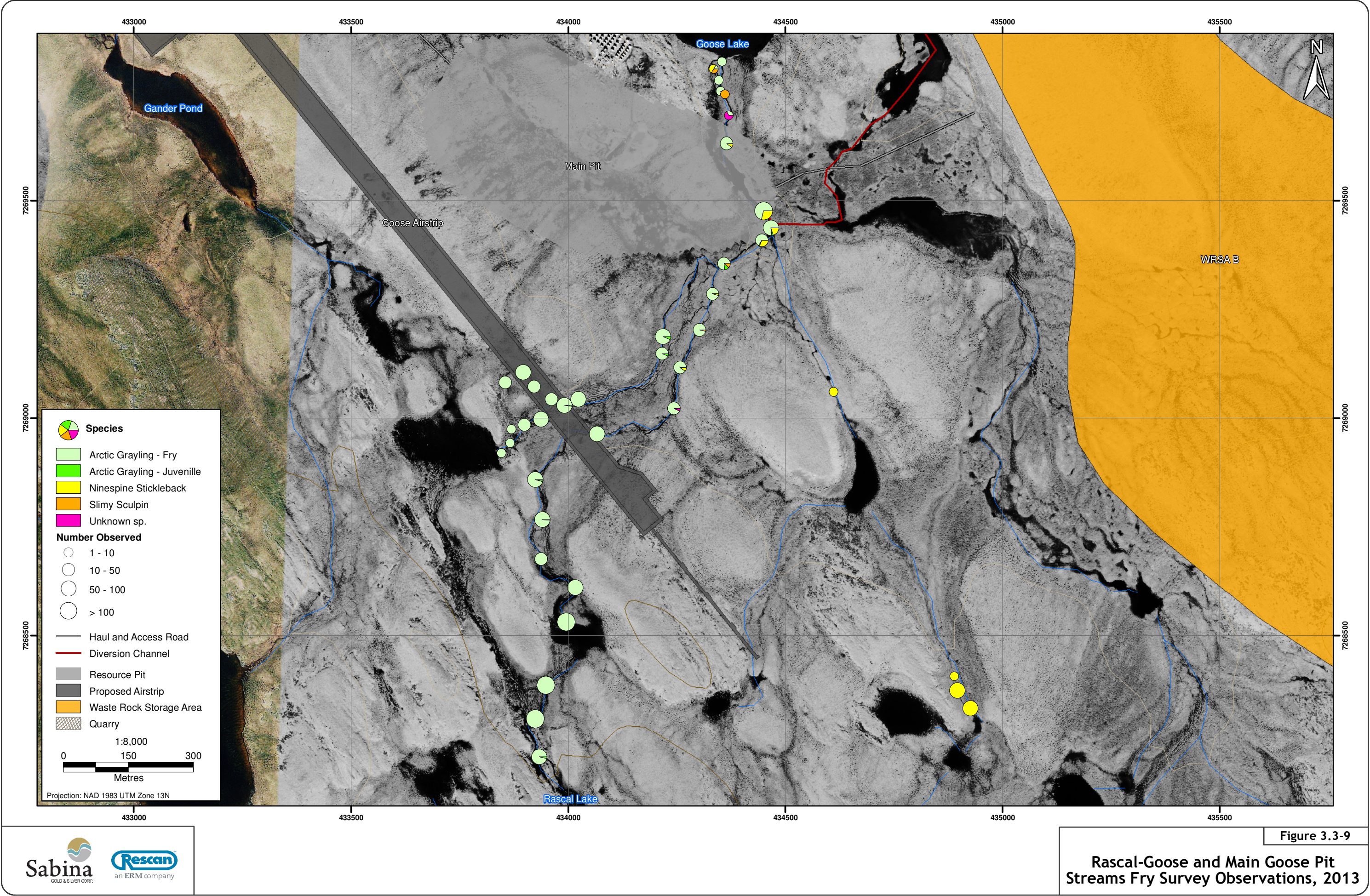
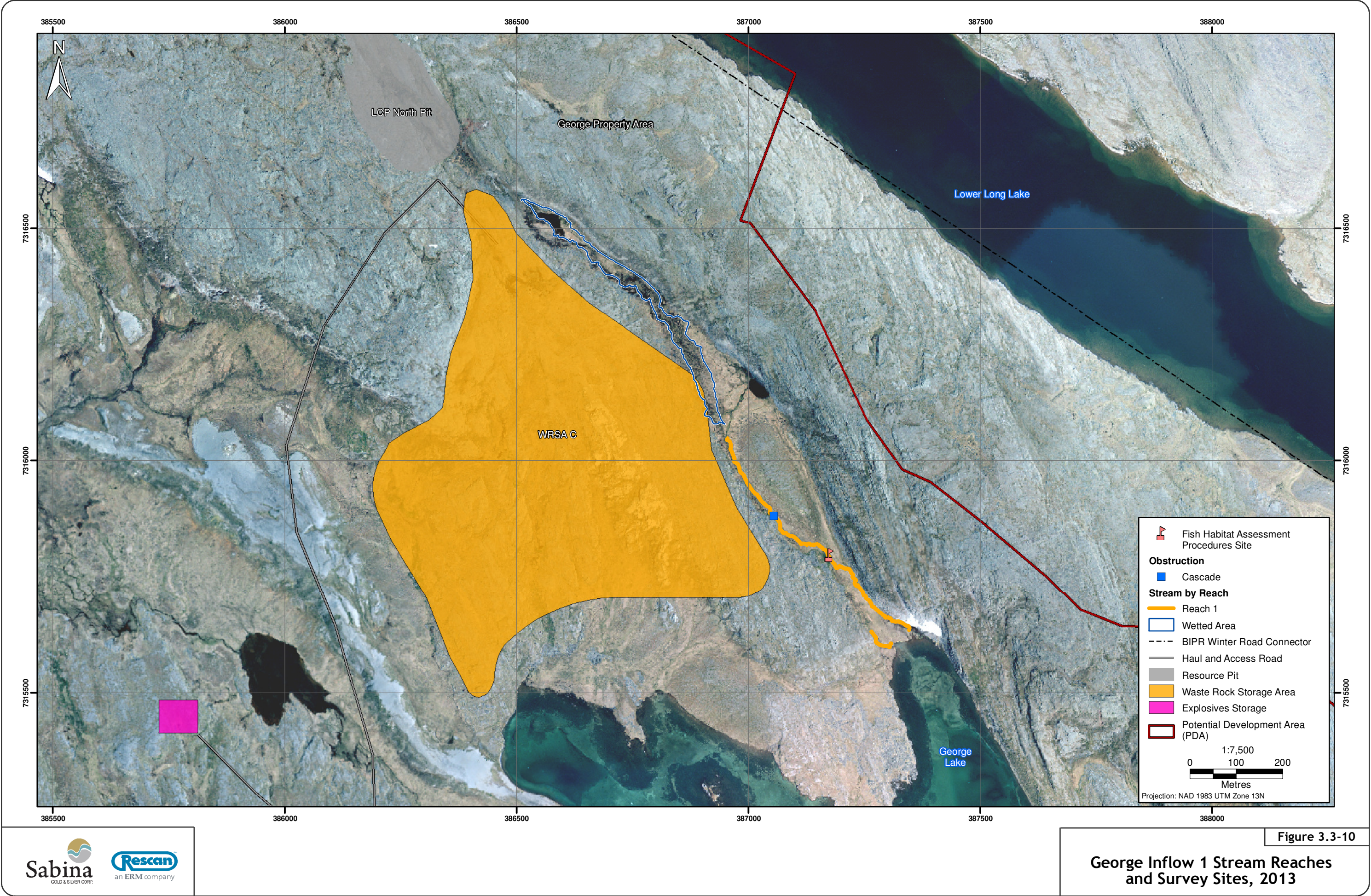


Figure 3.3-9

Rascal-Goose and Main Goose Pit
Streams Fry Survey Observations, 2013



3.3.1.3 *Biology*

Table 3.3-17 presents the mean fork length, total weight, and condition of fish species captured in surveyed Goose PDA streams in 2013.

Arctic Grayling captured in surveyed streams in 2013 ranged in size from 37 to 120 mm. Mean fork lengths at each site ranged from 51 mm at the Main Pit streams to 94 mm at Llama Lake Outflow. Mean total weights ranged from 2.2 g at the Main Pit streams to 10.3 g at Llama Lake Outflow. Mean condition factor for Arctic Grayling at all sites was within normal values for salmonid fishes and ranged from 1.07 g/mm³ to 1.12 g/mm³.

Mean Slimy Sculpin length ranged from 63 mm at Llama Lake Outflow to 72 mm at Wasp Lake Inflow. Mean total weight for sculpins ranged from 2.6 g at Llama Lake outflow to 4.0 g at Wasp Lake Inflow. Mean condition factor for Slimy Sculpin ranged from 1.04 to 1.07 g/mm³ at the Main Pit streams and Wasp Lake Inflow, respectively.

Ninespine Stickleback were smaller at the Main Pit streams, with a mean length of 23 mm, weight of 0.1 g, and condition of 0.83 g/mm³, compared to Llama Lake Outflow where stickleback had a mean length of 49 mm, weight of 2.3 g, and condition of 1.96 g/mm³.

3.3.2 **George Property PDA**

Two streams were sampled in the George Property PDA, in addition to the streams included in the road crossings survey. Appendix 3.3-1 shows the fish habitat data for each site. Appendix 3.3-2 shows the detailed habitat data collected from a subset of sites.

3.3.2.1 *Fish Habitat*

George Inflow 1

George Inflow 1 discharges into George Lake at the north-east end of the lake (Figure 3.3-10). George Inflow 1 is comprised of a single stream reach and a large wetted area (Table 3.3-18). The stream reach is shallow (bankfull depth = 0.05 m) and high gradient (5%) with intermittent channelization. While individual habitat units were not characterized (and therefore means cannot be weighted by unit length), approximately 90% of the habitat is composed of steep runs, with one pool habitat unit (Table 3.3-19). Intermittent channelization, coupled with the high gradient and shallow depth make fish use of the channel unlikely (Plate 3.3-39). A cascade approximately 250 m upstream of George Lake is an additional permanent fish barrier. The pH was measured at 4.47, which is very low compared to other stream in the area and may make the habitat unsuitable for fish. The cause of the low pH was unable to be determined, and requires additional sampling during other seasons to confirm the anomalous result.

There is a wetted area of ponded water upstream of Reach 1. It is shallow (wetted depth = 0.04 m) but large (18,418 m²). The substrate is a deep layer of organic fines. The presence of submerged grasses in the wetted area suggests that it is ephemeral and the area may decrease in size or become dry in late summer (Plate 3.3-40)

Occurrence Outflow

Occurrence Outflow is a short stream section separating Occurrence Lake and Sleigh Lake. The length of the stream is short (23 m) containing a single reach (Table 3.3-20). Given the length, it was not mapped using SHIM and the entire reach was measured in a single FHAP survey.

Table 3.3-17. Summary of Standard and Bootstrapped Mean Fork Length, Total Weight, and Condition of Fish Caught Electrofishing in Goose PDA Streams, 2013

Lake	Species	Standard Fork Length (mm)						Bootstrap Fork Length (mm)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Main Pit streams	Arctic Grayling	31	51	19	3	39	116	-	-	-	-
	Ninespine Stickleback	2	23	1	1	22	24	23	1	22	24
	Round Whitefish	1	53	-	-	53	53	-	-	-	-
	Slimy Sculpin	18	66	13	3	48	92	-	-	-	-
Wasp Lake inflow	Arctic Grayling	1	78	-	-	78	78	-	-	-	-
	Slimy Sculpin	1	72	-	-	72	72	-	-	-	-
Llama Lake outflow	Arctic Grayling	2	94	20	14	81	107	94	10	80	108
	Ninespine Stickleback	2	49	2	2	47	50	49	1	47	50
	Slimy Sculpin	2	63	2	2	61	64	62	1	61	64
		Standard Total Weight (g)						Bootstrap Total Weight (g)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Main Pit streams	Arctic Grayling	30	2.2	4.3	0.8	0.5	17.1	-	-	-	-
	Ninespine Stickleback	2	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.1
	Round Whitefish	1	1.2	-	-	1.2	1.2	-	-	-	-
	Slimy Sculpin	18	3.4	2.9	0.7	1.1	10.2	-	-	-	-
Wasp Lake inflow	Arctic Grayling	1	5.3	-	-	5.3	5.3	-	-	-	-
	Slimy Sculpin	1	4.0	-	-	4.0	4.0	-	-	-	-
Llama Lake outflow	Arctic Grayling	2	10.3	7.4	5.2	5.4	15.2	10.3	3.7	5.1	15.5
	Ninespine Stickleback	2	2.3	0.4	0.3	2.0	2.5	2.3	0.2	2.0	2.5
	Slimy Sculpin	2	2.6	0.9	0.6	2.0	3.2	2.6	0.4	2.0	3.2

(continued)

Table 3.3-17. Summary of Standard and Bootstrapped Mean Fork Length, Total Weight, and Condition of Fish Caught Electrofishing in Goose PDA Streams, 2013 (completed)

		Standard Condition (g/mm ³)						Bootstrap Condition (g/mm ³)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Main Pit streams	Arctic Grayling	30	1.07	0.24	0.04	0.71	1.65	-	-	-	-
	Ninespine Stickleback	2	0.83	0.15	0.11	0.73	0.93	0.83	0.08	0.72	0.94
	Round Whitefish	1	0.81	-	-	0.81	0.81	-	-	-	-
	Slimy Sculpin	18	1.04	0.17	0.04	0.76	1.35	-	-	-	-
Wasp Lake inflow	Arctic Grayling	1	1.12	-	-	1.12	1.12	-	-	-	-
	Slimy Sculpin	1	1.07	-	-	1.07	1.07	-	-	-	-
Llama Lake outflow	Arctic Grayling	2	1.11	0.17	0.12	1.00	1.22	1.11	0.08	1.00	1.23
	Ninespine Stickleback	2	1.96	0.05	0.04	1.93	2.00	1.96	0.03	1.93	2.00
	Slimy Sculpin	2	1.05	0.24	0.17	0.89	1.21	1.05	0.12	0.88	1.22

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available



Plate 3.3-39. Intermittent channelization and steep stream gradient at George Inflow 1, Reach 1, June 21, 2013.



Plate 3.3-40. Seasonally wetted area upstream of Reach 1 of George Inflow 1, June 21, 2013.

Table 3.3-18. Characteristics of George Inflow 1 Stream Reaches, 2013

Attribute	Units	George Inflow 1 1
Site	n/a	800
Morphology	n/a	Run
Secondary Habitat	n/a	Intermittent channelization
Reach Length	m	766.6
Mean Gradient	%	5.0
Mean Bankfull Width	m	0.3
Mean Wetted Width	m	0.3
Mean Bankfull Depth	m	0.05
Mean Wetted Depth	m	0.15
Bankfull area	m ²	192
Spawning	n/a	None
Overwintering	n/a	None
Rearing	n/a	None
Overall	n/a	None

n/a = not applicable

Table 3.3-19. Weighted Mean Habitat Characteristics of George Inflow 1 Stream Reaches, 2013

Attribute	Units	George Inflow 1 1
Organics	%	95
Fine	%	0
Gravel	%	0
Cobble	%	0
Boulder	%	5
Bedrock	%	0
Compaction	n/a	High
Bank Stability	n/a	Unstable
Bank Substrate	n/a	Fines
Number of Pools	no.	1
Mean Maximum Pool Depth	m	0.51
Mean Crest Depth	m	0.05
Mean Residual Depth	m	0.46
Pool	%	0
Boulder	%	4
Instream Vegetation	%	7
Overhanging Vegetation	%	0
Undercut Bank	%	0
Total Cover	%	11
Riffle	%	0
Pool	%	10

(continued)

Table 3.3-19. Weighted Mean Habitat Characteristics of George Inflow 1 Stream Reaches, 2013 (completed)

Attribute	Units	George Inflow 1
		1
Run	%	90
Cascade	%	0
Boulder Garden	%	0
Other	%	0

n/a = not applicable

No. = number

Table 3.3-20. Characteristics of Occurrence Outflow Stream Reaches, 2013

Attribute	Units	Occurrence Outflow
		1
Site	n/a	404
Morphology	n/a	Run
Secondary Habitat	n/a	-
Reach Length	m	23.0
Mean Gradient	%	1.0
Mean Bankfull Width	m	26.2
Mean Wetted Width	m	26.0
Mean Bankfull Depth	m	0.41
Mean Wetted Depth	m	0.38
Bankfull area	m ²	602.6
Spawning	n/a	None
Overwintering	n/a	None
Rearing	n/a	Good
Overall	n/a	Important

n/a = not applicable

Dashes indicate data not applicable

Occurrence Outflow is a wide (bankfull width = 26.2 m) stream with run morphology. The substrate is similar to the shoreline of Occurrence Lake and Sleigh Lake, and contains a high proportion of large particles like cobble and boulders (Table 3.3-21). There was little instream cover, however, it may provide good rearing habitat for smaller fish from the Occurrence Lake and Sleigh Lake communities. Given its small length, its primary value to fish is not from habitat within the reach, but from its role as a migration corridor between Occurrence Lake and Sleigh Lake (Plate 3.3-41).

3.3.2.2 Fish Community

Species Composition

Four fish species were captured or observed in surveyed George Property PDA streams in 2013: Arctic Grayling (Plate 3.3-40), Lake Trout, and Slimy Sculpin. Appendix 3.3-3 presents the sampling effort and catch summary. Appendix 3.3-4 presents the individual fish data. Table 3.3-19 presents the life history periodicity for species captured in the Project area in 2013. Section 3.2.2.1 describes the life history and general stream habitat use information pertaining to Arctic Grayling, Lake Trout, and Slimy Sculpin.

Table 3.3-21. Weighted Mean Habitat Characteristics of Occurrence Outflow Stream Reaches, 2013

Attribute	Units	Occurrence Outflow 1
Organics	%	20
Fine	%	10
Gravel	%	0
Cobble	%	35
Boulder	%	35
Bedrock	%	0
Compaction	n/a	-
Bank Stability	n/a	Unstable
Bank Substrate	n/a	Fines
Number of Pools	no.	0
Mean Maximum Pool Depth	m	0
Mean Crest Depth	m	0
Mean Residual Depth	m	0
Pool	%	0
Boulder	%	2
Instream Vegetation	%	2
Overhanging Vegetation	%	0
Undercut Bank	%	0
Total Cover	%	4
Riffle	%	0
Pool	%	0
Run	%	100
Cascade	%	0
Boulder Garden	%	0
Other	%	0

n/a = not applicable

Dashes indicate data not applicable

No. = number



Plate 3.3-41. View of Occurrence Lake outflow facing downstream towards Sleigh Lake, June 17, 2013.

CPUE

No fish were captured in Occurrence Outflow (Table 3.3-22). However, there are no barriers to fish migration in the stream, and Sleigh Lake and Occurrence Lake are fish-bearing. Occurrence Outflow is likewise assumed fish bearing.

Table 3.3-22. Summary of Electrofishing CPUE and Visual Observations of Fish in George PDA Streams, 2013

Site Name	Electro-fishing Effort(s)	Electrofishing (No. of Fish Captured)					Electrofishing	Visual Observation	
		Arctic Grayling	Ninespine Stickleback	Round Whitefish	Slimy Sculpin	Total	CPUE (Fish/100 s)	Slimy Sculpin	Total
George Property									
Occurrence outflow	351	-	-	-	-	0	0	-	-

CPUE = Catch-per-unit-effort

Dashes indicate no fish caught

George Inflow 1 was sampled as a Haul and Access Road crossing. Fish captured included Lake Trout, Slimy Sucker, and Arctic Grayling. Fish community and biological information for this reach can be found in Section 3.2.

3.4 LAKES

3.4.1 Goose Property PDA

3.4.1.1 Fish Habitat

Littoral zone lake habitat was assessed at Echo Lake, Giraffe Lake, Propeller Lake, Umwelt Lake and Wasp Lake in the Goose Property PDA. Sub-littoral habitat was assessed at Propeller Lake and Umwelt Lake. Lake habitat survey data can be found in Appendix 3.4-1.

Echo Lake

Echo Lake is a small (2.8 ha), shallow lake south of Goose Lake. The substrate of the littoral zone is primarily fines with sparsely occurring highly embedded boulders and cobbles. The lake is too shallow for a hydroacoustic bathymetric study; however point measurements indicated the deepest point is approximately 0.9 m. There are no permanent, channelized inflows or outflows: water enters the lake by way of overland flow from the south, east, and west of the lake and the ephemeral outflow on the south shoreline is channelized for approximately 25 m before the channel ends and the water seeps overland (Plate 3.4-1). Echo Lake is not sufficiently deep to provide overwintering habitat for fish and with no channelized inflows or outflows there is no migration corridor through which fish in Echo Lake could move to suitable overwintering habitat.

Giraffe Lake

Giraffe Lake is a shallow lake that receives water from Leaf Lake to the north and from several unnamed ponds to the west. It discharges south into Goose Lake through Giraffe Lake Outflow. The majority of the lake is less than 4 m in depth, but a deep area at the south-east end of the lake provides overwintering habitat with a maximum depth of 7 m. Giraffe Lake is one of the only lakes surveyed in the Goose Property in which fine substrates are dominant throughout most of the littoral area (Figure 3.4-1). Boulder and cobble substrate are dominant on the north end of the lake, and are found along the east and west shorelines forming “fingers” extending into the dominant fine substrate (Plate 3.4-2). Fish cover is sparse and is mainly provided by boulders. Algae were the only submerged vegetation observed.

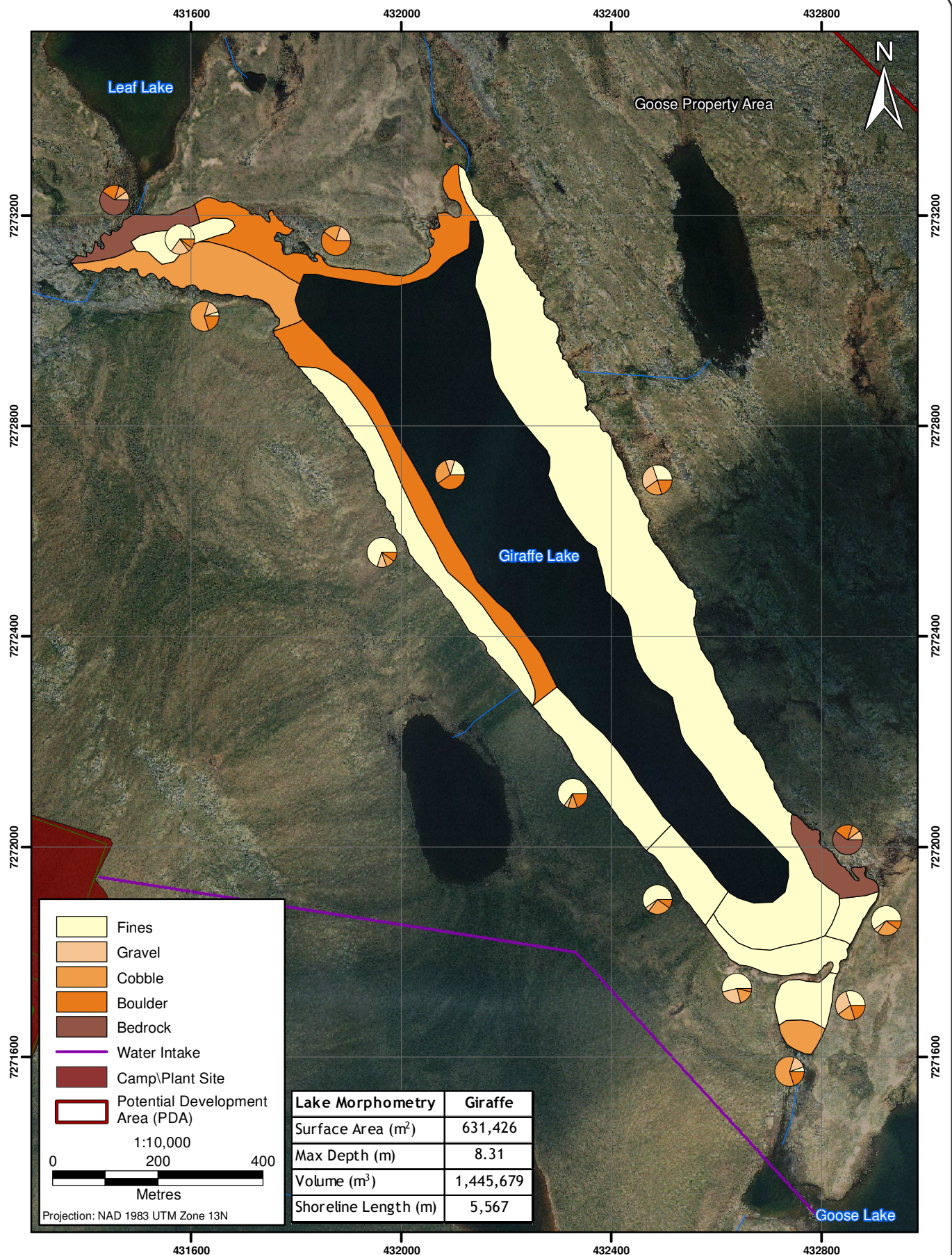




Plate 3.4-1. The outflow to Echo Lake becomes non-channelized approximately 25 m downstream of Echo Lake, June 20, 2013.



Plate 3.4-2. Fingers of cobble substrate extend into the dominant fine substrate in Giraffe Lake, July 13, 2013.

Propeller Lake

Propeller Lake is a large lake immediately downstream of Goose Lake. Its largest inflows originate from Goose Lake to the south-west (Goose-Propeller Stream) and an unnamed lake to the west. The shoreline substrate is heterogeneous, with gravel and cobble as the primary substrate types in areas exposed to wave action and fines dominant in sheltered bays (Figure 3.4-2). The maximum depth of the lake is 16 m, but the majority of the lake is less than 5 m depth (Figure 3.4-3). Fines are the primary substrate type, but there are small areas in which boulder and bedrock substrates are dominant (Figure 3.4-4). The single outflow discharges north-east to the Ellice River watershed. Numerous embayments provide areas of shallow, sheltered water, while the deep water further from shore provides abundant overwintering habitat (Plate 3.4-3). Cover is primarily provided by boulders and no submerged or emergent vegetation was observed except for algae.



Plate 3.4-3. An area of sheltered habitat in the lee of an island in Propeller Lake, August 3, 2013.

Umwelt Lake

Umwelt Lake is located downstream of Llama Lake in the Llama Watershed. The shoreline contains a mix of substrates, but is primarily comprised of cobble and boulder. Throughout the lake, the coarse shoreline substrate abruptly gives way to fine sediment at a depth of approximately 2 m (Figure 3.4-5), and this fine substrate dominates the benthic portion of the lake below this depth (Plate 3.4-4). The maximum depth is 4 m, and the lake has two inflows and one outflow (Figure 3.4-6).

Wasp Lake

Wasp Lake is a long, narrow lake (Figure 3.4-7). The deepest part of the lake (14 m) is located on the south end of the lake. The deep areas of the lake to the north and south are separated by a shallow midsection of approximately 100 m in length where depths do not exceed 2 m (Plate 3.4-5). Boulders are the dominant substrate type throughout most of the littoral zone. Bedrock is the dominant substrate in a single habitat unit at the south end of the lake and occurs as a subdominant substrate type throughout the lake. Fine sediment is dominant in a single habitat unit comprising the north-east end of the lake.



Plate 3.4-4. Fine substrate is dominant over most of the sublittoral zone in Umwelt Lake, August 10, 2013.

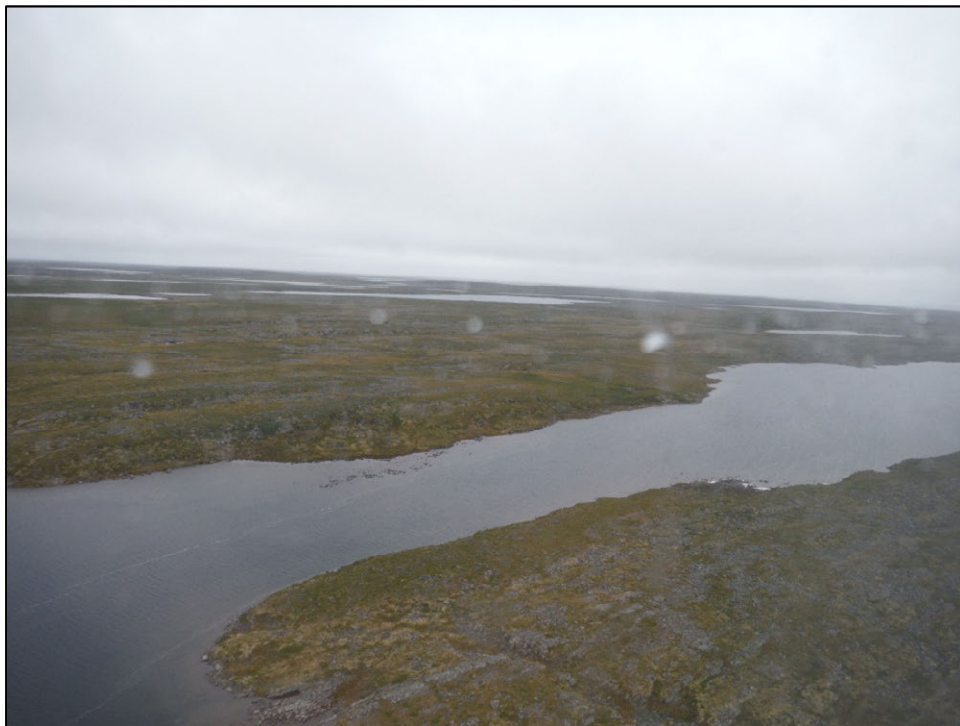


Plate 3.4-5. Aerial view of the shallow constriction in Wasp Lake, August 5, 2013

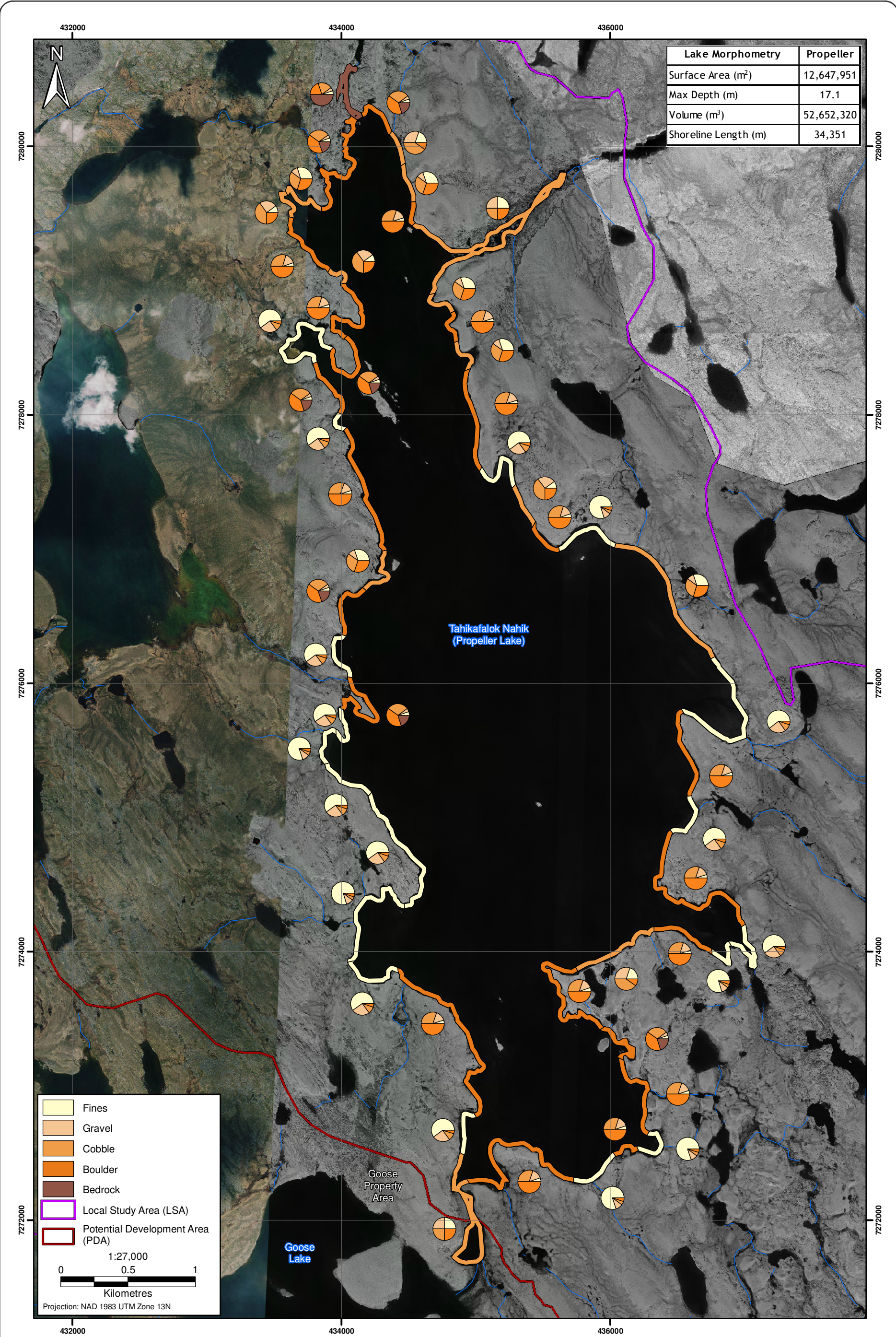


Figure 3.4-2



Shoreline Habitat Zones, Propeller Lake, 2013

Figure 3.4-2



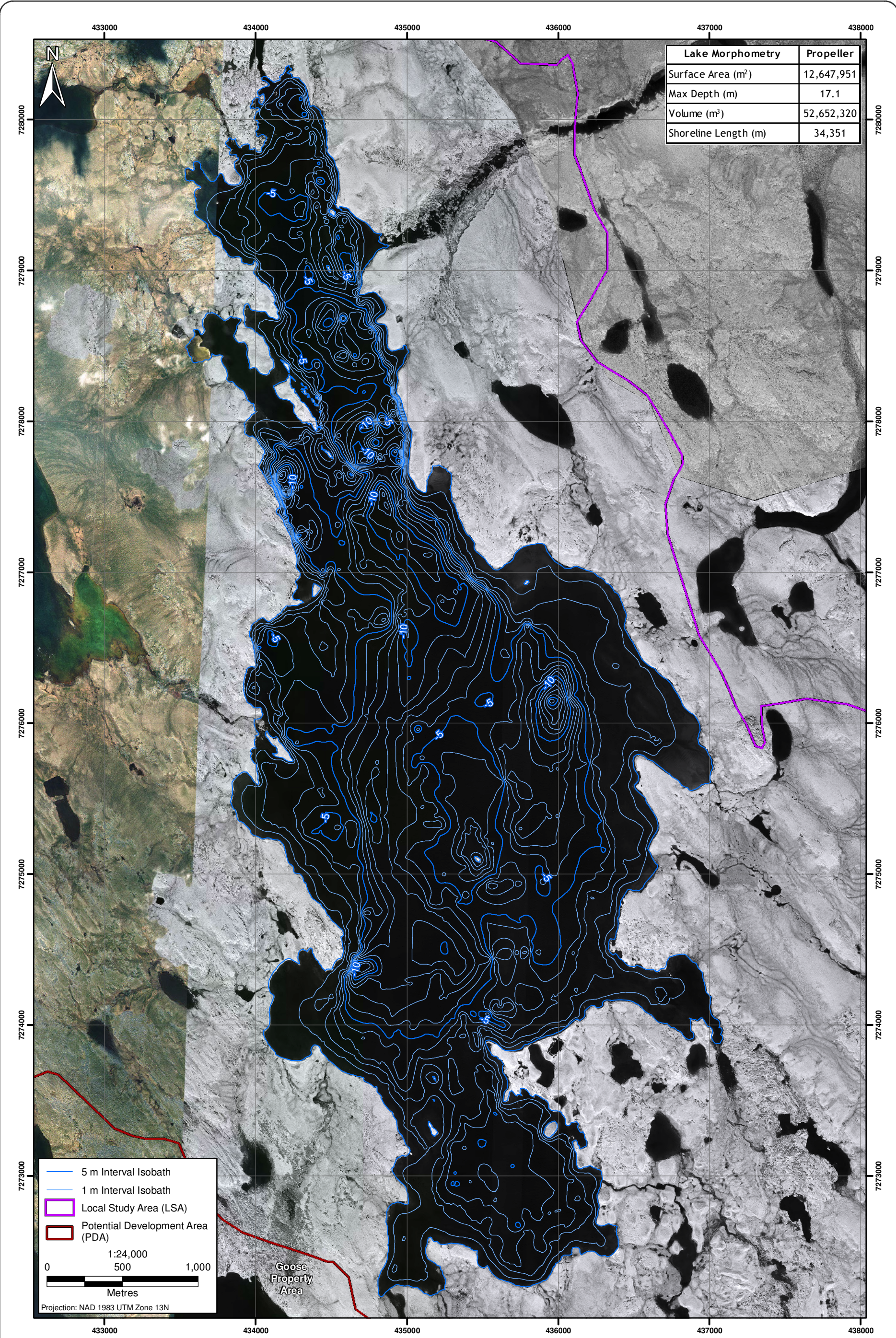


Figure 3.4-3

Figure 3.4-3

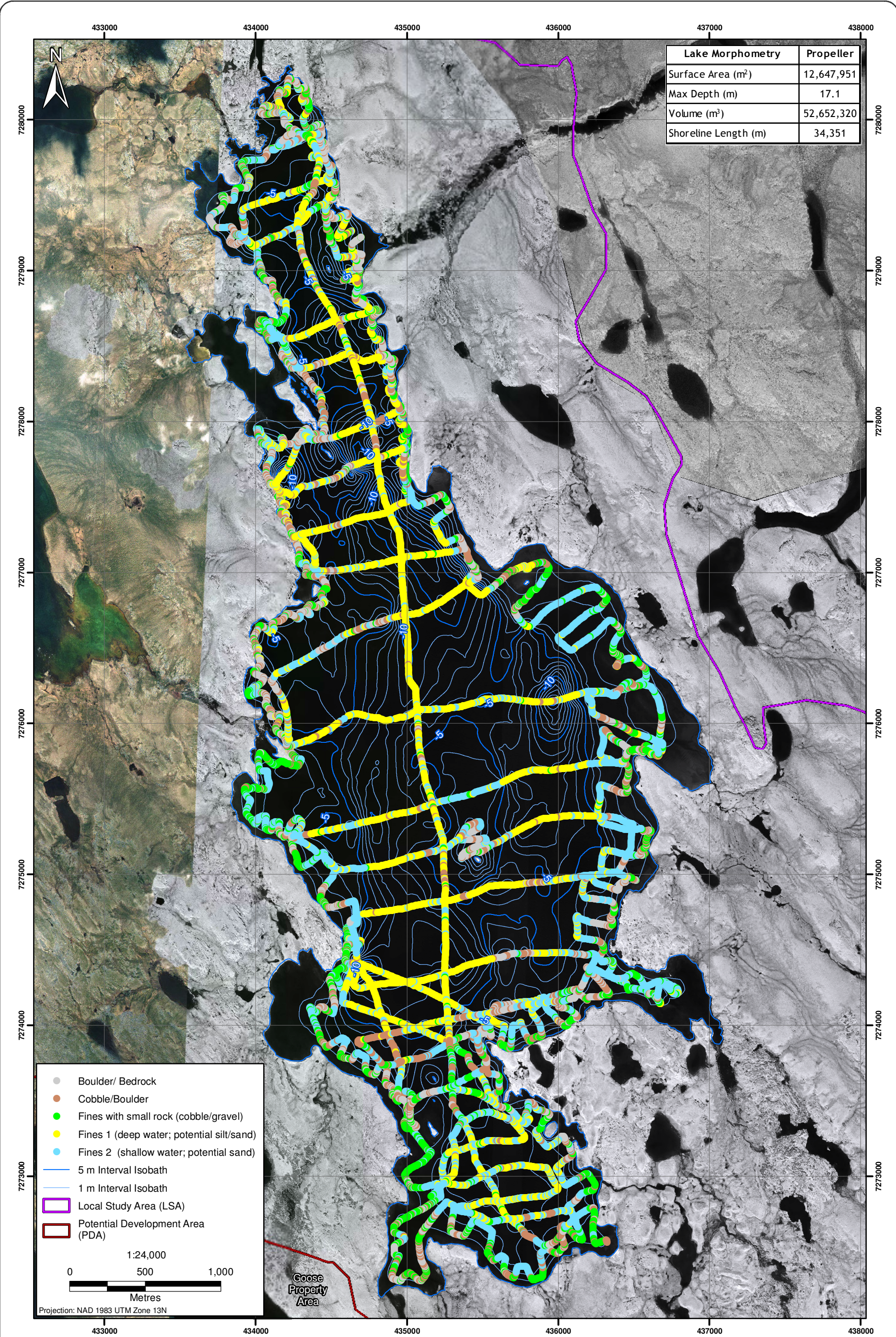


Figure 3.4-4

Figure 3.4-4

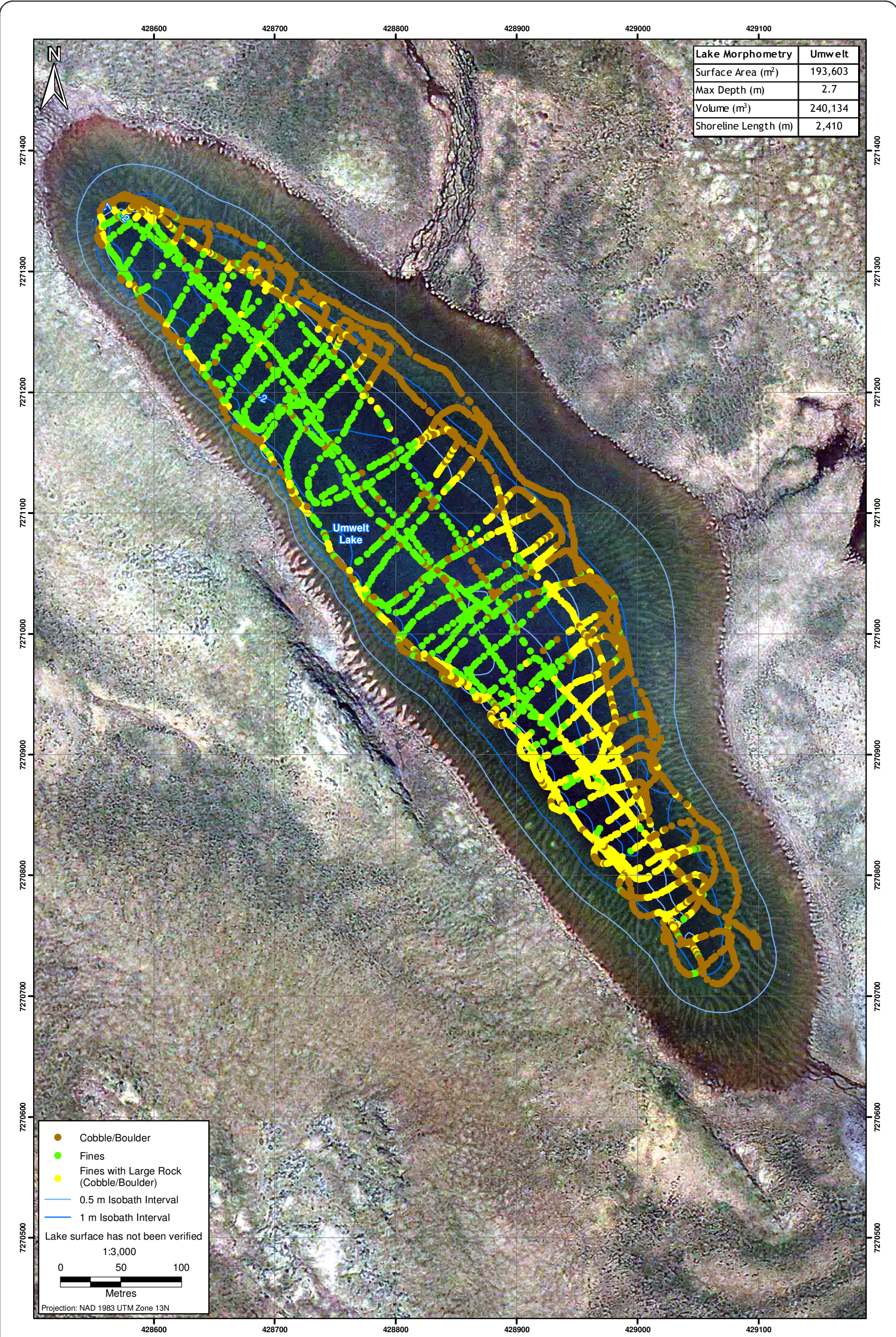


Figure 3.4-5



Umwelt Lake Sublittoral Substrate, 2013

Figure 3.4-5



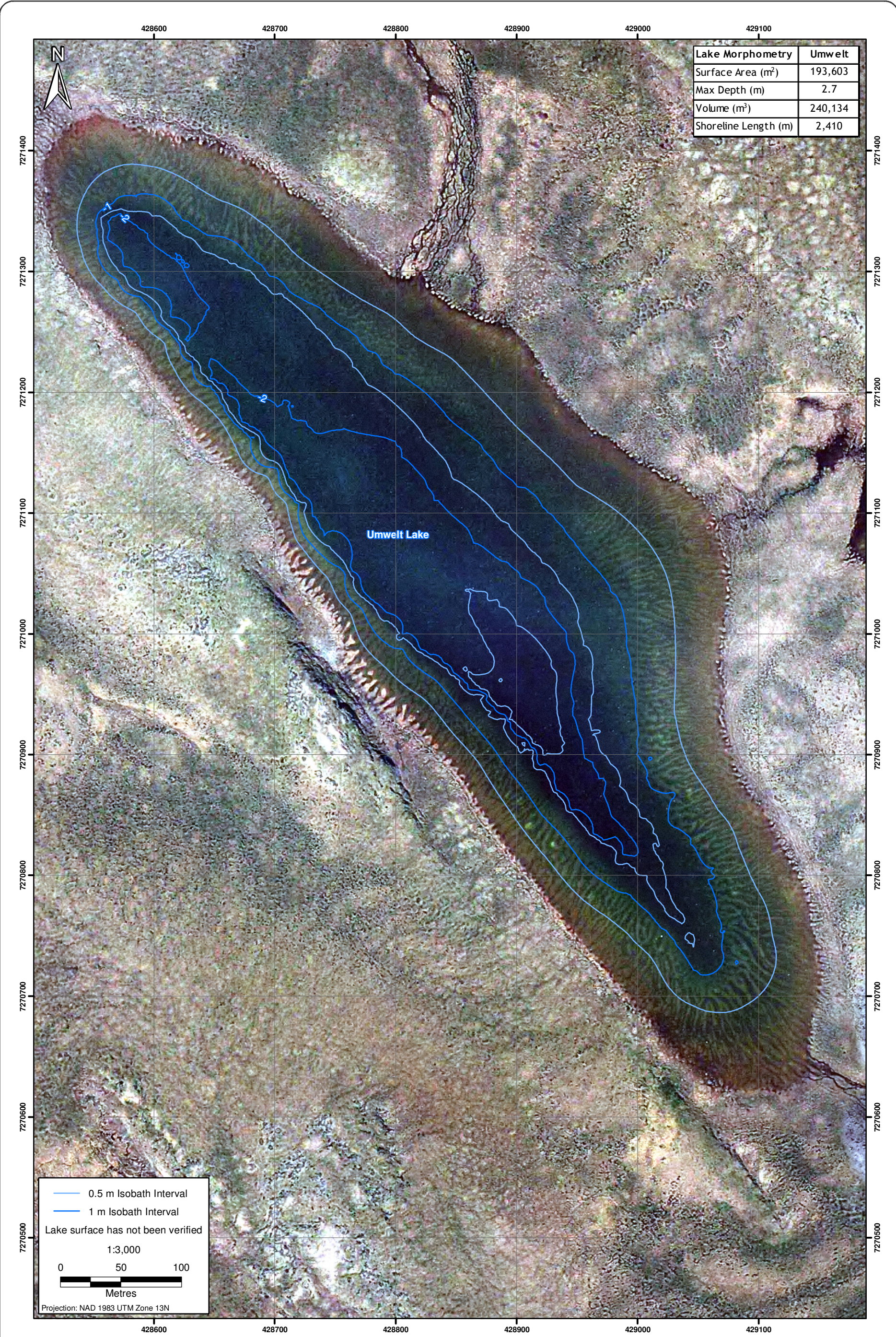
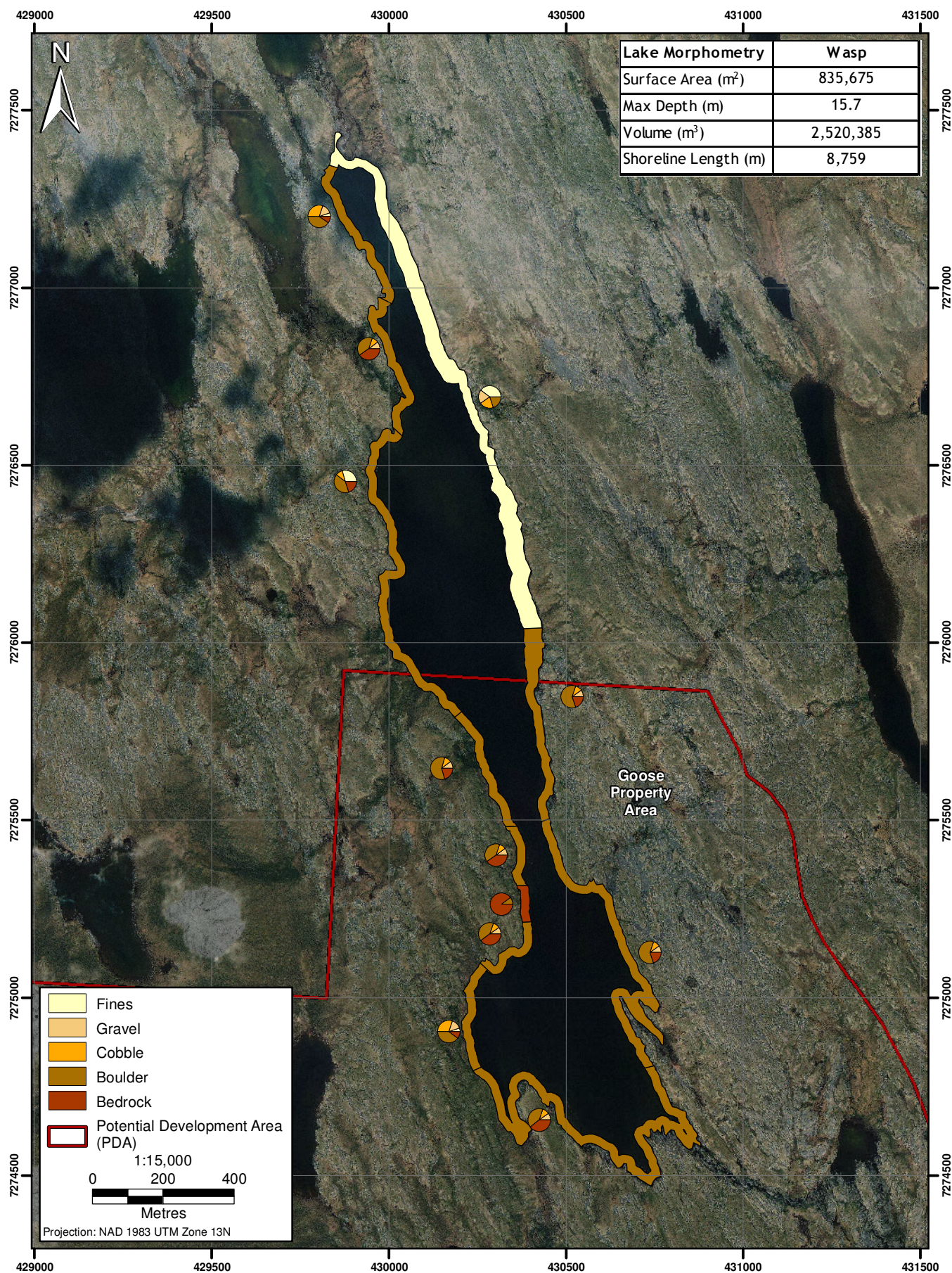


Figure 3.4-6

Figure 3.4-6



3.4.1.2 Fish Community

Species Composition

A total of six fish species were captured in lakes within the Goose PDA in 2013: Arctic Grayling, Burbot, Lake Trout, Ninespine Stickleback, Round Whitefish (Plate 3.4-6), and Slimy Sculpin. Appendix 3.4-2 presents the sampling effort and species summary for each lake. Table 3.4-1 shows a summary of the fish species and the number of fish captured in surveyed lakes in 2013, combining catch from all sampling methods (gillnet, minnow trap, electrofishing, angling, and seine net). Lake Trout were the most widespread species followed by Slimy Sculpin. Propeller Lake showed the greatest diversity of fish species, with six species captured. Echo Lake was the only Goose PDA lake sampled where no fish were captured.



Plate 3.4-6. Adult round whitefish captured at McCoy Lake, July 9, 2013.

Table 3.4-1. Number of Fish Captured in Goose PDA Lakes, 2013

Lakes	Number Captured						Total
	Arctic Grayling	Burbot	Lake Trout	Ninespine Stickleback	Round Whitefish	Slimy Sculpin	
Echo Lake	-	-	-	-	-	-	0
Giraffe Lake	-	1	21	3	2	39	66
Goose Lake	1	3	3	20	-	41	68
Propeller Lake	1	2	18	6	4	38	69
Wasp Lake	1	-	24	-	8	-	33
Reference B Lake	-	4	12	13	5	33	67

Dashes indicate that no fish were captured

Lake Trout and Round Whitefish 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 and Burbot are spring spawners, although grayling spawn mainly in streams and rivers

and Burbot spawn in shallow littoral zones of lakes. Upon hatching, young Arctic Grayling stay in the stream for the summer to rear and to feed, while young Burbot may migrate to and feed in river channels and tributary streams or remain in lakes and feed along shorelines. Both species overwinter in lakes that do not freeze to the bottom, which is assumed to require at least 4 m of depth. Ninespine Stickleback and Slimy Sculpin 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.

CPUE

Catch-per-unit-effort (CPUE) was recorded for gillnetting, electrofishing, and minnow trapping effort in all lakes and is presented separately below. Due to the difficulty of standardizing angling efforts, CPUE calculations for angling are not possible and only the total fish captured is provided.

Standard and bootstrap mean CPUE of gillnetting efforts for each lake and each species is presented in Table 3.4-2. Total CPUE for floating gillnets in surveyed lakes was lowest in Goose Lake (no fish captured in floating gillnets) and highest in Giraffe Lake (0.35 fish/100 m²/h). Total CPUE for sinking gillnets in surveyed lakes was lowest in Propeller Lake (0.06 fish/100 m²/h) and highest in Wasp Lake (2.33 fish/100 m²/h). In general, the CPUE was greater for sinking gillnets than for floating gillnets.

Angling was conducted at some lakes to complement gillnet sampling. Angling was undertaken at five lakes: Giraffe Lake, Propeller Lake, Wasp Lake, and Reference B Lake. Only Lake Trout were captured by angling in these lakes. The most fish were angled in Propeller Lake (15 Lake Trout), followed by Giraffe Lake and Wasp Lake (12 fish per lake), and the fewest angled in Reference B Lake (6 Lake Trout). However, as the effort was not standardized, the number of Lake Trout angled is not necessarily indicative of differences fish population sizes or lake productivity.

Electrofishing was conducted in Echo Lake, Giraffe Lake, and Propeller Lake in order to collect small species and juvenile fish that often occupy the littoral zone of lakes, as well as to collect Slimy Sculpin samples for tissue metal analyses (see Section 3.3.4 for results). Electrofishing was also conducted in Goose Lake and Reference B Lake solely to collect Slimy Sculpin; although this report includes community information gathered from these efforts, fishing efforts targeting a single species may not result in a catch rate that accurately represents the overall fish community.

Fish were captured by electrofishing in four of the five lakes sampled (Table 3.4-3). Among the lakes where fish were captured, electrofishing CPUE ranged from 0.00 fish/100 s at Echo Lake to 1.25 fish/100 s at Giraffe Lake. Slimy Sculpin was the most widespread and abundant species in surveyed lakes. Goose Lake, Propeller Lake, and Reference B Lake had the most diverse communities with four species captured by electrofishing at each lake.

No fish were captured at Echo Lake. Echo Lake is not connected to fish-bearing water bodies by fish-passable channels. In 2011, a total of 224.6 h of minnow trapping effort was expended in Echo Lake (Rescan 2012a) with no fish captured. In 2013, the lake was sampled by electrofishing, with a total of 1,047 electrofishing seconds of effort expended and again no fish were captured. As substantial sampling effort was made over multiple years using multiple sampling efforts with no fish captured, and there is no available overwintering habitat in Echo Lake or connected water bodies, Echo Lake is confirmed to be non-fish bearing.

Fish were only captured in one of the three lakes sampled by minnow trap (Table 3.4-4). No fish were captured by minnow trap in Goose Lake and Wasp Lake. A total of 2 Slimy Sculpin were captured in Propeller Lake resulting in a mean CPUE of 0.10 fish/trap/24 h (Table 3.4-4).

Table 3.4-2. Gillnet Standard and Bootstrap CPUE Summary Statistics for Goose Potential Development Area Lakes, 2013

Lake	Gillnet Type	Species	Standard CPUE (No. Fish/100 m ² /h)						Bootstrap CPUE (No. Fish/100 m ² /h)			
			n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose PDA												
Giraffe Lake	Floating	Lake Trout	2	0.35	0.49	0.35	0.02	0.68	0.35	0.25	0.00	0.69
		Total	2	0.35	0.49	0.35	0.02	0.68	0.35	0.24	0.00	0.69
	Sinking	Lake Trout	2	0.93	1.32	0.93	0.05	1.82	0.94	0.66	0.00	1.86
		Round Whitefish	2	0.27	0.38	0.27	0.01	0.52	0.27	0.19	0.00	0.53
		Total	2	1.20	1.69	1.20	0.06	2.34	1.19	0.85	0.00	2.40
Goose Lake	Floating	Total	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sinking	Lake Trout	2	0.69	0.97	0.69	0.03	1.34	0.69	0.49	0.00	1.37
		Total	2	0.69	0.97	0.69	0.03	1.34	0.68	0.48	0.00	1.37
Propeller Lake	Floating	Lake Trout	7	0.12	0.31	0.12	0.00	0.71	0.12	0.11	0.00	0.36
		Round Whitefish	7	0.23	0.47	0.18	0.00	1.11	0.23	0.16	0.00	0.58
		Total	7	0.35	0.77	0.29	0.00	1.82	0.34	0.27	0.00	0.94
	Sinking	Lake Trout	7	0.06	0.15	0.06	0.00	0.35	0.06	0.05	0.00	0.18
		Total	7	0.06	0.15	0.06	0.00	0.35	0.06	0.05	0.00	0.18
Wasp Lake	Floating	Lake Trout	5	0.26	0.37	0.16	0.00	0.73	0.26	0.15	0.00	0.56
		Total	5	0.26	0.37	0.16	0.00	0.73	0.26	0.15	0.00	0.56
	Sinking	Arctic Grayling	4	0.13	0.25	0.13	0.00	0.47	0.13	0.11	0.00	0.38
		Lake Trout	4	1.16	0.72	0.36	0.56	2.10	1.16	0.31	0.65	1.87
		Round Whitefish	4	1.04	1.00	0.50	0.03	2.14	1.05	0.43	0.23	1.86
		Total	4	2.33	1.72	0.86	0.59	4.29	2.32	0.74	0.95	3.72
Reference B Lake	Floating	Lake Trout	2	0.34	0.48	0.34	0.02	0.67	0.35	0.24	0.00	0.69
		Total	2	0.34	0.48	0.34	0.02	0.67	0.35	0.24	0.00	0.69
	Sinking	Lake Trout	2	0.22	0.31	0.22	0.01	0.43	0.22	0.16	0.00	0.44
		Round Whitefish	2	0.71	0.38	0.27	0.46	0.97	0.71	0.19	0.44	0.98
		Total	2	0.93	0.07	0.05	0.89	0.98	0.93	0.03	0.88	0.98

CPUE = catch-per-unit-effort (fish/100 m² of gillnet/h)

n = sample size (number of net sets)

SD = standard deviation of the mean

SE = standard error of the mean

CI = confidence interval (95%)

Dashes indicate data not available

No. = number

Table 3.4-3. Summary of Electrofishing CPUE and Visual Observations of Fish in Goose Potential Development Area Lakes, 2013

Site Name	Electro-fishing Effort (s)	Electrofishing (No. of Fish Captured)						Electrofishing	Visual Observation		
		Arctic Grayling	Burbot	Lake Trout	Ninespine Stickleback	Slimy Sculpin	Total	CPUE (fish/100 s)	Lake Trout	Unknown Species	Total
Goose PDA											
Echo Lake	1,047	-	-	-	-	-	0	0.00	-	-	-
Giraffe Lake	3,429	-	1	-	3	39	43	1.25	-	-	-
Goose Lake	5,953	1	3	-	20	41	65	1.09	-	-	-
Propellor Lake	4,169	1	2	-	6	36	45	1.08	-	-	-
Reference B Lake	12,349	-	4	2	13	33	52	0.42	-	-	-

CPUE = Catch-per-unit-effort

Dashes indicate no fish caught

No. = number

Table 3.4-4. Minnow Trap Standard CPUE Summary Statistics for Goose Potential Development Area Lakes, 2013

LakeSpecies		Standard CPUE (No. Fish/Trap/24 h)					
		n	Mean	SD	SE	Lower CI	Upper CI
Goose Property							
Goose Lake	Total	20	0.00	0.00	0.00	0.00	0.00
Propeller Lake	Slimy Sculpin	20	0.10	0.30	0.07	0.00	0.98
	Total	20	0.10	0.30	0.07	0.00	0.98
Wasp Lake	Total	20	0.00	0.00	0.00	0.00	0.00

CPUE = catch-per-unit-effort (# of fish/ 24 h)

n = sample size (number of trap sets)

SD = standard deviation

SE = standard error

CI = confidence interval (95%)

No. = number

3.4.1.3 Lake Trout Spawning Survey

A spawning survey was conducted on Goose Lake to locate spawning areas for Lake Trout. Spawning surveys were carried out from September 5 and September 8 and coincided with anticipated spawning periods for Lake Trout (Scott and Crossman, 1973). Appendix 3.4-3 shows the detailed results of the Lake Trout survey.

Three locations in Goose Lake were identified as potential spawning locations of varying quality based on substrate and depth (Figure 3.4-8). A small area of fair quality spawning habitat was observed on the northwest part of Goose Lake where there is a small patch of deeper, semi-clean cobbles and boulders near the Giraffe Lake outflow. A larger area near the southern shore of Goose Lake, located east of the constriction that forms the Goose “neck” has good quality spawning habitat with cobble and boulder substrate that is relatively clean of algae (a requirement of Lake Trout spawning habitat). In this location, cobble and boulder substrate persists to a depth of approximately 2.5 m, while throughout the rest of the lake the cobble and boulder substrate changes to fine sediment at approximately 1.5 m. A shoal north-east of the Goose “neck” has excellent spawning habitat. Wave action on the shallow shoal reduces the prevalence of fine substrates, resulting in clean substrate with good intersubstrate flow. This area has abundant patches of gravel and cobble at 2 to 3 m depth. The habitat quality is highest at the north and northeast sides of the shoal where at least five adult Lake Trout were observed.

The results of the desktop study of Lake Trout potential spawning areas for Propeller Lake are indicated in Figure 3.4-9. Based on Lake Trout spawning preferences, bathymetry and bottom substrate data, eight potential spawning areas were indicated for Propeller Lake. These areas tend to have more cobble, gravel, boulder substrate, have a steep drop-off or are in areas suspected to have wave action based on prevailing winds, and are between 2 and 3 m in depth. These suspected areas need to be ground-truthed to confirm that they are spawning locations.

3.4.1.4 Biology

Growth and Health

Tables 3.4-5 to 3.4-12 present summaries of the standard and bootstrapped mean fork length, weight and condition of fish species separated by sampling method in each of the sampled lakes in the Goose PDA. Appendix 3.4-4 presents the individual fish data.

Lake Trout were captured by gillnetting, angling, and/or electrofishing in 10 of 13 sampled lakes. Of the Lake Trout captured in gillnets, mean fork length ranged from 386 mm (Wasp Lake) to 567 mm (Propeller Lake; Table 3.4-5), and mean weight ranged from 525.8 g (Wasp Lake) to 1,880.0 g (Propeller Lake; Table 3.4-6). Mean condition factor for Lake Trout captured by gillnetting at all sites was within normal values for salmonid fishes and ranged from 0.89 to 1.14 g/mm³ (Table 3.4-7). Similarly, Lake Trout captured by angling ranged in mean length from 400 mm (Wasp Lake) to 508 mm (Propeller Lake), and mean weight ranged from 631.8 g (Wasp Lake) to 1,395.0 g (Propeller Lake; Table 3.4-8). Mean condition factor for Lake Trout captured by angling was within normal values for salmonids and ranged from 0.93 to 1.03 g/mm³. All Lake Trout captured were adults

Slimy Sculpin were captured by electrofishing and/or minnow trapping in four of the five sampled lakes. Of the Slimy Sculpin captured by electrofishing, mean total length ranged from 49 mm (Propeller Lake) to 60 mm (Reference B Lake), mean weight ranged from 1.3 g (Propeller Lake) to 2.2 g (Reference B Lake), and mean condition ranged from 0.78 (Giraffe Lake) to 0.88 g/mm³ (Reference B Lake). Slimy Sculpin captured in minnow traps were larger than those captured by electrofishing. The two Slimy Sculpin captured in minnow traps were captured in Propeller Lake.

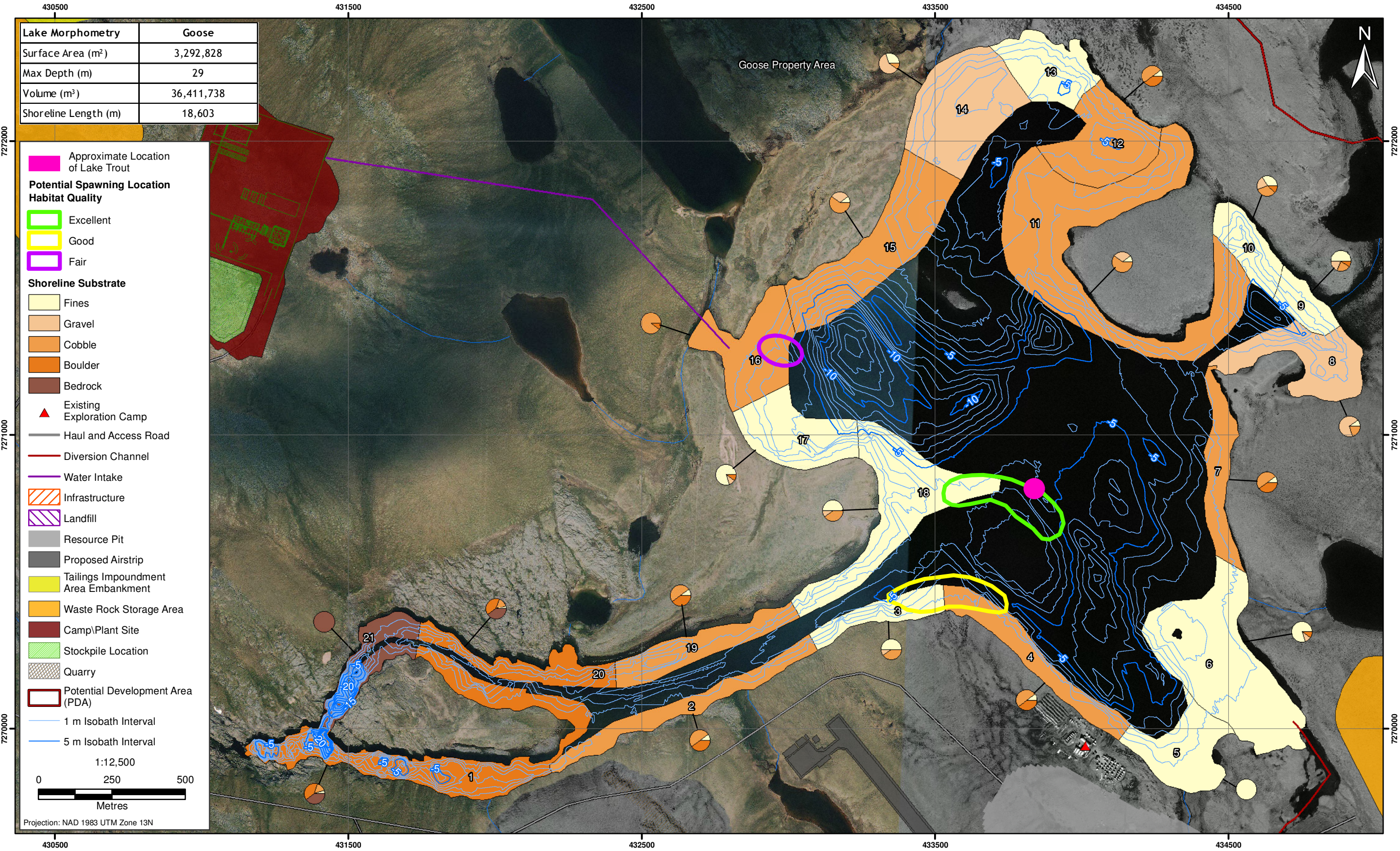


Figure 3.4-8

Lake Trout Spawning Survey
Observations, Goose Lake, 2013

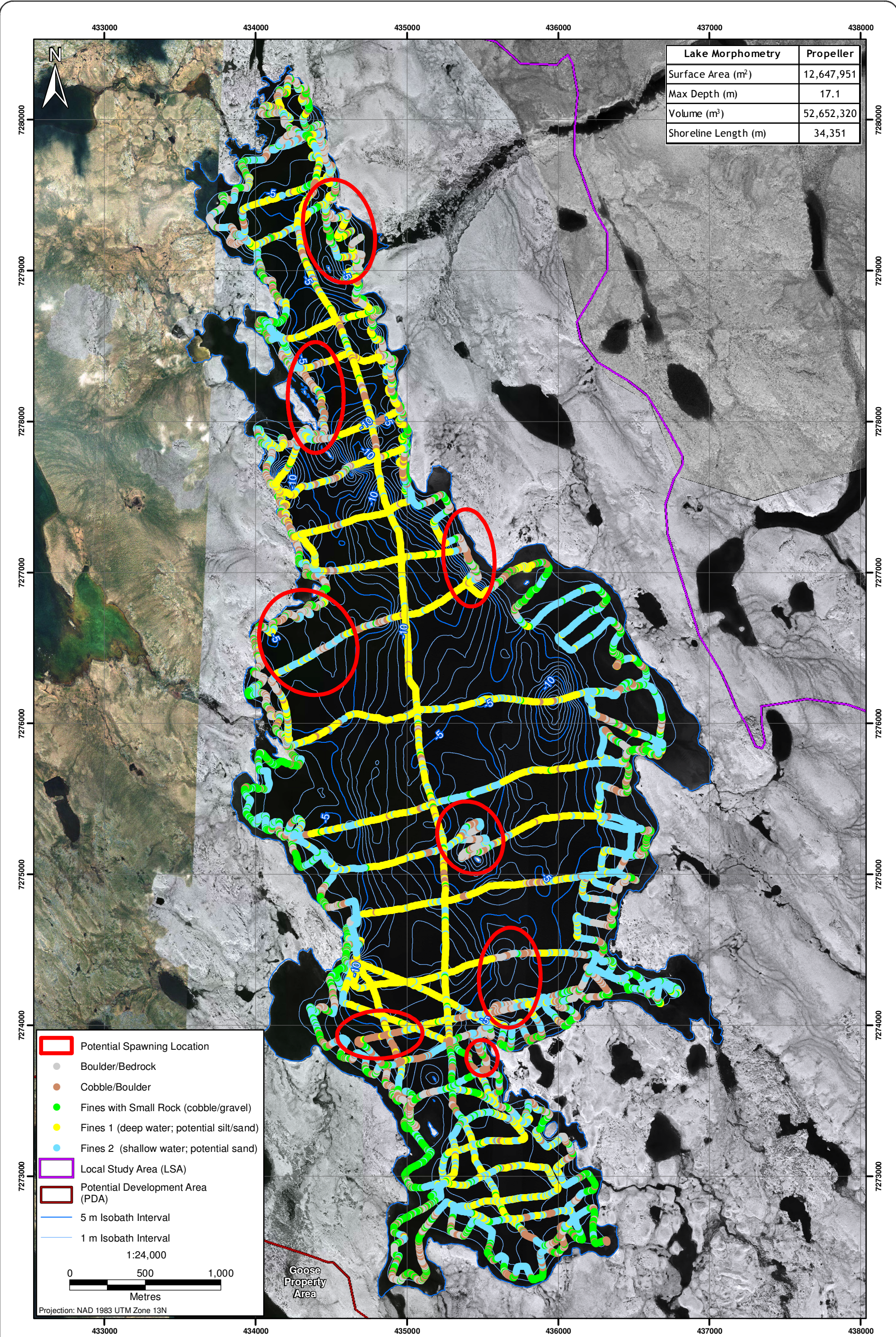


Figure 3.4-9



Potential Lake Trout Spawning Locations, Propeller Lake, 2013

Figure 3.4-9



Table 3.4-5. Summary of Standard and Bootstrapped Mean Fork Length of Fish Captured by Gillnet in Goose Potential Development Area Lakes, 2013

Lake	Species	Standard Fork Length (mm)						Bootstrap Fork Length (mm)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property											
Giraffe Lake	Lake Trout	9	430	53	18	362	520	430	16	399	463
	Round Whitefish	2	400	26	19	382	417	400	13	381	418
Goose Lake	Lake Trout	3	435	24	14	411	457	435	11	410	458
Propeller Lake	Lake Trout	3	567	120	69	440	649	568	56	430	651
	Round Whitefish	4	309	96	48	181	379	308	42	219	373
Wasp Lake	Arctic Grayling	1	316	-	-	316	316	-	-	-	-
	Lake Trout	11	386	56	17	326	492	-	-	-	-
	Round Whitefish	8	331	59	21	222	386	331	20	289	365
Reference B Lake	Lake Trout	4	453	41	20	415	505	453	18	421	494

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Table 3.4-6. Summary of Standard and Bootstrapped Mean Total Weight of Fish Captured by Gillnet in Goose Potential Development Area Lakes, 2013

Lake	Species	Standard Total Weight (g)						Bootstrap Total Weight (g)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property											
Giraffe Lake	Lake Trout	9	870.3	313.9	104.6	511.6	1439.6	870.0	98.3	696.1	1077.6
	Round Whitefish	2	652.0	87.7	62.0	593.1	710.9	652.1	43.6	590.0	714.0
Goose Lake	Lake Trout	3	821.3	107.0	61.8	706.9	889.3	821.2	49.8	698.0	890.0
Propeller Lake	Lake Trout	3	1880.0	968.1	559.0	925.0	2758.5	1879.1	458.9	870.0	2800.0
	Round Whitefish	4	323.8	203.9	101.9	61.0	499.4	324.8	88.6	137.5	467.5
Wasp Lake	Arctic Grayling	1	367.0	-	-	367.0	367.0	-	-	-	-
	Lake Trout	11	525.8	208.8	62.9	324.5	932.5	-	-	-	-
	Round Whitefish	8	372.1	151.5	53.6	101.8	530.4	372.4	49.9	266.4	461.9
Reference B Lake	Lake Trout	4	929.5	233.6	116.8	672.4	1194.3	929.4	101.4	743.5	1120.0

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Table 3.4-7. Summary of Standard and Bootstrapped Mean Condition of Fish Captured by Gillnet in Goose Potential Development Area Lakes, 2013

Lake	Species	Standard Condition (g/mm ³)						Bootstrap Condition (g/mm ³)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property											
Giraffe Lake	Lake Trout	9	1.06	0.06	0.02	0.99	1.14	1.06	0.02	1.03	1.10
	Round Whitefish	2	1.03	0.06	0.05	0.98	1.07	1.03	0.03	0.98	1.07
Goose Lake	Lake Trout	3	1.00	0.06	0.04	0.93	1.05	1.00	0.03	0.93	1.05
Propeller Lake	Lake Trout	3	0.98	0.13	0.08	0.84	1.09	0.98	0.06	0.83	1.09
	Round Whitefish	4	0.90	0.07	0.04	0.82	0.98	0.90	0.03	0.84	0.96
Wasp Lake	Arctic Grayling	1	1.16	-	-	1.16	1.16	-	-	-	-
	Lake Trout	11	0.89	0.11	0.03	0.72	1.04	-	-	-	-
	Round Whitefish	8	0.95	0.09	0.03	0.82	1.06	0.95	0.03	0.89	1.01
Reference B Lake	Lake Trout	4	0.99	0.11	0.05	0.91	1.13	0.99	0.05	0.92	1.09

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Table 3.4-8. Summary of Standard and Bootstrapped Mean Fork Length, Total Weight and Condition of Lake Trout Captured by Angling in Goose Potential Development Area Lakes, 2013

Lake	Standard Fork Length (mm)						Bootstrap Fork Length (mm)			
	n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property										
Giraffe Lake	10	446	51	16	392	529	-	-	-	-
Propeller Lake	15	509	139	36	326	696	-	-	-	-
Wasp Lake	12	400	57	17	316	493	-	-	-	-
Reference B Lake	4	446	20	10	430	472	446	9	431	464
	Standard Total Weight (g)						Bootstrap Total Weight (g)			
	n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property										
Giraffe Lake	10	913.8	247.9	78.4	657.6	1327.5	-	-	-	-
Propeller Lake	15	1395.1	914.8	236.2	335.8	2873.8	-	-	-	-
Wasp Lake	12	631.8	269.3	77.7	306.5	1158.5	-	-	-	-
Reference B Lake	4	841.5	27.0	13.5	820.0	874.1	841.6	11.8	820.0	863.0
	Standard Condition (g/mm ³)						Bootstrap Condition (g/mm ³)			
	n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property										
Giraffe Lake	10	1.03	0.17	0.06	0.72	1.30	-	-	-	-
Propeller Lake	15	0.93	0.18	0.05	0.65	1.20	-	-	-	-
Wasp Lake	12	0.94	0.08	0.02	0.77	1.05	-	-	-	-
Reference B Lake	4	0.95	0.10	0.05	0.83	1.03	0.95	0.04	0.87	1.03

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Table 3.4-9. Summary of Standard and Bootstrapped Mean Fork Length of Fish Captured By Electrofishing in Goose Potential Development Area Lakes, 2013

Lake	Species	Standard Fork Length (mm)						Bootstrap Fork Length (mm)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property											
Giraffe Lake	Slimy Sculpin	39	55	11	2	35	73	-	-	-	-
Goose Lake	Slimy Sculpin	41	56	13	2	36	81	-	-	-	-
Propeller Lake	Arctic Grayling	1	150	-	-	150	150	-	-	-	-
	Burbot	2	101	28	20	82	119	100	14	81	120
	Ninespine Stickleback	6	41	10	4	24	47	41	4	33	46
	Slimy Sculpin	36	49	14	2	34	76	-	-	-	-
Reference B Lake	Slimy Sculpin	33	60	13	2	37	82	-	-	-	-

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Table 3.4-10. Summary of Standard and Bootstrapped Mean Total Weight of Fish Captured By Electrofishing in Goose Potential Development Area Lakes, 2013

		Standard Total Weight (g)						Bootstrap Total Weight (g)			
Lake	Species	n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property											
Giraffe Lake	Slimy Sculpin	39	1.5	0.8	0.1	0.4	3.3	-	-	-	-
Goose Lake	Slimy Sculpin	41	1.7	1.2	0.2	0.4	4.1	-	-	-	-
Propeller Lake	Arctic Grayling	1	38.0	-	-	38.0	38.0	-	-	-	-
	Burbot	2	7.3	5.8	4.1	3.4	11.2	7.3	2.9	3.2	11.4
	Ninespine Dttickleback	5	0.7	0.2	0.1	0.6	0.9	0.7	0.1	0.6	0.8
	Slimy Sculpin	36	1.3	1.2	0.2	0.3	3.8	-	-	-	-
Reference B Lake	Slimy Sculpin	33	2.2	1.3	0.2	0.4	4.8	-	-	-	-

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Note: Slimy Sculpin total weight was calculated by excluding weight of internal parasites

Dashes indicate data not available

Table 3.4-11. Summary of Standard and Bootstrapped Mean Condition of Fish Captured By Electrofishing in Goose Potential Development Area Lakes, 2013

		Standard Condition (g/mm ³)						Bootstrap Condition (g/mm ³)			
Lake	Species	n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property											
Giraffe Lake	Slimy Sculpin	39	0.78	0.11	0.02	0.52	0.94	-	-	-	-
Goose Lake	Slimy Sculpin	41	0.84	0.09	0.01	0.68	0.96	-	-	-	-
Propeller Lake	Arctic Grayling	1	1.13	-	-	1.13	1.13	-	-	-	-
	Burbot	2	0.64	0.04	0.03	0.61	0.66	0.63	0.02	0.61	0.66
	Ninespine Stickleback	5	0.82	0.22	0.10	0.57	1.06	0.82	0.09	0.64	0.99
	Slimy Sculpin	36	0.87	0.07	0.01	0.76	1.00	-	-	-	-
Reference B Lake	Slimy Sculpin	33	0.88	0.08	0.01	0.74	1.02	-	-	-	-

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Note: Slimy Sculpin condition was calculated by excluding weight of internal parasites

Dashes indicate data not available

Table 3.4-12. Summary of Standard and Bootstrapped Mean Fork Length, Total Weight and Condition Fish Captured By Minnow Trap in Goose Potential Development Area Lakes, 2013

Lake	Species	Measure	Standard Measure						Bootstrap Measure			
			n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Goose Property												
Propeller Lake	Slimy Sculpin	Total Length (mm)	2	63	2	2	61	64	62	1	61	64
		Total Weight (g)	2	2.5	0.7	0.5	2.0	3.0	2.5	0.4	2.0	3.0
		Condition (g/mm³)	2	1.01	0.18	0.13	0.89	1.13	1.01	0.09	0.88	1.14

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Note: Slimy Sculpin total weight and condition were calculated by excluding weight of internal parasites

Round Whitefish were captured by gillnet in three of five lakes that were sampled. The mean length of Round Whitefish ranged from 309 mm (Propeller Lake) to 400 mm (Giraffe Lake). Mean weight of Round Whitefish ranged from 323.8.0 g (Propeller Lake) to 652.0 g (Giraffe Lake). Mean condition of Round Whitefish fell within normal values for salmonid fish and ranged from 0.90 (Propeller Lake) to 1.06 g/mm³ (Giraffe Lake). All Round Whitefish captured were adults.

A single adult Arctic Grayling was captured by gillnetting in Wasp Lake. Juvenile Arctic Grayling were captured by electrofishing in Propeller Lake. Of the electrofished Arctic Grayling, mean length was 150 mm (Propeller Lake), mean weight was 38.0 g (Propeller Lake), and mean condition was 1.13 g/mm³ (Propeller Lake).

Burbot and Ninespine Stickleback were captured by electrofishing in four lakes, however, length and weight data were available for Propeller Lake only.

Length-frequency distributions were plotted for all lakes in which at least 15 Lake Trout were captured (Figure 3.4-10). In all lakes, the majority of Lake Trout captured were in the 400 to 450 mm size class, including lakes for which distributions could not be created. Where distributions could be analyzed, the lengths followed an approximately normal distribution. However, the lengths of Lake Trout captured in Propeller Lake were bimodally distributed, with modes at 350 to 400 mm and 600 to 650 mm, which may be indicative of two distinct age classes.

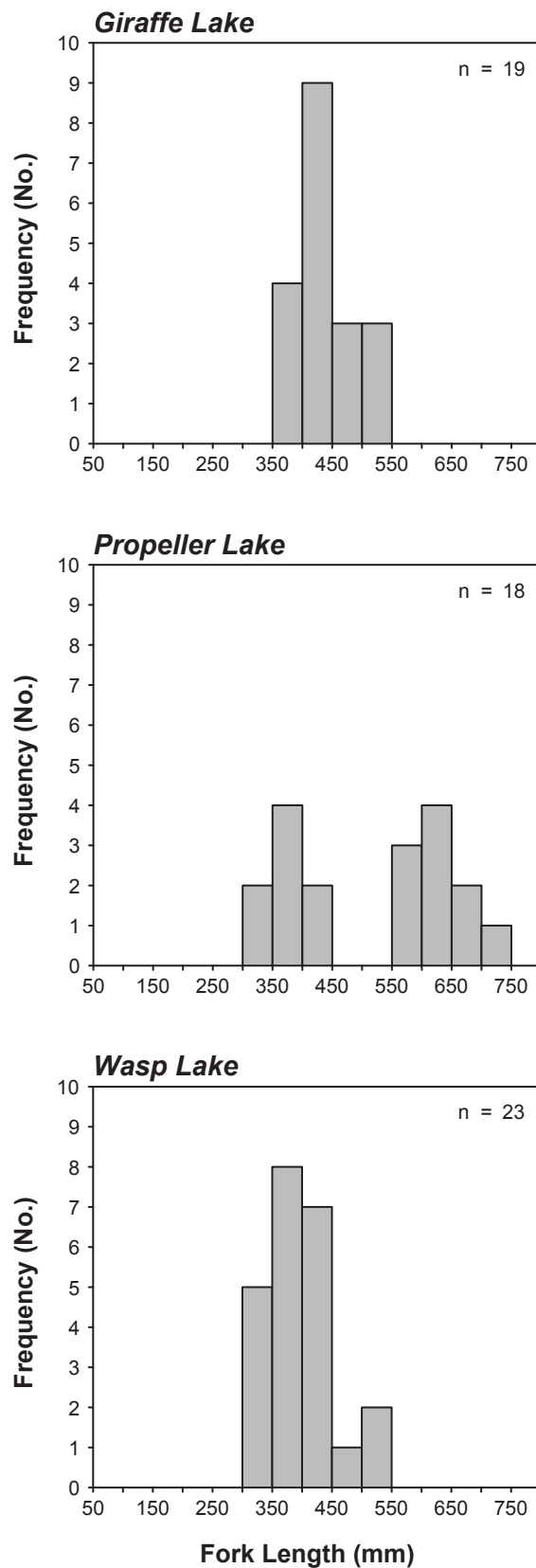
The length-frequency distributions for Slimy Sculpin were highly variable between lakes (Figures 3.4-11). Within the Goose PDA, the majority of Slimy Sculpin fell into size classes ranging from 45 mm to 65 mm. Small-bodied fish typically have negatively skewed length-frequency distributions by the presence of a large proportion of juveniles. The lengths of Slimy Sculpin from Propeller were negatively skewed with a mode at 35 to 40 mm. However, most lakes revealed a normally distributed length-frequency distribution. This may in part be due to sampling bias, as larger sculpin are easier to see and may be captured more readily than YOY fish. Alternately, very young Slimy Sculpin may rear in less-accessible areas (such as deep water or under boulders) than larger fish.

Length-frequency distributions could not be created from Arctic Grayling, Burbot, Ninespine Stickleback and Round Whitefish data, due to low sample sizes.

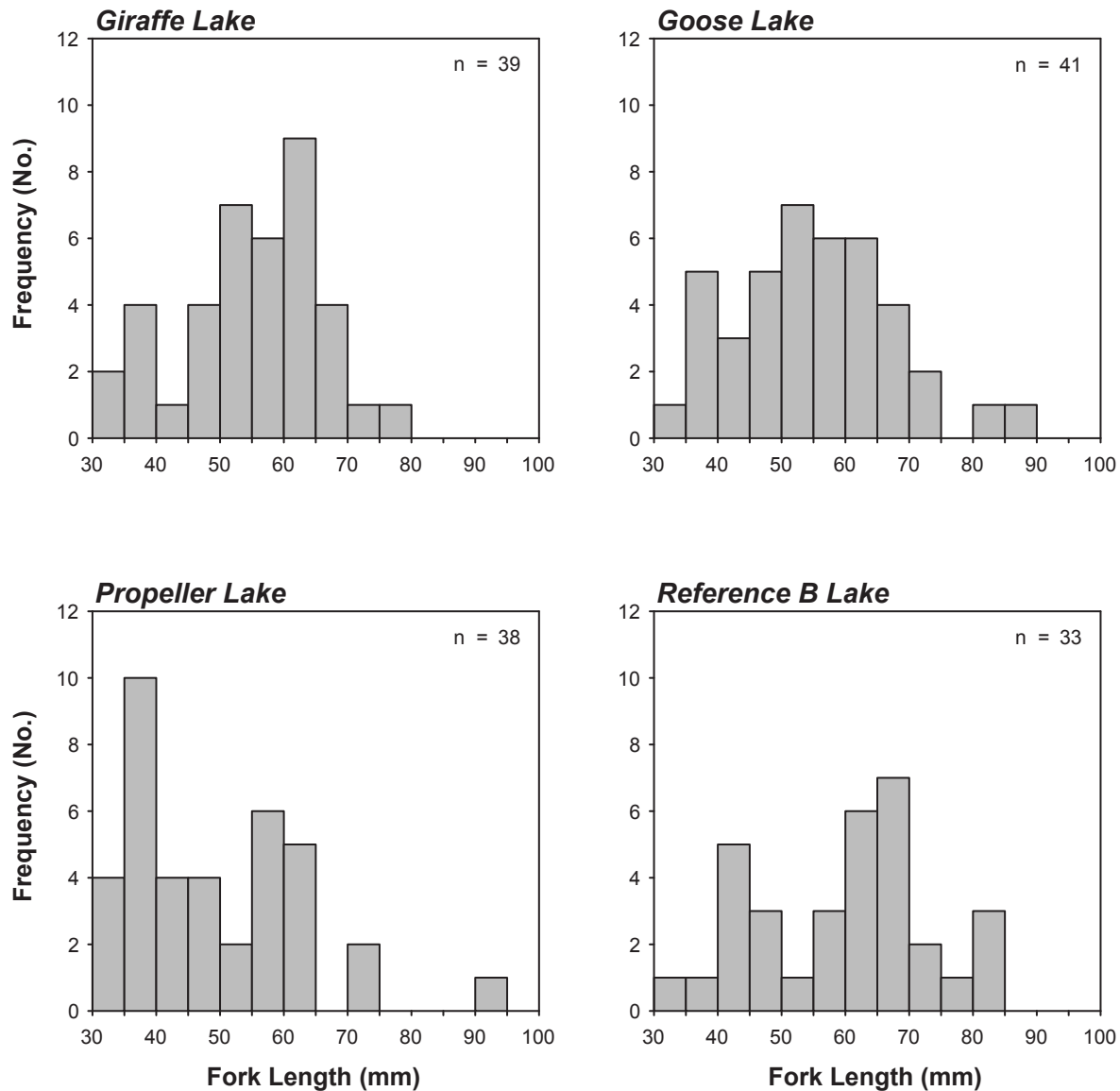
Weight-length regressions were prepared to indicate the relative health of each species in each lake. The slope of the weight-length regressions shows the change in weight with length. Difference in the slope of the relationships indicates differences in the respective health among lakes, with heavy body weight at a given length indicating healthy fish and low weights indicating decreased health and low energy storage. The strength of the weight-length relationship decreases with low sample size or high variability within the population. A summary of the statistical relationships can be found in Table 3.4-13.

The weight-length regressions for Lake Trout showed a significant ($P < 0.05$) positive relationship in all lakes from the Goose PDA (Figure 3.4-12). Similarly, all populations of Slimy Sculpin showed a significant ($P < 0.05$) positive correlation between weight and length (Figure 3.4-13). Round Whitefish populations showed significant ($P < 0.05$) positive relationships between weight and length in all lakes with more than three samples (Figure 3.4-14).

In the majority of cases, fish weight was strongly related to fish length as shown by adjusted R^2 values of 0.9 or higher. There were only three instances where adjusted R^2 values were more moderate: Lake Trout from Giraffe Lake (adjusted $R^2 = 0.836$) and Lake Trout from Reference B Lake (adjusted $R^2 = 0.712$). It is not known whether the reduced strength of these relationships was caused by inaccuracies during sampling (e.g., due to high winds affecting the accuracy of the balance) or if the fish in these lakes had more variability in condition. Reference B Lake was sampled on a windy day, which likely decreased the accuracy of measurements of weight.



Note: Length-frequency distribution is a combination of fish that were angled and gillnetted.



Note: Length-frequency distribution for Propeller Lake is a combination of fish that were electrofished and minnow trapped.

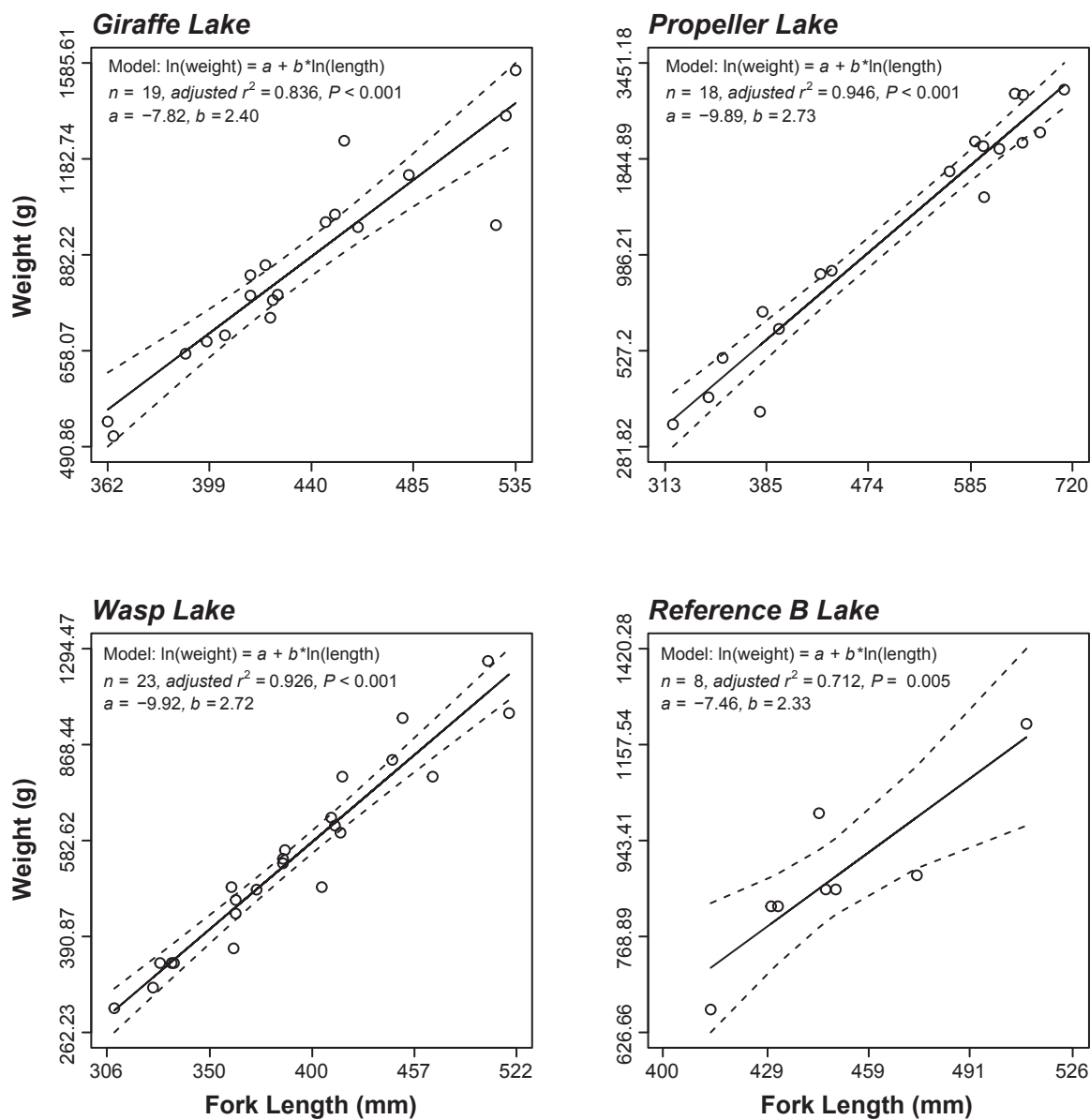
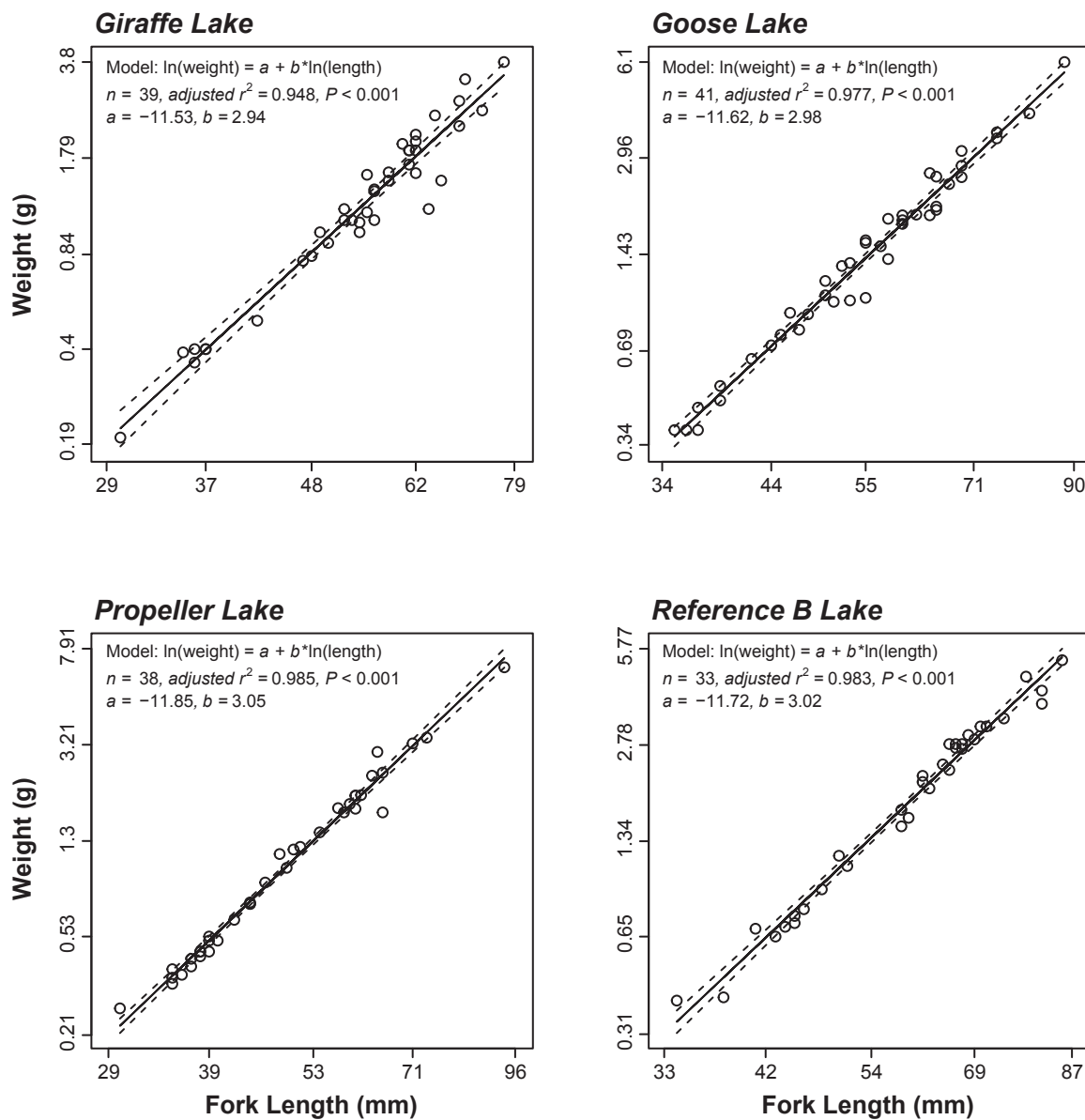


Figure 3.4-12



Note: axis values have been backtransformed from the natural log (Ln).

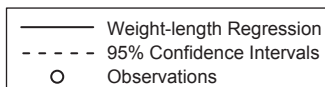
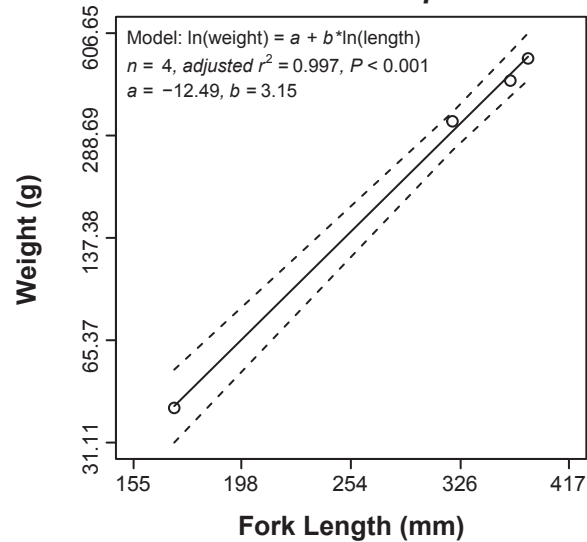
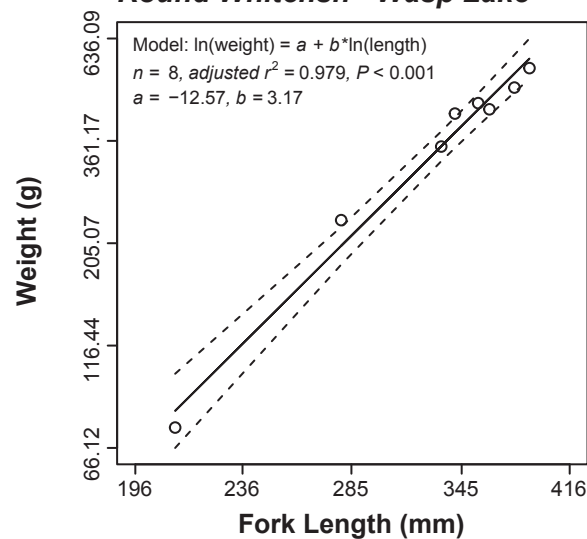


Figure 3.4-13

Round Whitefish - Propeller Lake**Round Whitefish - Wasp Lake**

Note: Axis values have been backtransformed from the natural log (Ln).

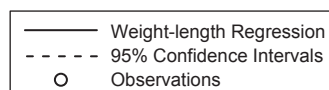


Table 3.4-13. Statistical Significance of Weight-length Regressions of Fish from Goose PDA Lakes, 2013

Species	Lake	Df of Category	Df of Error	F Value	P Value
Lake Trout	Giraffe	1	17	92.8	<0.001
	Propeller	1	16	298.1	<0.001
	Wasp	1	21	276.4	<0.001
	Reference B	1	6	18.3	0.005
Slimy Sculpin	Giraffe	1	37	696.4	<0.001
	Goose	1	39	1693.1	<0.001
	Propeller	1	36	2427.9	<0.001
	Reference B	1	31	1811.5	<0.001
Round Whitefish	Propeller	1	2	1071.5	<0.001
	Wasp	1	6	326.8	<0.001

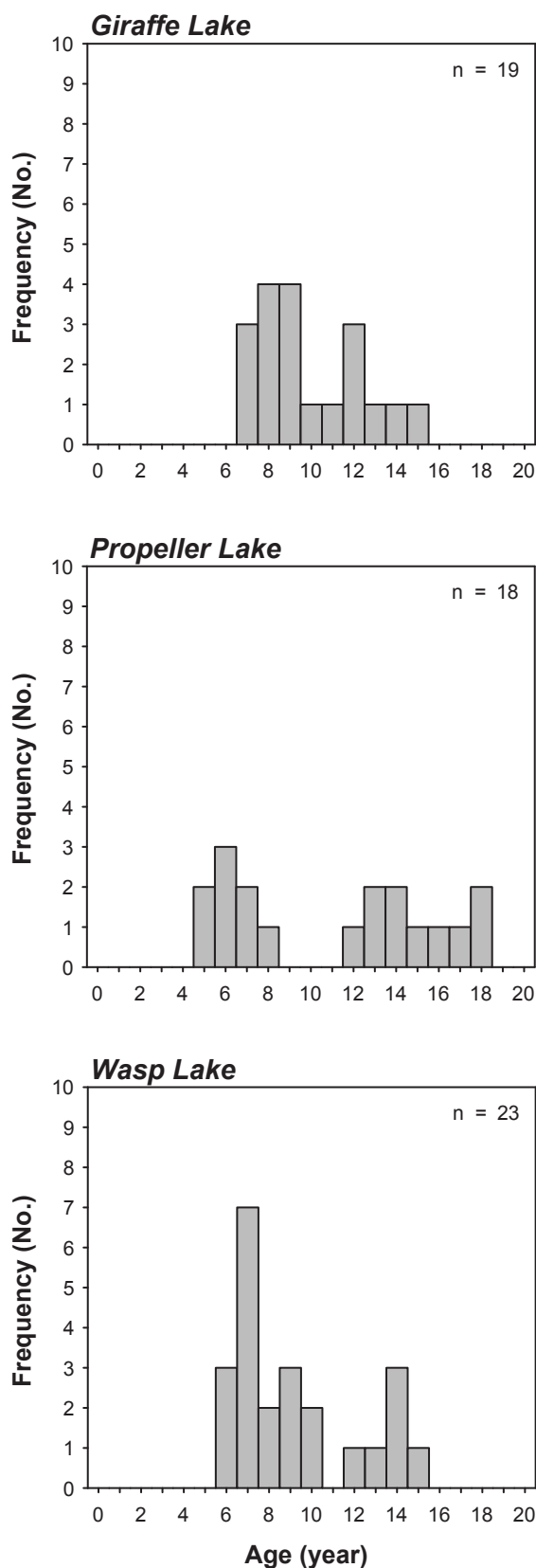
Df = degrees of freedom

A minimum of 15 Lake Trout were captured and aged in Wasp Lake, Propeller Lake, and Giraffe Lake, allowing for the creation of age-frequency distributions (Figure 3.4-15). In these lakes, as well as lakes in which fewer than 15 Lake Trout were captured, captured individuals represented a moderate range of ages (0 through 20 years), and the majority of Lake Trout fell within ages 6 through 12 years. This could reflect size selectivity in the fish sampling gear, since smaller fish are less easily captured by gillnets, while very large fish are both less numerous and capable of breaking through gillnets. Instances of younger Lake Trout (e.g., age 0 to 3) were generally captured by electrofishing, but electrofishing was not carried out in all lakes. The Lake Trout captured at Propeller Lake show a bimodal age distribution indicating two broad but distinct cohorts within the lake, representing young (ages 5 through 9 years) and older (ages 12 through 19 years) fish. A similar distribution was evident among Lake Trout from Wasp Lake, with modes at ages 7 to 8 and 14 to 15 years.

The ages of captured Slimy Sculpins ranged between ages 0 and 8 years, with the majority of sculpin falling into the 2-year age class and the others normally distributed around that age class (Figure 3.4-16). Although the maximum age was 8 years, most sculpin ranged between 1 and 4 years, suggesting that most were juvenile fish, as sexual maturity is estimated at 3 to 4 years for Slimy Sculpin (McPhail, 2007).

Fewer than 15 Round Whitefish and Arctic Grayling were captured in any of the lakes, and meaningful age-frequency distributions could not be created. Round Whitefish ranged in age from 2 to 14 years. The ages of the two Arctic Grayling were not available.

Growth models were created to characterize the relationship between fish length and fish age in PDA lakes. Table 3.4-14 indicates the model of best fit for each species at each lake. For Lake Trout, the modified von Bertalanffy model and linear model were the models of best fit among lakes. Figure 3.4-17 shows growth models relating length and age for Lake Trout in the Goose PDA. At Giraffe Lake and Wasp Lake, the linear model was the best fit model for most lakes as most individuals were similar in length and age, and smaller size-classes were not present. Lake Trout from Propeller Lake represented a greater range of lengths and ages, and the modified von Bertalanffy model outperformed the linear model.



Note: Age-frequency distribution is a combination of fish that were angled and gillnetted.

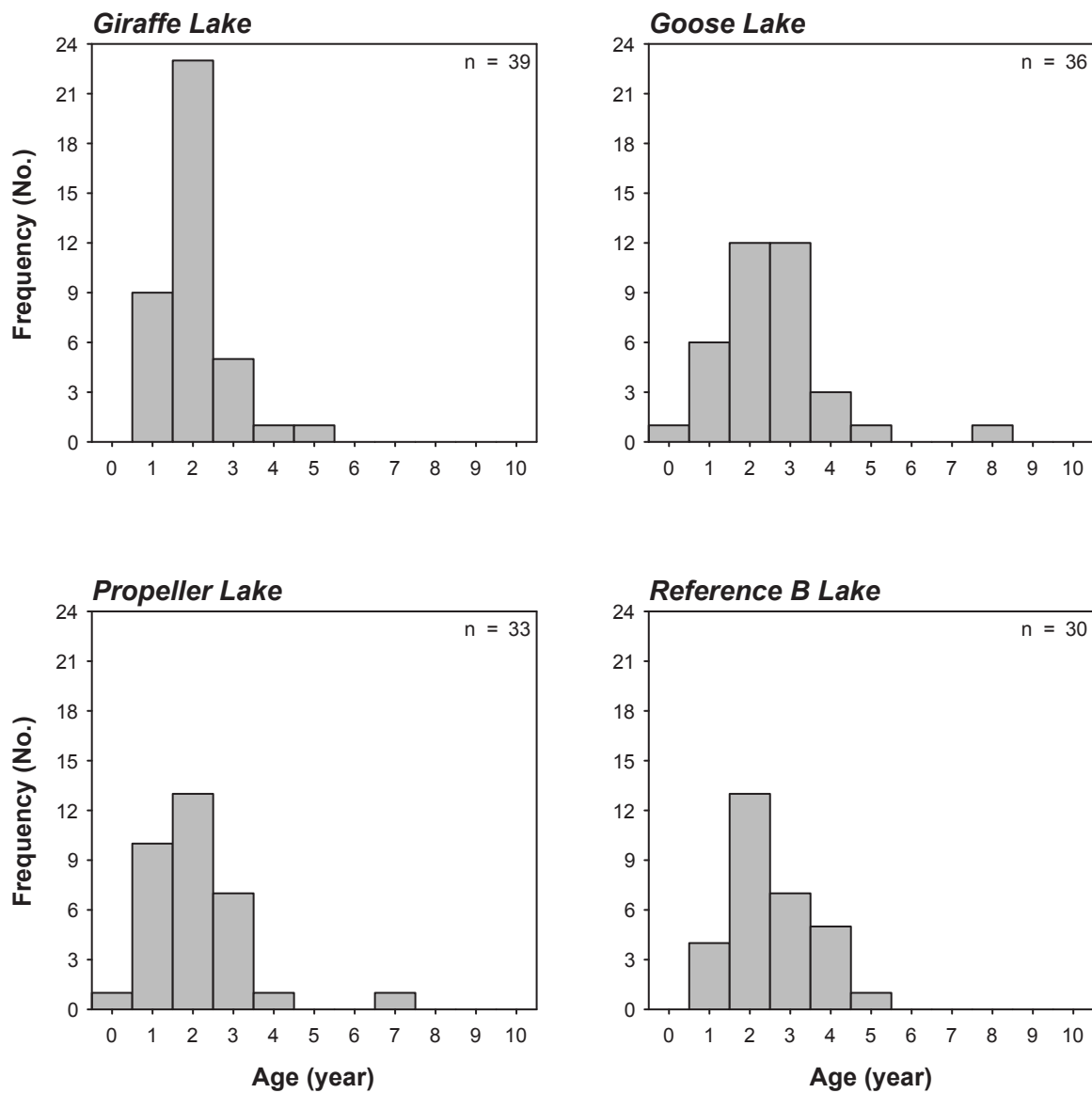


Figure 3.4-16

Table 3.4-14. Statistical Results for von Bertalanffy Growth Curves of Fish among Goose PDA Lakes, 2013

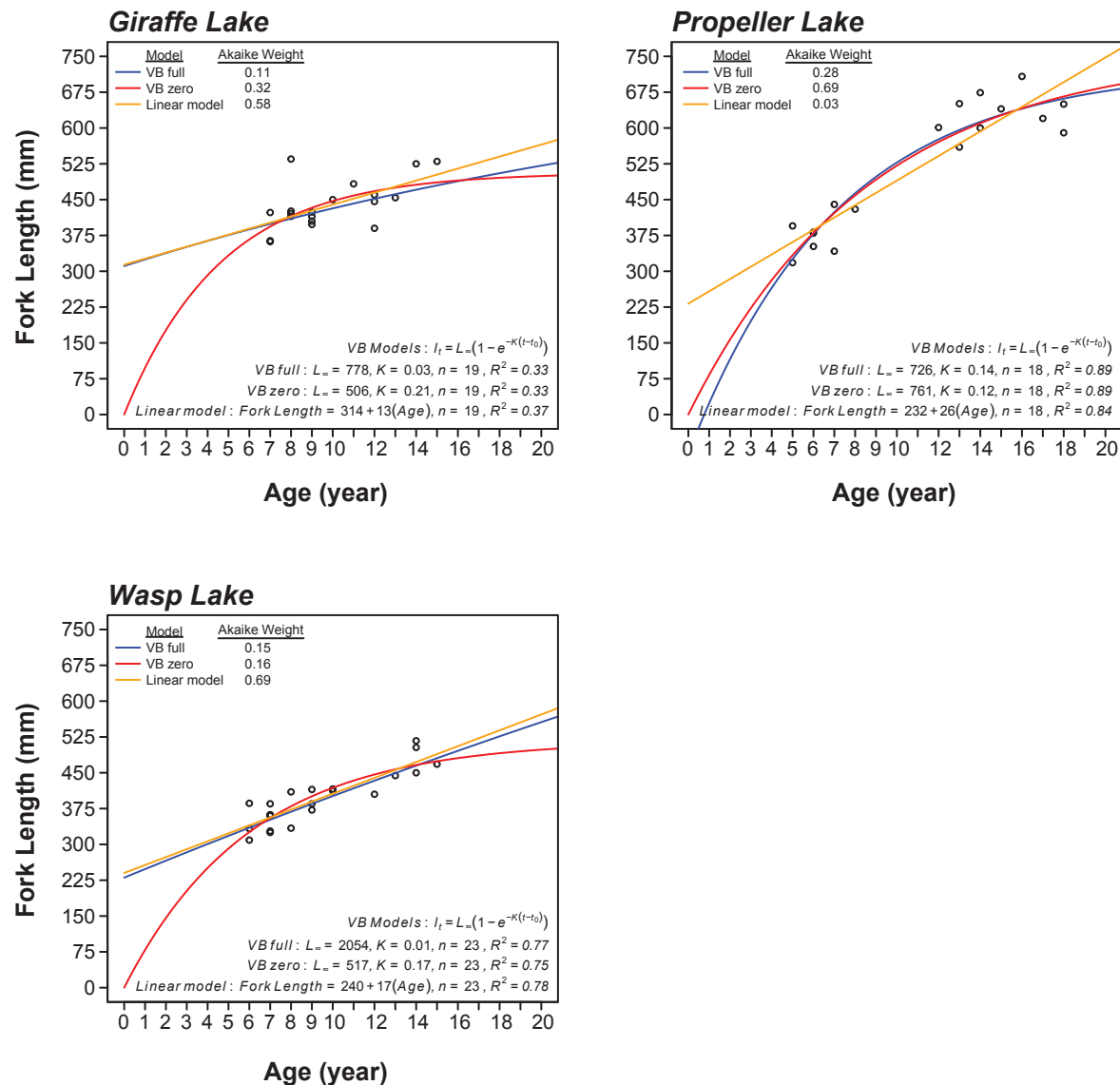
Species	Property	Lake	Model of Best Fit	AIC _w	R ²	N	Parameter	Estimate	SE	Df of Category	Df of Error	F Value	P Value
Lake Trout	Goose	Giraffe	Linear Model	0.58	0.37	19	-	-	-	1	17	10.1	0.006
		Propeller	VB zero	0.69	0.89	18	L _∞	761.48	51.42	-	-	-	<0.001
							K	0.115	0.017	-	-	-	<0.001
		Wasp	Linear Model	0.69	0.78	23	-	-	-	1	21	74.7	<0.001
Slimy Sculpin	Goose	Giraffe	VB zero	0.56	0.41	39	L _∞	66.65	4.18	-	-	-	<0.001
							K	0.992	0.186	-	-	-	<0.001
		Goose	Linear Model	0.71	0.37	36	-	-	-	1	34	19.8	<0.001
		Propeller	Linear Model	0.73	0.62	33	-	-	-	1	31	50.3	<0.001
		Reference B	Linear Model	0.53	0.19	30	-	-	-	1	28	6.73	0.015

Df = degrees of freedom, SE = standard error of the estimate, N = sample size

L_∞ = is the length (mm) that the fish would attain if it were allowed to grow for an infinite time, K = is a growth constant (year⁻¹)

AIC_w = Akaike Information Criteria weight, VB zero = modified von Bertalanffy model

Dashes indicate data not available, Bold P values are statistically significant (<0.05)



Note: Age-frequency distribution for George Lake is a combination of fish that were electrofished and beach seined.

The growth of Slimy Sculpin in most lakes was best described by the linear models (Table 3.4-14; Figure 3.4-18). Giraffe Lake was an exception: the best fit was the modified von Bertalanffy model. Slimy Sculpin are small, short-lived species; as a result, they may not exhibit asymptotic growth, thus a linear relationship between length and age is predominant in the lakes.

Insufficient numbers of Round Whitefish and Arctic Grayling were captured in any one lake to allow for the creation of growth models.

Fish Health

Data were collected with the intention of contributing supporting general fish community and biology information with additional data on fish health. The collected data are suitable for analyzing the three principal biological responses: fish survival, energy use, and energy storage (Table 3.4-15). The methodology and responses are compatible with MMER sampling programs. Slimy Sculpin and Lake Trout were chosen as target species for this data collection.

Table 3.4-15. Summary of Three Responses Providing Additional Fish Health Information

Response	Health Indicator	Information Gathered from Lethal Sampling	Information Gathered from Non-Lethal Sampling
Survival	Survival	*Age *Age-frequency distribution Length-frequency distribution	*Length-frequency distribution Age-frequency distribution
Energy Use	Growth	Length-at-age	Length-at-age
	Reproduction	Gonad weight at body weight	*Relative abundance of YOY
Energy Storage	Condition	*Body weight at length *Liver size at body weight	*Body weight at length

Adapted from Environment Canada (2012)

YOY = young of year

Slimy Sculpin were chosen as they were the only species present throughout the entire study area. In addition, this species is relatively sedentary and have high reproductive rates compared to larger-bodied fish such as Lake Trout. Sedentary fish more accurately reflect the conditions of the site at which they are captured than mobile fish that may have spent large parts of their life in other areas. Species with high reproductive rates are less likely to experience population declines due to regular sampling. Slimy Sculpin have an expected longevity of approximately seven years (McPhail 2007). The average age at maturation is three years for males and four years for females. Growth patterns are relatively plastic and maximum growth and growth-at-age varies between systems. Sculpins are carnivorous and eat a variety of aquatic insects, larvae, and plankton.

In previous years, Lake Trout were lethally sampled this additional fish health data; however, due to concerns about the long-term impacts of lethal sampling on large-bodied fish populations, lethal sampling of Lake Trout was not repeated in 2013. Instead, non-lethal biological information was gathered from captured Lake Trout, as well as tissue samples for metal concentration analyses. This data will supplement information from previous years and is an important for understanding fish health in the Goose Property PDA as large-bodied fish may respond to the environment differently than small-bodied fish.

This data was collected from fish from Giraffe Lake, Goose Lake, Reference B Lake, and Propeller Lake.

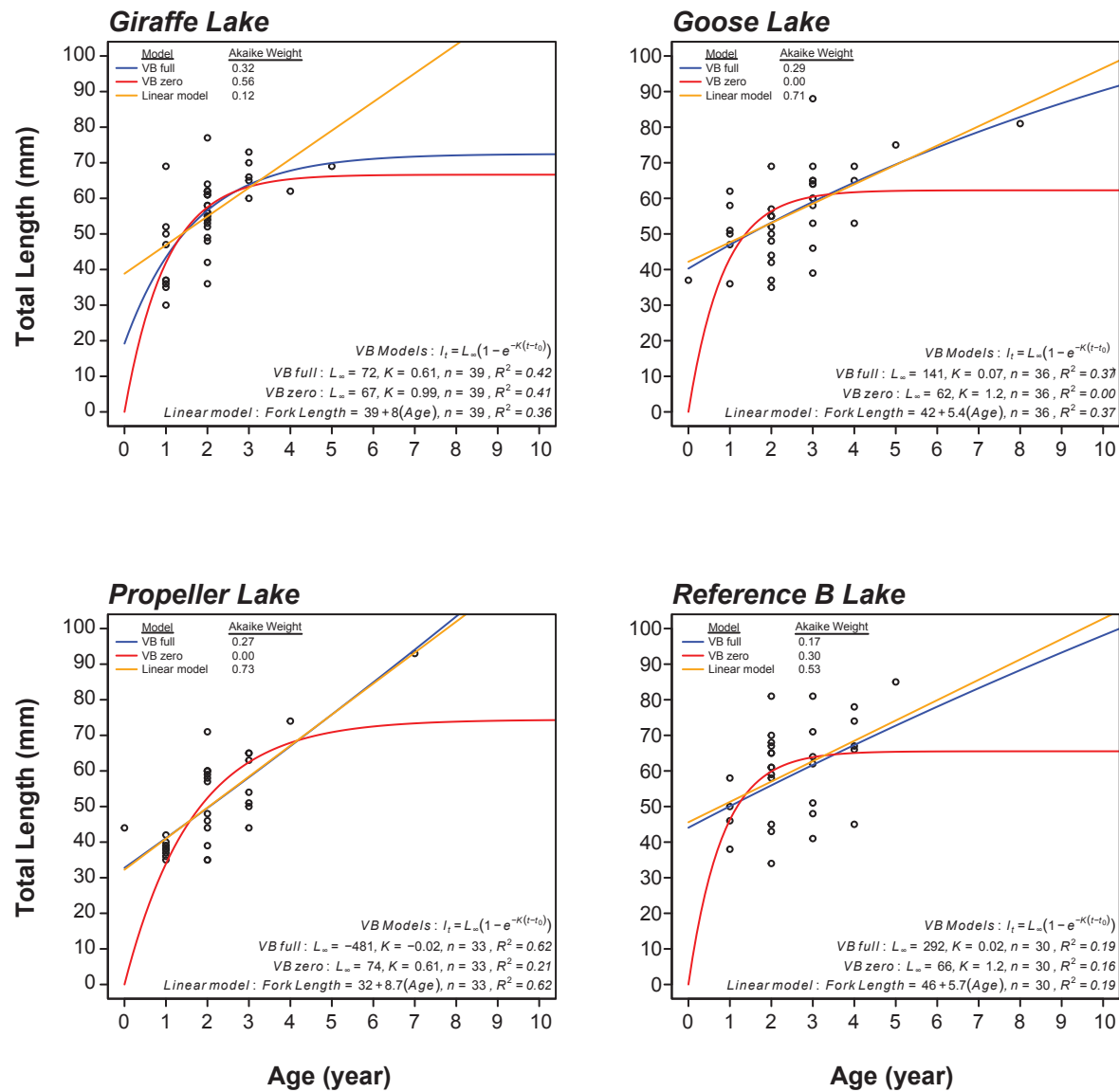


Figure 3.4-18

In cases where analyses were identical to those undertaken to describe the general biological characteristics of fish from lake environments the results are summarized here and presented in more detail in Section 3.4.2. All individual fish data for the fish health sampling are reported in Appendix 3.4-4 with other biological data collected from lakes.

Survival

The data necessary for measuring survival (length and age) can be gathered non-lethally, so length and age data from both non-lethally sampled Lake Trout and lethally-sampled Slimy Sculpin are included.

Lake Trout

Lake Trout were captured by gillnet, angling, and electrofishing. Mean fork length ranged from 430 mm (Giraffe Lake) to 567 mm (Propeller Lake; Table 3.4-5). The length of Lake Trout captured by angling was similar, ranging from 446 mm (Giraffe Lake) to 509 mm (Propeller Lake; Table 3.4-8). All Lake Trout captured by gillnets and angling were adults.

Where sufficient data (> 15 samples) was available, length-frequency distributions were plotted for Lake Trout in each lake (Figure 3.4-10). The majority of Lake Trout captured fell into the 400 to 450 mm size class. Lake Trout from Propeller Lake showed a bimodal distribution, which may be indicative of two distinct age classes.

Lake Trout age-frequency distributions were unavailable for most lakes due to small sample sizes, but there was evidence of a bimodal age distribution in Wasp Lake and Propeller Lake (Figures 3.4-15). Lake Trout from all lakes represented a moderate range of ages (0 years through 20 years), and the majority of Lake Trout fell between 6 years and 12 years old.

Slimy Sculpin

Slimy Sculpin were captured by electrofishing and minnow trapping. Slimy Sculpin captured by electrofishing ranged in mean total length from 49 mm (Propeller Lake) to 60 mm (Reference B Lake; Table 3.4-9). The mean length of the two Slimy Sculpin captured by minnow traps in Propeller Lake was 63 mm.

The length-frequency distributions for Slimy Sculpin varied among lakes (Figure 3.4-11). The majority of Slimy Sculpin fell into size classes ranging from 45 mm to 65 mm. Most lakes revealed a normally distributed length-frequency distribution, which may in part be due to sampling bias, while Propeller Lake was negatively skewed with a mode at 35 to 40 mm, which would be the expected length-frequency distribution for small-bodied fish.

Age-frequency distributions for Slimy Sculpin ranged between ages 0 and 8, with the majority of sculpin falling into the 2-year age class and normally distributed around that age class (Figure 3.4-16). Although the maximum age was 8 years, most sculpin ranged between 1 and 4 years which suggests that the majority of captured Slimy Sculpin have not reached sexual maturity, as expected for small-bodied fish.

Energy Use

Fish growth (expressed as an increase in body length over time) and reproduction are two primary uses of energy for fish, and energy allocation to those two uses was identified as a potential indicator of fish health (Environment Canada 2012).

Fish growth was explored through the use of von Bertalanffy growth models examining the relationship between length and age. Creating representative growth models requires age data from individuals

from a large range of body lengths and ages. Length and age data were available for both Lake Trout and Slimy Sculpin.

Reproductive investment can be explored through gonad weight at body weight or by the relative abundance of YOY (% composition of YOY). However, gonad weight should be obtained immediately prior to spawning to most accurately determine energy allocation. Slimy Sculpin were sampled recently after spawning and in most fish the gonads appeared reduced and may not be well representative of energy use. The GSI for Slimy Sculpin are reported; however, the relative abundance of YOY may provide a better estimate of energy use and is also reported for Slimy Sculpin. Juvenile Lake Trout were not targeted when sampling and relative abundance of YOY's could not be estimated. Determining reproductive investment through the relationship between gonad weight and body weight requires lethal sampling, and was also not available for Lake Trout.

Lake Trout

There was sufficient data to construct growth models for Lake Trout from Giraffe Lake and Propeller Lake (Figure 3.4-17). Table 3.4-14 indicates the model of best fit for each lake. At Giraffe Lake, the linear model was the best fit model as most individuals were similar in length and age. Lake Trout from Propeller Lake represented greater range of lengths and ages, and the modified von Bertalanffy model outperformed the linear model.

Slimy Sculpin

For Slimy Sculpin, the linear model best fit the data from all lakes except Giraffe Lake, where it was outperformed by the modified von Bertalanffy model (Figure 3.4-18; Table 3.4-14). Slimy Sculpin are small, short-lived species and may not reach an asymptotic length, thus typically resulting in a linear relationship between length and age.

The gonads of the majority of Slimy Sculpin from all lakes were undeveloped (Table 3.4-16). Identification of sex in undeveloped fish is difficult, especially in small-bodied fish where undeveloped gonads are very small. Instances in which sex could be determined were always skewed towards males. Male Slimy Sculpin mature sexually at age 3, while female sculpin do not generally mature until age 4 (McPhail 2007). The majority of Slimy Sculpin were less than 4 years of age, so the majority of females in this group would not be expected to be sexually mature. Given the identification bias introduced by maturation age and the proportion of unidentified individuals, the sex ratios calculated from the captured sculpin may not accurately depict the sex ratios of the populations.

The gonadosomatic index (GSI) was calculated for both immature and mature Slimy Sculpin (Table 3.4-17). The mean GSI, representing energy allocated to reproduction, was relatively similar between immature and mature Slimy Sculpin for each sex and was generally less than 1%. The mean GSI ranged from 0.36 % for mature females from Giraffe Lake to 1.99 % for mature females from Propeller Lake. The mean GSI for mature fish may be reduced due to sampling timing, and GSI may be higher during spawning season.

Given uncertainties related to estimates of gonadal development, reproductive energy use was also examined using the relative abundance of YOY as an indicator. The proportion of YOY Slimy Sculpin in monitoring lake populations was low (Table 3.4-18). A single YOY fish was captured from Goose Lake and from Propeller Lake, which represented 0.03 of all fish captured. No YOY were captured at the other lakes. This is either indicative of the Slimy Sculpin allocating little energy towards reproduction or an artifact of possible sampling bias, as larger sculpin are easier to see and may be captured more readily than YOY fish or very young Slimy Sculpin may rear in less-accessible areas (such as deep water or under boulders) than larger fish.

Table 3.4-16. Sex and Reproductive Status of Slimy Sculpin from Potential Development Area Lakes, 2013

Lake	Sex				Sex Ratio (M:F)	Reproductive Status					Percent Ripe or Maturing
	n	Male	Female	Unidentified		n	Undeveloped	Maturing	Ripe	Unknown	
Giraffe Lake	39	11	6	22	1.83	39	33	6			15.4
Goose Lake	41	12	7	22	1.71	41	25	9	7		39.0
Propeller Lake	38	11	3	24	3.67	38	26	5	4	3	23.7
Reference B Lake	33	12	5	16	2.40	33	25	4	2	2	18.2

n = number of fish

M = male

F = female

Table 3.4-17. Gonadosomatic Index (GSI) for Slimy Sculpin from Goose PDA Lakes, 2013

			GSI (%)					
Lake	Maturity	Sex	n	Mean	SD	SE	Lower CI	Upper CI
Giraffe Lake	Immature	Female	5	0.81	0.38	0.17	0.34	1.23
		Male	5	0.68	0.49	0.22	0.25	1.38
		Unknown	1	0.60	-	-	0.60	0.60
	Mature	Female	1	0.36	-	-	0.36	0.36
		Male	4	0.53	0.32	0.16	0.17	0.86
Goose Lake	Immature	Female	2	0.78	0.27	0.19	0.60	0.96
		Male	2	0.45	0.36	0.26	0.21	0.69
		Unknown	12	0.62	0.30	0.09	0.12	1.02
	Mature	Female	5	1.39	0.47	0.21	0.90	1.99
		Male	10	0.95	0.41	0.13	0.19	1.50
		Unknown	1	0.19	-	-	0.19	0.19
Propeller Lake	Immature	Female	2	1.15	0.38	0.27	0.90	1.41
		Male	3	0.80	0.56	0.32	0.32	1.37
		Unknown	4	0.28	0.26	0.13	0.07	0.62
	Mature	Female	1	1.99	-	-	1.99	1.99
		Male	8	0.94	0.34	0.12	0.45	1.34
Reference B Lake	Immature	Female	4	0.44	0.19	0.10	0.22	0.61
		Male	3	0.64	0.43	0.25	0.18	0.95
		Unknown	5	0.50	0.41	0.19	0.18	1.09
	Mature	Female	1	0.96	-	-	0.96	0.96
		Male	4	1.08	0.36	0.18	0.77	1.51

n = number of fish

SD = standard deviation of the mean

SE = standard error of the mean

CI = 95% confidence interval

Dashes indicate not applicable

Table 3.4-18. Proportion of Young-of-Year Slimy Sculpin at Goose PDA Lakes, 2013

Site	n	Proportion	
		0+	> 0+
Giraffe Lake	39	0.00	1.00
Goose Lake	36	0.03	0.97
Propeller Lake	33	0.03	0.97
Reference B Lake	30	0.00	1.00

0+ = young-of-year

n = number of fish

3.4.1.5 Energy Storage

Fish condition (Fulton's Condition K or weight-length regressions) and relative liver size (liver weight-body weight regression and HSI) are used as indicators of energy reserves or storage (Environment Canada 2012).

Measures of condition can be gathered non-lethally, so condition is reported for Lake Trout as well as Slimy Sculpin. Relative liver size and HSI are only reported for lethally sampled Slimy Sculpin.

Lake Trout

Lake Trout were captured by gillnetting, angling, and electrofishing. Mean condition factor for gillnetted Lake Trout at all sites was within normal values for salmonid fishes. The mean condition of Lake Trout ranged from 0.98 g/mm³ (Propeller Lake) to 1.06 g/mm³ (Giraffe Lake; Table 3.4-13).

Weight-length regressions were prepared as an indicator of the relative health (i.e., condition) of Lake Trout. The weight-length regressions for Lake Trout had a significant ($P < 0.05$) positive correlation at all lakes from the Goose PDA (Figure 3.4-12). At the majority of lakes, the weight-length relationship was strong with adjusted R^2 values of 0.9 or higher. There were only two instances where adjusted R^2 values were more moderate: Lake Trout from Giraffe Lake (adjusted $R^2 = 0.836$) and Lake Trout from Reference B Lake (adjusted $R^2 = 0.712$). In these cases it is not known if weights were not as accurate (e.g., due to high winds affecting the accuracy of the balance) or fish had more variability in condition. Reference B Lake was sampled on a windy day, which likely decreased the accuracy of weight measures.

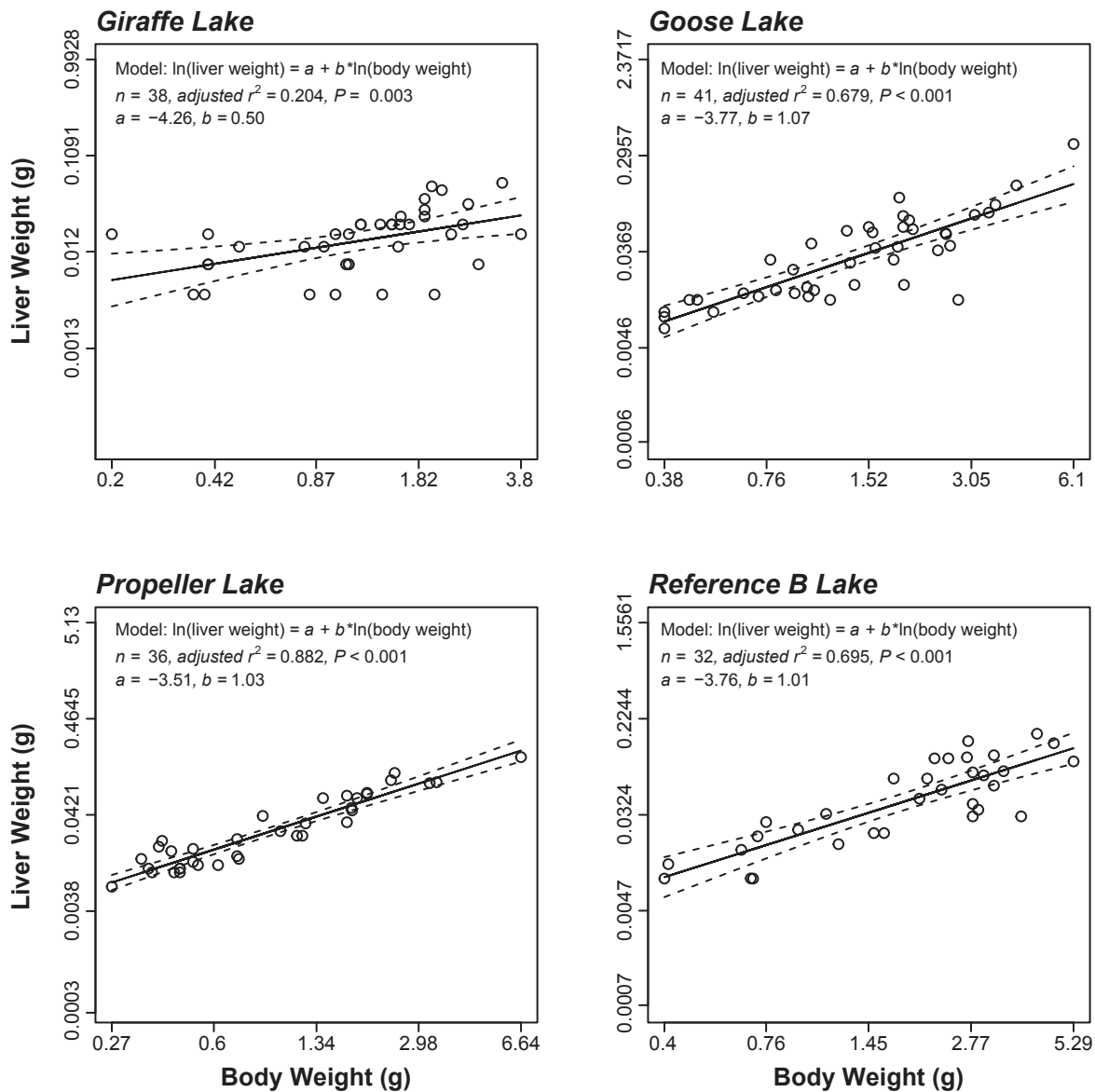
Slimy Sculpin

Slimy Sculpin were captured by electrofisher and minnow traps. The condition factor of Slimy Sculpin captured by electrofishing ranged from 0.78 (Giraffe Lake) to 0.88 g/mm³ (Reference B Lake; Table 3.4-11). The mean condition of the two Slimy Sculpin captured by minnow trap in Propeller Lake was 1.01 g/mm³.

Weight-length regressions were prepared as an indicator of the relative health of Slimy Sculpin. There was a significant positive correlation between weight and length for Slimy Sculpin from all lakes from the Goose Property (Figure 3.4-13). All weight-length relationships were strong with adjusted R^2 values of 0.9 or higher.

The HSI and relative liver size analyses compare liver size to body weight, as increased liver size is related to available energy reserves and to other health effects such as exposure to toxic substances (Environment Canada 2012) and provides information on energy storage and condition.

Relative liver size analysis was conducted using liver weight-body weight regressions. Similar to weight-length regressions, the slope of the weight-body weight shows relationship between liver weight and body weight. Differences in the slope of the regressions indicate differences in the relative liver size among populations. The strength of the relationship (slope) varies with the sample size and measurement error, but can also provide information regarding the variability of energy storage in the population. All F-values and P-values for the regressions for each lake are indicated in Table 3.4-19. The liver weight-body weight regressions for Slimy Sculpin showed a significant ($P < 0.05$) positive correlation for fish from all lakes (Figure 3.4-19). The strength of the relationship as measured by the adjusted R^2 was generally moderate to weak across lakes and ranged from 0.204 (Giraffe Lake) to 0.882 (Propeller Lake). Weaker correlations may be due to measurement error, which is difficult to eliminate due to the small size of the livers weighed and may be increased due to the measurement of dry weights instead of wet weights. For example, wet weights of nine livers that were measured fresh from Goose Lake were significantly correlated to body weight and had an adjusted R^2 of 0.88. When the analysis was conducted using the dry weights of the same livers, the adjusted R^2 decreases to 0.68. However, when comparing across lakes, the variability of some lakes is considerably higher than others (e.g., Giraffe Lake) and may suggest a high variability in energy storage in the population.



**Liver Weight-Body Weight Regression for Slimy Sculpin
from Goose Potential Development Area Lakes, 2013**

Figure 3.4-19

Table 3.4-19. Statistical Results for Liver Weight-Body Weight Regressions of Slimy Sculpin from Goose PDA Lakes, 2013

Lake	Df of Category	Df of Error	F Value	P Value
Giraffe	1	36	10.48	0.003
Goose	1	39	85.63	<0.001
Propeller	1	34	263.62	<0.001
Reference B	1	30	71.69	<0.001

Df = degrees of freedom

Significant P-values are bolded

Mean HSI ranged from 1.66 (Giraffe Lake) to 3.11 (Propeller Lake; Table 3.4-20). A higher HSI indicates a larger liver relative to body weight, which generally indicates larger stores of energy. However, a large liver may also be caused by exposure to toxic substances. Given the lack of development in the area and the lack of high concentrations of heavy metals in sculpin tissues (see Section 3.4.1.8), the large livers of Propeller Lake and Goose Lake Slimy Sculpin is most likely an indicator of large energy reserves.

Table 3.4-20. Hepatosomatic Index (HSI) for Slimy Sculpin from Goose PDA Lakes, 2013

Lake	HSI (%)					
	n	Mean	SD	SE	Lower CI	Upper CI
Giraffe Lake	38	1.66	1.47	0.24	0.31	4.82
Goose Lake	41	2.64	1.28	0.20	0.93	6.23
Propeller Lake	36	3.11	0.97	0.16	1.93	4.95
Reference B Lake	32	2.57	1.12	0.20	1.05	4.74

n = number of fish

SD = standard deviation of the mean

SE = standard error of the mean

CI = 95% confidence interval

Tissue Metal Concentrations

Tissue metal concentrations were sampled non-lethally from Giraffe Lake Lake Trout using tissue biopsies. Whole body tissue metal concentrations were taken for Slimy Sculpin from Goose Lake, Propeller Lake, Giraffe Lake, and Reference B Lake. The mean tissue metal concentrations were compared to fish tissue guidelines, as described in Section 2.6.3.1. Observed tissue metal concentrations and quality control results are presented in Appendix 3.4-5.

Lake Trout

Thirteen of the 34 metals analyzed were found below the detection limit in 60% or more of the samples: aluminum, barium, beryllium, bismuth, boron, cadmium, lithium, molybdenum, tellurium, tin, uranium, vanadium, and zirconium. These metals were not included for further analysis.

Table 3.4-21 presents a summary of the mean tissue metal concentrations in Lake Trout muscle tissue from Giraffe Lake fish. Min and max DLs are reported because some DLs were raised for samples with low tissue volumes. The mean mercury concentration was measured at 0.5873 mg/kg ww, above the Health Canada (2012) guideline of 0.5 mg/kg ww. In samples from Giraffe Lake, four of the eight tissue samples exceeded the guideline limit.

Table 3.4-21. Summary of Mean Tissue Metal Concentration in Lake Trout from Giraffe Lake, 2013

Variable	Units	Min DL	Max DL	Giraffe Lake (n = 8)						
				Proportion Below DL	Mean	SE	Lower CI	Upper CI	Min	Max
Total Length	mm			0	442.4	15.1	401.0	517.7	398.0	525.0
Moisture	%	0.10	0.10	0	70.69	0.80	67.75	73.84	67.70	74.10
Aluminum	mg/kg ww	1.0	2.0	0.75	-	-	-	-	-	-
Antimony	mg/kg ww	0.0020	0.0040	0.5	0.0036	0.0014	0.0005	0.0107	0.0005	0.0114
Arsenic	mg/kg ww	0.0060	0.0120	0	0.0202	0.0050	0.0078	0.0447	0.0074	0.0460
Barium	mg/kg ww	0.010	0.110	0.625	-	-	-	-	-	-
Beryllium	mg/kg ww	0.0020	0.0040	1	-	-	-	-	-	-
Bismuth	mg/kg ww	0.0020	0.0040	1	-	-	-	-	-	-
Boron	mg/kg ww	0.20	0.40	1	-	-	-	-	-	-
Cadmium	mg/kg ww	0.0020	0.0040	1	-	-	-	-	-	-
Calcium	mg/kg ww	4.0	8.0	0	142.8	40.9	60.3	366.5	60.3	399.0
Cesium	mg/kg ww	0.0010	0.0020	0	0.0531	0.0113	0.0278	0.1157	0.0262	0.1260
Chromium	mg/kg ww	0.040	0.080	0.25	0.085	0.022	0.025	0.181	0.020	0.183
Cobalt	mg/kg ww	0.0040	0.0080	0	0.0337	0.0049	0.0208	0.0575	0.0206	0.0599
Copper	mg/kg ww	0.040	0.080	0	0.267	0.021	0.196	0.373	0.192	0.389
Iron	mg/kg ww	1.0	2.0	0	4.6	0.7	2.6	8.4	2.4	8.8
Lead	mg/kg ww	0.010	0.020	0.25	0.166	0.075	0.005	0.554	0.004	0.590
Lithium	mg/kg ww	0.10	0.20	1	-	-	-	-	-	-
Magnesium	mg/kg ww	0.40	0.80	0	349.5	14.766	306.225	419.175	305	426
Manganese	mg/kg ww	0.010	0.020	0	0.124	0.010	0.082	0.168	0.080	0.172
Mercury	mg/kg ww	0.0020	0.0200	0	0.5873	0.1373	0.2334	1.2848	0.2250	1.3900
Molybdenum	mg/kg ww	0.0080	0.0160	0.875	-	-	-	-	-	-
Nickel	mg/kg ww	0.040	0.080	0.125	0.095	0.022	0.036	0.216	0.033	0.242
Phosphorus	mg/kg ww	2.0	4.0	0	2530.0	110.5	1962.5	2834.3	1910.0	2850.0
Potassium	mg/kg ww	4.0	8.0	0	4948.8	273.4	3690.8	5991.3	3570.0	6070.0
Rubidium	mg/kg ww	0.010	0.020	0	8.038	0.752	6.204	11.820	6.130	12.100

(continued)

Table 3.4-21. Summary of Mean Tissue Metal Concentration in Lake Trout from Giraffe Lake, 2013 (completed)

Variable	Units	Min DL	Max DL	Giraffe Lake (n = 8)						
				Proportion Below DL	Mean	SE	Lower CI	Upper CI	Min	Max
Selenium	mg/kg ww	0.020	0.040	0	0.464	0.015	0.393	0.511	0.385	0.512
Sodium	mg/kg ww	4.0	8.0	0	334.6	45.6	243.2	587.6	243.0	642.0
Strontium	mg/kg ww	0.020	0.040	0	0.187	0.067	0.043	0.537	0.040	0.574
Tellurium	mg/kg ww	0.0040	0.0080	1	-	-	-	-	-	-
Thallium	mg/kg ww	0.00040	0.00080	0	0.00873	0.00089	0.00543	0.01244	0.00515	0.01260
Tin	mg/kg ww	0.020	0.040	1	-	-	-	-	-	-
Uranium	mg/kg ww	0.00040	0.00080	1	-	-	-	-	-	-
Vanadium	mg/kg ww	0.020	0.040	1	-	-	-	-	-	-
Zinc	mg/kg ww	0.20	0.40	0	3.89	0.17	3.24	4.59	3.17	4.61
Zirconium	mg/kg ww	0.040	0.080	1	-	-	-	-	-	-

*DL = detection limit, n = sample size, SE = standard error of the mean, min = minimum, max = maximum, ww = wet weight
CI = 95% confidence interval, dashes indicate data not available*

Mean concentration of additional metals analysed fell below guideline limits. The mean arsenic concentration was 0.0202 mg/kg wwt (wet weight), which is below the 3.5 mg/kg wwt Canadian Food Inspection Agency (CFIA; 2011) guidelines for food fish.

Slimy Sculpin

No significant difference was found in mean body length among lakes (ANOVA, $F_{7,56} = 1.03$, $P = 0.42$) and, therefore, comparisons of mean metal concentrations unadjusted for body length were made.

Antimony, beryllium, bismuth, lithium, tellurium, and tin were found below the detection limit in 60% or more of Slimy Sculpin from all sites and were not included in further analysis. Lead was below the detection limit in 60% or more of Slimy Sculpin from all sites. Since the majority of the total number of samples was below the detection limit, no further analyses were completed.

Mean mercury concentrations in tissues of fish from the Goose PDA ranged from 0.0405 mg/kg wwt (Propeller Lake) to 0.0795 mg/kg wwt (Giraffe Lake; Table 3.4-22). The mercury concentration of all Slimy Sculpin was below the Health Canada guideline of 0.5 mg/kg wwt. In Giraffe Lake, the higher mercury concentration in Slimy Sculpin coincides with high mercury concentrations in Giraffe Lake Trout, and is likely a result of natural geological variation among the lakes.

Abnormalities and Parasites

Plerocercoids of an unknown tapeworm species were frequently found in the body cavities of lethally sampled Slimy Sculpin (Plate 3.4-7). The prevalence of the parasites was highly variable among lakes (Table 3.4-23). The parasites infected between 22.2% (Propeller Lake) and 77.8% (Propeller Lake) of Slimy Sculpin sampled. The intensity of parasitism (percent of parasite weight relative to total body weight) also varied among lakes (Table 3.4-24). Mean parasite weight ranged from 8.00 % (Reference B Lake) to 20.19 % (Giraffe Lake) of Slimy Sculpin total body weight.



Plate 3.4-7. A large plerocercoid stage tapeworm from the body cavity of a Slimy Sculpin, July 5, 2013.

Table 3.4-22. Summary of Mean Tissue Metal Concentrations in Slimy Sculpin, Goose Potential Development Area 2013

Variable	Units	Detection Limit	Giraffe Lake (n = 8)							Goose Lake (n = 8)						
			Proportion Censored	Mean	SE	Lower CI	Upper CI	Min	Max	Proportion Censored	Mean	SE	Lower CI	Upper CI	Min	Max
Total Length	mm		0	54.50	0.76	52.00	57.65	52.00	58.00	0	60.38	2.58	53.35	73.25	53.00	75.00
Moisture	%	0.10	0	72.70	0.39	70.90	74.33	70.60	74.50	0	70.25	0.71	68.01	73.56	67.90	73.80
Aluminum	mg/kg ww	1.0	0.125	2.1	0.5	0.7	4.7	0.6	5.0	0.125	4.2	2.4	0.6	17.7	0.5	20.8
Antimony	mg/kg ww	0.0020	1	-	-	-	-	-	-	0.875	-	-	-	-	-	-
Arsenic	mg/kg ww	0.0060	0	0.0245	0.0013	0.0189	0.0281	0.0188	0.0282	0	0.0427	0.0082	0.0242	0.0885	0.0228	0.0967
Barium	mg/kg ww	0.010	0	2.223	0.326	1.090	3.661	1.050	3.860	0	3.078	0.475	1.452	5.246	1.410	5.480
Beryllium	mg/kg ww	0.0020	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Bismuth	mg/kg ww	0.0020	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Boron	mg/kg ww	0.20	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Cadmium	mg/kg ww	0.0020	0	0.0079	0.0011	0.0028	0.0111	0.0025	0.0113	0	0.0140	0.0043	0.0059	0.0381	0.0057	0.0434
Calcium	mg/kg ww	4.0	0	6533.8	837.5	3340.5	10015.0	3260.0	10400.0	0	8312.5	739.4	5239.8	10700.0	4930.0	10700.0
Cesium	mg/kg ww	0.0010	0	0.0186	0.0021	0.0106	0.0274	0.0105	0.0286	0	0.0136	0.0021	0.0087	0.0246	0.0087	0.0268
Chromium	mg/kg ww	0.040	0.125	0.207	0.071	0.016	0.532	0.011	0.551	0	0.213	0.064	0.061	0.538	0.061	0.585
Cobalt	mg/kg ww	0.0040	0	0.0350	0.0039	0.0217	0.0516	0.0210	0.0527	0	0.0587	0.0050	0.0441	0.0842	0.0437	0.0875
Copper	mg/kg ww	0.040	0	0.483	0.022	0.372	0.559	0.351	0.568	0	0.543	0.036	0.418	0.719	0.410	0.741
Iron	mg/kg ww	1.0	0	14.6	3.5	7.4	34.0	7.3	37.1	0	23.8	9.5	7.6	77.3	7.5	88.6
Lead	mg/kg ww	0.010	1	-	-	-	-	-	-	0.875	-	-	-	-	-	-
Lithium	mg/kg ww	0.10	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Magnesium	mg/kg ww	0.40	0	299.75	12.15	251.13	348.95	245.00	350.00	0	360.88	10.41	316.20	396.08	312.00	398.00
Manganese	mg/kg ww	0.010	0	1.535	0.120	1.067	2.096	1.030	2.180	0	2.551	0.339	1.187	4.054	1.070	4.260
Mercury	mg/kg ww	0.0010*	0	0.0795	0.0070	0.0515	0.1113	0.0487	0.1150	0.25	0.0653	0.0107	0.0369	0.1195	0.0368	0.1280
Molybdenum	mg/kg ww	0.0080	0.625	0.0067	0.0005	0.0053	0.0086	0.0053	0.0086	0.1250	0.0094	0.0009	0.0054	0.0125	0.0048	0.0125
Nickel	mg/kg ww	0.040	0	0.397	0.038	0.258	0.547	0.247	0.553	0	0.350	0.054	0.202	0.583	0.198	0.595
Phosphorus	mg/kg ww	2.0	0	6136.3	594.7	3664.3	8510.5	3540.0	8780.0	0	6382.5	409.6	4688.0	7732.0	4520.0	7760.0
Potassium	mg/kg ww	4.0	0	3331.3	46.7	3152.8	3549.0	3130.0	3570.0	0	3346.3	54.6	3078.5	3494.8	3040.0	3500.0
Rubidium	mg/kg ww	0.010	0	3.144	0.159	2.584	3.767	2.570	3.790	0	3.734	0.271	2.858	4.793	2.830	4.870
Selenium	mg/kg ww	0.020	0	0.350	0.009	0.317	0.381	0.317	0.383	0	0.253	0.013	0.186	0.292	0.178	0.296
Sodium	mg/kg ww	4.0	0	675.6	30.9	566.7	789.3	566.0	793.0	0	821.0	44.1	711.4	1045.5	710.0	1070.0
Strontium	mg/kg ww	0.020	0	11.463	1.464	5.707	17.035	5.600	17.700	0	16.085	1.419	9.779	20.773	9.180	21.000
Tellurium	mg/kg ww	0.0040	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Thallium	mg/kg ww	0.00040	0	0.00413	0.00043	0.00223	0.00593	0.00210	0.00623	0	0.00465	0.00057	0.00295	0.00760	0.00287	0.00800
Tin	mg/kg ww	0.020	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Uranium	mg/kg ww	0.00040	0	0.00183	0.00029	0.00082	0.00303	0.00079	0.00314	0	0.00234	0.00054	0.00082	0.00474	0.00075	0.00486
Vanadium	mg/kg ww	0.020	0	0.052	0.008	0.026	0.086	0.026	0.089	0	0.063	0.015	0.028	0.145	0.028	0.160
Zinc	mg/kg ww	0.20	0	25.95	1.87	16.89	32.02	15.70	32.60	0	23.78	2.78	16.69	37.47	16.50	38.40
Zirconium	mg/kg ww	0.040	1	-	-	-	-	-	-	1	-	-	-	-	-	-

(continued)

Table 3.4-22. Summary of Mean Tissue Metal Concentrations in Slimy Sculpin, Goose Potential Development Area 2013 (completed)

Variable	Units	Detection Limit	Propeller Lake (n = 8)							Reference B Lake (n = 8)						
			Proportion Censored	Mean	SE	Lower CI	Upper CI	Min	Max	Proportion Censored	Mean	SE	Lower CI	Upper CI	Min	Max
Total Length	mm		0	53.00	2.76	44.35	64.65	44.00	65.00	0	60.25	6.24	35.75	81.00	34.00	81.00
Moisture	%	0.10	0	70.75	0.54	68.82	72.75	68.80	72.80	0	71.08	0.52	68.59	72.94	68.20	73.10
Aluminum	mg/kg wwt	1.0	0.5	2.0	1.0	0.2	7.5	0.2	8.3	0.25	2.5	0.7	0.5	5.4	0.5	5.4
Antimony	mg/kg wwt	0.0020	0.875	-	-	-	-	-	-	0.875	-	-	-	-	-	-
Arsenic	mg/kg wwt	0.0060	0	0.0198	0.0016	0.0152	0.0250	0.0152	0.0251	0	0.0157	0.0006	0.0137	0.0186	0.0137	0.0191
Barium	mg/kg wwt	0.010	0	3.025	0.425	1.764	4.571	1.760	4.650	0	5.055	0.776	1.678	7.781	1.410	7.910
Beryllium	mg/kg wwt	0.0020	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Bismuth	mg/kg wwt	0.0020	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Boron	mg/kg wwt	0.20	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Cadmium	mg/kg wwt	0.0020	0	0.0081	0.0008	0.0052	0.0117	0.0049	0.0118	0	0.0039	0.0005	0.0023	0.0058	0.0022	0.0060
Calcium	mg/kg wwt	4.0	0	5872.5	912.9	3527.0	10341.3	3450.0	10700.0	0	7391.3	987.0	3619.3	11898.0	3180.0	12500.0
Cesium	mg/kg wwt	0.0010	0	0.0173	0.0020	0.0097	0.0248	0.0097	0.0251	0	0.0283	0.0068	0.0112	0.0601	0.0109	0.0623
Chromium	mg/kg wwt	0.040	0	0.376	0.128	0.043	1.034	0.041	1.100	0	0.299	0.086	0.082	0.729	0.081	0.791
Cobalt	mg/kg wwt	0.0040	0	0.0482	0.0071	0.0288	0.0850	0.0285	0.0913	0	0.0232	0.0026	0.0143	0.0364	0.0135	0.0381
Copper	mg/kg wwt	0.040	0	0.536	0.036	0.411	0.678	0.404	0.691	0	0.490	0.030	0.390	0.612	0.383	0.613
Iron	mg/kg wwt	1.0	0	11.1	2.0	6.4	21.9	6.2	23.6	0	15.2	2.7	7.4	28.4	7.3	30.3
Lead	mg/kg wwt	0.010	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Lithium	mg/kg wwt	0.10	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Magnesium	mg/kg wwt	0.40	0	318.25	18.78	244.63	391.55	242.00	394.00	0	357.88	15.03	282.10	409.53	273.00	416.00
Manganese	mg/kg wwt	0.010	0	3.984	0.675	2.272	7.519	2.240	8.030	0	2.131	0.298	0.877	3.373	0.785	3.490
Mercury	mg/kg wwt	0.0010*	0	0.0405	0.0033	0.0243	0.0510	0.0222	0.0512	0.125	0.0437	0.0037	0.0264	0.0553	0.0251	0.0557
Molybdenum	mg/kg wwt	0.0080	0.25	0.0098	0.0019	0.0036	0.0185	0.0035	0.0195	0.5	0.0080	0.0015	0.0043	0.0149	0.0043	0.0154
Nickel	mg/kg wwt	0.040	0	0.379	0.079	0.163	0.786	0.157	0.842	0	0.220	0.044	0.103	0.443	0.100	0.476
Phosphorus	mg/kg wwt	2.0	0	5025.0	545.2	3624.8	7679.8	3560.0	7860.0	0	5972.5	554.1	3715.5	8374.8	3460.0	8660.0
Potassium	mg/kg wwt	4.0	0	3057.5	82.7	2658.5	3337.3	2620.0	3360.0	0	3260.0	59.5	3067.0	3496.5	3060.0	3500.0
Rubidium	mg/kg wwt	0.010	0	4.875	0.415	3.892	6.676	3.860	6.700	0	3.879	0.227	3.145	4.794	3.120	4.850
Selenium	mg/kg wwt	0.020	0	0.247	0.021	0.189	0.342	0.187	0.352	0	0.284	0.018	0.222	0.363	0.219	0.373
Sodium	mg/kg wwt	4.0	0	757.3	23.4	652.8	831.7	644.0	832.0	0	677.9	53.6	465.8	915.5	439.0	943.0
Strontium	mg/kg wwt	0.020	0	12.485	1.587	7.178	19.665	6.910	20.400	0	15.213	2.370	5.046	24.143	4.290	25.000
Tellurium	mg/kg wwt	0.0040	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Thallium	mg/kg wwt	0.00040	0	0.00722	0.00078	0.00469	0.01103	0.00464	0.01150	0	0.00396	0.00054	0.00169	0.00614	0.00152	0.00630
Tin	mg/kg wwt	0.020	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Uranium	mg/kg wwt	0.00040	0	0.00140	0.00031	0.00051	0.00270	0.00048	0.00276	0	0.00119	0.00035	0.00051	0.00308	0.00051	0.00341
Vanadium	mg/kg wwt	0.020	0.375	0.035	0.010	0.009	0.083	0.009	0.091	0.125	0.040	0.009	0.015	0.089	0.013	0.097
Zinc	mg/kg wwt	0.20	0	20.43	1.00	16.31	24.31	15.80	24.40	0	24.76	1.41	20.21	30.10	20.00	30.40
Zirconium	mg/kg wwt	0.040	1	-	-	-	-	-	-	1	-	-	-	-	-	-

DL = detection limit, n = sample size, SE = standard error of the mean, min = minimum, max = maximum, wwt = wet weight

CI = 95% confidence interval, dashes indicate data not available

* DL for one samples in Reference B Lake was raised to 0.045 due to detection of analyte at comparable level in Method Blank.

Table 3.4-23. Percent of Slimy Sculpin with Tapeworms in Goose PDA Lakes, 2013

Lake	n	Percent	
		Without Parasites	With Parasites
Giraffe Lake	39	43.6	56.4
Goose Lake	41	63.4	36.6
Propeller Lake	36	77.8	22.2
Reference B Lake	33	69.7	30.3

n = sample size

Table 3.4-24. Intensity of Parasitism in Slimy Sculpin from Goose PDA Lakes, 2013

Lake	Parasite: Fish Weight (%)					
	n	Mean	SD	SE	Lower CI	Upper CI
Giraffe Lake	22	20.19	9.72	2.07	6.43	40.56
Goose Lake	15	14.91	7.94	2.05	0.93	26.99
Propeller Lake	7	12.32	7.00	2.65	4.40	22.64
Reference B Lake	10	8.00	4.75	1.50	2.69	15.74

Only Slimy Sculpin with parasites were included in this calculation.

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

CI = 95% confidence interval

3.4.1.6 Diet

Appendix 3.4-6 presents the results of the diet analyses for Slimy Sculpin sampled in 2013. Stomach contents are indicative of the diet at the time of sampling, and therefore differences in diets between lakes are reflective of temporal availability of food, and not actual benthic invertebrate community structure. Slimy Sculpin diet in all lakes in the Goose PDA was dominated numerically by Chironomid (midge) larvae, which made up between 55% and 74% of the total diet (Figure 3.4-20). Slimy Sculpin diet from lakes within the Goose PDA were consistent across all lakes with > 50 % of the diet at all four lakes provided by Chironomids, and lesser amounts of between 7 and 26% provided by other dipterans and Coleoptera. Nematodes were only observed in stomachs from Giraffe Lake.

3.4.2 George Property PDA

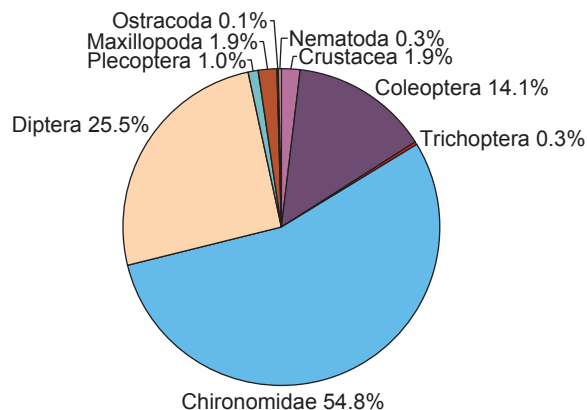
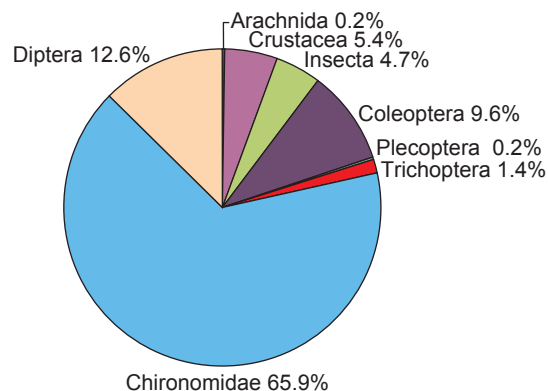
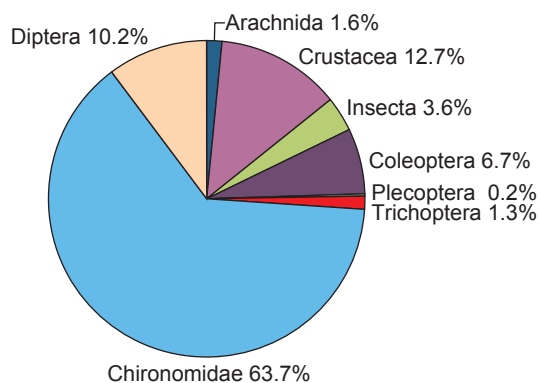
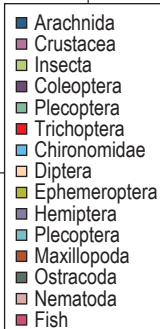
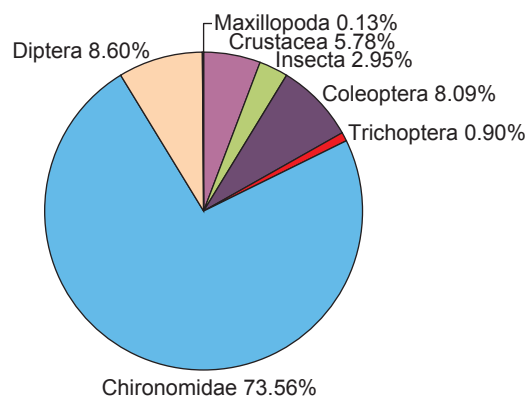
3.4.2.1 Fish Habitat

Littoral zone lake habitat was assessed at Bob Lake, McCoy Lake, and Reference Q Lake in the George PDA. Lake habitat survey data can be found in Appendix 3.4-1.

Bob Lake

Bob Lake is a small lake adjacent to George Lake and separated by a narrow esker. The esker creates a steep, sparsely vegetation shoreline along the east side of Bob Lake, in contrast to the low gradient shoreline of the rest of the lake (Plate 3.4-8). Bob Lake has no identified inflows or outflows, and appears to be isolated from all other water bodies. The maximum depth of Bob Lake is 5 m.

The substrate of Bob Lake is dominated by cobble or cobble/boulder complexes (Figure 3.4-21). A minority of habitat units have primarily fine sediments, most notably at the north end of the lake. Sparse vascular aquatic vegetation was observed at the north end of the lake.

Giraffe Lake**Goose Lake****Propeller Lake****Reference B Lake**

**Mean Percentage Composition (by Number)
of the Stomach Contents of Slimy Sculpin from
Goose Potential Development Area Lakes, 2013**

Figure 3.4-20

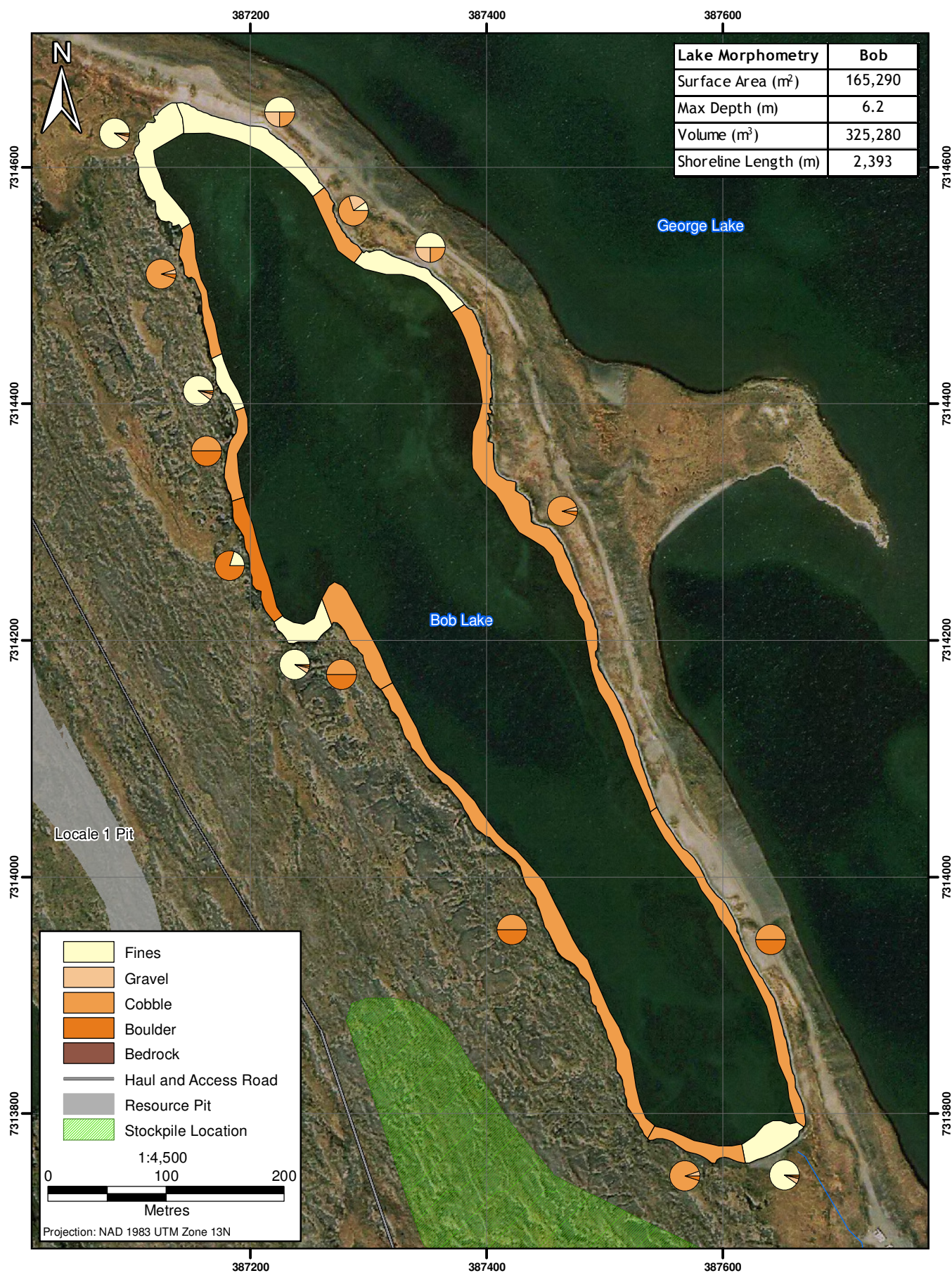


Figure 3.4-21



Plate 3.4-8. A view from the esker on the east side of the lake shows the steep shoreline, Bob Lake, July 10, 2013.

McCoy Lake

McCoy Lake is a moderate sized lake south-west of George Lake and north-east of Reference Q Lake. The majority of McCoy Lake is less than 4 m deep, with a maximum lake depth of 8 m. The shoreline of the lake is complex, with multiple embayments and peninsulas (Plate 3.4-9). The substrate in the majority of the shoreline, including the peninsulas, was comprised of primarily large substrate particles: boulders and cobbles (Figure 3.4-22). Fine sediments were the dominant substrate type in several of the bays, where the substrate was more sheltered from ice and wave scour.

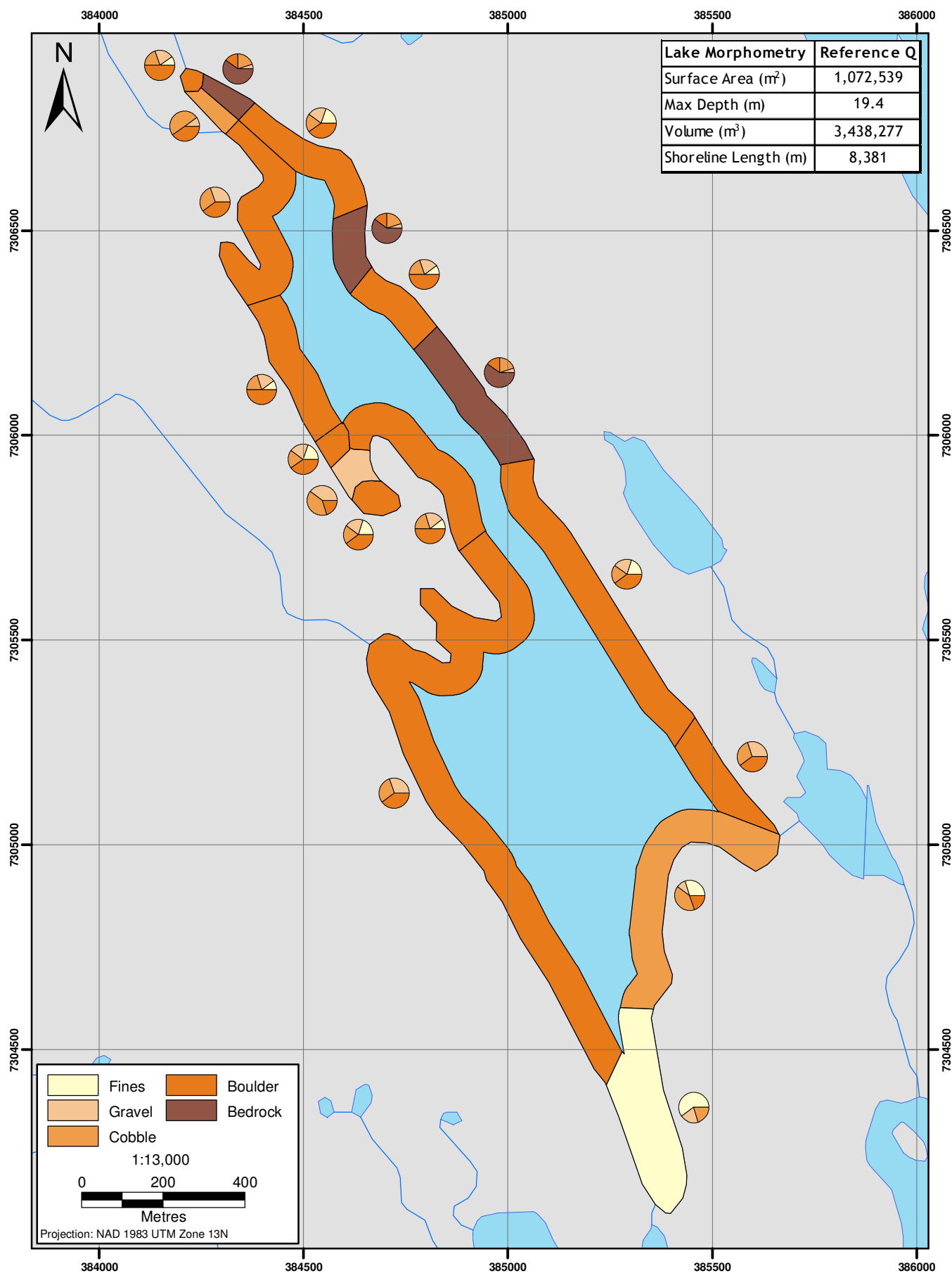
Reference Q Lake

Reference Q Lake is located south-west of the George Lake property. It has three primary inflows and one outflow. It is a relatively deep lake relative to width, with a maximum depth of 14 m and a minimum width of less than 200 m. Boulders are the predominant substrate in the littoral zone (Figure 3.4-23). The only area in which fines were the dominant substrate type is near the inflow at the southern end of the lake. Bedrock outcroppings are the dominant substrate along zones on the east shoreline (Plate 3.4-10).

3.4.2.2 Fish Community

Species Composition

A total of five fish species were captured in lakes within the George PDA in 2013: Arctic Grayling, Burbot, Lake Trout (Plate 3.4-11), Round Whitefish, and Slimy Sculpin. Appendix 3.4-2 presents the sampling effort and species summary for each lake. Table 3.4-25 shows a summary of the fish species and the number of fish captured in George PDA surveyed lakes in 2013 using all methodology (gillnet, electrofishing, and beach seine). Lake Trout were the most widespread species followed by Slimy Sculpin. McCoy Lake showed the greatest diversity of fish species, with four species captured. Efforts in Bob Lake and Occurrence Lake resulted in the capture of a single species per lake, Lake Trout and Arctic Grayling, respectively. Lytle Lake was the only lake sampled where no fish were captured.



Shoreline Habitat Zones,
Reference Q Lake, 2013

Figure 3.4-23

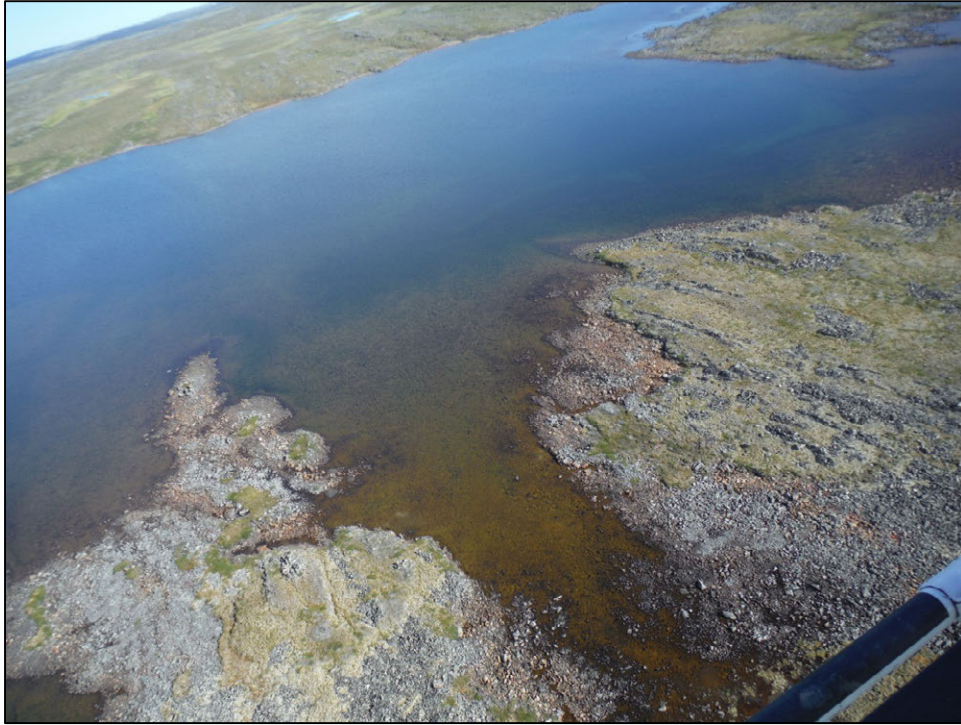


Plate 3.4-9. A complex shoreline with multiple peninsulas and embayments, McCoy Lake, July 9, 2013.



Plate 3.4-10. Boulder and bedrock substrates, Reference Q Lake, July 7, 2013.



Plate 3.4-11. Adult Lake Trout captured at Komatic Lake, July 8, 2013.

Table 3.4-25. Number of Fish Captured in George PDA Lakes, 2013

Lakes	Number Captured						Total
	Arctic Grayling	Burbot	Lake Trout	Ninespine Stickleback	Round Whitefish	Slimy Sculpin	
Bob Lake	-	-	7	-	-	-	7
George Lake	12	-	12	-	-	35	59
Komatic Lake	-	-	16	-	-	34	50
Lytle Lake	-	-	-	-	-	-	0
McCoy Lake	-	2	11	-	2	36	51
Occurrence Lake	1	-	-	-	-	-	1
Reference Q Lake	-	-	5	-	6	32	43

Dashes indicate that no fish were captured

Lake Trout and Round Whitefish 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 and Burbot are spring spawners, although grayling spawn mainly in streams and rivers and Burbot spawn in shallow littoral zones of lakes. Upon hatching, young Arctic Grayling stay in the stream for the summer to rear and to feed, while young Burbot may migrate to and feed in river channels and tributary streams or remain in lakes and feed along shorelines. Both species overwinter in lakes that do not freeze to the bottom, which is assumed to require at least 4 m of depth. Ninespine Stickleback and Slimy Sculpin 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.

CPUE

Catch-per-unit-effort (CPUE) was recorded for gillnetting, electrofishing, and beach seining effort in all lakes.

Standard and bootstrap mean gillnet CPUE is presented for each lake and each species in Table 3.4-26. Total CPUE for floating gillnets in surveyed lakes was lowest in Bob Lake (no fish captured) and highest in Komatic Lake (2.44 fish/100 m²/h). Total CPUE for sinking gillnets in surveyed lakes was lowest in Occurrence Lake (no fish captured) and highest in Bob Lake (1.68 fish/100 m²/h). In general, the CPUE was greater for sinking gillnets than for floating gillnets.

Electrofishing was conducted in McCoy Lake and ReferenceQ Lake in order to collect small species and juvenile fish that often occupy the littoral zone of lakes, as well as to collect Slimy Sculpin samples for tissue metal analyses (see Section 3.4.1 for results). Electrofishing was also conducted in George Lake and Komatic B Lake solely to collect Slimy Sculpin; although this report includes community information gathered from these efforts, fishing efforts targeting a single species may not result in a catch rate that accurately represents the overall fish community. Electrofishing was conducted in Bob Lake, Lytle Lake, and Occurrence Lake solely to characterize fish populations.

Fish were captured by electrofishing in five of the seven lakes sampled (Table 3.4-27). Among the lakes where fish were captured, electrofishing CPUE ranged from 0.00 fish/100 s at Lytle Lake and Occurrence Lake to 0.85 fish/100 s at Reference Q Lake. Slimy Sculpin was the most widespread and abundant species in surveyed lakes. George Lake and McCoy Lake had the most diverse communities with three species captured by electrofishing at each lake.

No fish were captured at Lytle Lake and Occurrence Lake. Two large fish were observed in Occurrence Lake, confirming its fish-bearing status. Lytle Lake is connected by fish-passable channels to fish-bearing water bodies, Occurrence Lake and George Lake, and is assumed to be fish-bearing despite the lack of fish captured.

Beach seining was conducted at George Lake only. The area seined during each of the 16 seine hauls was relatively consistent and ranged from 45 m² to 75 m², depending on the substrate and ease of deployment for the seine. Slimy Sculpin were the only species captured by seining, although Arctic Grayling were observed during seining efforts. The mean CPUE (corrected for the area of shoreline seined) was 0.65 fish/100 m² (Table 3.4-28).

3.4.2.3 *Biology*

Growth and Health

Tables 3.4-29 to 3.4-34 present summaries of the standard and bootstrapped mean fork length, weight and condition of fish species separated by sampling method in each of the sampled lakes in the George PDA. Appendix 3.4-4 presents the individual fish data.

Lake Trout were captured by gillnetting, and/or electrofishing in five of the sampled lakes. Of the Lake Trout captured in gillnets, mean fork length ranged from 417 mm (McCoy Lake) to 477 mm (George Lake; Table 3.4-29), and mean weight ranged from 838.9 g (McCoy Lake) to 1,282.0 g (George Lake; Table 3.4-30). Mean condition factor for Lake Trout captured by gillnetting at all sites was within normal values for salmonid fishes and ranged from 0.97 to 1.14 g/mm³ (Table 3.4-31). Lake Trout captured by electrofishing ranged in mean length from 75 mm (Bob Lake) to 88 mm (George Lake), mean weight from 4.1 g (Bob Lake) to 8.3 g (George Lake), and mean condition from 0.97 (Bob Lake) to 1.03 g/mm³ (George Lake; Table 3.4-32 to Table 3.4-34). All Lake Trout captured by gillnet and angling were adults, and all Lake Trout captured by electrofishing were juveniles.

Table 3.4-26. Gillnet Standard and Bootstrap CPUE Summary Statistics for George Potential Development Area Lakes, 2013

Lake	Gillnet Type	Species	Standard CPUE (No. Fish/100 m ² /h)						Bootstrap CPUE (No. Fish/100 m ² /h)			
			n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
George Property												
Bob Lake	Floating	Total	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sinking	Lake Trout	2	1.68	1.08	0.76	0.95	2.40	1.67	0.54	0.91	2.44
		Total	2	1.68	1.08	0.76	0.95	2.40	1.67	0.54	0.91	2.44
George Lake	Floating	Lake Trout	4	0.11	0.23	0.11	0.00	0.42	0.11	0.10	0.00	0.34
		Total	4	0.11	0.23	0.11	0.00	0.42	0.12	0.10	0.00	0.34
	Sinking	Lake Trout	5	0.42	0.48	0.22	0.00	1.01	0.42	0.19	0.05	0.79
		Total	5	0.42	0.48	0.22	0.00	1.01	0.41	0.19	0.05	0.79
Komatic Lake	Floating	Lake Trout	1	2.44	-	-	2.44	2.44	-	-	-	-
		Total	1	2.44	-	-	2.44	2.44	-	-	-	-
	Sinking	Lake Trout	2	1.51	0.19	0.14	1.38	1.64	1.51	0.10	1.37	1.64
		Total	2	1.51	0.19	0.14	1.38	1.64	1.51	0.10	1.37	1.64
McCoy Lake	Floating	Lake Trout	4	0.29	0.34	0.17	0.00	0.60	0.29	0.14	0.00	0.58
		Round Whitefish	4	0.08	0.15	0.08	0.00	0.28	0.08	0.07	0.00	0.23
		Total	4	0.37	0.45	0.22	0.00	0.89	0.37	0.19	0.00	0.73
	Sinking	Lake Trout	4	0.49	0.21	0.11	0.26	0.68	0.49	0.09	0.31	0.67
		Round Whitefish	4	0.06	0.12	0.06	0.00	0.23	0.06	0.05	0.00	0.19
		Total	4	0.55	0.15	0.07	0.38	0.68	0.55	0.06	0.43	0.67
Occurrence Lake	Floating	Arctic Grayling	2	0.30	0.43	0.30	0.02	0.59	0.30	0.22	0.00	0.61
		Total	2	0.30	0.43	0.30	0.02	0.59	0.31	0.22	0.00	0.61
	Sinking	Total	1	0.00	-	-	0.00	0.00	-	-	-	-
Reference Q Lake	Floating	Lake Trout	4	0.08	0.16	0.08	0.00	0.29	0.08	0.07	0.00	0.24
		Round Whitefish	4	0.48	0.55	0.28	0.00	0.97	0.48	0.24	0.00	0.96
		Total	4	0.56	0.65	0.33	0.00	1.24	0.56	0.28	0.00	1.11
	Sinking	Lake Trout	4	0.34	0.31	0.15	0.02	0.72	0.35	0.13	0.08	0.64
		Total	4	0.34	0.31	0.15	0.02	0.72	0.34	0.13	0.08	0.64

CPUE = catch-per-unit-effort (fish/100 m² of gillnet/h)

n = sample size (number of net sets)

SD = standard deviation of the mean

SE = standard error of the mean

CI = confidence interval (95%)

Dashes indicate data not available

No. = number

Table 3.4-27. Summary of Electrofishing CPUE and Visual Observations of Fish in George Potential Development Area Lakes, 2013

Site Name	Electro-fishing Effort (s)	Electrofishing (No. of Fish Captured)						Electrofishing	Visual Observation		
		Arctic Grayling	Burbot	Lake Trout	Ninespine Stickleback	Slimy Sculpin	Total	CPUE (fish/100 s)	Lake Trout	Unknown Species	Total
George PDA											
Bob Lake	1,096	-	-	1	-	-	1	0.09	1	-	1
George Lake	10,376	12	-	4	-	29	45	0.43	-	-	-
Komatic Lake	4,900	-	-	6	-	34	40	0.82	-	-	-
Lytle Lake	1,217	-	-	-	-	-	0	0.00	-	-	-
McCoy Lake	5,427	-	2	2	-	36	40	0.74	-	-	-
Occurrence Lake	1,109	-	-	-	-	-	0	0.00	-	2	2
Reference Q Lake	3,754	-	-	-	-	32	32	0.85	-	-	-

CPUE = Catch-per-unit-effort

Dashes indicate no fish caught

No. = number

Table 3.4-28. Beach Seine CPUE Summary Statistics for Potential Development Area Lakes, 2013

Lake	Species	Standard CPUE (No. Fish/100 m ²)					
		n	Mean	SD	SE	Lower CI	Upper CI
George Lake	Slimy Sculpin	16	0.65	1.45	0.36	0.00	4.09
	Total	16	0.65	1.45	0.36	0.00	4.09

CPUE = catch-per-unit-effort (fish/100 m² of seined area)

n = sample size (number of net sets)

SD = standard deviation

SE = standard error

CI = confidence interval (95%)

No. = number

Table 3.4-29. Summary of Standard and Bootstrapped Mean Fork Length of Fish Captured by Gillnet in George Potential Development Area Lakes, 2013

Lake	Species	Standard Fork Length (mm)						Bootstrap Fork Length (mm)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
George Property											
Bob Lake	Lake Trout	6	436	42	17	371	477	436	15	403	463
George Lake	Lake Trout	8	477	52	18	392	523	477	17	441	508
Komatic Lake	Lake Trout	10	443	104	33	301	624	-	-	-	-
McCoy Lake	Lake Trout	9	417	91	30	269	565	418	29	360	474
	Round Whitefish	2	291	147	104	192	390	292	74	187	395
Occurrence Lake	Arctic Grayling	1	110	-	-	110	110	-	-	-	-
Reference Q Lake	Lake Trout	5	426	98	44	298	534	426	39	346	499
	Round Whitefish	6	367	38	16	315	416	367	14	339	394

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Table 3.4-30. Summary of Standard and Bootstrapped Mean Total Weight of Fish Captured by Gillnet in George Potential Development Area Lakes, 2013

Lake	Species	Standard Total Weight (g)						Bootstrap Total Weight (g)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
George Property											
Bob Lake	Lake Trout	6	766.3	189.0	77.2	555.9	996.4	766.8	70.0	634.5	900.7
George Lake	Lake Trout	8	1282.0	416.3	147.2	621.7	1686.9	1281.1	137.6	997.4	1529.9
Komatic Lake	Lake Trout	9	849.1	409.2	136.4	317.2	1594.4	850.6	129.7	616.0	1123.8
McCoy Lake	Lake Trout	9	836.9	518.9	173.0	236.6	1844.6	835.0	163.2	555.9	1185.2
	Round Whitefish	2	297.0	336.6	238.0	70.9	523.1	295.1	167.7	59.0	535.0
Occurrence Lake	Arctic Grayling	1	16.0	-	-	16.0	16.0	-	-	-	-
Reference Q Lake	Lake Trout	5	871.4	573.8	256.6	234.8	1570.2	873.6	230.4	437.4	1332.4
	Round Whitefish	6	535.0	165.5	67.6	334.4	751.9	534.7	61.6	417.3	655.5

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Table 3.4-31. Summary of Standard and Bootstrapped Mean Condition of Fish Captured by Gillnet in George Potential Development Area Lakes, 2013

Lake	Species	Standard Condition (g/mm ³)						Bootstrap Condition (g/mm ³)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
George Property											
Bob Lake	Lake Trout	6	0.93	0.17	0.07	0.69	1.12	0.92	0.06	0.80	1.05
George Lake	Lake Trout	8	1.14	0.11	0.04	0.99	1.30	1.14	0.04	1.07	1.21
Komatic Lake	Lake Trout	9	1.09	0.16	0.05	0.76	1.21	1.09	0.05	0.98	1.16
McCoy Lake	Lake Trout	9	1.03	0.05	0.02	0.96	1.08	1.03	0.02	1.00	1.06
	Round Whitefish	2	0.89	0.02	0.02	0.87	0.90	0.89	0.01	0.87	0.90
Occurrence Lake	Arctic Grayling	1	1.20	-	-	1.20	1.20	-	-	-	-
Reference Q Lake	Lake Trout	5	0.97	0.14	0.06	0.82	1.12	0.97	0.06	0.86	1.08
	Round Whitefish	6	1.06	0.08	0.03	0.94	1.16	1.06	0.03	0.99	1.11

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Table 3.4-32. Summary of Standard and Bootstrapped Mean Fork Length of Fish Captured By Electrofishing in George Potential Development Area Lakes, 2013

		Standard Fork Length (mm)						Bootstrap Fork Length (mm)			
Lake	Species	n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
George Property											
Bob Lake	Lake Trout	1	75	-	-	75	75	-	-	-	-
George Lake	Arctic Grayling	12	113	61	18	82	257	-	-	-	-
	Lake Trout	2	88	32	23	66	109	88	16	65	110
	Slimy Sculpin	29	52	7	1	38	62	-	-	-	-
Komatic Lake	Slimy Sculpin	34	52	15	3	31	80	-	-	-	-
McCoy Lake	Slimy Sculpin	29	53	10	2	34	72	-	-	-	-
Reference Q Lake	Slimy Sculpin	32	59	10	2	43	82	-	-	-	-

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Table 3.4-33. Summary of Standard and Bootstrapped Mean Total Weight of Fish Captured By Electrofishing in George Potential Development Area Lakes, 2013

Lake	Species	Standard Total Weight (g)						Bootstrap Total Weight (g)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
George Property											
Bob Lake	Lake Trout	1	4.1	-	-	4.1	4.1	-	-	-	-
George Lake	Arctic Grayling	12	34.9	76.6	22.1	5.8	217.1	-	-	-	-
	Lake Trout	2	8.3	7.7	5.5	3.1	13.4	8.3	3.9	2.8	13.7
	Slimy Sculpin	29	1.3	0.5	0.1	0.7	2.3	-	-	-	-
Komatic Lake	Slimy Sculpin	34	1.7	1.6	0.3	0.3	5.5	-	-	-	-
McCoy Lake	Slimy Sculpin	29	1.5	0.8	0.2	0.3	3.3	-	-	-	-
Reference Q Lake	Slimy Sculpin	32	2.0	1.3	0.2	0.7	5.4	-	-	-	-

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Note: Slimy Sculpin total weight was calculated by excluding weight of internal parasites

Dashes indicate data not available

Table 3.4-34. Summary of Standard and Bootstrapped Mean Condition of Fish Captured By Electrofishing in George Potential Development Area Lakes, 2013

Lake	Species	Standard Condition (g/mm ³)						Bootstrap Condition (g/mm ³)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
George Property											
Bob Lake	Lake Trout	1	0.97	-	-	0.97	0.97	-	-	-	-
George Lake	Arctic Grayling	12	1.02	0.10	0.03	0.88	1.19	-	-	-	-
	Lake Trout	2	1.03	0.01	0.01	1.02	1.03	1.03	0.00	1.02	1.03
	Slimy Sculpin	29	0.91	0.14	0.03	0.75	1.17	-	-	-	-
Komatic Lake	Slimy Sculpin	34	0.99	0.16	0.03	0.73	1.24	-	-	-	-
McCoy Lake	Slimy Sculpin	29	0.96	0.24	0.04	0.71	1.45	-	-	-	-
Reference Q Lake	Slimy Sculpin	32	0.88	0.13	0.02	0.64	1.11	-	-	-	-

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Note: Slimy Sculpin condition was calculated by excluding weight of internal parasites

Dashes indicate data not available

Slimy Sculpin were captured by electrofishing and/or beach seining in four of the seven sampled lakes. Of the Slimy Sculpin captured by electrofishing, mean total length ranged from 52 mm (George Lake and Komatic Lake) to 59 mm (Reference Q Lake), mean weight ranged from 1.3 g (George Lake) to 2.0 g (Reference Q Lake), and mean condition ranged from 0.88 (Reference Q Lake) to 0.99 g/mm³ (Komatic Lake). The Slimy Sculpin captured in a beach seine were larger than those that were captured by electrofishing. The mean length, weight, and condition of Slimy Sculpin captured in beach seines from George Lake were 56 mm, 1.8 g, and 0.89 g/mm³, respectively (Table 3.4-35).

Round Whitefish were captured by gillnet in two of the seven lakes that were sampled. The mean lengths of Round Whitefish were 291 mm (McCoy Lake) and 367 mm (Reference Q Lake). Mean weights of Round Whitefish were 297.0 g (McCoy Lake) and 535.0 g (Reference Lake). Mean condition of Round Whitefish fell within normal values for salmonid fish and was 0.89 (McCoy Lake) to 1.06 g/mm³ (Reference Q Lake). All Round Whitefish captured were adults.

A single juvenile Arctic Grayling was captured by gillnet Occurrence Lake. Juvenile Arctic Grayling were captured by electrofishing in George Lake. Of the electrofished Arctic Grayling, mean length ranged was 113 mm, mean weight was 34.9 g, and mean condition was 1.02 g/mm³.

Burbot were captured by electrofishing in McCoy Lake, but biological data is not available.

The length-frequency distributions for Slimy Sculpin were highly variable between lakes (Figure 3.4-24). The majority of Slimy Sculpin fell into size classes ranging from 45 mm to 65 mm. Small-bodied fish typically have negatively skewed length-frequency distributions by the presence of a large proportion of juveniles. The lengths of Slimy Sculpin from Komatic Lake were negatively skewed with a mode at 35 to 40 mm. However, most lakes revealed a normally distributed length-frequency distribution. This may in part be due to sampling bias, as larger sculpin are easier to see and may be captured more readily than YOY fish. Alternately, very young Slimy Sculpin may rear in less-accessible areas (such as deep water or under boulders) than larger fish. In George Lake, the lengths of 86% of the captured sculpin were evenly distributed between 45 mm and 65 mm with very few large adults or small juvenile fish.

Length-frequency distributions could not be created from Arctic Grayling, Burbot, Lake Trout and Round Whitefish data, due to low sample sizes.

Weight-length regressions were prepared to indicate the relative health of each species in each lake. The slope of the weight-length regressions shows the change in weight with length. Difference in the slope of the relationships indicates differences in the respective health among lakes, with heavy body weight at a given length indicating healthy fish and low weights indicating decreased health and low energy storage. The strength of the weight-length relationship decreases with low sample size or high variability within the population. A summary of the statistical relationships can be found in Table 3.4-36.

The weight-length regressions for Lake Trout showed a significant ($P < 0.05$) positive relationship in all lakes (Figure 3.4-25). Similarly, all populations of Slimy Sculpin showed a significant ($P < 0.05$) positive correlation between weight and length (Figure 3.4-26). Arctic Grayling populations showed significant ($P < 0.05$) positive relationships between weight and length in all lakes with more than three samples (Figure 3.4-27).

In the majority of cases, fish weight was strongly related to fish length as shown by adjusted R^2 values of 0.9 or higher. There were only one instance where adjusted R^2 values were more moderate: Slimy Sculpin from McCoy Lake (adjusted $R^2 = 0.865$). It is not known whether the reduced strength of this relationship was caused by inaccuracies during sampling (e.g., due to high winds affecting the accuracy of the balance) or if the fish from McCoy Lake had more variability in condition.

Table 3.4-35. Summary of Standard and Bootstrapped Mean Fork Length, Total Weight and Condition of Fish Captured by Beach Seine in George Potential Development Area Lakes, 2013

			Standard Measure						Bootstrap Measure			
Lake	Species	Measure	n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
George Property												
George Lake	Slimy Sculpin	Total Length (mm)	6	56	10	4	46	70	56	4	50	64
		Total Weight (g)	6	1.8	1.0	0.4	0.9	3.3	1.8	0.4	1.1	2.5
		Condition (g/mm ³)	6	0.89	0.09	0.04	0.77	0.99	0.89	0.03	0.83	0.95

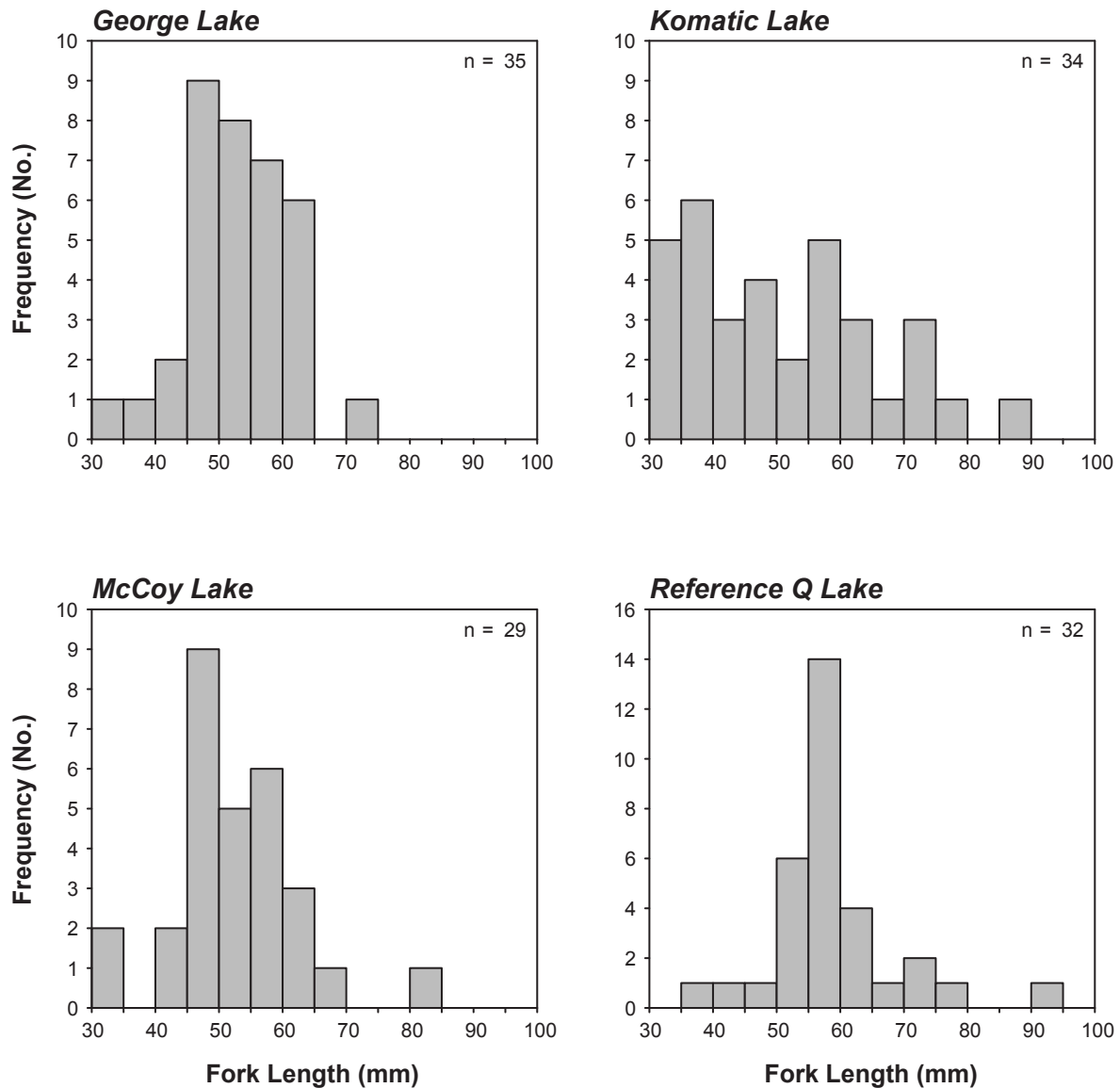
CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

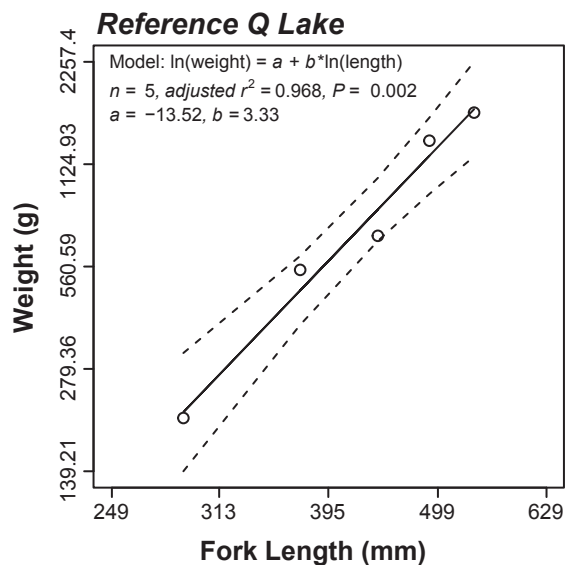
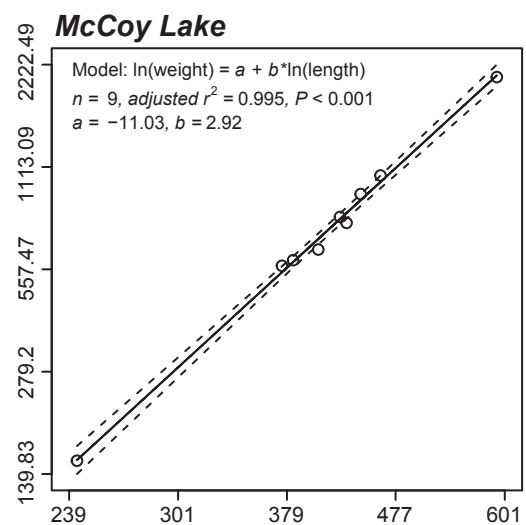
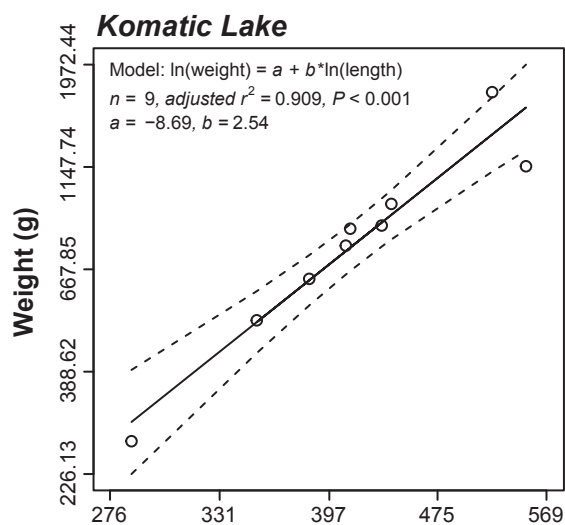
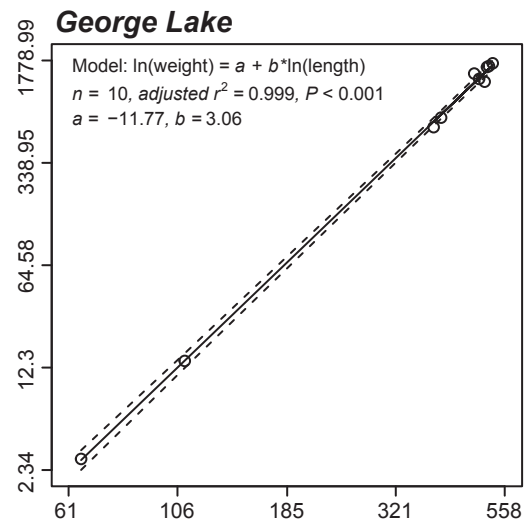
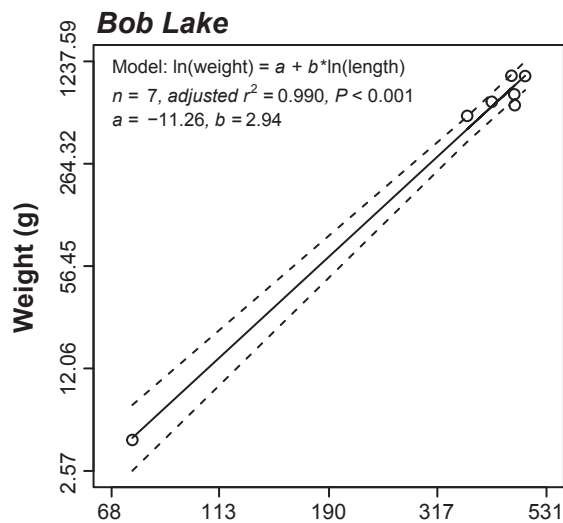
SE = standard error of the mean

Note: Slimy Sculpin total weight and condition were calculated by excluding weight of internal parasites

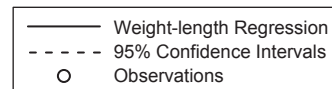


Note: Length-frequency distribution for George Lake is a combination of fish that were electrofished and beach seined.

Figure 3.4-24

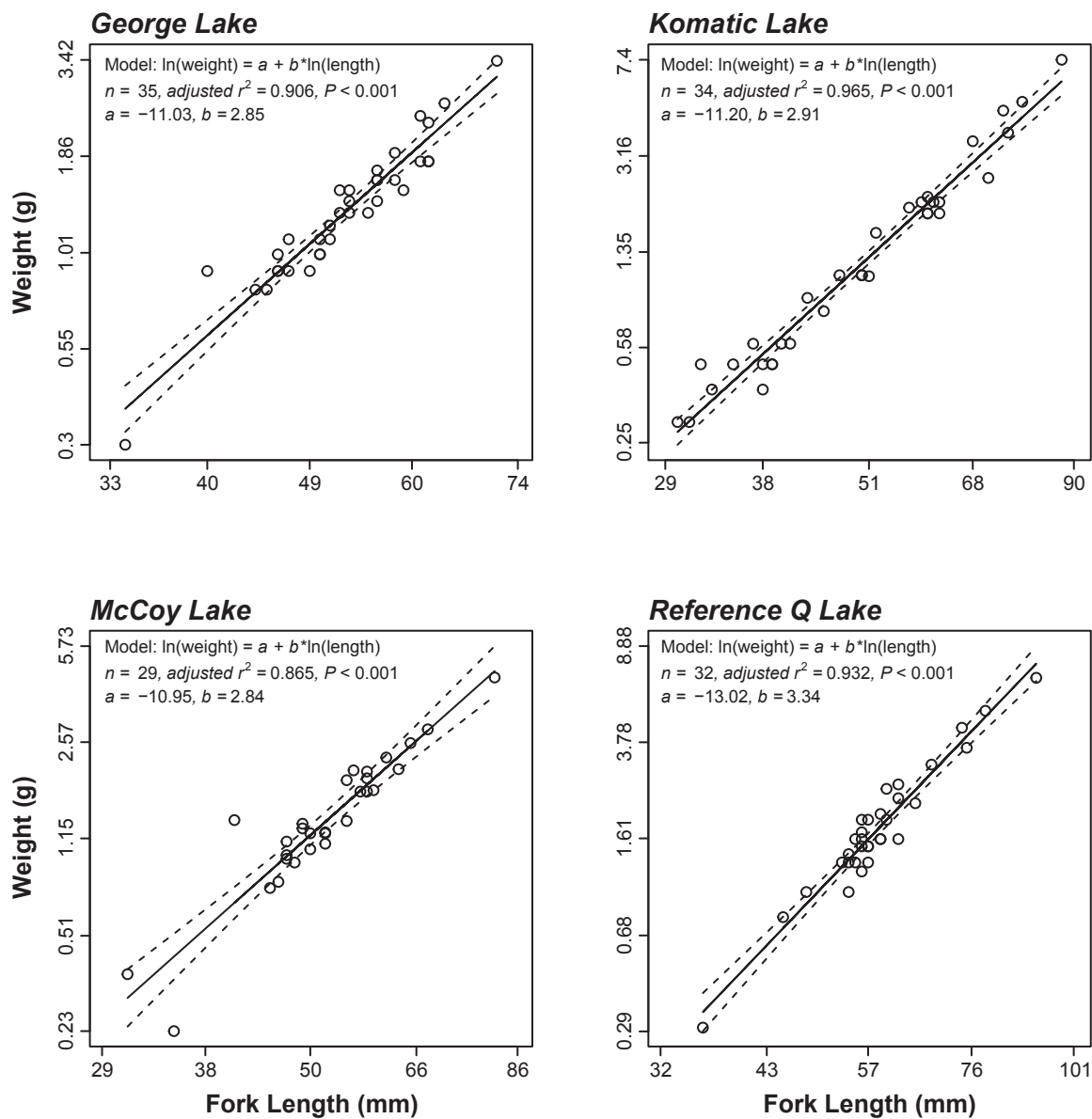


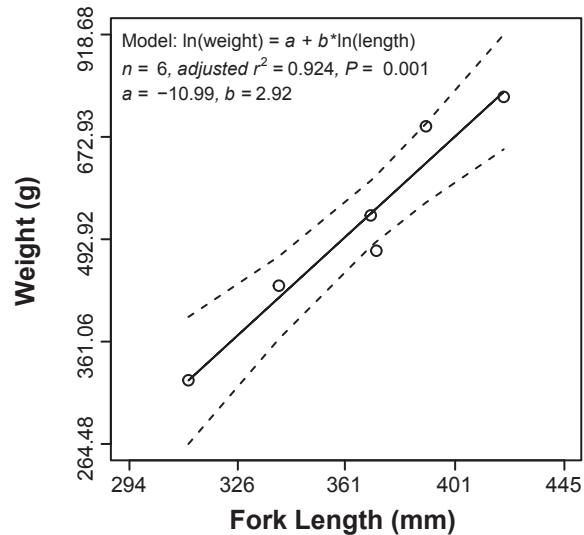
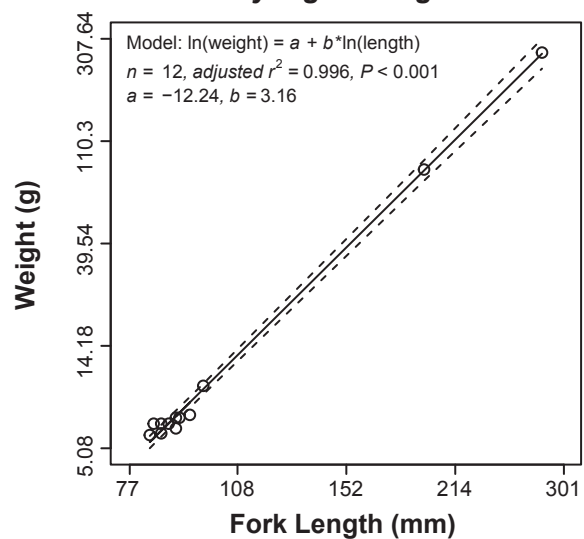
Fork Length (mm)



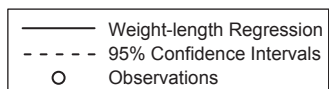
Note: axis values have been backtransformed from the natural log (Ln).

Figure 3.4-25



Round Whitefish - Reference Q Lake**Arctic Grayling - George Lake**

Note: Axis values have been backtransformed from the natural log (Ln).



**Weight-Length Regression for Round Whitefish
and Arctic Grayling from George Potential
Development Area Lakes, 2013**

Figure 3.4-27

Table 3.4-36. Statistical Significance of Weight-length Regressions of Fish from George PDA Lakes, 2013

Species	Lake	Df of Category	Df of Error	F Value	P Value
Lake Trout	Bob	1	5	616.7	<0.001
	George	1	8	6258.5	<0.001
	Komatic	1	7	81.1	<0.001
	McCoy	1	7	1697.4	<0.001
	Reference Q	1	3	123.6	0.002
Slimy Sculpin	George	1	33	329.4	<0.001
	Komatic	1	32	923.3	<0.001
	McCoy	1	27	180.0	<0.001
	Reference Q	1	30	426.1	<0.001
Round Whitefish	Reference Q	1	4	62.1	0.001
	Wasp	1	6	326.8	<0.001
Arctic Grayling	George	1	10	2527.1	<0.001

Df = degrees of freedom

Fewer than 15 Lake Trout, Round Whitefish, or Arctic Grayling were captured at all lakes, therefore age-frequency distributions could not be created.

The ages of captured Slimy Sculpins ranged between ages 0 and 8 years, with the majority of sculpin falling into the 2-year age class and the others normally distributed around that age class (Figure 3.4-28). Although the maximum age was 8 years, most sculpin ranged between 1 and 4 years, suggesting that most were juvenile fish, as sexual maturity is estimated at 3 to 4 years for Slimy Sculpin (McPhail, 2007).

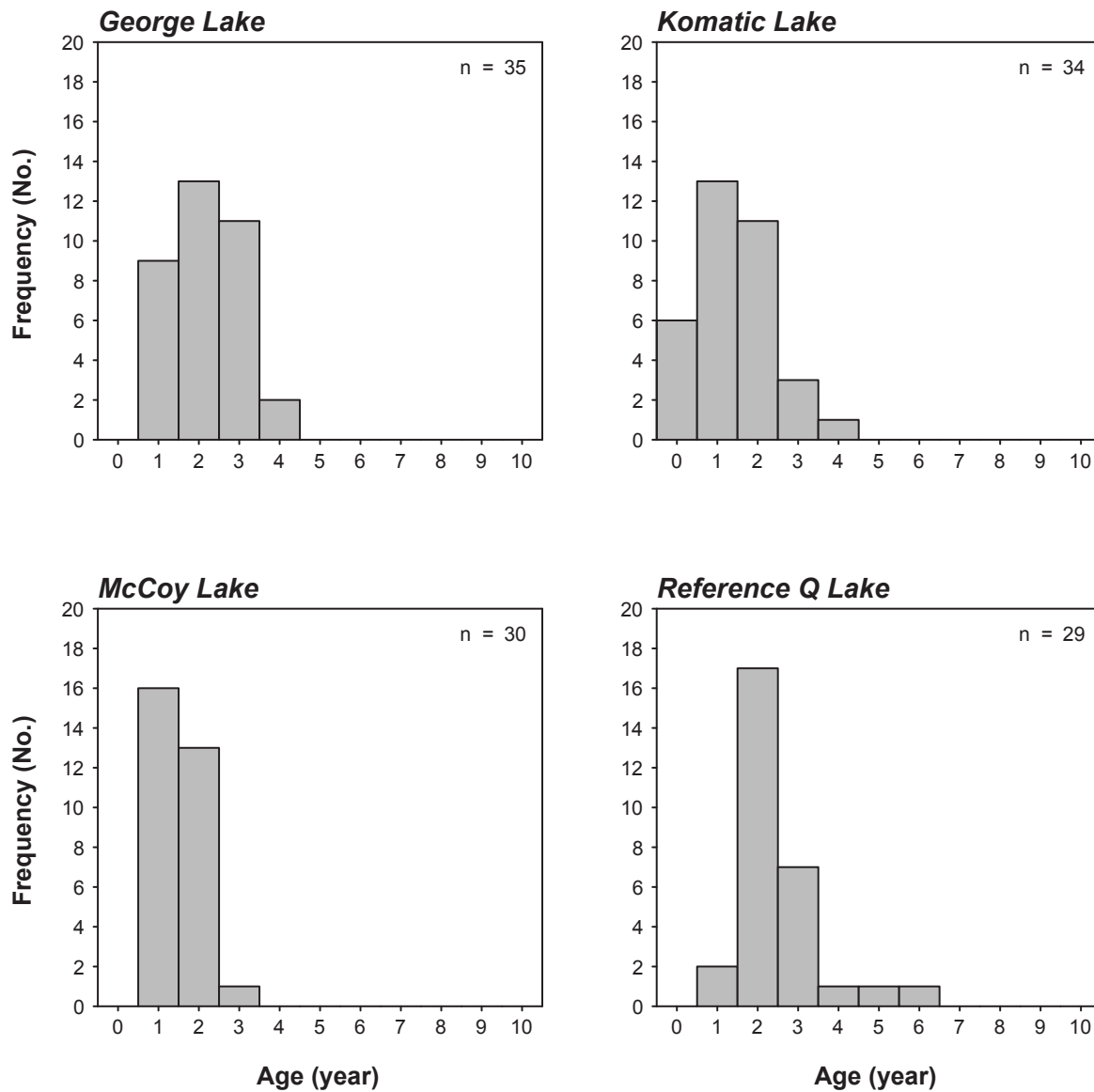
Fewer than 15 Round Whitefish and Arctic Grayling were captured in any of the lakes, and meaningful age-frequency distributions could not be created. Round Whitefish were not aged. Arctic Grayling from George Lake ranged from 0 to 4 years old.

Growth models were created to characterize the relationship between fish length and fish age in PDA lakes. Table 3.4-37 indicates the model of best fit for each species at each lake. Only Slimy Sculpin were captured in sufficient numbers to create growth models.

The growth of Slimy Sculpin in all lakes was best described by the linear models (Figure 3.4-29). Slimy Sculpin are small, short-lived species; as a result, they may not exhibit asymptotic growth, thus a linear relationship between length and age is predominant in the lakes.

Fish Health

Data were collected with the intention of contributing supporting general fish community and biology information with additional data on fish health. The collected data are suitable for analyzing the three principal biological responses: fish survival, energy use, and energy storage. The methodology and responses are compatible with MMER sampling programs. Slimy Sculpin and Lake Trout were chosen as target species for this data collection.



Note: Age-frequency distribution for George Lake is a combination of fish that were electrofished and beach seined.

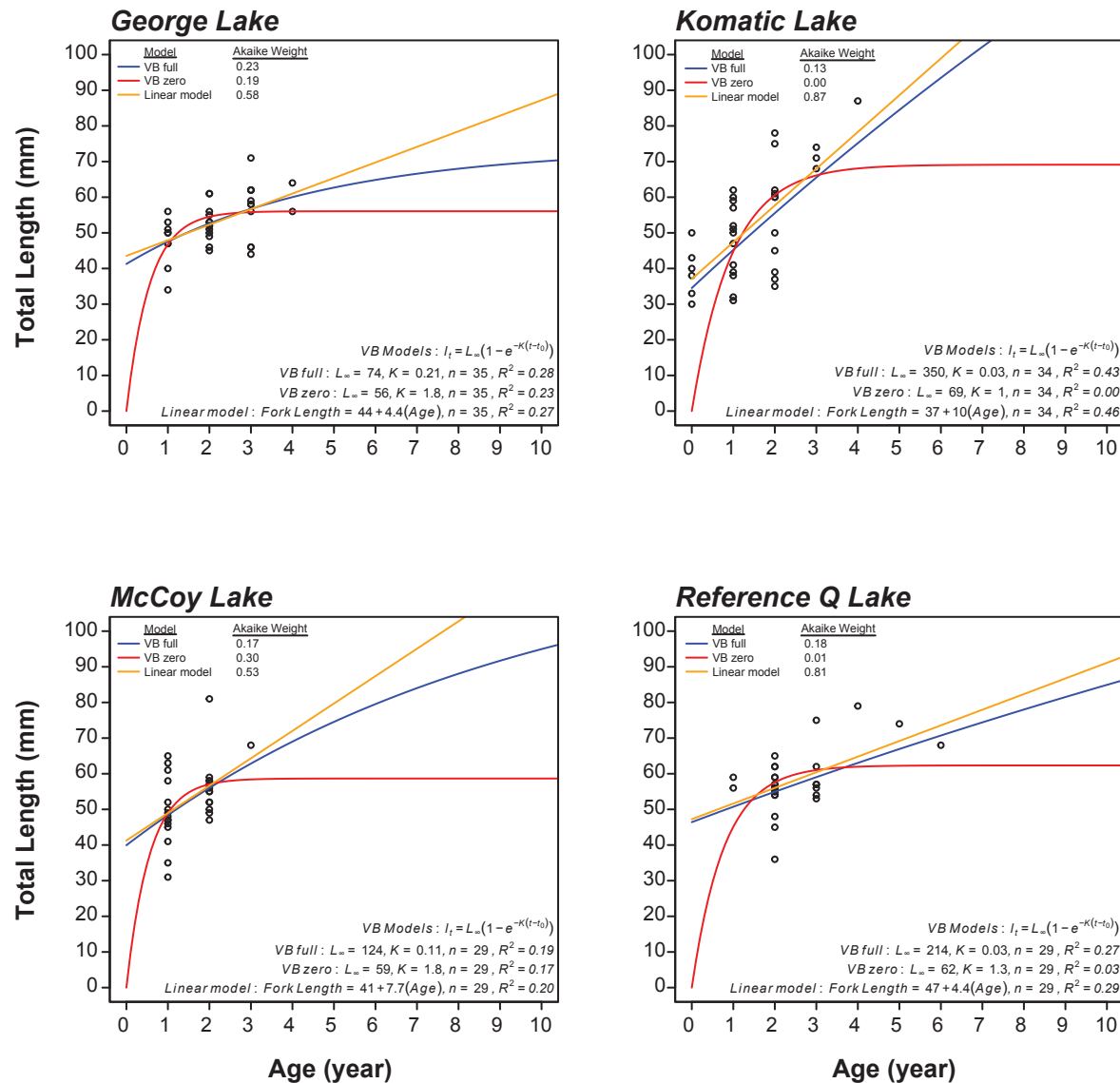


Figure 3.4-29

Table 3.4-37. Statistical Results for von Bertalanffy Growth Curves of Fish from George PDA Lakes, 2013

Species	Property	Lake	Model of Best Fit	AIC _w	R ²	N	Parameter	Estimate	SE	Df of Category	Df of Error	F Value	P Value
Slimy Sculpin	George	George	Linear Model	0.58	0.27	35	-	-	-	1	33	12.4	0.001
		Komatic	Linear Model	0.87	0.46	34	-	-	-	1	32	27.4	<0.001
		McCoy	Linear Model	0.53	0.20	29	-	-	-	1	27	6.81	0.015
		Reference Q	Linear Model	0.81	0.29	29	-	-	-	1	27	11.2	0.002

Df = degrees of freedom, SE = standard error of the estimate, N = sample size

L_∞ = is the length (mm) that the fish would attain if it were allowed to grow for an infinite time, K = is a growth constant (year⁻¹)

AIC_w = Akaike Information Criteria weight, VB zero = modified von Bertalanffy model

Dashes indicate data not available, Bold P values are statistically significant (<0.05)

Slimy Sculpin were chosen as they were the only species present throughout the entire study area. In addition, this species is relatively sedentary and have high reproductive rates compared to larger-bodied fish such as Lake Trout. Sedentary fish more accurately reflect the conditions of the site at which they are captured than mobile fish that may have spent large parts of their life in other areas. Species with high reproductive rates are less likely to experience population declines due to regular sampling. Slimy Sculpin have an expected longevity of approximately seven years (McPhail 2007). The average age at maturation is three years for males and four years for females. Growth patterns are relatively plastic and maximum growth and growth-at-age varies between systems. Sculpins are carnivorous and eat a variety of aquatic insects, larvae, and plankton.

In previous years, Lake Trout were lethally sampled this additional fish health data; however, due to concerns about the long-term impacts of lethal sampling on large-bodied fish populations, lethal sampling of Lake Trout was not repeated in 2013. Instead, non-lethal biological information was gathered from captured Lake Trout, as well as tissue samples for metal concentration analyses. This data will supplement information from previous years and is an important for understanding fish health in the George Property PDA as large-bodied fish may respond to the environment differently than small-bodied fish.

This detailed fish health data was collected from fish from George Lake, Komatic Lake, Reference C Lake and McCoy Lake.

In cases where analyses were identical to those undertaken to describe the general biological characteristics of fish from lake environments the results are summarized here and presented in more detail in Section 3.4.2. All individual fish data for the fish health sampling are reported in Appendix 3.4-4 with other biological data collected from lakes.

Survival

The data necessary for measuring survival (length and age) can be gathered non-lethally, so length and age data from both non-lethally sampled Lake Trout and lethally-sampled Slimy Sculpin are included.

Lake Trout

Lake Trout were captured by gillnet and electrofishing. Mean fork length ranged from 417 mm (McCoy Lake) to 477 mm (George Lake; Table 3.4-29). Lake Trout captured by electrofishing in George Lake had a mean length of 88 mm (Table 3.4-32). All Lake Trout captured by gillnets were adults and Lake Trout captured by electrofishing were juveniles.

There was insufficient numbers of Lake Trout (<15) from any of the lakes to allow for the creation of length-frequency distributions.

Slimy Sculpin

Slimy Sculpin were captured by electrofishing and beach seining. Slimy Sculpin captured by electrofishing ranged in mean total length from mean total length from 52 mm (Komatic Lake) to 59 mm (Reference Q Lake). The beach seined sculpin from George Lake were larger had a mean length of 56 mm.

The length-frequency distributions for Slimy Sculpin varied among lakes (Figure 3.4-24). The majority of Slimy Sculpin fell into size classes ranging from 45 mm to 65 mm. Most lakes revealed a normally distributed length-frequency distribution, which may in part be due to sampling bias, while Komatic Lake was negatively skewed with a mode at 35 to 40 mm, which would be the expected length-frequency distribution for small-bodied fish.

Age-frequency distributions for Slimy Sculpin ranged between ages 0 and 8, with the majority of sculpin falling into the 2-year age class and normally distributed around that age class (Figure 3.4-28). Although the maximum age was 8 years, most sculpin ranged between 1 and 4 years which suggests that the majority of captured Slimy Sculpin have not reached sexual maturity, as expected for small-bodied fish.

Energy Use

Fish growth (expressed as an increase in body length over time) and reproduction are two primary uses of energy for fish, and energy allocation to those two uses was identified as a potential indicator of fish health (Environment Canada 2012).

Fish growth was explored through the use of von Bertalanffy growth models examining the relationship between length and age. Creating representative growth models requires age data from individuals from a large range of body lengths and ages. Length and age data from sufficient numbers of individuals were available for Slimy Sculpin.

Reproductive investment can be explored through gonad weight at body weight or by the relative abundance of YOY (% composition of YOY). However, gonad weight should be obtained immediately prior to spawning to most accurately determine energy allocation. Slimy Sculpin were sampled recently after spawning and in most fish the gonads appeared reduced and may not be well representative of energy use. The GSI for Slimy Sculpin are reported; however, the relative abundance of YOY may provide a better estimate of energy use and is also reported for Slimy Sculpin. Juvenile Lake Trout were not targeted when sampling and relative abundance of YOY's could not be estimated. Determining reproductive investment through the relationship between gonad weight and body weight requires lethal sampling, and was also not available for Lake Trout.

The linear model best fit the data from all lakes (Figure 3.4-29; Table 3.4-31). Slimy Sculpin are small, short-lived species and may not reach an asymptotic length, thus typically resulting in a linear relationship between length and age.

The gonads of the majority of Slimy Sculpin from all lakes were undeveloped (Table 3.4-38). Identification of sex in undeveloped fish is difficult, especially in small-bodied fish where undeveloped gonads are very small. Instances in which sex could be determined were always skewed towards males. Male Slimy Sculpin mature sexually at age 3, while female sculpin do not generally mature until age 4 (McPhail 2007). The majority of Slimy Sculpin were less than 4 years of age, so the majority of females in this group would not be expected to be sexually mature. Given the identification bias introduced by maturation age and the proportion of unidentified individuals, the sex ratios calculated from the captured sculpin may not accurately depict the sex ratios of the populations.

The gonadosomatic index (GSI) was calculated for both immature and mature Slimy Sculpin (Table 3.4-39). The mean GSI, representing energy allocated to reproduction, was relatively similar between immature and mature Slimy Sculpin for each sex and was generally less than 1%. The mean GSI ranged from 0.11 % for mature unknowns from George Lake to 6.57 % for mature females from George Lake. The mean GSI for mature fish may be reduced due to sampling timing, and GSI may be higher during spawning season.

Given uncertainties related to estimates of gonadal development, reproductive energy use was also examined using the relative abundance of YOY as an indicator. The proportion of YOY Slimy Sculpin in monitoring lake populations was low (Table 3.4-40). The Slimy Sculpin sampled from Komatic Lake showed the highest proportion of YOY, as 0.18 of all fish captured were in their first growing season. No YOY were captured at the other lakes. This is either indicative of the Slimy Sculpin allocating little energy towards reproduction or an artifact of possible sampling bias, as larger sculpin are easier to see and may be captured more readily than YOY fish or very young Slimy Sculpin may rear in less-accessible areas (such as deep water or under boulders) than larger fish.

Table 3.4-38. Sex and Reproductive Status of Slimy Sculpin from George PDA Lakes, 2013

Lake	Sex				Sex Ratio (M:F)	Reproductive Status					Percent Ripe or Maturing
	n	Male	Female	Unidentified		n	Undeveloped	Maturing	Ripe	Unknown	
George Lake	35	9	12	14	0.75	35	20	7	8		42.9
Komatic Lake	34	4	3	27	1.33	34	30	3		1	8.8
McCoy Lake	30	4	3	23	1.33	30	26	3	1		13.3
Reference Q Lake	32	10	2	20	5.00	32	24	5	3		25.0

n = number of fish

M = male

F = female

Table 3.4-39. Gonadosomatic Index (GSI) for Slimy Sculpin from George PDA Lakes, 2013

Lake	Maturity	Sex	GSI (%)					
			n	Mean	SD	SE	Lower CI	Upper CI
George Lake	Immature	Female	2	1.45	0.44	0.31	1.16	1.74
		Male	3	1.15	0.66	0.38	0.72	1.85
		Unknown	4	1.46	0.59	0.29	0.80	2.11
	Mature	Female	9	6.57	14.04	4.68	0.88	35.74
		Male	5	0.95	0.74	0.33	0.18	1.91
		Male	1	0.52	-	-	0.52	0.52
	Mature	Unknown	1	0.11	-	-	0.11	0.11
		Female	1	0.59	-	-	0.59	0.59
		Male	2	0.41	0.36	0.25	0.17	0.65
		Unknown	0	-	-	-	-	-
McCoy Lake	Immature	Female	1	0.78	-	-	0.78	0.78
		Male	1	0.20	-	-	0.20	0.20
		Unknown	4	0.74	0.32	0.16	0.30	0.95
	Mature	Female	1	0.67	-	-	0.67	0.67
		Male	2	1.72	0.54	0.38	1.36	2.09
Reference Q Lake	Immature	Female	1	0.30	-	-	0.30	0.30
		Male	4	0.61	0.43	0.22	0.22	1.06
		Unknown	4	0.66	0.22	0.11	0.45	0.93
	Mature	Female	0	-	-	-	-	-
		Male	6	0.53	0.24	0.10	0.28	0.88
		Unknown	2	0.74	0.82	0.58	0.19	1.29

n = number of fish

SD = standard deviation of the mean

SE = standard error of the mean

CI = 95% confidence interval

Dashes indicate not applicable

Table 3.4-40. Proportion of Young-of-Year Slimy Sculpin at George PDA Lakes, 2013

Site	n	Proportion	
		0+	> 0+
George Lake	35	0.00	1.00
Komatic Lake	34	0.18	0.82
McCoy Lake	30	0.00	1.00
Reference Q Lake	29	0.00	1.00

0+ = young-of-year

n = number of fish

3.4.2.4 Energy Storage

Fish condition (Fulton's Condition K or weight-length regressions) and relative liver size (liver weight-body weight regression and HSI) are used as indicators of energy reserves or storage (Environment Canada 2012).

Measures of condition can be gathered non-lethally, so condition is reported for Lake Trout as well as Slimy Sculpin sampled. Relative liver size and HSI are only reported for lethally sampled Slimy Sculpin.

Lake Trout

Lake Trout were captured by gillnetting and electrofishing. Mean condition factor for gillnetted Lake Trout at all sites was within normal values for salmonid fishes. The mean condition of Lake Trout ranged from 0.97 g/mm³ (Reference Q Lake) to 1.14 g/mm³ (George Lake; Table 3.4-31).

Weight-length regressions were prepared as an indicator of the relative health (i.e., condition) of Lake Trout. The weight-length regressions for Lake Trout had a significant ($P < 0.05$) positive correlation at all lakes from the George PDA (Figure 3.4-28). At all lakes, the weight-length relationship was strong with adjusted R^2 values of 0.9 or higher.

Slimy Sculpin

Slimy Sculpin were captured by electrofisher and beach seine. Slimy Sculpin captured by electrofishing ranged in mean condition from 0.88 (Reference Q Lake; Table 3.4-34) to 0.99 g/mm³ (Komatic Lake). The mean condition of Slimy Sculpin captured by beach seine from George Lake was 0.89 g/mm³ (Table 3.4-35).

Weight-length regressions were prepared as an indicator of the relative health of Slimy Sculpin. There was a significant positive correlation between weight and length for Slimy Sculpin from all lakes from the George PDA (Figure 3.4-26). All weight-length relationships were strong with adjusted R^2 values of 0.9 or higher, except for McCoy Lake which had an adjusted R^2 value of 0.865.

The HSI and relative liver size analyses compare liver size to body weight, as increased liver size is related to available energy reserves and to other health effects such as exposure to toxic substances (Environment Canada 2012) and is a supporting endpoint for energy storage and condition.

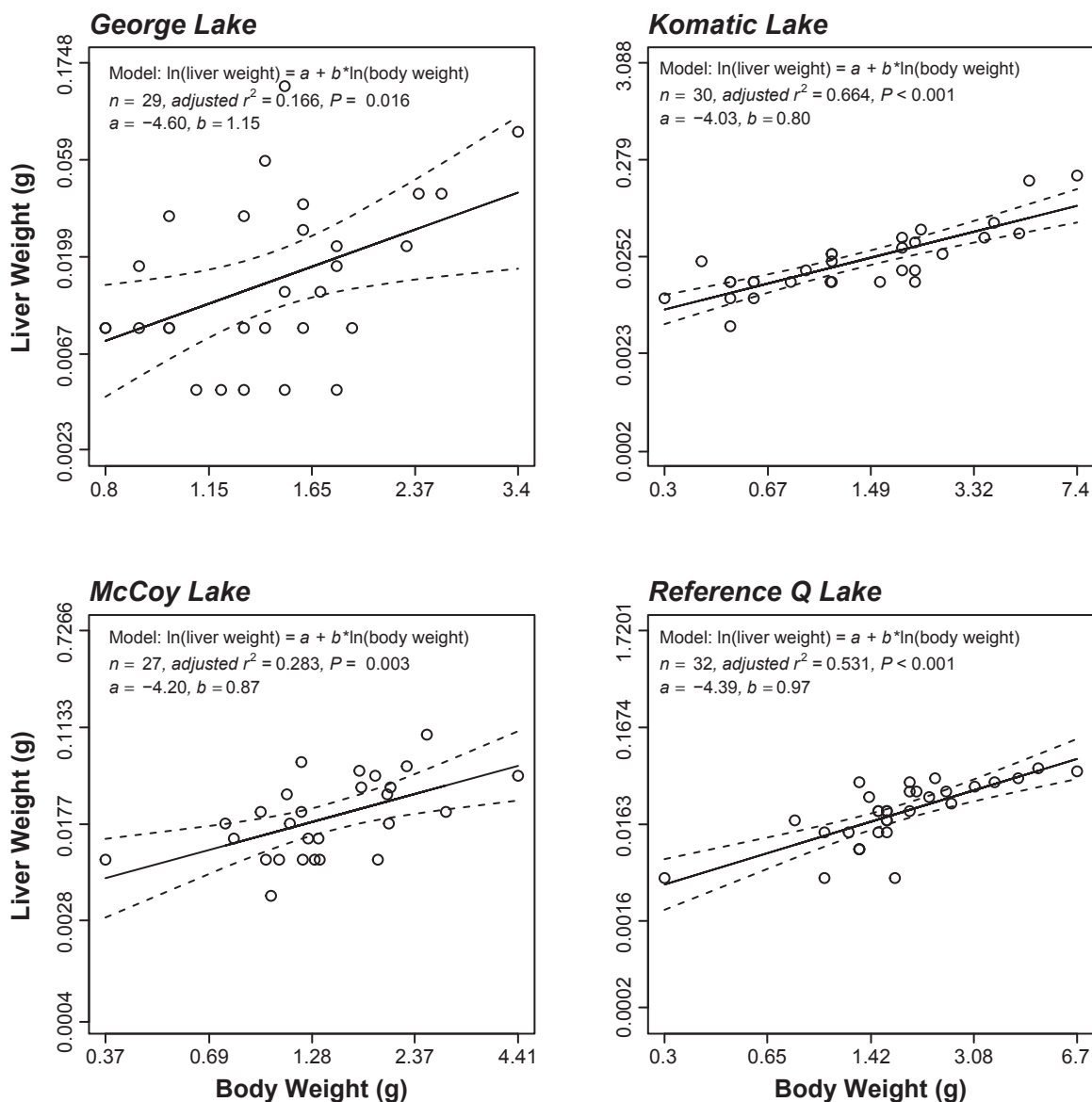
Relative liver size analysis was conducted using liver weight-body weight regressions. Similar to weight-length regressions, the slope of the weight-body weight shows relationship between liver weight and body weight. Differences in the slope of the regressions indicate differences in the relative liver size among populations. The strength of the relationship (slope) varies with the sample size and measurement error, but can also provide information regarding the variability of energy storage in the population. All F-values and P-values for the regressions for each lake are indicated in Table 3.4-41. The liver weight-body weight regressions for Slimy Sculpin showed a significant ($P < 0.05$) positive correlation for fish from all lakes (Figure 3.4-30). The strength of the relationship as measured by the adjusted R^2 was generally moderate to weak across lakes and ranged from 0.166 (George Lake) to 0.664 (Komatic Lake). Weaker correlations may be due to measurement error, which is difficult to eliminate due to the small size of the livers weighed and may be increased due to the measurement of dry weights instead of wet weights. However, when comparing across lakes, the variability of some lakes is considerably higher than others (e.g., George Lake) and may suggest a high variability in energy storage in the population.

Table 3.4-41. Statistical Results for Liver Weight-Body Weight Regressions of Slimy Sculpin from George PDA Lakes, 2013

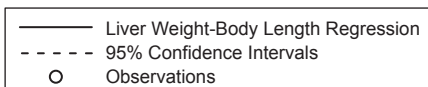
Lake	Df of Category	Df of Error	F Value	P Value
George	1	27	6.58	0.016
Komatic	1	28	58.40	<0.001
McCoy	1	25	11.26	0.003
Reference Q	1	30	36.09	<0.001

Df = degrees of freedom

Significant P-values are bolded



Note: axis values have been backtransformed from the natural log (Ln)



**Liver Weight-Body Weight Regression for Slimy Sculpin
from George Potential Development Area Lakes, 2013**

Figure 3.4-30

Mean HSI ranged from 1.66 (Giraffe Lake) to 3.11 (Propeller Lake; Table 3.4-42). A higher HSI indicates a larger liver relative to body weight, which generally indicates larger stores of energy. However, a large liver may also be caused by exposure to toxic substances. Given the lack of development in the area and the lack of high concentrations of heavy metals in sculpin tissues (see Section 3.4.2), the large livers of Propeller Lake and Goose Lake Slimy Sculpin is most likely an indicator of large energy reserves.

Table 3.4-42. Hepatosomatic Index (HSI) for Slimy Sculpin from George PDA Lakes, 2013

Lake	HSI (%)					
	n	Mean	SD	SE	Lower CI	Upper CI
George Lake	29	1.52	1.70	0.32	0.28	5.61
Komatic Lake	30	1.90	1.00	0.18	0.79	3.90
McCoy Lake	27	1.72	1.08	0.21	0.46	4.22
Reference Q Lake	32	1.36	0.64	0.11	0.41	2.61

n = number of fish

SD = standard deviation of the mean

SE = standard error of the mean

CI = 95% confidence interval

Tissue Metal Concentrations

Whole body tissue metal concentrations were taken for Slimy Sculpin from George Lake, Komatic Lake, McCoy Lake, and Reference Q Lake. The mean tissue metal concentrations were compared to fish tissue guidelines, as described in Section 2.7.3.2. Observed tissue metal concentrations and quality control results are presented in Appendix 3.4-5.

Slimy Sculpin

No significant difference was found in mean body length among lakes (ANOVA, $F_{7,56} = 1.03$, $P = 0.42$) and, therefore, comparisons of mean metal concentrations unadjusted for body length were made.

Antimony, beryllium, bismuth, lithium, tellurium, and tin were found below the detection limit in 60% or more of Slimy Sculpin from all sites and were not included in further analysis. Lead was below the detection limit in 60% or more of Slimy Sculpin from all sites except for George Lake and Reference Q Lake (50% of samples were below the detection limit). Since the majority of the total number of samples was below the detection limit, no further analyses were completed.

Table 3.4-43 present the summary of the mean tissue metal concentrations of Slimy Sculpin whole body tissue from monitoring sites in the George PDA. Mean mercury concentrations in tissues of fish ranged from 0.0363 mg/kg wwt (George Lake) to 0.0554 mg/kg wwt (Komatic Lake). The mercury concentration of all Slimy Sculpin was below the Health Canada guideline of 0.5 mg/kg wwt. The mercury concentration of all Slimy Sculpin was below the Health Canada guideline of 0.5 mg/kg wwt.

Abnormalities and Parasites

Plerocercoids of an unknown tapeworm species were frequently found in the body cavities of lethally sampled Slimy Sculpin. The prevalence of the parasites was highly variable among lakes (Table 3.4-44). The parasites infected between 35.3% (Komatic Lake) and 78.1% (Reference Q Lake) of Slimy Sculpin sampled. The intensity of parasitism (percent of parasite weight relative to total body weight) also varied among lakes (Table 3.4-45). Mean parasite weight ranged from 5.88 % (George Lake) to 15.86% (Reference Q Lake) of Slimy Sculpin total body weight.

Table 3.4-43. Summary of Mean Tissue Metal Concentrations in Slimy Sculpin, George Potential Development Area, 2013

Variable	Units	Detection Limit	George Lake (n = 8)							Komatic Lake (n = 8)						
			Proportion Censored	Mean	SE	Lower CI	Upper CI	Min	Max	Proportion Censored	Mean	SE	Lower CI	Upper CI	Min	Max
Total Length	mm		0	52.50	1.52	45.70	57.65	45.00	58.00	0	59.75	5.17	50.00	85.43	50.00	87.00
Moisture	%	0.10	0	70.64	0.87	67.12	73.45	67.00	73.50	0	71.95	0.66	69.33	74.56	69.10	74.70
Aluminum	mg/kg ww	1.0	0	3.7	0.6	1.3	6.4	1.1	6.6	0.25	1.6	0.3	0.7	3.0	0.7	3.2
Antimony	mg/kg ww	0.0020	0.75	-	-	-	-	-	-	0.875	-	-	-	-	-	-
Arsenic	mg/kg ww	0.0060	0	0.2169	0.0136	0.1695	0.2738	0.1690	0.2780	0	0.1730	0.0171	0.1234	0.2495	0.1220	0.2570
Barium	mg/kg ww	0.010	0	1.983	0.265	1.268	3.080	1.250	3.090	0	0.968	0.123	0.565	1.558	0.522	1.600
Beryllium	mg/kg ww	0.0020	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Bismuth	mg/kg ww	0.0020	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Boron	mg/kg ww	0.20	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Cadmium	mg/kg ww	0.0020	0	0.0205	0.0025	0.0113	0.0283	0.0110	0.0288	0	0.0154	0.0021	0.0088	0.0249	0.0083	0.0259
Calcium	mg/kg ww	4.0	0	9163.8	712.3	5819.3	11565.0	5380.0	11600.0	0	7338.8	864.9	4317.5	11310.0	4160.0	11800.0
Cesium	mg/kg ww	0.0010	0	0.0383	0.0109	0.0208	0.1002	0.0200	0.1140	0	0.0193	0.0028	0.0109	0.0337	0.0104	0.0363
Chromium	mg/kg ww	0.040	0	0.587	0.280	0.070	2.138	0.060	2.350	0.5	0.207	0.111	0.019	0.825	0.019	0.924
Cobalt	mg/kg ww	0.0040	0	0.1439	0.0152	0.0960	0.2030	0.0949	0.2070	0	0.1851	0.0460	0.0666	0.4227	0.0651	0.4510
Copper	mg/kg ww	0.040	0	0.617	0.027	0.519	0.721	0.517	0.730	0	0.613	0.044	0.472	0.802	0.470	0.818
Iron	mg/kg ww	1.0	0	15.0	2.1	8.3	23.8	8.1	24.0	0	14.6	2.0	8.3	24.0	7.9	25.1
Lead	mg/kg ww	0.010	0.5	-	-	-	-	-	-	0.875	-	-	-	-	-	-
Lithium	mg/kg ww	0.10	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Magnesium	mg/kg ww	0.40	0	355.00	14.88	296.95	419.95	291.00	428.00	0	337.63	15.02	286.05	392.60	285.00	394.00
Manganese	mg/kg ww	0.010	0	8.254	1.061	5.215	13.748	5.110	14.500	0	5.778	1.061	2.790	10.931	2.550	11.500
Mercury	mg/kg ww	0.0010	0	0.0363	0.0113	0.0162	0.0997	0.0158	0.1090	0	0.0554	0.0091	0.0307	0.1044	0.0288	0.1140
Molybdenum	mg/kg ww	0.0080	0.125	0.0126	0.0017	0.0066	0.0206	0.0061	0.0216	0.125	0.0113	0.0012	0.0074	0.0161	0.0072	0.0164
Nickel	mg/kg ww	0.040	0	0.447	0.044	0.269	0.574	0.260	0.578	0	0.496	0.085	0.243	0.825	0.240	0.825
Phosphorus	mg/kg ww	2.0	0	8138.8	459.5	6041.0	9782.0	5740.0	9880.0	0	5790.0	445.4	4176.8	7777.8	4070.0	8000.0
Potassium	mg/kg ww	4.0	0	3085.0	83.9	2755.3	3428.5	2750.0	3460.0	0	3177.5	143.5	2551.3	3713.8	2490.0	3740.0
Rubidium	mg/kg ww	0.010	0	1.836	0.266	1.135	3.039	1.130	3.160	0	3.115	0.215	2.282	3.903	2.270	3.950
Selenium	mg/kg ww	0.020	0	0.431	0.022	0.344	0.504	0.344	0.508	0	0.287	0.012	0.228	0.328	0.220	0.328
Sodium	mg/kg ww	4.0	0	858.3	39.3	724.8	1053.4	719.0	1080.0	0	785.1	32.6	639.3	887.6	623.0	892.0
Strontium	mg/kg ww	0.020	0	9.515	0.816	5.868	12.383	5.460	12.400	0	8.553	0.974	5.102	13.058	4.930	13.600
Tellurium	mg/kg ww	0.0040	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Thallium	mg/kg ww	0.00040	0	0.00638	0.00068	0.00382	0.00961	0.00349	0.01000	0	0.00297	0.00023	0.00217	0.00394	0.00213	0.00398
Tin	mg/kg ww	0.020	1	-	-	-	-	-	-	0.875	-	-	-	-	-	-
Uranium	mg/kg ww	0.00040	0	0.00217	0.00016	0.00139	0.00261	0.00127	0.00262	0	0.00226	0.00043	0.00111	0.00447	0.00107	0.00468
Vanadium	mg/kg ww	0.020	0.125	0.027	0.003	0.015	0.038	0.014	0.039	0.125	0.035	0.004	0.018	0.055	0.017	0.057
Zinc	mg/kg ww	0.20	0	39.25	2.43	31.37	49.87	30.90	50.20	0	28.23	2.04	22.20	37.93	21.90	38.70
Zirconium	mg/kg ww	0.040	1	-	-	-	-	-	-	1	-	-	-	-	-	-

(continued)

Table 3.4-43. Summary of Mean Tissue Metal Concentrations in Slimy Sculpin, George Potential Development Area, 2013 (completed)

Variable	Units	Detection Limit	McCoy Lake (n = 8)							Reference Q Lake (n = 8)						
			Proportion Censored	Mean	SE	Lower CI	Upper CI	Min	Max	Proportion Censored	Mean	SE	Lower CI	Upper CI	Min	Max
Total Length	mm		0	57.25	2.79	47.53	67.48	47.00	68.00	0	60.50	1.39	56.00	66.95	56.00	68.00
Moisture	%	0.10	0	72.28	0.26	71.11	73.17	71.00	73.20	0	71.35	0.58	68.85	73.37	68.60	73.40
Aluminum	mg/kg ww	1.0	0	9.4	4.4	1.3	33.6	1.2	38.3	0.125	2.4	0.5	0.7	4.6	0.7	4.6
Antimony	mg/kg ww	0.0020	0.875	-	-	-	-	-	-	0.875	-	-	-	-	-	-
Arsenic	mg/kg ww	0.0060	0	0.1205	0.0119	0.0774	0.1704	0.0747	0.1720	0	0.0496	0.0050	0.0307	0.0720	0.0284	0.0741
Barium	mg/kg ww	0.010	0	1.210	0.148	0.573	1.670	0.513	1.680	0	1.265	0.173	0.709	2.134	0.641	2.220
Beryllium	mg/kg ww	0.0020	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Bismuth	mg/kg ww	0.0020	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Boron	mg/kg ww	0.20	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Cadmium	mg/kg ww	0.0020	0	0.0187	0.0022	0.0107	0.0277	0.0097	0.0283	0	0.0250	0.0064	0.0110	0.0582	0.0109	0.0631
Calcium	mg/kg ww	4.0	0	7255.0	802.9	3688.5	9640.0	3370.0	9710.0	0	8700.0	1279.9	4025.8	12730.0	3730.0	12800.0
Cesium	mg/kg ww	0.0010	0	0.0232	0.0035	0.0160	0.0428	0.0159	0.0470	0	0.0127	0.0017	0.0076	0.0214	0.0076	0.0229
Chromium	mg/kg ww	0.040	0.125	0.392	0.240	0.025	1.750	0.015	2.060	0	0.203	0.095	0.043	0.740	0.041	0.837
Cobalt	mg/kg ww	0.0040	0	0.0994	0.0257	0.0450	0.2432	0.0423	0.2710	0	0.0885	0.0105	0.0532	0.1284	0.0531	0.1300
Copper	mg/kg ww	0.040	0	0.682	0.034	0.572	0.851	0.563	0.868	0	0.612	0.035	0.479	0.748	0.478	0.758
Iron	mg/kg ww	1.0	0	25.7	9.4	9.8	79.1	9.7	90.0	0	10.2	1.3	6.5	17.2	6.2	18.1
Lead	mg/kg ww	0.010	0.875	-	-	-	-	-	-	0.5	-	-	-	-	-	-
Lithium	mg/kg ww	0.10	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Magnesium	mg/kg ww	0.40	0	307.13	12.57	259.70	353.03	259.00	356.00	0	330.88	16.61	261.15	396.90	251.00	399.00
Manganese	mg/kg ww	0.010	0	3.429	0.930	1.673	8.641	1.650	9.530	0	2.844	0.712	1.108	6.706	1.080	7.430
Mercury	mg/kg ww	0.0010	0	0.0510	0.0061	0.0318	0.0821	0.0311	0.0864	0	0.0420	0.0036	0.0290	0.0580	0.0285	0.0601
Molybdenum	mg/kg ww	0.0080	0.5	0.0089	0.0012	0.0062	0.0149	0.0062	0.0155	0.5	0.0086	0.0008	0.0067	0.0126	0.0067	0.0132
Nickel	mg/kg ww	0.040	0	0.502	0.126	0.277	1.206	0.277	1.310	0	0.715	0.062	0.482	0.969	0.471	0.983
Phosphorus	mg/kg ww	2.0	0	6790.0	547.9	4318.3	8643.3	4110.0	8820.0	0	7205.0	810.1	4522.0	10052.8	4480.0	10100.0
Potassium	mg/kg ww	4.0	0	2756.3	187.2	1959.3	3421.3	1870.0	3430.0	0	3025.0	104.4	2570.8	3465.8	2520.0	3520.0
Rubidium	mg/kg ww	0.010	0	3.993	0.272	2.998	5.192	2.930	5.290	0	3.046	0.212	2.309	3.870	2.270	3.900
Selenium	mg/kg ww	0.020	0	0.450	0.019	0.348	0.507	0.329	0.512	0	0.473	0.028	0.376	0.597	0.371	0.604
Sodium	mg/kg ww	4.0	0	849.1	34.6	720.2	986.5	716.0	1000.0	0	923.8	23.5	820.0	1003.4	813.0	1010.0
Strontium	mg/kg ww	0.020	0	7.553	0.930	3.542	10.465	3.150	10.500	0	8.374	1.174	3.947	12.265	3.620	12.300
Tellurium	mg/kg ww	0.0040	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Thallium	mg/kg ww	0.00040	0	0.00337	0.00011	0.00295	0.00392	0.00292	0.00399	0	0.00419	0.00042	0.00265	0.00597	0.00257	0.00612
Tin	mg/kg ww	0.020	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Uranium	mg/kg ww	0.00040	0	0.00228	0.00046	0.00125	0.00480	0.00124	0.00519	0	0.00234	0.00050	0.00105	0.00485	0.00102	0.00524
Vanadium	mg/kg ww	0.020	0.125	0.041	0.011	0.018	0.100	0.015	0.113	0.25	0.043	0.011	0.016	0.096	0.016	0.099
Zinc	mg/kg ww	0.20	0	29.94	2.24	22.99	39.31	22.60	39.40	0	29.80	6.68	12.57	63.85	12.10	67.80
Zirconium	mg/kg ww	0.040	0.875	-	-	-	-	-	-	1	-	-	-	-	-	-

DL = detection limit, n = sample size, SE = standard error of the mean, min = minimum, max = maximum, ww = wet weight

CI = 95% confidence interval, dashes indicate data not available

Table 3.4-44. Percent of Slimy Sculpin with Tapeworms in George PDA Lakes, 2013

Lake	n	Percent	
		Without Parasites	With Parasites
George Lake	35	54.3	45.7
Komatic Lake	34	64.7	35.3
McCoy Lake	30	36.7	63.3
Reference Q Lake	32	21.9	78.1

n = sample size

Table 3.4-45. Intensity of Parasitism in Slimy Sculpin from George PDA Lakes, 2013

Lake	n	Percent	
		Without Parasites	With Parasites
George Lake	35	54.3	45.7
Komatic Lake	34	64.7	35.3
McCoy Lake	30	36.7	63.3
Reference Q Lake	32	21.9	78.1

Only Slimy Sculpin with parasites were included in this calculation.

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

CI = 95% confidence interval

3.4.2.5 Diet

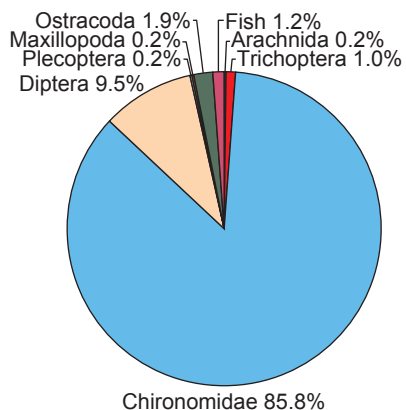
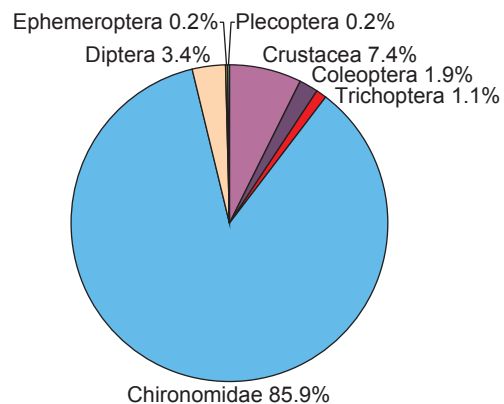
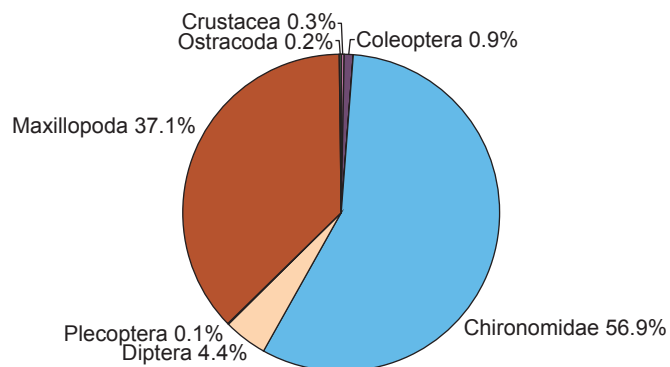
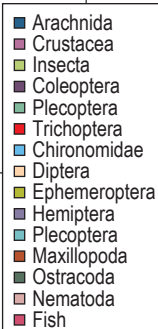
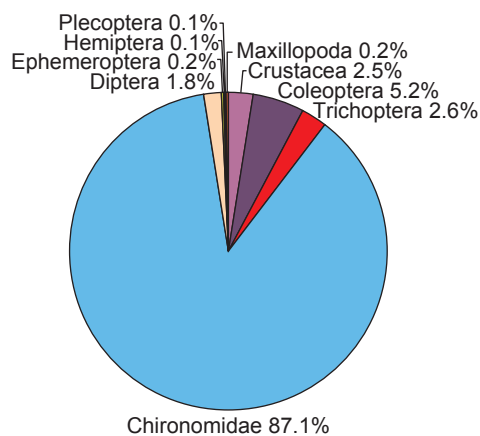
Appendix 3.4-6 presents the results of the diet analyses for Slimy Sculpin sampled in 2013. Stomach contents are indicative of the diet at the time of sampling, and therefore differences in diets between lakes are reflective of temporal availability of food, and not actual benthic invertebrate community structure. Slimy Sculpin diet in all lakes in the George PDA was dominated numerically by Chironomid (midge) larvae, which made up between 57% and 87% of the total diet (Figure 3.4-31). Slimy Sculpin diet from lakes within the Goose PDA were consistent across all lakes with > 50 % of the diet at all four lakes provided by Chironomids, and lesser amounts of between 7 and 26% provided by other dipterans and Coleoptera. Diet for fish from McCoy Lake was different than all other lakes due to a high proportion of Maxillopoda (37%) found in the diets of Slimy Sculpin. Fish were only observed in Slimy Sculpin stomachs from George Lake.

3.5 GOOSE PDA PONDS

3.5.1 Fish Habitat

3.5.1.1 Pond 1

Pond 1 is a shallow pond with a maximum depth of 2.5 m located upstream of Umwelt Lake (Figure 2.2-2). The majority of the pond area is less than 1 m deep, with deeper water limited to a small area at the center of the pond. Fine sediment-dominated substrates are primarily found at the center of the pond (Figure 3.5-1 and Plate 3.5-1). A band of boulder and cobble substrate surrounds the fine sediments, and the shoreline substrate is a combination of fines, cobbles, and boulders. The pond is too shallow to provide overwintering habitat for fish or to provide cover for rearing fish (Figure 3.5-2).

George Lake**Komatic Lake****McCoy Lake****Reference Q Lake**

**Mean Percentage Composition (by Number)
of the Stomach Contents of Slimy Sculpin from
George Potential Development Area Lakes, 2013**

Figure 3.4-31



Plate 3.5-1. Fine substrate dominant with cobble subdominant, Pond 1, August 10, 2013.

3.5.1.2 Pond A

Pond A is deeper than Pond 1, with a maximum depth of 4 m. The littoral substrate of Pond A is entirely comprised of fine sediments, although some boulders and bedrock outcroppings are found interspersed with fines at the deepest areas of the littoral zone (Figure 3.5-3). Floating mats of vegetation line the shoreline at the south end of the pond, near the outflow. Pond A has a single, well-channelized, ephemeral inflow to the north of the pond. The single outflow is located at the south end of the pond is non-channelized flow overland that does not provide fish passage. The overland flow drains south to Ponds A2 and A3 (Plate 3.5-2). Pond A does not have sufficient depth to provide overwintering habitat for fish (Figure 3.5-4).



Plate 3.5-2. Aerial view of Pond A, looking south towards Ponds A2 and A3, August 11, 2013.

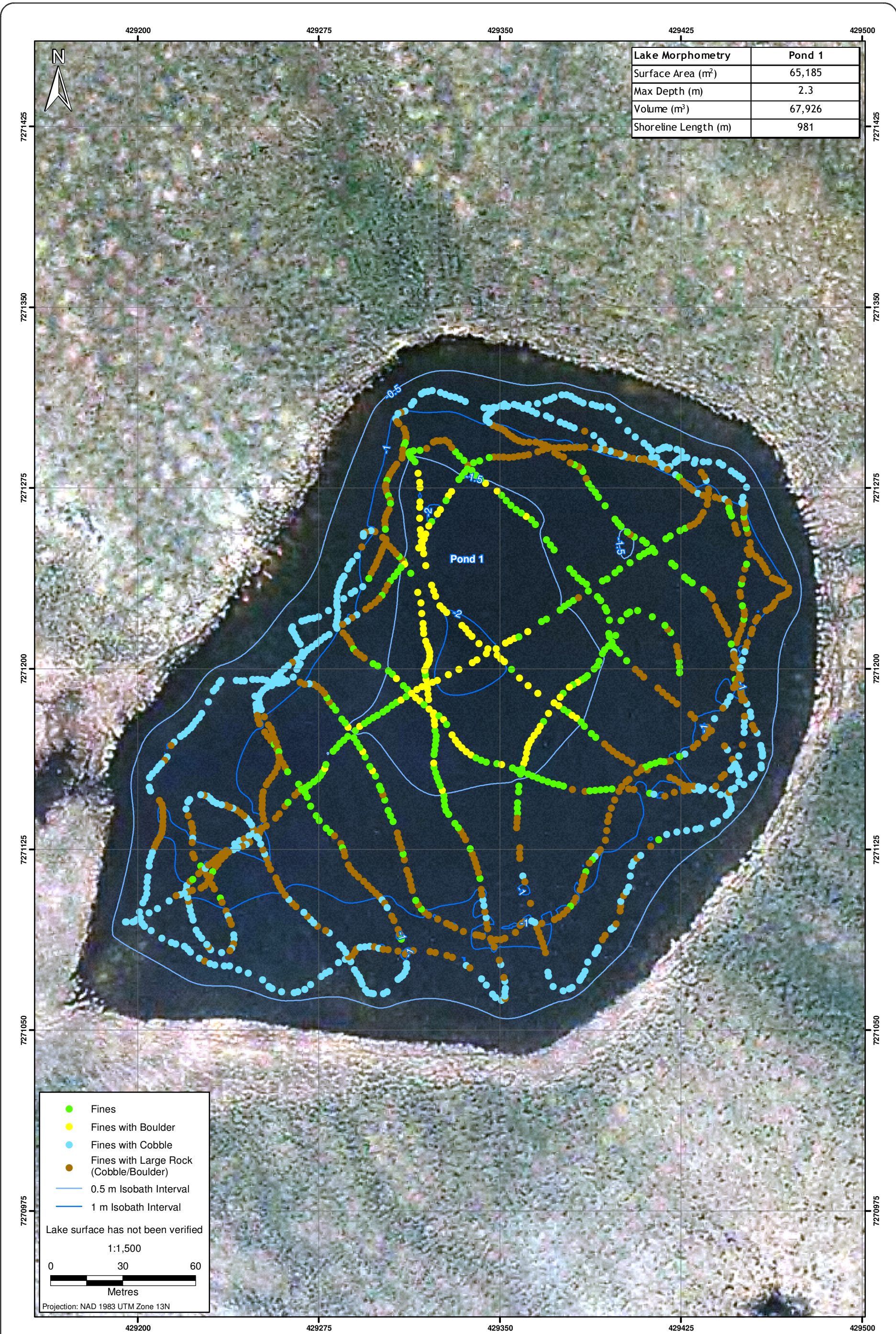


Figure 3.5-1



Pond 1 Sublittoral Substrate, 2013

Figure 3.5-1



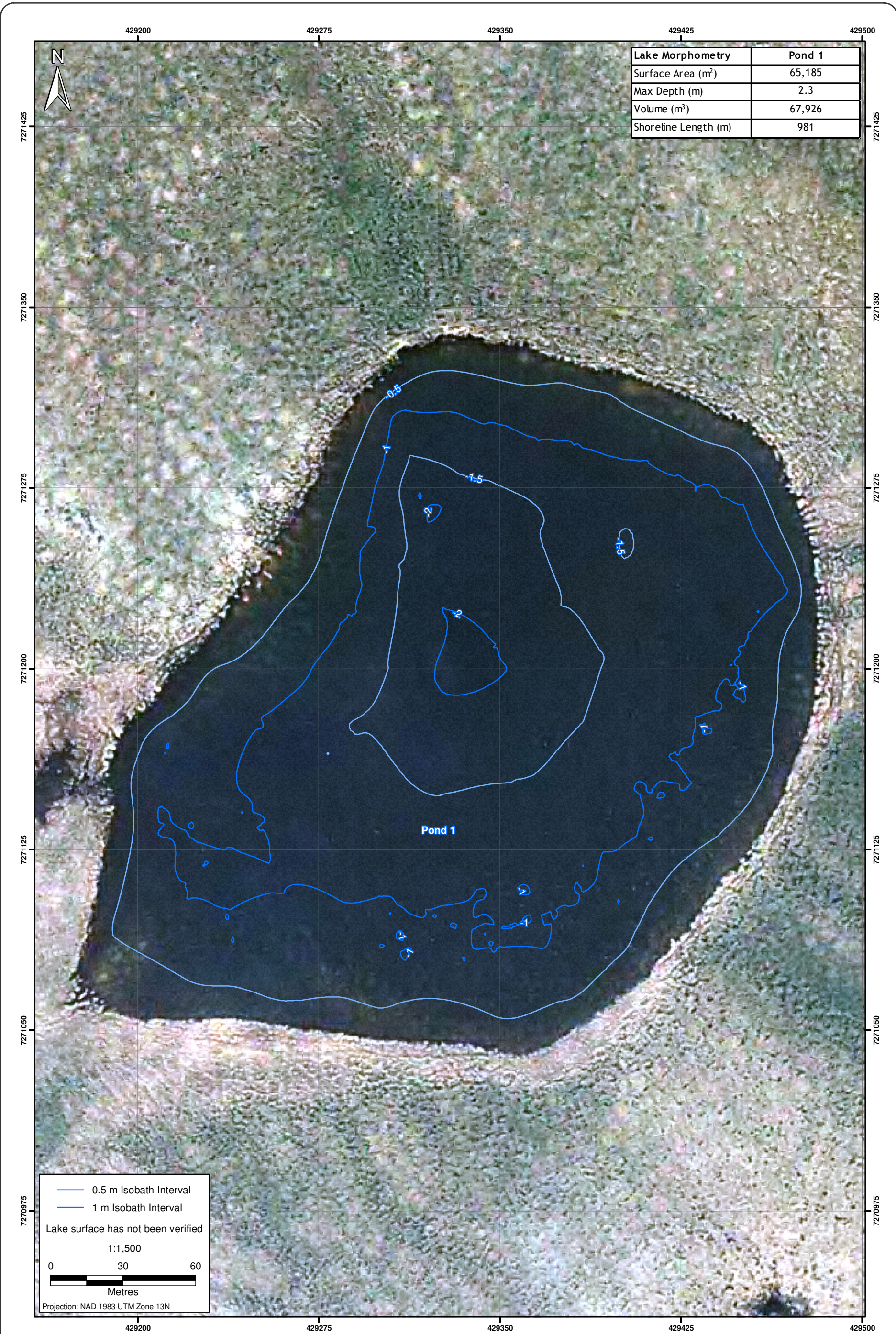


Figure 3.5-2



Pond 1 Biogeographic Bathymetry, 2013

Figure 3.5-2



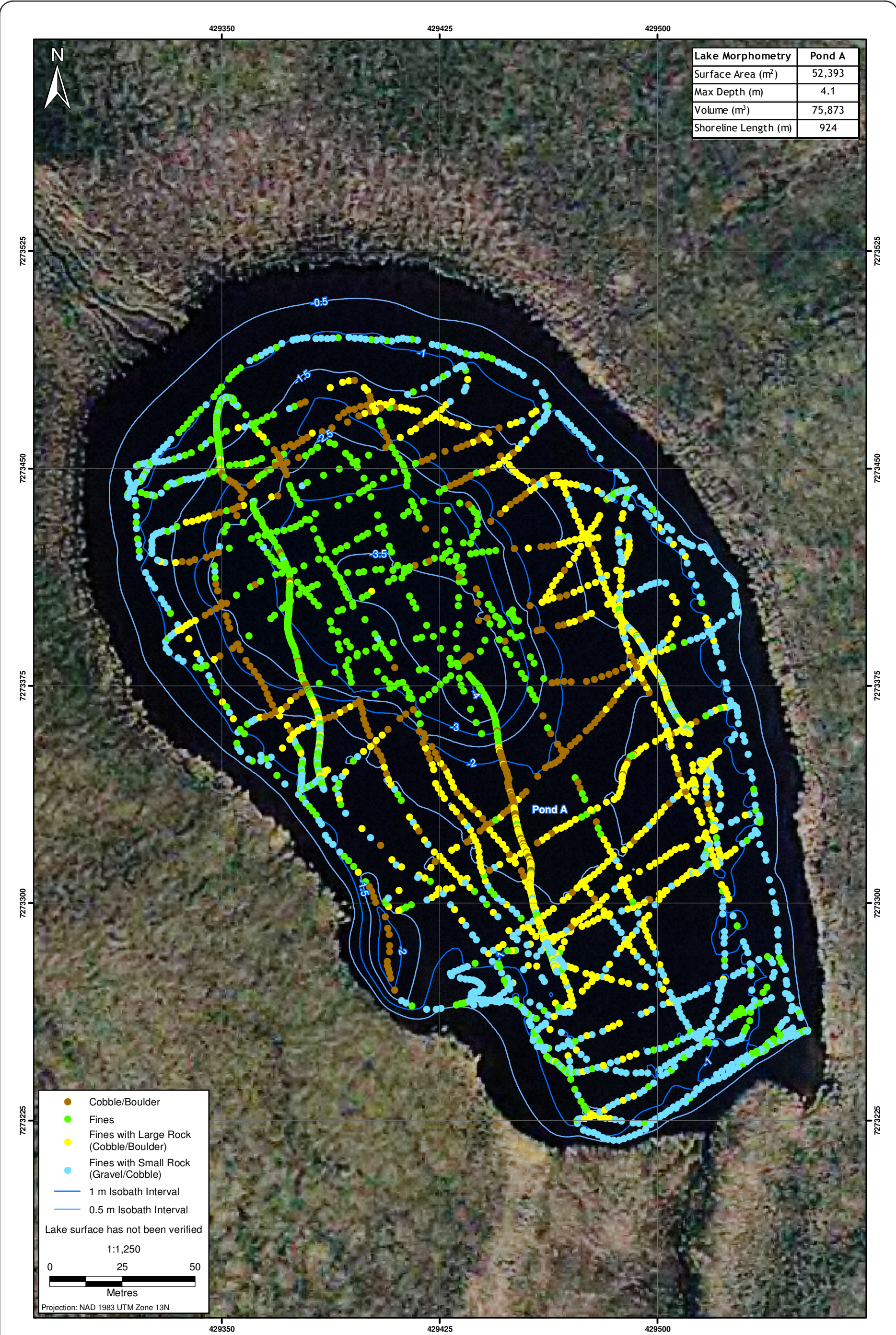


Figure 3.5-3



Pond A Sublittoral Substrate, 2013

Figure 3.5-3



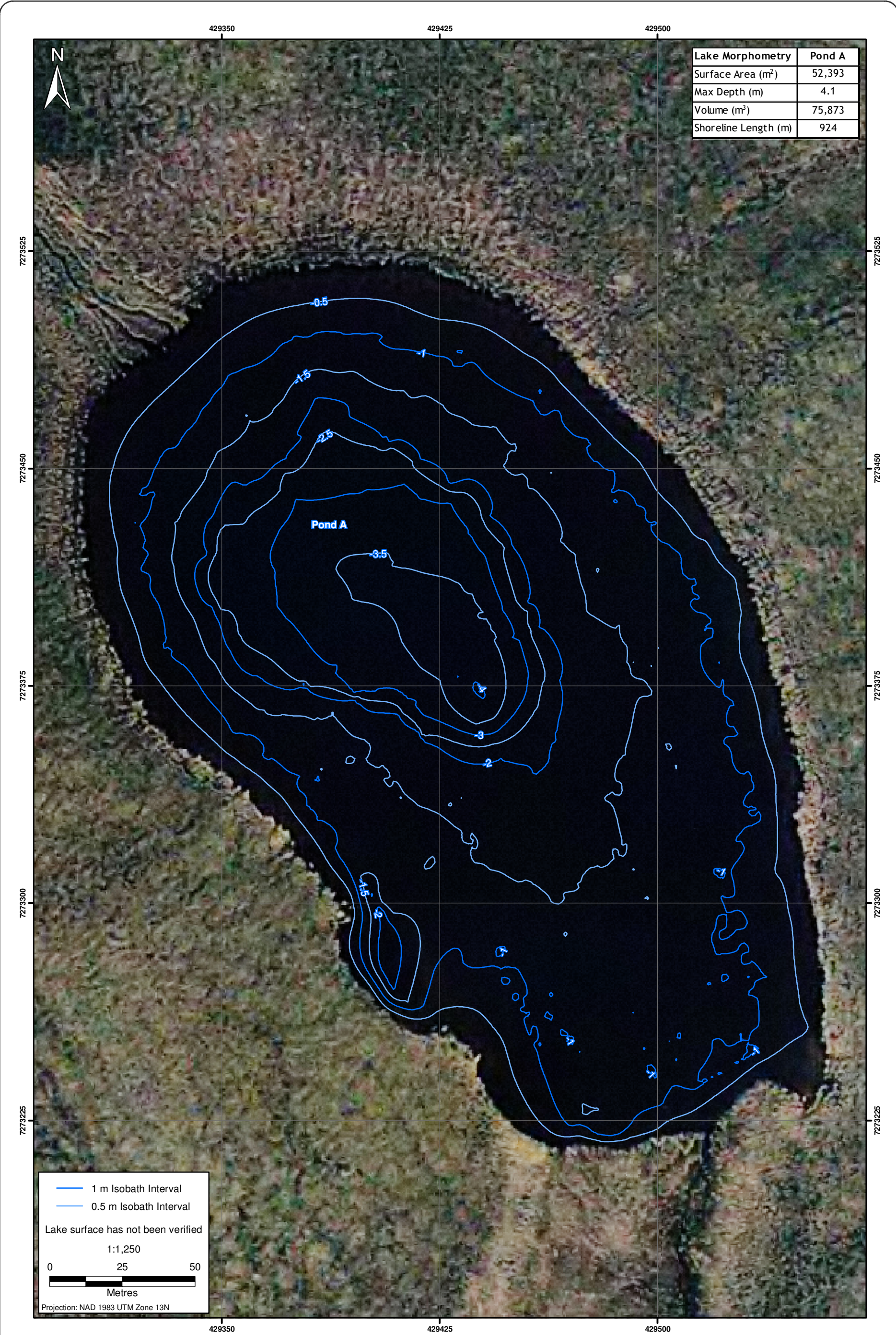


Figure 3.5-4



Pond A Biogeographic Bathymetry, 2013

Figure 3.5-4



3.5.1.3 Pond A1, Pond A2, and Pond A3

Ponds A1, A2 and A3 are similar in size, location, and morphology. Pond A1 is located upstream of Pond A to the north. Ponds A2 and A3 are located south of Pond A. All three ponds are small and shallow with shorelines comprised of floating vegetation mats. Pond A1 receives water from a small unnamed pond to the north and has a single outflow to the south. Ponds A2 and A3 are fed by overland flow and seeps and do not have channelized outflows.

3.5.1.4 Echo Pond

Echo Pond is located in the Wolf Lake watershed east of Echo Lake and south of Goose Lake. The eastern and western shorelines are steep and dominated by boulder and bedrock substrate (Plate 3.5-3). The northern and southern shorelines of the lake are comprised of primarily cobble and fine substrates. It has no channelized inflows or outflows. The maximum depth was estimated to be 4 m through an aerial survey.



Plate 3.5-3. Bedrock shorelines on the eastern shoreline (background) and cobble and fine substrate shorelines on the south shoreline (foreground), Echo Pond, June 20, 2013.

3.5.2 Fish Community

3.5.2.1 Species Composition

One fish species (Ninespine Stickleback) was observed at Goose PDA surveyed ponds in 2013. Appendix 3.5-1 presents the sampling effort and catch summary. No fish were captured by electrofishing at the eight ponds sampled (Table 3.5-1). Visual observations confirmed fish presence at Pond 1; however, all 4 of the Ninespine Stickleback observed in the pond were dead, possibly from a winterkill. Fish can move into Pond 1 from Umwelt Lake during high flows at freshet and may get stranded in the pond when flows decrease. Although the observed fish were dead, their presence is still confirmation that Pond 1 is fish-bearing.

Table 3.5-1. Summary of Electrofishing CPUE and Visual Observations of Fish in PDA Ponds, 2013

Site Name	Electro-fishing Effort(s)	Electrofishing (No. of Fish Captured)						Electrofishing CPUE (Fish/100 s)	Visual Observation	
		Arctic Grayling	Burbot	Lake Trout	Ninespine Stickleback	Slimy Sculpin	Total		Ninespine Stickleback	Total
Pond 1	1,020	-	-	-	-	-	0	0	4	4
Pond 2	1,026	-	-	-	-	-	0	0	-	-
Pond A	1,047	-	-	-	-	-	0	0	-	-
Pond A1	501	-	-	-	-	-	0	0	-	-
Pond A2	500	-	-	-	-	-	0	0	-	-
Pond A3	500	-	-	-	-	-	0	0	-	-
Pond D	1003	-	-	-	-	-	0	0	-	-
Echo Pond	629	-	-	-	-	-	0	0	-	-

CPUE = Catch-per-unit-effort

No. = number

Dashes indicate no fish captured

A total of 1,026 seconds of electrofishing effort were expended at Pond 2 in 2013. An additional 208 h of minnow trapping effort were expended at Pond 2 in 2011 (Rescan 2012b). No fish were captured or observed during either year. The outflow to Pond 2 is intermittently channelized (see Section 3.3) and does not provide fish passage that would allow fish to move upstream from Pond 1 to Pond 2. Pond 2 does not provide overwintering habitat (Rescan 2012b) and is not connected by fish-passable streams to other water bodies that could provide overwintering habitat. Due to the lack of overwintering habitat and the zero catch despite substantial fishing effort using multiple sampling methods over two years, Pond 2 is confirmed to be non-fish bearing.

The 2013 sampling period is the second year of fish community sampling at Pond A. In addition to the 1,047 seconds of electrofishing undertaken in 2013, a total of 3.7 h of gillnetting effort and 286.0 h of minnow trapping effort were expended at Pond A in 2011. No fish have been captured or observed during any of the sampling. The pond itself does not provide overwintering habitat, nor is it connected by fish-passable channels to water bodies that could provide overwintering habitat. As a result, Pond A is confirmed to be a non-fish bearing water body.

The outflow of Pond A1 is fish passable and provides connectivity to Pond A. A total of 604 seconds of electrofishing effort were expended at Pond A1 and the Pond A1 outflow in 2013 and 207.3 h of minnow trapping effort were expended in 2011 with no resulting catch. As with Pond A, Pond A1 does not provide overwintering habitat for fish and is not directly connected to any other water bodies with sufficient depth to provide overwintering habitat (Rescan 2012b). Pond A1 is also confirmed to be non-fish bearing.

Ponds A2 and A3 were electrofished for 500 seconds each in 2013 with no fish captured or observed. No other sampling has been undertaken on these water bodies. However, both ponds do not contain overwintering habitat for fish and are not connected to other water bodies by fish-passable channels.

During 2013, Pond D was sampled by electrofisher for 1,003 electrofishing seconds and during 2011 it was sampled by gillnet for 3.6 h and by minnow trap for 224.0 h, resulting in a single Slimy Sculpin captured by minnow trap in 2011 confirming its status as fish-bearing. Pond D has a maximum depth of 4 m, providing marginal fish habitat. The Pond D outflow discharges into Wasp Lake, which contains potential good quality overwintering habitat and is confirmed fish-bearing; however, SHIM surveys of the Pond D outflow found multiple barriers to fish passage, including sections of underground flow (see Section 3.2 for details and locations of obstacles). Pond D is not connected to any other water bodies that could provide overwintering habitat.

A total of 629 seconds of electrofishing effort were undertaken at 2013 in Echo Pond with no fish captured. This effort is the only fishing effort expended at the pond to date. While it is not sufficient effort to confirm non-fish bearing status, the small size of Echo Pond and the lack of overwintering habitat or passable connections to other water bodies suggest a low probability of fish presence.

3.6 WATER MANAGEMENT AND/OR FISHERIES OFFSETTING AREAS

3.6.1 Fish Habitat

3.6.1.1 Gander Pond Stream

There are three reaches that form the Gander Pond stream, starting from the downstream end of Gander Pond stream where it discharges into Goose Lake and moving upstream south-east towards an unnamed lake near Rascal-Goose stream Lake (Figure 3.6-1).

Reach 1 of Gander Pond Stream is the outflow of Gander Pond into Goose Lake (Table 3.6-1). It is a heterogeneous reach containing riffle, pool, run, and cascade habitat (Table 3.6-2). At the time of sampling, the water levels were high and the wetted width exceeded the bankfull width. There is

abundant instream cover present at Reach 1, created by deep pools, instream boulders, undercut banks, instream vegetation, and overhanging vegetation which provides good rearing habitat. The presence of some patches of gravel and cobble substrate provides fair spawning habitat and an important fish habitat overall. A cascade located mid-reach may form a barrier to fish migration during periods of low flow, but does not during high flow periods (Plate 3.6-1 and Plate 3.6-2). A second cascade further downstream does not form an impassable barrier to fish but may prevent very small fish from moving upstream at low flows.

Table 3.6-1. Characteristics of Gander Pond Stream Reaches, 2013

Attribute	Units	Gander Pond Stream Reach		
		1	2	3
Site	n/a	101	804	-
Morphology	n/a	Run	Run	NCD
Secondary Habitat	n/a	Braided	Intermittent Channelization	-
Reach Length	m	473	385	254
Mean Gradient	%	2	1	-
Mean Bankfull Width	m	0.7	1.2	-
Mean Wetted Width	m	1.1	4.5	-
Mean Bankfull Depth	m	0.15	0.15	-
Mean Wetted Depth	m	0.20	0.31	-
Bankfull area	m ²	331	462	-
Spawning	n/a	Fair	Poor	None
Overwintering	n/a	None	None	None
Rearing	n/a	Good	Fair	None
Overall	n/a	Important	Marginal	None

NCD = non-classified drainage

Dashes indicate data not available

n/a = not applicable



Plate 3.6-1. The cascade in Gander Pond Stream Reach 1 is passable at high flows, June 14, 2013.

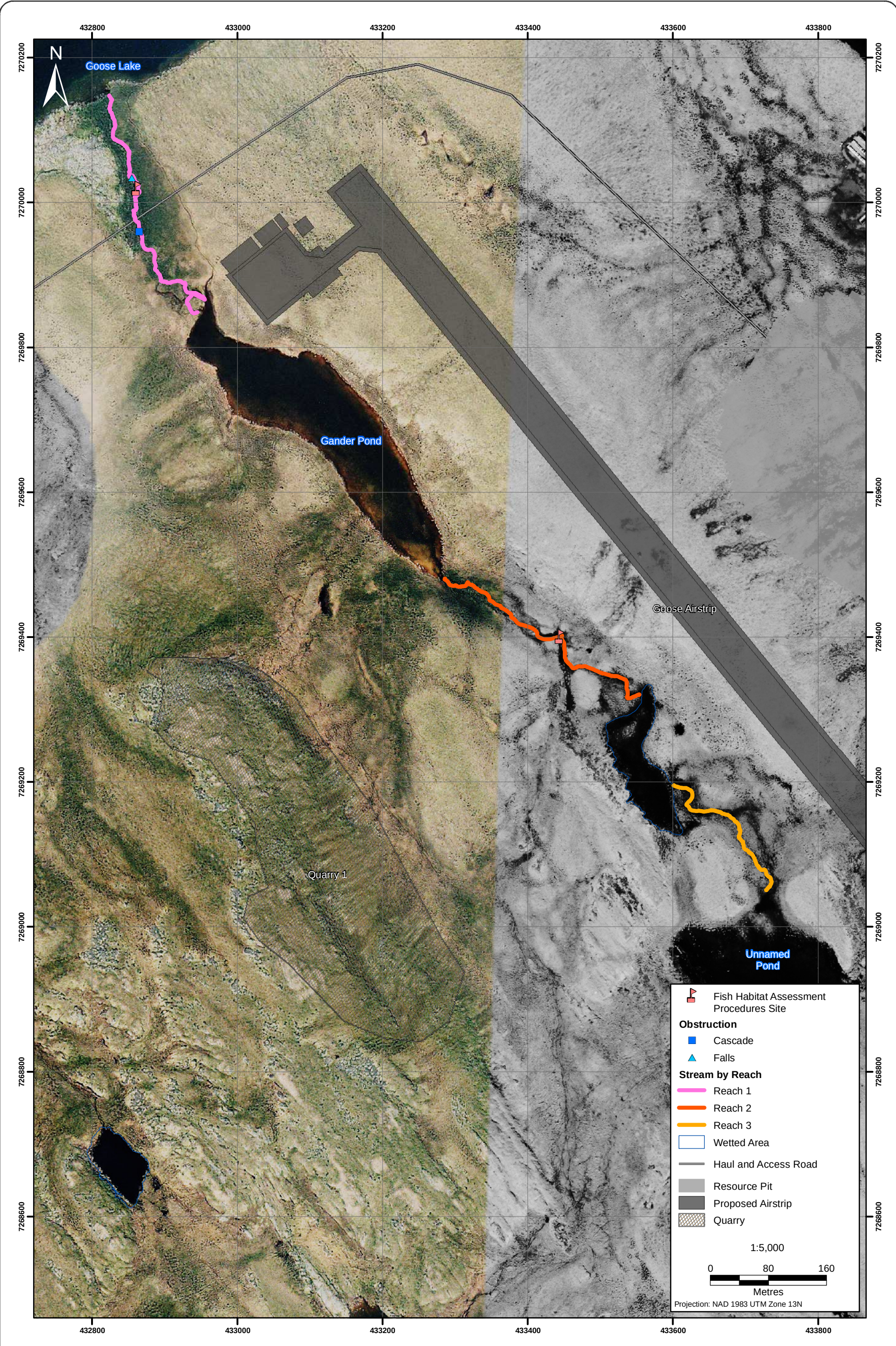


Figure 3.6-1



Gander Pond Stream Reaches and Survey Sites, 2013

Figure 3.6-1



Table 3.6-2. Weighted Mean Habitat Characteristics of Gander Pond Stream Reaches, 2013

Attribute	Units	Gander Pond Stream Reach		
		1	2	3
Organics	%	40	0	-
Fine	%	2	70	-
Gravel	%	16	5	-
Cobble	%	25	20	-
Boulder	%	17	25	-
Bedrock	%	0	0	-
Compaction	n/a	Medium	Medium	-
Bank Stability	n/a	Stable	Stable	-
Bank Substrate	n/a	Cobble	Fines	-
Number of Pools	no.	3	0	-
Mean Maximum Pool Depth	m	0.53	-	-
Mean Crest Depth	m	0.18	-	-
Mean Residual Depth	m	0.35	-	-
Pool	%	16	0	-
Boulder	%	8	2	-
Instream Vegetation	%	3	5	-
Overhanging Vegetation	%	1	0	-
Undercut Bank	%	1	1	-
Total Cover	%	29	8	-
Riffle	no.	1	0	-
Pool	no.	3	0	-
Run	no.	2	1	-
Cascade	no.	1	0	-
Boulder Garden	no.	0	0	-
Other	no.	0	0	-

No. = number; Dashes indicate data not available; n/a = not applicable

Channelization is intermittent at Reach 2, the Gander Pond inflow (Plate 3.6-3). The stream was flooded during the survey, but the low bankfull depth (0.15 m) indicates that it is shallow at normal flows. The substrate is primarily fine substrate with embedded boulder and cobbles. There is a moderate amount of cover. The quality of the habitat for rearing is fair, although the intermittent channelization and shallow depths make it unsuitable for larger stream fish. Spawning habitat is poor due to the high proportion of fine sediments. Reach 2 has marginal fish habitat overall from the intermittent channelization.

At Reach 3, there was no visible channel and was considered a non-classified drainage. Although there was substantial water present at the time of the survey, it was present only as overland flow and is likely ephemeral (Plate 3.6-4). NCD sites are not considered fish habitat.



Plate 3.6-2. The cascade in Gander Pond Stream Reach 1 is impassable at low flows, June 22, 2013.



Plate 3.6-3. View of intermittent channelization at Reach 2 of Gander Pond Stream, facing north-west towards Gander Pond, June 22, 2013.



Plate 3.6-4. Non-channelized ephemeral wetted areas at Reach 3 of Gander Pond Stream, June 22, 2013.

3.6.1.2 Goose-Propeller Off-channel Area

The Goose-Propeller off-channel areas consist of a network of streams, ponds, wetted areas, and areas of overland flow that are located to the east of Goose Outflow. Water in this area generally flows north from an unnamed lake to the south-east, although the flow pattern is often indistinct and some ponds appear stagnant and unconnected to other water bodies (Plate 3.6-5). Due to the amorphous nature of the wetted area, it could not be mapped using the reach-based methods employed elsewhere in the study area and was described in more general terms.

Where the off-channel area discharges into Goose Outflow, the two channels create a relatively deep, flowing area with boulder substrate. Most of the fish captured during electrofishing efforts were captured within 100 m of Goose Outflow, although several fish were observed or captured further upstream. For the 50 m directly upstream of Goose Outflow, there is a visible channel, although non-channelized flow was also observed to both sides of the channel (Plate 3.6-6). The channel is wide (wetted width 6 m) and relatively deep (bankfull depth = 0.45 m). The substrate is primarily boulders.

Approximately 150 m upstream of Goose Outflow, water flows without channelization over an area approximately 30 m in width (Plate 3.6-7). This morphology continues for 600 m, with small sections of relatively deep, channelized flow and wide, shallow overland flow. Wetted depths range from 0.13 m to 0.37 m and wetted widths range from 1.2 m to 35 m (Plate 3.6-8). This section of the area is highly heterogeneous and is difficult to characterize.



Plate 3.6-5. Aerial view of Goose-Propeller Off-channel Area looking south-east towards the unnamed lake (top right), June 19, 2013.



Plate 3.6-6. Channelized flow at Goose-Propeller Off-channel Area, June 19, 2013.



Plate 3.6-7. Overland flow approximately 150 m upstream of Goose Outflow, June 19, 2013.



Plate 3.6-8. Deep, channelized flow approximately 250 m upstream of Goose Outflow, June 19, 2013.

The 150 m of stream at the outflow of the unnamed lake forms a distinct, although likely ephemeral, channel (Plate 3.6-9). The channel has an average wetted width of 4.0 m and an average wetted depth of 0.1 m. The flow was slow at the time of the survey.



Plate 3.6-9. Channelization downstream of the unnamed lake, June 19, 2013.

While much of the water flows from the unnamed lake to Goose Outflow through the route described above, there were numerous small channels and ponds located east and west of the main flow path. West of the main flow path, there are large areas of wet, stagnant flow (Plate 3.6-10). East of the main flow path, water collects and forms a series of small, unconnected ponds and sloughs along the base of a low ridge (Plate 3.6-11).

The Goose-Propeller off-channel area was surveyed during freshet, when flow was high. During low flow season, sections where water was observed flowing over land with no channelization are likely dry and the off-channel area likely becomes a series of stagnant pools (where the channel is deep and permanent) separated by dewatered areas.

3.6.1.3 McCoy Lake Outflow

McCoy Lake Outflow is a short (110 m in length) stream connecting McCoy Lake to an unnamed lake to the south-west (Table 3.6-3). The habitat is homogenous with no reach-breaks. The stream is wide (19 m bankfull width) and shallow (0.17 m bankfull depth). The substrate is composed of mixed fines and boulders, with boulders dominant mid-stream and fines dominant along the margins. Cover is sparse and primarily associated with the instream boulders (Plate 3.6-12). The instream cover provides good rearing habitat and is considered important fish habitat overall.

3.6.1.4 Canyon Lakes

The Canyon Lakes consist of a series of long, narrow lakes connected by short stream reaches. There are six lakes in the series, three of which were surveyed for littoral habitat quality. All of the Canyon Lakes are located within a canyon with high, steep walls. Water discharges north from a headwater lake through an outflow to Canyon Lake 5 and flows north through Canyon Lake 4, Canyon Lake 3, and Canyon Lake 2.



Plate 3.6-10. Wetted area west of main flow path, June 19, 2013.



Plate 3.6-11. Stagnant slough east of the main flow path, June 19, 2013.



Plate 3.6-12. View of McCoy Outflow facing east towards McCoy Lake, June 21, 2013.

Table 3.6-3. Characteristics of McCoy Outflow Stream Reaches, 2013

Attribute	Units	Reach 1
Site	n/a	810
Morphology	n/a	Run
Secondary Habitat	n/a	-
Reach Length	m	110
Mean Gradient	%	0.5
Mean Bankfull Width	m	19
Mean Wetted Width	m	22
Mean Bankfull Depth	m	0.14
Mean Wetted Depth	m	0.22
Bankfull area	m ²	2,420
Fine	%	50
Gravel	%	5
Cobble	%	5
Boulder	%	40
Bedrock	%	0
Bank Stability	n/a	Stable
Bank Substrate	n/a	Cobble
Number of Pools	no.	0
Mean Maximum Pool Depth	m	-

(continued)

Table 3.6-3. Characteristics of McCoy Outflow Stream Reaches, 2013 (completed)

Attribute	Units	Reach 1
Mean Crest Depth	m	-
Mean Residual Depth	m	-
Pool	%	0
Boulder	%	5
Instream Vegetation	%	1
Overhanging Vegetation	%	0
Undercut Bank	%	1
Total Cover	%	0
Riffle	no.	0
Pool	no.	0
Run	no.	1
Cascade	no.	0
Boulder Garden	no.	0
Other	no.	0
Spawning	n/a	None
Overwintering	n/a	None
Rearing	n/a	Good
Overall	n/a	Important

N/A = not applicable

No. = number

Dashes indicate data not available

The shoreline of Canyon Lake 5 is dominated by steep boulder and cobble scree slopes (Figure 3.6-2). Gravel and fines are only dominant at the south and north ends of the lake. There is a single outlet to the north and a single inlet to the south. The shoreline is very steep, resulting in a narrow littoral zone throughout the middle of the lake, but the north and south ends of the lake are shallow (Plate 3.6-13). There is a shallow (less than 1 m), wide stream reach at the north end of the lake which forms the outflow to Canyon Lake 4.

Canyon Lake 4 is a small lake with a single inflow and outflow. Despite the small surface area, Canyon Lake 4 is relatively deep with a maximum depth of 6 m. The shoreline substrate is heterogenous, with at least one unit dominated by fines, gravel, cobble, and boulder each.

Canyon Lake 3 is separated from Canyon Lake 4 by a short (less than 50 m) stream reach. The littoral habitat at Canyon Lake 3 is relatively homogenous (Figure 3.6-3). The majority of the shoreline is comprised of two habitat units: boulder-cobble scree slope on the west side of the lake and cobble-dominated scree slope on the east side of the lake. Fines and gravel are only present at small habitat units at the north and south ends of the lake. In particular, the sediment of an embayment on the north end of the lake is dominated by fine sediments with abundant algae and aquatic vascular plants. As with Canyon Lake 1, there is a single inflow at the south end of the lake and a single outflow at the north end of the lake. The shallow outflow is bisected by a mid-channel island made of large boulders (Plate 3.6-14).

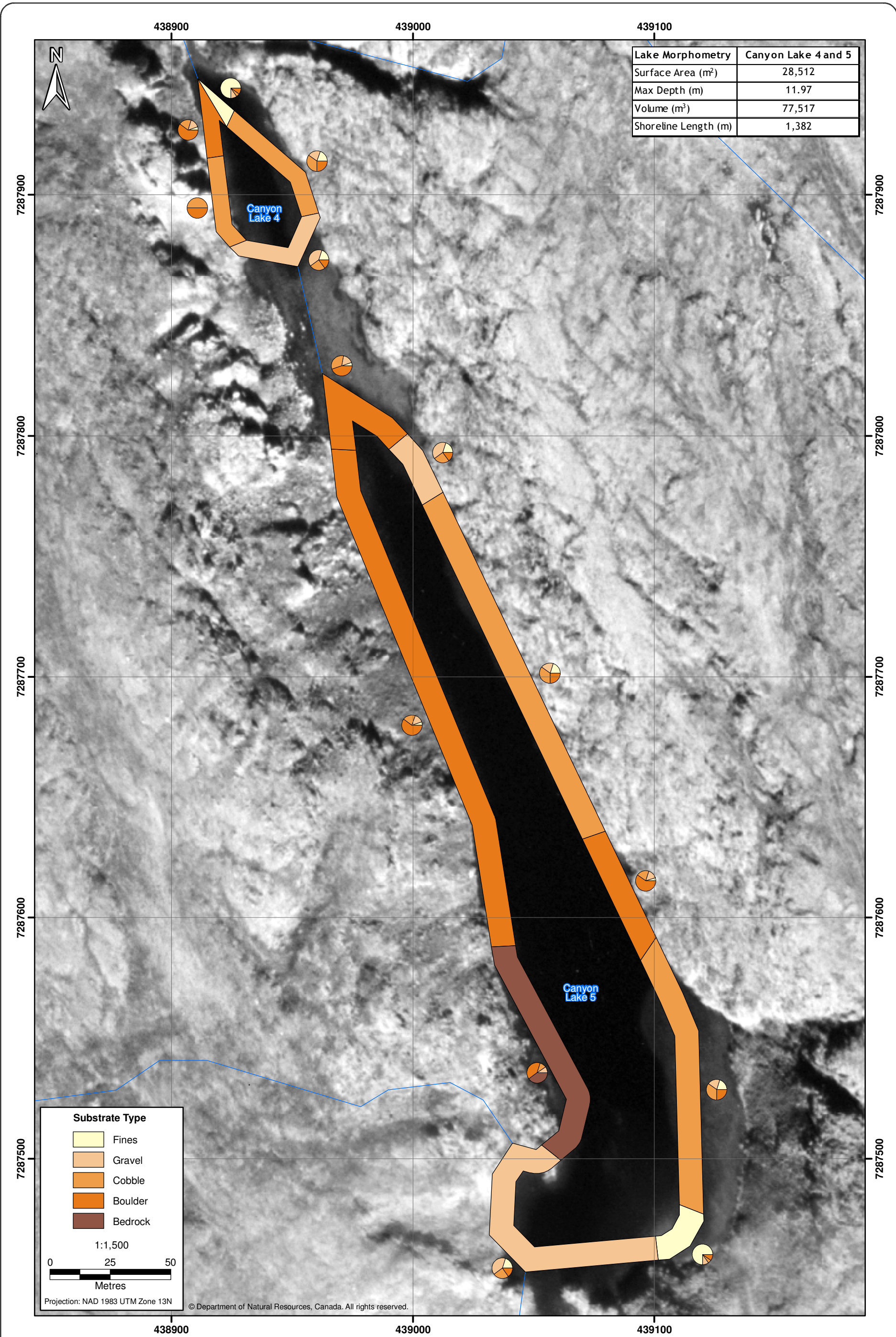


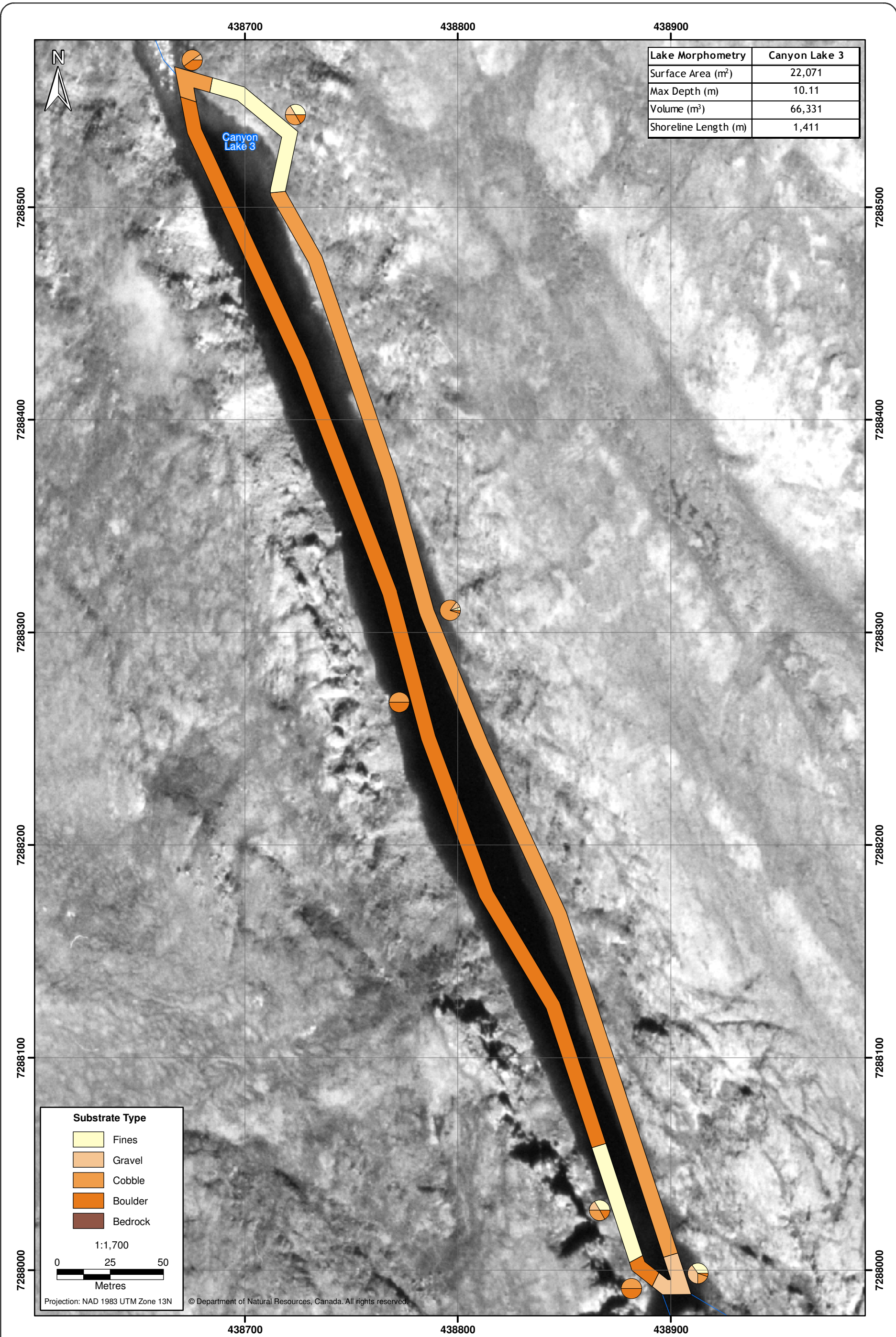
Plate 3.6-13. View of Canyon Lake 5 facing north towards Canyon Lake 4, August 2, 2013.



Plate 3.6-14. Boulder island (left) and vegetation at the inflow to Canyon Lake 3, August 8, 2013.

Canyon Lake 3 is separated from Canyon Lake 2 by a short (approximately 40 m) stream reach that forms the only inflow to Canyon Lake 2. The single outflow is located at the north end of the lake (Figure 3.6-4). The lake is shallow near the inlet and outlet, but deep mid-lake (Plate 3.6-15). Fine sediments are predominant near the inflow of the lake. Boulder substrate is predominant at the outflow of the lake.





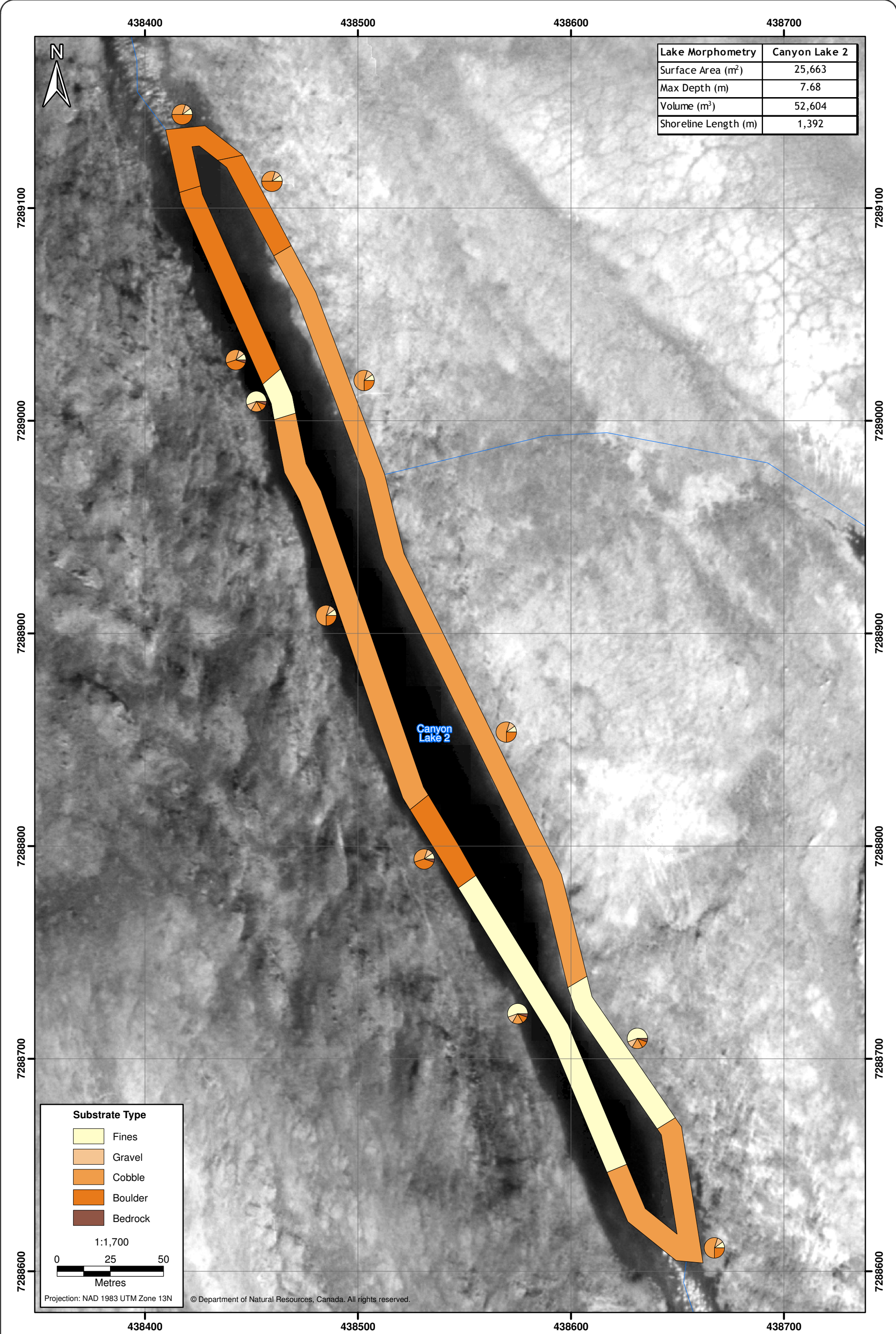




Plate 3.6-15. Shallow water at the Canyon Lake 2 inlet, August 10, 2013.

3.6.2 Fish Community

3.6.2.1 Species Composition

Five fish species were captured at water management and/or offset-related streams and in 2013: Arctic Grayling, Burbot, Lake Trout, Ninespine Stickleback and Slimy Sculpin. No fish were captured at Pond E. Appendix 3.6-1 presents the sampling effort and species summary for each offset area. Appendix 3.6-2 presents the individual fish data. Table 3.6-4 shows a summary of the fish species and numbers captured or observed at surveyed sites in 2013.

Table 3.6-4. Number of Fish Captured or Observed at Water Management/Offset Areas, 2013

Site	Fish Community Composition (No.)					Total No.
	Arctic Grayling	Burbot	Lake Trout	Ninespine Stickleback	Slimy Sculpin	
<i>Streams</i>						
Gander Pond stream	100	1	-	14	1	116
Goose - Propeller	12	-	-	2	1	15
Long Lake inflow	-	-	1	-	8	9
McCoy outflow	-	-	1	-	2	3
<i>Lakes</i>						
Canyon Lake 5	7	-	6	1	1	15
Canyon Lake 3	5	1	2	1	15	24
Canyon Lake 2	6	2	1	6	6	21
<i>Ponds</i>						
Pond E	-	-	-	-	-	0

Dashes indicate that no fish were captured

CPUE

Catch-per-unit-effort was recorded for gillnetting, electrofishing, and minnow trapping at offset areas. Angling effort was difficult to standardize due to using various lures and gear and different levels of experience among anglers, thus only the total number of fish captured are presented. Arctic Grayling fry surveys present the total number of fish observed.

Streams

Fish were captured or observed at streams during Arctic Grayling spawning and fry surveys and sampling conducted by electrofishing (in shallow areas) and angling (in deep areas).

An Arctic Grayling spawning survey was conducted at the Goose - Propeller Off-channel Areas. All observed Arctic Grayling (7 juveniles; 1 adult) were located near the main Goose Outflow channel, however, two Ninespine Stickleback were located further from Goose Outflow (Figure 3.6-5).

Arctic Grayling fry surveys were conducted at the Gander Pond Stream on August 11. During the survey, no fry were observed downstream of Gander Pond, however a total of 99 Arctic Grayling fry (less than 70 mm fork length) were observed upstream of Gander Pond (Figure 3.6-6). This suggests that for this area, spawning Arctic Grayling may be coming downstream from Rascal Lake and not upstream from Goose Lake.

Fish were captured at all four streams sampled using electrofishing (Table 3.6-5). McCoy Lake outflow had the highest CPUE of 2.26 fish/100 s, and Goose - Propeller Off-channel Area had the lowest CPUE of 0.67 fish/100 s. Species diversity was highest at Gander Pond Stream, with four species captured.

Deep pools in Long Lake Outflow were sampled by angling, capturing one Lake Trout.

Lakes

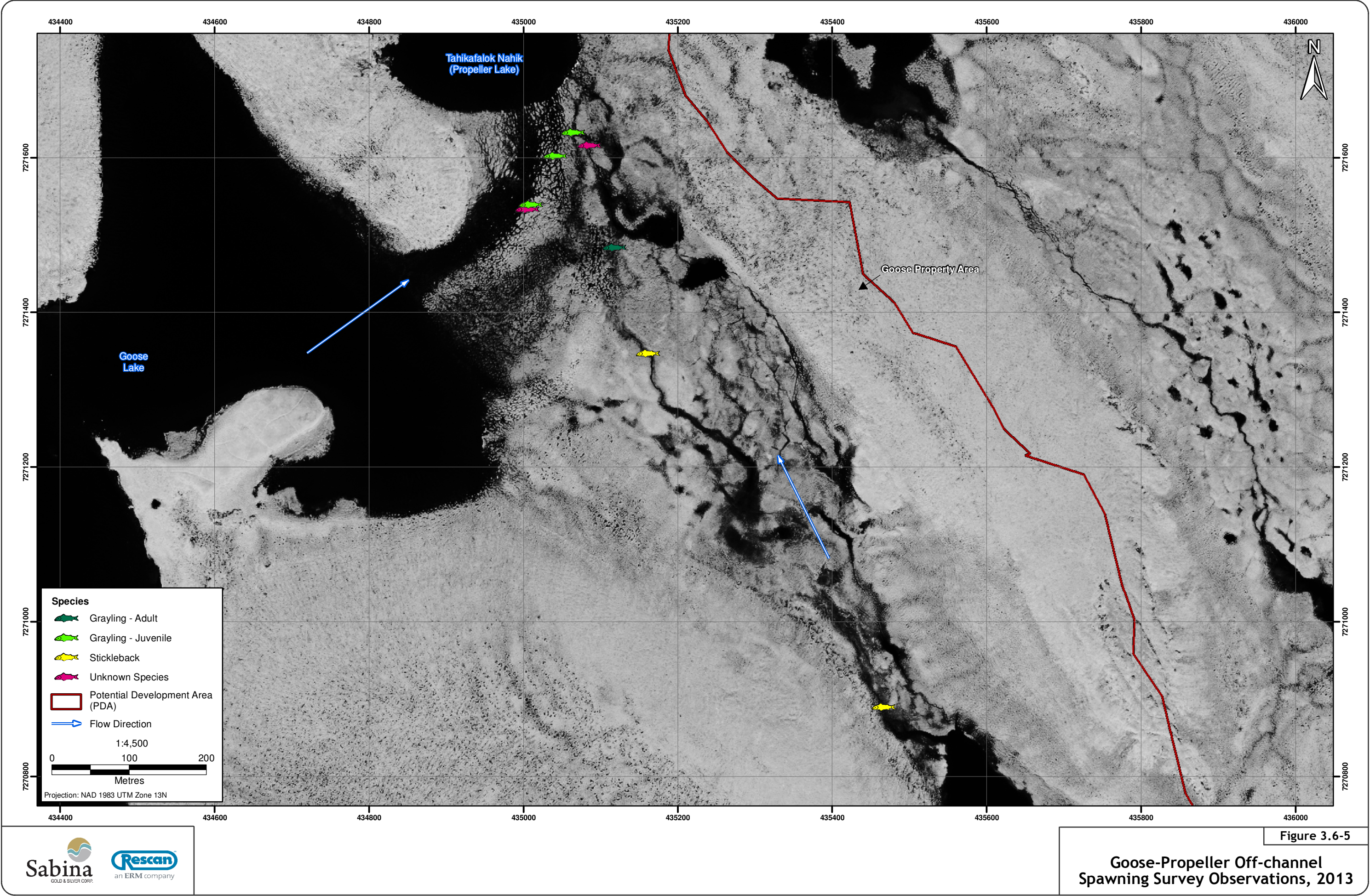
Fish were captured at the Canyon lakes by electrofishing, gillnetting, minnow trapping, and angling. All five species captured in the Canyon lakes system were captured at Canyon Lake 3 and Canyon Lake 2, while only four species were captured at Canyon Lake 5.

Arctic Grayling and Lake Trout were captured by gillnet at all three sampled Canyon lakes. Two floating gillnets were set in each of the Canyon lakes with a mean effort per floating gillnet set of 1.6 h. Two sinking gillnets were set in each Canyon lakes. The mean effort per sinking gillnet set was 1.76 h. Standard and bootstrap mean CPUE is presented for each lake and each species in Table 3.6-6. Total CPUE for floating gillnets was lowest at Canyon Lake 3 (no fish captured) and highest at Canyon Lake 5 (1.46 fish/100 m²/h). Total CPUE for sinking gillnets at surveyed lakes was lowest at Canyon Lake 2 (0.23 fish/100 m²/h) and highest at Canyon Lake 5 (2.19 fish/100 m²/h).

Fish were sampled by angling at Canyon Lake 3 and 2. Two Arctic Grayling and one Lake Trout were captured at Canyon Lake 3, and two Arctic Grayling were captured at Canyon Lake 2.

Fish were sampled by electrofishing at three Canyon lakes. Electrofishing CPUE ranged from 0.36 fish/100 s at Canyon Lake 5 to 1.98 fish/100 s at Canyon Lake 3. Most fish captured by electrofishing were Slimy Sculpin; however, a single Burbot was also captured at Canyon Lake 2.

Minnow traps captured fish at all three Canyon lakes. Total minnow trap CPUE ranged from 0.05 fish/24 h (Canyon Lake 5) to 0.45 fish/24 h (Canyon Lake 3; Table 3.6-7). Ninespine Stickleback were captured in all lakes. Burbot and Slimy Sculpin were also captured at Canyon Lake 2.



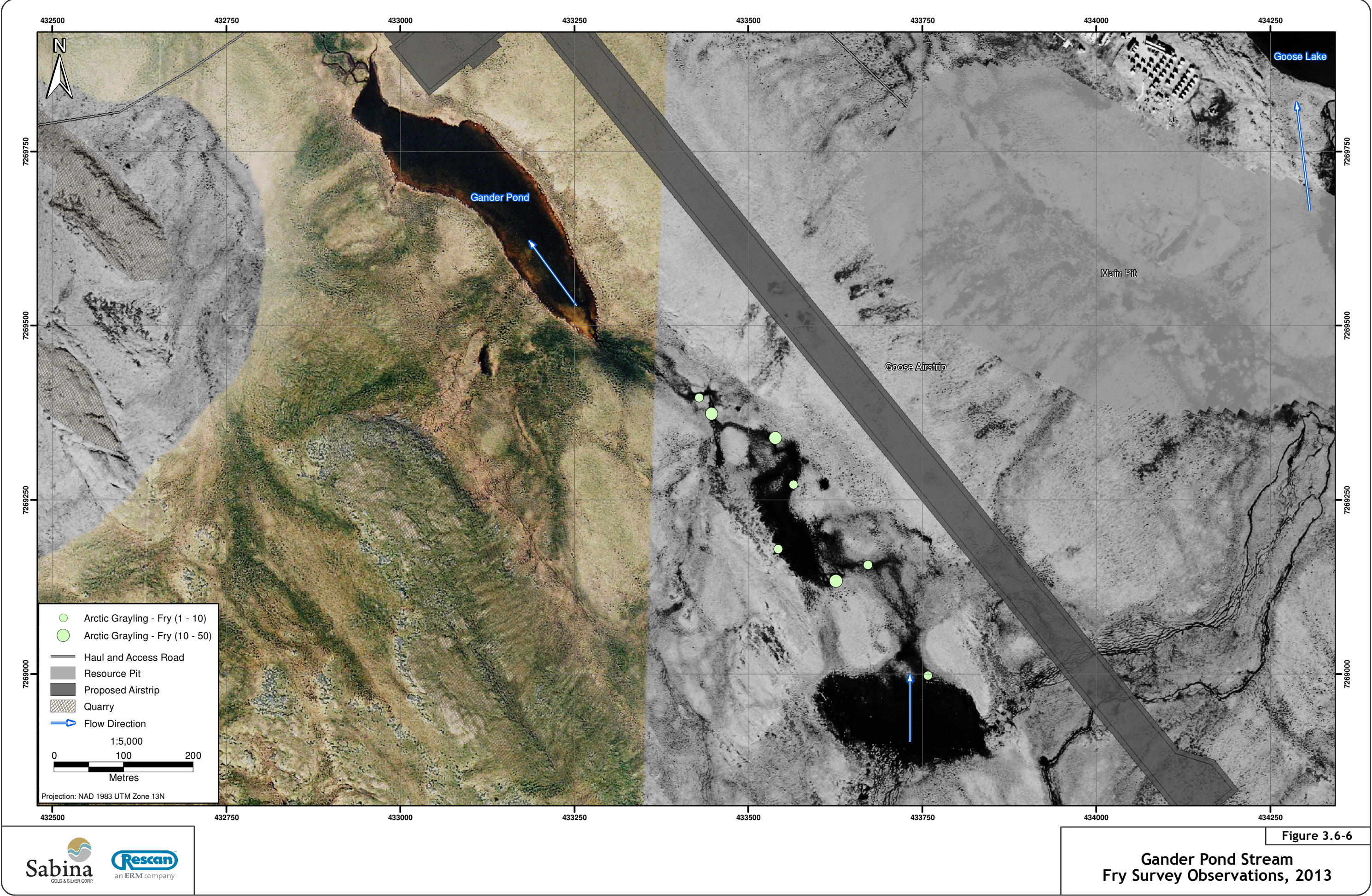


Table 3.6-5. Summary of Electrofishing CPUE and Visual Observations of Fish at Offset Areas, 2013

Site Name	Electro-fishing Effort (s)	Electrofishing (No. of Fish Captured)						Electrofishing	Visual Observation	
		Arctic Grayling	Burbot	Lake Trout	Ninespine Stickleback	Slimy Sculpin	Total	CPUE (Fish/100 s)	Slimy Sculpin	Total
<i>Streams</i>										
Gander Pond Stream	1,135	1	1	-	14	1	17	1.50	-	-
Goose - Propeller	593	4	-	-	-	-	4	0.67	1	1
McCoy Lake outflow	133	-	-	1	-	2	3	2.26	-	-
Long Lake outflow	729	-	-	-	-	8	8	1.10	-	-
<i>Lakes</i>										
Canyon Lake 5	276	-	-	-	-	1	1	0.36	-	-
Canyon Lake 3	759	-	-	-	-	15	15	1.98	-	-
Canyon Lake 2	642	-	1	-	-	5	6	0.93	-	-
<i>Ponds</i>										
Pond E	1,000	-	-	-	-	-	0	0	-	-

CPUE = Catch-per-unit-effort

No. = number

Dashes indicate no fish captured

Table 3.6-6. Gillnet Standard and Bootstrap CPUE Summary Statistics for Offset Areas, 2013

Lake	Gillnet Type	Species	Standard CPUE (No. Fish/100 m ² /h)						Bootstrap CPUE (No. Fish/100 m ² /h)			
			n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Canyon Lake 5	Floating	Arctic Grayling	2	1.19	0.13	0.09	1.10	1.27	1.19	0.06	1.10	1.27
		Lake Trout	2	0.27	0.39	0.27	0.01	0.53	0.28	0.19	0.00	0.55
		Total	2	1.46	0.26	0.18	1.28	1.64	1.46	0.13	1.27	1.64
	Sinking	Arctic Grayling	2	0.82	1.16	0.82	0.04	1.60	0.83	0.58	0.00	1.64
		Lake Trout	2	1.37	1.94	1.37	0.07	2.67	1.38	0.97	0.00	2.74
		Total	2	2.19	3.10	2.19	0.11	4.28	2.20	1.55	0.00	4.39
Canyon Lake 3	Floating	Total	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sinking	Arctic Grayling	2	1.08	1.53	1.08	0.05	2.11	1.08	0.76	0.00	2.16
		Lake Trout	2	0.36	0.51	0.36	0.02	0.70	0.36	0.25	0.00	0.72
		Total	2	1.44	2.04	1.44	0.07	2.81	1.45	1.02	0.00	2.89
Canyon Lake 2	Floating	Arctic Grayling	2	0.82	1.16	0.82	0.04	1.60	0.82	0.58	0.00	1.64
		Total	2	0.82	1.16	0.82	0.04	1.60	0.83	0.57	0.00	1.64
	Sinking	Lake Trout	2	0.23	0.32	0.23	0.01	0.45	0.23	0.16	0.00	0.46
		Total	2	0.23	0.32	0.23	0.01	0.45	0.23	0.16	0.00	0.46

CPUE = catch-per-unit-effort (fish/100 m² of gillnet/h)

n = sample size (number of net sets)

SD = standard deviation of the mean

SE = standard error of the mean

CI = confidence interval (95%)

No. = number

Table 3.6-7. Minnow Trap Standard CPUE Summary Statistics for Offset Areas, 2013

Lake	Species	Standard CPUE (No. Fish/24 h)					
		n	Mean	SD	SE	Lower CI	Upper CI
Canyon Lake 5	Ninespine Stickleback	19	0.05	0.22	0.05	0.00	0.54
	Total	19	0.05	0.22	0.05	0.00	0.54
Canyon Lake 3	Ninespine Stickleback	20	0.06	0.27	0.06	0.00	0.63
	Total	20	0.06	0.27	0.06	0.00	0.63
Canyon Lake 2	Burbot	19	0.05	0.23	0.05	0.00	0.56
	Ninespine Stickleback	19	0.34	1.23	0.28	0.00	3.41
	Slimy Sculpin	19	0.06	0.24	0.06	0.00	0.58
	Total	19	0.45	1.24	0.29	0.00	3.41

CPUE = catch-per-unit-effort (# of fish/ 24 h)

n = sample size (number of trap sets)

SD = standard deviation of the mean

SE = standard error of the mean

CI = confidence interval (95%)

No. = number

Ponds

No fish were captured or observed at Pond E.

3.6.3 Biology

Streams

Table 3.6-8 presents summaries of the standard and bootstrapped mean fork length, weight, and condition of fish species captured by electrofishing at each of the sampled.

Arctic Grayling were captured by electrofishing at two of the four sampled streams. The mean fork length of the Arctic Grayling ranged from 77 mm (Gander Pond Stream) to 154 mm (Goose - Propeller), and the mean weight ranged from 9.1 g (Gander Pond Stream) to 39.5 g (Goose - Propeller). The mean condition factor for Arctic Grayling captured from electrofishing ranged from 1.01 (Goose - Propeller) to 1.99 g/mm³ (Gander Pond Stream).

Mean Slimy Sculpin length ranged from 50 mm at Gander Pond Stream to 59 mm at McCoy Lake outflow. Mean total weight for sculpins ranged from 1.2 g at Gander Pond Stream to 1.8 g at McCoy Lake outflow. Mean condition factor for Slimy Sculpin ranged from 0.88 to 0.96 g/mm³ at McCoy Lake outflow and Gander Pond Stream, respectively.

The mean length of Ninespine Stickleback captured at Gander Pond Stream was 46 mm, mean weight was 0.7 g, and mean condition was 0.66 g/mm³. The length of the single Burbot captured at Gander Pond stream was 95 mm, the weight was 8.1 g, and the body condition was 0.94 g/mm³. Lastly, a Lake Trout captured at McCoy Lake outflow was 155 mm in length, weighed 42.6 g, and had a condition of 1.14 g/mm³.

Age data was not gathered for fish from the offset streams, and the number of fish captured was not sufficient create accurate length-frequency distributions.

Lakes

Lake Trout were captured by gillnet or angling at all Canyon lakes that were sampled. The mean fork length of the Lake Trout captured in gillnets ranged from 245 mm (Canyon Lake 3) to 277 mm (Canyon Lake 5), and mean weight ranged from 151.0 g (Canyon Lake 3) to 302.3 g (Canyon Lake 5; Table 3.6-9). The mean condition factors for Lake Trout captured in gillnets at Canyon Lake sites were within normal values for salmonid fishes and ranged from 1.03 to 1.09 g/mm³. One Lake Trout was captured by angling at Canyon Lake 3 and was 209 mm, 88.0 g, and had a condition of 0.96 g/mm³ (Table 3.6-10). All Lake Trout captured were adults.

Slimy Sculpin were captured by electrofishing or minnow trapping at all sampled Canyon lakes. The mean total length of Slimy Sculpin captured by electrofishing ranged from 45 mm (Canyon Lake 5) to 53 mm (Canyon Lake 3), mean weight ranged from 1.2 g (Canyon Lake 5) to 1.7 g (Canyon Lake 3), and mean condition ranged from 0.87 (Canyon Lake 2) to 1.32 g/mm³ (Canyon Lake 5; Table 3.6-8). The single Slimy Sculpin captured in a minnow trap at Canyon Lake 2 was 40 mm long, 0.5 g, with a condition of 0.78 g/mm³ (Table 3.6-11).

Arctic Grayling were captured by gillnet or angling at all sampled Canyon lakes. The mean fork length of Arctic Grayling captured in gillnets ranged from 226 mm (Canyon Lake 3) to 280 mm (Canyon Lake 5), and mean weight ranged from 131.0 g (Canyon Lake 3) to 241.9 g (Canyon Lake 5). The mean condition factor for Arctic Grayling captured by gillnetting sites was within normal values for salmonid fishes at all sites and ranged from 1.05 to 1.09 g/mm³. The mean length of Arctic Grayling captured by angling was 274 mm, the mean weight was 206.5 g, and the mean condition was 1.01 g/mm³. Arctic Grayling captured by angling at Canyon Lake 2 had a mean length of 233 mm, a mean weight of 149.0 g, and a mean condition of 1.19 g/mm³. All captured grayling were adults.

Table 3.6-8. Summary of Standard and Bootstrapped Mean Fork Length, Total Weight and Condition of Fish Captured by Electrofishing in Offset Areas, 2013

Site	Species	Standard Fork Length (mm)						Bootstrap Fork Length (mm)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Streams											
Gander Pond stream	Arctic Grayling	1	77	-	-	77	77	-	-	-	-
	Burbot	1	95	-	-	95	95	-	-	-	-
	Ninespine stickleback	14	46	6	2	36	55	-	-	-	-
	Slimy Sculpin	1	50	-	-	50	50	-	-	-	-
Goose-Propeller	Arctic Grayling	4	154	27	14	124	184	154	12	133	176
McCoy Lake outflow	Lake Trout	1	155	-	-	155	155	-	-	-	-
	Slimy Sculpin	2	59	13	10	49	68	58	7	49	68
Lakes											
Canyon Lake 5	Slimy Sculpin	1	45	-	-	45	45	-	-	-	-
Canyon Lake 3	Slimy Sculpin	14	53	11	3	36	68	-	-	-	-
Canyon Lake 2	Burbot	1	230	-	-	230	230	-	-	-	-
	Slimy Sculpin	5	53	12	5	40	65	53	5	44	62
		Standard Total Weight (g)						Bootstrap Total Weight (g)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Streams											
Gander Pond stream	Arctic Grayling	1	9.1	-	-	9.1	9.1	-	-	-	-
	Burbot	1	8.1	-	-	8.1	8.1	-	-	-	-
	Ninespine stickleback	14	0.7	0.2	0.1	0.3	1.0	-	-	-	-
	Slimy Sculpin	1	1.2	-	-	1.2	1.2	-	-	-	-
Goose-Propeller	Arctic Grayling	4	39.5	19.1	9.6	19.0	60.9	39.5	8.2	24.5	54.5
McCoy Lake outflow	Lake Trout	1	42.6	-	-	42.6	42.6	-	-	-	-
	Slimy Sculpin	2	1.8	0.8	0.6	1.2	2.3	1.8	0.4	1.2	2.3
Lakes											
Canyon Lake 5	Slimy Sculpin	1	1.2	-	-	1.2	1.2	-	-	-	-
Canyon Lake 3	Slimy Sculpin	13	1.7	1.0	0.3	0.3	3.3	-	-	-	-
Canyon Lake 2	Slimy Sculpin	5	1.6	1.1	0.5	0.4	2.9	1.6	0.4	0.7	2.4
		Standard Condition (g/mm ³)						Bootstrap Condition (g/mm ³)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Streams											
Gander Pond stream	Arctic Grayling	1	1.99	-	-	1.99	1.99	-	-	-	-
	Burbot	1	0.94	-	-	0.94	0.94	-	-	-	-
	Ninespine stickleback	14	0.66	0.18	0.05	0.44	0.99	-	-	-	-
	Slimy Sculpin	1	0.96	-	-	0.96	0.96	-	-	-	-
Goose-Propeller	Arctic Grayling	4	1.01	0.04	0.02	0.98	1.06	1.01	0.02	0.99	1.04
McCoy Lake outflow	Lake Trout	1	1.14	-	-	1.14	1.14	-	-	-	-
	Slimy Sculpin	2	0.88	0.20	0.14	0.74	1.01	0.88	0.10	0.73	1.02
Lakes											
Canyon Lake 5	Slimy Sculpin	1	1.32	-	-	1.32	1.32	-	-	-	-
Canyon Lake 3	Slimy Sculpin	13	0.92	0.31	0.08	0.49	1.45	-	-	-	-
Canyon Lake 2	Slimy Sculpin	5	0.87	0.18	0.08	0.65	1.09	0.87	0.07	0.73	1.01

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Table 3.6-9. Summary of Standard and Bootstrapped Mean Fork Length, Total Weight and Condition of Fish Captured by Gillnet in Offset Areas, 2013

Lake	Species	Standard Fork Length (mm)						Bootstrap Fork Length (mm)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Canyon Lake 5	Arctic Grayling	7	280	50	19	207	341	280	17	245	313
	Lake Trout	6	278	87	36	196	414	278	33	219	347
Canyon Lake 3	Arctic Grayling	3	226	41	23	183	254	227	19	180	255
	Lake Trout	1	245	-	-	245	245	-	-	-	-
Canyon Lake 2	Arctic Grayling	4	265	22	11	237	287	265	10	244	282
	Lake Trout	1	272	-	-	272	272	-	-	-	-
		Standard Total Weight (g)						Bootstrap Total Weight (g)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Canyon Lake 5	Arctic Grayling	7	241.9	101.2	38.3	107.4	374.2	241.8	34.9	173.3	309.1
	Lake Trout	6	302.3	303.1	123.8	74.3	813.1	301.5	113.6	120.2	551.2
Canyon Lake 3	Arctic Grayling	3	131.7	57.7	33.3	71.2	176.6	131.8	27.4	67.0	178.0
	Lake Trout	1	151.0	-	-	151.0	151.0	-	-	-	-
Canyon Lake 2	Arctic Grayling	4	204.5	42.5	21.3	155.5	251.9	204.6	18.3	167.3	240.8
	Lake Trout	1	219.0	-	-	219.0	219.0	-	-	-	-
		Standard Condition (g/mm ³)						Bootstrap Condition (g/mm ³)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Canyon Lake 5	Arctic Grayling	7	1.05	0.12	0.05	0.94	1.25	1.05	0.04	0.98	1.14
	Lake Trout	6	1.09	0.07	0.03	0.98	1.17	1.09	0.03	1.03	1.14
Canyon Lake 3	Arctic Grayling	3	1.08	0.06	0.04	1.03	1.15	1.08	0.03	1.03	1.15
	Lake Trout	1	1.03	-	-	1.03	1.03	-	-	-	-
Canyon Lake 2	Arctic Grayling	4	1.09	0.05	0.03	1.06	1.16	1.09	0.02	1.06	1.14
	Lake Trout	1	1.09	-	-	1.09	1.09	-	-	-	-

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Table 3.6-10. Summary of Standard and Bootstrapped Mean Fork Length, Total Weight and Condition of Fish Captured by Angling in Offset Areas, 2013

Lake	Species	Standard Fork Length (mm)						Bootstrap Fork Length (mm)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Canyon Lake 3	Arctic Grayling	2	274	11	8	266	281	274	5	266	281
	Lake Trout	1	209	-	-	209	209	-	-	-	-
Canyon Lake 2	Arctic Grayling	2	233	11	8	225	240	232	5	225	240
		Standard Total Weight (g)						Bootstrap Total Weight (g)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Canyon Lake 3	Arctic Grayling	2	206.5	23.3	16.5	190.8	222.2	206.5	11.6	190.0	223.0
	Lake Trout	1	88.0	-	-	88.0	88.0	-	-	-	-
Canyon Lake 2	Arctic Grayling	2	149.0	19.8	14.0	135.7	162.3	149.0	9.9	135.0	163.0
		Standard Condition (g/mm ³)						Bootstrap Condition (g/mm ³)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Canyon Lake 3	Arctic Grayling	2	1.01	0.00	0.00	1.01	1.01	1.01	0.00	1.01	1.01
	Lake Trout	1	0.96	-	-	0.96	0.96	-	-	-	-
Canyon Lake 2	Arctic Grayling	2	1.19	0.01	0.01	1.18	1.19	1.19	0.00	1.18	1.19

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Table 3.6-11. Summary of Standard and Bootstrapped Mean Fork Length, Total Weight and Condition of Fish Captured by Minnow Trapping in Offset Areas, 2013

Lake	Species	Standard Fork Length (mm)						Bootstrap Fork Length (mm)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Canyon Lake 5	Ninespine stickleback	1	59	-	-	59	59	-	-	-	-
Canyon Lake 3	Ninespine stickleback	1	46	-	-	46	46	-	-	-	-
Canyon Lake 2	Burbot	1	120	-	-	120	120	-	-	-	-
	Ninespine stickleback	5	54	3	1	51	58	54	1	52	56
	Slimy Sculpin	1	40	-	-	40	40	-	-	-	-
		Standard Total Weight (g)						Bootstrap Total Weight (g)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Canyon Lake 5	Ninespine stickleback	1	1.1	-	-	1.1	1.1	-	-	-	-
Canyon Lake 3	Burbot	1	8.6	-	-	8.6	8.6	-	-	-	-
	Ninespine stickleback	4	1.1	0.2	0.1	0.9	1.4	1.1	0.1	0.9	1.3
	Slimy Sculpin	1	0.5	-	-	0.5	0.5	-	-	-	-
		Standard Condition (g/mm ³)						Bootstrap Condition (g/mm ³)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Canyon Lake 5	Ninespine stickleback	1	0.51	-	-	0.51	0.51	-	-	-	-
Canyon Lake 3	Burbot	1	0.50	-	-	0.50	0.50	-	-	-	-
	Ninespine stickleback	4	0.65	0.13	0.07	0.54	0.82	0.65	0.06	0.55	0.76
	Slimy Sculpin	1	0.78	-	-	0.78	0.78	-	-	-	-

CI = 95% confidence interval

n = sample size

SD = standard deviation of the mean

SE = standard error of the mean

Dashes indicate data not available

Burbot were captured by electrofishing and minnow trapping. The length of the single Burbot captured by electrofishing at Canyon Lake 3 was 230 mm. The Burbot captured in a minnow trap at Canyon Lake 2 was 120 mm in length, weighed 8.6 g, and had a mean body condition of 0.50 g/mm³.

Ninespine Stickleback were captured in minnow traps at all Canyon lakes. The mean fork length of Ninespine Stickleback ranged from 46 mm (Canyon Lake 3) to 59 mm (Canyon Lake 5). The mean weight was 1.1 g at both Canyon Lake 5 and Canyon Lake 2, and the mean condition was 0.51 g/mm³ and 0.65 g/mm³ at Canyon Lake 5 and 2, respectively.

The number of fish captured at each lake was insufficient to draw conclusions from length distributions, but further information regarding fish health was gathered from weight-length regressions (Figure 3.6-7). The relationship between weight and length was significant for all species from all lakes ($P < 0.05$). All F-values and P-values for the regressions for each species by lake are presented in Table 3.6-12. However, due to the small sample size, the estimates of slope, intercept and variability of the relationships may not be accurate to the population and should be interpreted with caution.

Table 3.6-12. Statistical Results for Weight-Length Regressions of Fish from Offset Areas, 2013

Species	Lake	Df of Category	Df of Error	F value	P value
Lake Trout	Canyon Lake 5	1	4	1,559.97	<0.001
Slimy Sculpin	Canyon Lake 3	1	11	63.22	<0.001
	Canyon Lake 2	1	4	152.41	<0.001
Arctic Grayling	Canyon Lake 5	1	5	229.36	<0.001
	Canyon Lake 3	1	3	1,561.97	<0.001
	Canyon Lake 2	1	4	536.20	<0.001

Df = degrees of freedom

Age-frequency distributions were not appropriate given the small number of fish captured from each lake. Instead, a summary of fish ages is presented in Table 3.6-13.

Table 3.6-13. Summary of Standard and Bootstrapped Age of Fish Captured at Offset Areas, 2013

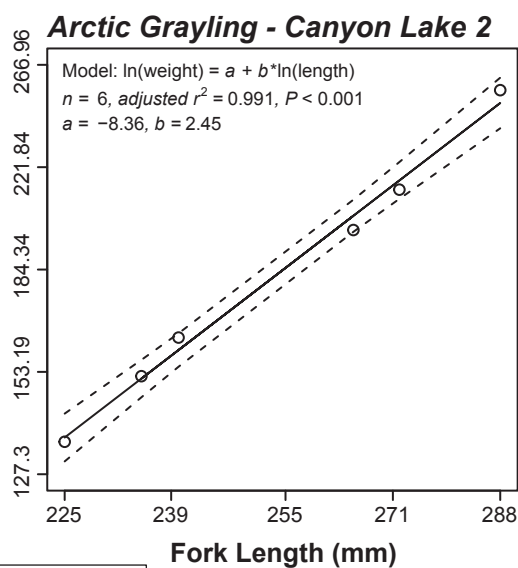
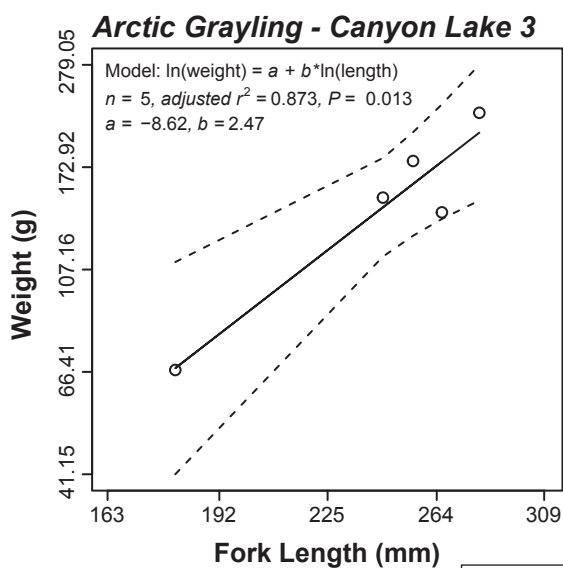
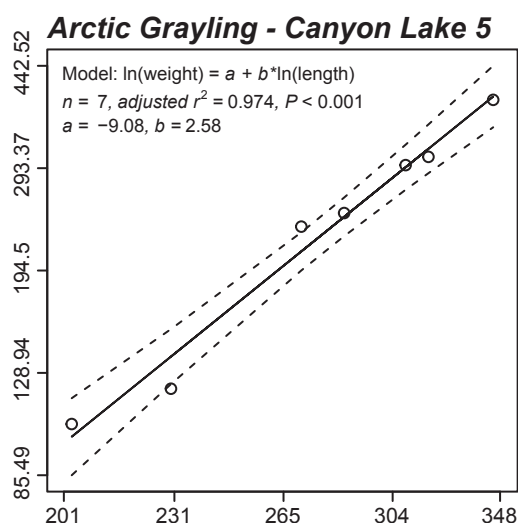
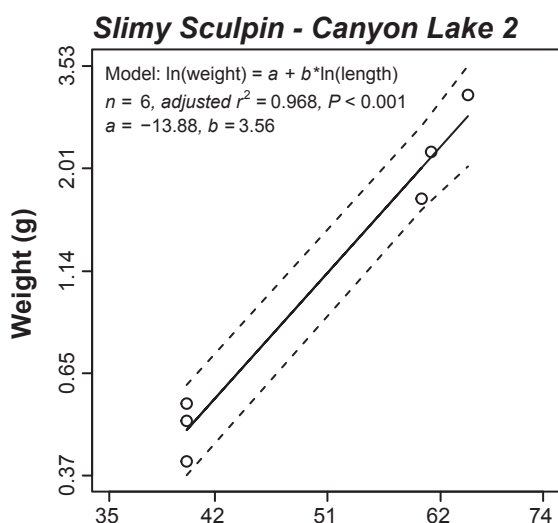
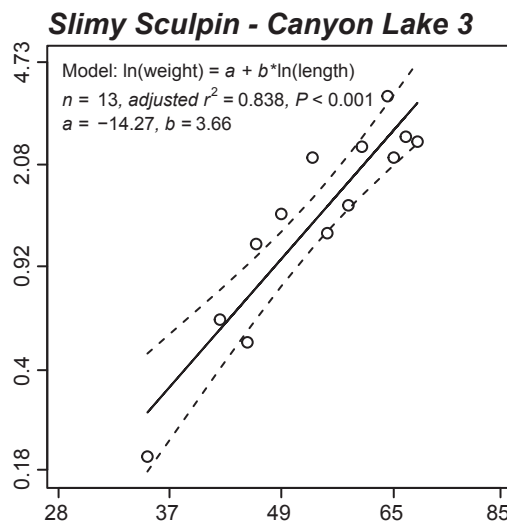
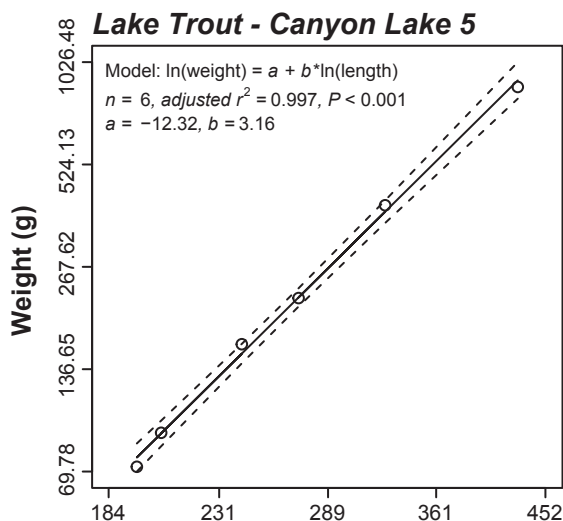
Lake	Species	Standard Age (Years)						Bootstrap Age (Years)			
		n	Mean	SD	SE	Lower CI	Upper CI	Mean	SD	Lower CI	Upper CI
Canyon Lake 5	Arctic Grayling	7	5.3	2.4	0.9	2.2	8.7	5.3	0.8	3.7	6.9
	Lake Trout	6	5.5	2.2	0.9	3.1	8.0	5.5	0.8	4.0	7.0
Canyon Lake 3	Arctic Grayling	5	3.8	1.1	0.5	2.2	4.9	3.8	0.4	2.8	4.6
	Lake Trout	2	4.5	0.7	0.5	4.0	5.0	4.5	0.4	4	5
	Slimy Sculpin	1	2.0	-	-	2.0	2.0	-	-	-	-
Canyon Lake 2	Arctic Grayling	6	4.0	0.9	0.4	3.0	5.0	4.0	0.3	3.3	4.7
	Lake Trout	1	4	-	-	4	4	-	-	-	-

n = sample size (number of fish)

SD = standard deviation

SE = standard error

CI = confidence interval (95%)



— Weight-length Regression
 --- 95% Confidence Intervals
 ○ Observations

Note: axis values have been backtransformed from the natural log (Ln).

Figure 3.6-7

4. Summary

4. Summary

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold & Silver Corp. (Sabina) located in the West Kitikmeot region of Nunavut. Exploration programs were run out of both the Goose and George camps in 2013.

The 2013 baseline program was designed to survey fish habitat and community composition in stream, lake, and pond habitats with the potential to be affected by Project development or to support on-going planning for potential fisheries offsetting works.

Goose Potential Development Area

Potential infrastructure within the Goose Potential Development Area (PDA) that was considered during the 2013 fish work included a Tailings Impoundment Area (TIA), two Waste Rock Storage Areas (WRSAs), three open pit locations, a camp/mill location, and connecting local site roads. A total of six road crossing sites, eight streams, eight lakes, and eight ponds were surveyed in 2013.

Three of the six stream crossing sites identified along proposed road routes in the Goose PDA were characterised as important rearing habitat for Arctic Grayling, Slimy Sculpin, Burbot, and Ninespine Stickleback. The remaining three sites crossed dry/intermittently wetted channels or non-channelized wetted areas with no fishery value.

In addition to the six potential road crossings, eight other streams were located adjacent to or within proposed infrastructure. These stream sites were assessed using SHIM methods. Habitat at most of the stream reaches was important to at least one fish life history stage. Most of the surveyed reaches were small, low gradient runs, but a variety of habitats including riffles, pools, and boulder gardens were also identified. Fish barriers were identified in Giraffe Inflow and Wasp Inflow. The natural barrier present at Giraffe Inflow prevents fish from entering the water within the bounds of the potential Tailings Impoundment Area (TIA). Extensive sampling within Giraffe Inflow failed to capture any fish, and the stream is likely non-fish bearing. The fish community at stream sites included Arctic Grayling, Slimy Sculpin, Lake Trout, Burbot, and Ninespine Stickleback, though Arctic Grayling and Slimy Sculpin were the most common species encountered. Spawning and fry surveys indicated that the Rascal-Goose stream, streams intersecting the potential Main Pit, and Gander Pond stream are used by spawning Arctic Grayling and provide critical spawning habitat for Arctic Grayling.

Lake surveys in the Goose PDA included assessments of shoreline and littoral habitat in three lakes, sublittoral habitat surveys in two lakes using hydroacoustic bathymetry and bottom typing, fish community surveys in four lakes, and a Lake Trout spawning survey in Goose Lake. Most lakes were characterised by boulder and cobble-dominated shorelines and sparse aquatic vegetation. Fish communities were sampled at ten lakes using beach seining, gillnetting, minnow trapping, angling, and electrofishing. The lake fish community included: Arctic Grayling, Burbot, Lake Trout, Ninespine Stickleback, Round Whitefish, and Slimy Sculpin. Lake Trout were the most widespread species, but Slimy Sculpin were the most numerous. No fish were captured at Echo Lake, which was determined to be non-fish bearing.

Eight ponds were surveyed in the Goose PDA. Potential fish habitat in Pond 1 and Pond A was quantified using hydroacoustic bathymetry and bottom typing. The fish community compositions of all eight ponds were surveyed using electrofishing. Pond 2 was the only confirmed fish-bearing pond. Three ponds within the potential TIA (Ponds A, A2 and A3) were reconfirmed to be non-fish bearing.

Baseline data on fish survival, energy use and storage, tissue metals, and diet were gathered from Lake Trout and Slimy Sculpin. Slimy Sculpin tissue metals were sampled from four lakes and tissue metal concentrations were below all relevant guidelines. Lake Trout tissue metals were sampled from Giraffe Lake, the lake immediately downstream of the potential TIA. The concentration of most metals in Lake Trout tissue from Giraffe Lake were below relevant guidelines, with the exception of mercury, in which the baseline average concentration was above the Health Canada Guidelines (guideline value 0.50 mg/kg ww, mean concentration 0.58 mg/kg ww).

George Potential Development Area

Potential infrastructure within the George PDA that was considered during the 2013 fish survey included three Waste Rock Storage Areas, an ore stockpile, three open pits, potential other infrastructure including a camp and landfill, and connecting local site roads. A total of four road crossing sites, two streams, and seven lakes were surveyed in 2013.

Four crossing sites were surveyed in the George PDA; two were classified as streams and two were non-classified drainages containing no fish habitat values. The two stream crossings provide important rearing habitat for Arctic Grayling, Lake Trout, and Slimy Sculpin, and George Inflow 2 was identified as critical Arctic Grayling spawning habitat.

In addition to the potential road crossing streams, two other streams in the George PDA were also surveyed. The quality and quantity of fish habitat was characterized in the streams using SHIM methods. No fish were captured in the two streams, although Occurrence Outflow is assumed fish-bearing. George Inflow 1 was determined to be unsuitable for fish habitat due to the high gradient.

Seven lakes were surveyed in the George PDA. Work completed included littoral habitat and littoral substrate surveys in three lakes and fish community sampling using gillnetting, beach seining, angling, and electrofishing at six lakes. The lake fish community included: Arctic Grayling, Burbot, Lake Trout, Ninespine Stickleback, Round Whitefish, and Slimy Sculpin. Although no fish were captured at Lytle Lake, which intersects the proposed Locale 1 Pit, it is connected to fish-bearing water bodies and likely serves as ephemeral fish habitat.

Baseline data on fish survival, energy use and storage, tissue metals, and diet were gathered from Slimy Sculpin. Slimy Sculpin tissue metals from all four lakes exhibited tissue metal concentrations below all relevant guidelines.

Water Management and/or Fisheries Offsetting

Four streams, four lakes, and one pond were sampled to support potential fisheries offsetting projects. Four streams and one pond (Pond E) were located in the Goose and George PDAs. The four lakes were located outside of the Goose and George Properties in the Canyon Lakes area approximately 17 km northeast of the Goose PDA. Sampling details varied based on habitat and the information required, but included at least one of the following methods: SHIM habitat mapping; FHAP habitat assessments; shoreline substrate surveys; and community surveys by angling, electrofishing, gillnetting, and/or minnow trapping. The fish community at potential offsetting locations was similar to that found within the Project footprint, including: Arctic Grayling, Burbot, Lake Trout, Ninespine Stickleback and Slimy Sculpin. Arctic Grayling and Slimy Sculpin were the most common species encountered.

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Appendix 3.2-1

Haul and Access Road Stream Crossing Fish Habitat Data,
2013

Appendix 3.2-1. Haul and Access Road Stream Crossing Fish Habitat Data, 2013

					Location				Water Characteristics				Channel Characteristics								Substrate					Pool Type					Max Pool Depth (m)	Crest Height (m)	Barrier Type	Temporary or Permanent	
					DS Easting	DS Northing	US Easting	US Northing	Temp (°C)	pH	Turbidity	Current Flow	Habitat Type	Distance From Start (m)	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock										
Goose		100	14-Jun-13	SL, TM	432888	7270063	-	-	11	5.9	C	Low	Dry Channel	0	100	2.5	0.04	0.17	0.9	1.4	0	5	20	75	0	-	-	-	D	P					
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	432861	7270020	432891	7269925	14.5	6.7	C	High	P	0	12.2	2.0	0.35	0.35	1.8	1.8	40	0	20	5	0	S	0.50	0.14	N	-					
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	432861	7270020	432891	7269925	14.5	6.7	C	High	R	12.2	19.2	2.0	0.31	0.31	1.2	1.2	20	0	40	40	0	-	-	-	N	-					
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	432861	7270020	432891	7269925	14.5	6.7	C	High	P	31.4	3.9	0.0	0.51	0.51	1.9	1.9	10	50	40	0	0	S	0.51	0.18	N	-					
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	432861	7270020	432891	7269925	14.5	6.7	C	High	G	35.3	21	1.5	0.30	0.30	2.4	2.4	0	40	40	20	0	-	-	-	N	-					
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	432861	7270020	432891	7269925	14.5	6.7	C	High	C	56.3	10.5	3.0	0.28	0.28	2.5	2.5	0	10	30	60	0	-	-	-	N	-					
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	432861	7270020	432891	7269925	14.5	6.7	C	High	P	66.8	17.6	1.0	0.34	0.34	4.3	4.3	80	10	10	0	0	S	0.57	0.22	N	-					
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	432861	7270020	432891	7269925	14.5	6.7	C	High	G	84.4	26.5	2.0	0.34	0.34	2.8	2.8	90	0	10	0	0	-	-	-	N	-					
Goose		102	14-Jun-13	SL, TM	431996	7269679	432055	7269604	17	5.7	C	High	G	0	11	4.0	0.13	0.28	1	1.2	0	0	50	50	0	-	-	-	N	-					
Goose		102	14-Jun-13	SL, TM	431996	7269679	432055	7269604	17	5.7	C	High	P	11	2.6	0.0	0.22	0.22	1.1	1.1	0	50	50	0	0	S	0.26	0.07	N	-					
Goose		102	14-Jun-13	SL, TM	431996	7269679	432055	7269604	17	5.7	C	High	G	13.6	10.6	3.0	0.16	0.26	1.2	1.4	10	20	35	35	0	-	-	-	N	-					
Goose		102	14-Jun-13	SL, TM	431996	7269679	432055	7269604	17	5.7	C	High	NCD	74.2	8.6	0.0	0.20	0.20	1.6	1.6	60	20	20	0	0	S	0.31	0.08	N	-					
Goose		102	14-Jun-13	SL, TM	431996	7269679	432055	7269604	17	5.7	C	High	G	82.8	13.9	3.0	0.10	0.16	0.2	0.2	20	80	0	0	0	-	-	-	N	-					
Goose		102	14-Jun-13	SL, TM	431996	7269679	432055	7269604	17	5.7	C	High	P	96.7	4.2	0.0	0.20	0.25	0.5	0.85	0	50	50	0	0	S	0.24	0.1	N	-					
Goose		103	14-Jun-13	SL, TM	430179	7270435	430084	7270372	10	6.4	C	High	G/O	0	67.8	3.0	0.33	1.30	19.5	21.5	0	0	20	80	0	-	-	-	BF	P					
Goose		103	14-Jun-13	SL, TM	430179	7270435	430084	7270372	10	6.4	C	High	G	67.8	27	1.0	0.53	0.80	19.0	22.8	0	0	20	80	0	-	-	-	-	-					
Goose		103	14-Jun-13	SL, TM	430179	7270435	430084	7270372	10	6.4	C	High	P	94.8	19.5	1.0	0.45	0.64	30.0	34	0	0	20	80	0	D	0.81	0.71	BF	P					
Goose		104	14-Jun-13	SL, TM	430174	7270465	430114	7270529	6.2	6.2	C	High	P	0	19	0.0	0.37	0.57	12.8	15.8	0	0	30	70	0	D	0.89	0.22	BF	P					
Goose		104	14-Jun-13	SL, TM	430174	7270465	430114	7270529	6.2	6.2	C	High	G	19	40	1.0	0.24	0.36	8.4	11.2	0	0	30	70	0	-	-	-	BF	P					
Goose		104	14-Jun-13	SL, TM	430174	7270465	430114	7270529	6.2	6.2	C	High	BF	59	41	1.0	0.40	1.12	58.0	62	0	0	20	80	0	-	-	-	BF	P					
Goose		105	14-Jun-13	SL, TM	429653	7271335	429597	7271257	16.4	-	C	High	NCD	0	100	3.0	0.18	0.28	0.3	0.25	70	25	5	0	0	-	-	-	NC	P					
George	George Inflow	400	17-Jun-13	KW, SL	386325	7315192	386217	7315342	-	-	C	High	G	0	100	1	0.2	0.15	2.8	1.4	80	0	20	0	0	-	-	-	N	-					
George	George Inflow	400	17-Jun-13	KW, SL	386325	7315192	386217	7315342	-	-	C	High	P	25	2	0	0.8	0.67	2.25	0.82	50	0	50	0	0	S	0.93	0.46	N	-					
George	George Inflow	400	17-Jun-13	KW, SL	386325	7315192	386217	7315342	-	-	C	High	P	35	3	0	0.5	0.35	2.8	2.25	100	0	0	0	0	S	0.75	0.23	N	-					
George	George Inflow	400	17-Jun-13	KW, SL	386325	7315192	386217	7315342	-	-	C	High	P	55	5	0	0.6	0.4	1.4	1.05	100	0	0	0	0	S	1.18	0.43	N	-					
George	George Inflow	400	17-Jun-13	KW, SL	386325	7315192	386217	7315342	-	-	C	High	P	60	5	0	0.84	0.65	4	2.2	100	0	0	0	0	S	1.05	0.29	N	-					
George	Lytle - George	401	17-Jun-13	KW, SL	386677	7314593	386887	7314689	7.6	6.73	C	High	G	0	50	1	0.24	0.18	2.4	2.1	0	0	25	75	0	-	-	-	N	-					
George	Lytle - George	401	17-Jun-13	KW, SL	386677	7314593	386887	7314689	7.6	6.73	C	High	R	0	60	1	0.28	0.28	4.5	6.1	0	0	60	40	0	-	-	-	N	-					
George	Lytle - George	401	17-Jun-13	KW, SL	386677	7314593	386887	7314689	7.6	6.73	C	High	G	60	40	0	0.78	0.56	20	18.3	65	0	20	15	0	-	-	-	N	-					
George		402	17-Jun-13	KW, SL	387833	7313275	-	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
George		404	17-Jun-13	KW, KK	387729	7312942	387723	7312957	6.8	6.5	C	High	G	0	23	1	0.41	0.21	26.2	26	30	0	35	35	0	-	-	-	N	-					
George		405	17-Jun-13	KW, KK	388162	7312856	-	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					

Dashes indicate not applicable or no data available

NCD = non-classified drainage

Turbidity: C = clear

Habitat Type: P = pool, G = glide, R = riffle, C = cascade, O = other

Pool Type: S = scour, D = dammed

Barrier Type: N = none, BF = boulder field, P = permanent, D = dry, NC = no distinct channel, water drains over lanc

Bank Stability: S = stable, U = unstable, H = highly stable

Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut banl

Appendix 3.2-1. Haul and Access Road Stream Crossing Fish Habitat Data, 2013

									Cover											
									% Pool	% Boulder	% Instream Vegetation	% Overhanging Vegetation	% Undercut Bank	% LWD	% SWD	Canopy (%)	Left Bank Riparian (%)	Right Bank Riparian (%)		
Property	Site	Station ID	Survey Date	Survey Crew	Left Bank Height (m)	Right Bank Height (m)	Left Bank Stability	Right Bank Stability											Photos	Comments
Goose		100	14-Jun-13	SL, TM	0.20	0.20	S	S	0	0	0	0	0	0	0	0	100	100	79-80	Boulderfield with seeps of water in some places, not fish bearing
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	0.18	0.35	S	U	20	0	5	0	5	0	0	0	100	100	81-83	Overflowing right bank
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	0.20	0.25	S	S	0	20	0	5	0	0	0	0	100	100	84	Overflowing banks
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	0.14	0.30	S	S	30	0	0	0	0	0	0	0	100	100	85	Overflowing banks
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	0.20	0.21	S	S	0	25	0	0	0	0	0	0	100	100	86	Overflowing banks
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	0.09	0.23	S	S	5	5	0	0	0	0	0	0	100	100	87	Overflowing banks
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	0.30	0.4	S	S	75	0	0	0	0	0	0	0	100	100	88	VO 4 fish
Goose	Gander Pond Outflow	101	14-Jun-13	SL, TM	0.20	0.25	S	S	0	0	10	0	0	0	0	0	100	100	89	Overflowing banks
Goose		102	14-Jun-13	SL, TM	0.20	0.28	S	S	0	10	0	0	0	0	0	0	100	100	90	Small stream, flowing but very narrow in some stretches, unlikely fish bearing
Goose		102	14-Jun-13	SL, TM	0.16	0.23	S	S	15	0	0	0	0	0	0	0	100	100	91	-
Goose		102	14-Jun-13	SL, TM	0.26	0.27	S	S	0	5	10	0	0	0	0	0	100	100	92	-
Goose		102	14-Jun-13	SL, TM	0.12	0.07	S	S	15	0	5	0	0	0	0	0	100	100	93	-
Goose		102	14-Jun-13	SL, TM	0.10	0.16	S	S	0	0	0	0	0	0	0	0	100	100	94	Slender glide
Goose		102	14-Jun-13	SL, TM	0.25	0.2	S	S	15	0	0	0	0	0	0	0	100	100	95	Slender
Goose		103	14-Jun-13	SL, TM	-	-	H	H	0	40	0	0	0	0	0	0	15	10	106-107	Shrub, boulder garden
Goose		103	14-Jun-13	SL, TM	0.27	0.52	H	H	5	25	0	0	0	0	0	0	50	0	108-109	-
Goose		103	14-Jun-13	SL, TM	0.19	0.45	H	H	25	10	10	0	0	0	0	0	50	75	110-112	Fish barriers throughout, intermittent stream
Goose		104	14-Jun-13	SL, TM	0.20	0.2	H	H	10	10	0	10	0	0	0	0	10	50	113	DS impassable, fish barriers throughout, long stretch of boulders
Goose		104	14-Jun-13	SL, TM	0.12	0.1	H	H	2	15	0	15	0	0	0	0	80	80	114-116	-
Goose		104	14-Jun-13	SL, TM	0.72	0.75	H	H	2	2	0	1	0	0	0	0	60	80	117-128	-
Goose		105	14-Jun-13	SL, TM	0.07	0.07	S	S	1	0	2	0	0	0	0	0	100	100	138-141	-
George	George Inflow	400	17-Jun-13	KW, SL	0	0	U	U	0	0	7	0	13	0	0	-	100	100	247-249	-
George	George Inflow	400	17-Jun-13	KW, SL	0	0	U	U	55	0	10	0	15	0	0	-	100	100	255	-
George	George Inflow	400	17-Jun-13	KW, SL	0	0	U	U	20	0	15	0	5	0	0	-	100	100	256	Spawning ARGR observed
George	George Inflow	400	17-Jun-13	KW, SL	0	0	U	U	30	0	10	0	10	0	0	-	100	100	264-266	Spawning ARGR observed, VO 2 Adult ARGR
George	George Inflow	400	17-Jun-13	KW, SL	0	0	U	U	40	0	10	0	5	0	0	-	100	100	267-273	Spawning ARGR observed, VO 7 Adult ARGR
George	Lytle - George	401	17-Jun-13	KW, SL	0	0	U	U	0	60	5	0	10	0	0	-	85	100	289-290	-
George	Lytle - George	401	17-Jun-13	KW, SL	0	0	S	S	0	30	7	0	0	0	0	-	90	100	291-292	-
George	Lytle - George	401	17-Jun-13	KW, SL	0	0	U	U	0	3	7	0	0	0	0	-	100	90	279-280	-
George		402	17-Jun-13	KW, SL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	299-309	A series of underground seeps occasionally ponding above ground, surveyed pond to Occurrence Lake
George		404	17-Jun-13	KW, KK	0	0	S	S	0	2	2	0	0	0	0	-	100	50	312-314	Not really a stream, a short constriction in a single lake
George		405	17-Jun-13	KW, KK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	331-347	No channel, just wet ground, some slight channelization near lake but not continuous, photos document lake to road site

Dashes indicate not applicable or no data available
NCD = non-classified drainage
Turbidity: C = clear
Habitat Type: P = pool, G = glide, R = riffle, C = cascade, O = other
Pool Type: S = scour, D = dammed
Barrier Type: N = none, BF = boulder field, P = permanent, D = dry, NC = no distinct channel, water drains over lanc
Bank Stability: S = stable, U = unstable, H = highly stable
Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut banl

Appendix 3.2-2

Haul and Access Road Stream Crossing Sampling Effort
and Species Summary, 2013

Appendix 3.2-2. Haul and Access Road Stream Crossing Fish Sampling Summary, 2013

Property	Local Name	Site #	Date (m/d/y)	Crew	Zone	Easting	Northing	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)	Comments
Goose	Goose inflow (haul rd crossing)	1201	8/12/2013	KK, LT	13	434636	7269618	EF	1	-	-	-	1	106	141	1.5	N	395	40	12	Smithroot	LR-24	NSSB	-	2	26	30	
Goose	Gander Pond outflow	101 (or 702)	6/19/2013	KK, AB	13	432837	7270080	EF	1	-	-	Clear	1	831	300	1.5	N	675	30	12	Smithroot	LR-24	NSSB	-	14	36	56	
Goose	Gander Pond outflow	101 (or 702)	6/19/2013	KK, AB	13	432837	7270080	EF	1	-	-	Clear	1	831	300	1.5	N	675	30	12	Smithroot	LR-24	ARGR	IM	1	77	77	
Goose	Gander Pond outflow	101 (or 702)	6/19/2013	KK, AB	13	432837	7270080	EF	1	-	-	Clear	1	831	300	1.5	N	675	30	12	Smithroot	LR-24	SLSC	-	1	50	50	
Goose	Gander Pond outflow	101 (or 702)	6/19/2013	KK, AB	13	432837	7270080	EF	1	-	-	Clear	1	831	300	1.5	N	675	30	12	Smithroot	LR-24	BURB	IM	1	95	95	
George	George inflow	400	6/17/2013	KK, TM	13	386293	7315225	EF	1	-	-	Clear	1	244	50	1	N	500	30	12	Smithroot	LR-24	NFC	-	0	-	-	VO 7 Adult ARGR so discontinued EF survey and performed spawning survey instead
George	George inflow	400	6/17/2013	KK, TM	13	386293	7315225	VO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ARGR	M	7	-	-	
George	Lytle-George	401	6/17/2013	KK, TM	13	386687	7314689	EF	1	7.3	-	Clear	1	473	100	13.5	N	625	30	12	Smithroot	LR-24	LKTR	IM	1	191	191	
George	George inflow	200	7/10/2013	KW, RD	13	386396	7315186	EF	1	11.3	58.8	Clear	1	977	200	0.5	O	365	30	12	Smithroot	LR-24	LKTR	IM	1	132	132	
George	George inflow	200	7/10/2013	KW, RD	13	386396	7315186	EF	1	11.3	58.8	Clear	1	977	200	0.5	O	365	30	12	Smithroot	LR-24	SLSC	-	2	62	77	
George	George inflow	200	7/10/2013	KW, RD	13	386396	7315186	EF	1	11.3	58.8	Clear	1	977	200	0.5	O	365	30	12	Smithroot	LR-24	ARGR	IM	4	28	31	YOY's

Species Code
ARGR = Arctic grayling
BURB = burbot
LKTR = lake trout
NSSB = ninespine stickleback
SLSC = slimy sculpin
NFC = no fish caught
YOY = young-of-year

Stage
IM = immature
M = mature
U = unknown
EF = electrofishing
VO = visual observation
Dashes indicate data not available

Appendix 3.2-3

Individual Fish Data — Haul and Access Road Stream
Crossings, 2013

Appendix 3.2-3. Individual Fish Data - Haul and Access Road Stream Crossings, 2013

Date (m/d/y)	Property	Waterbody	Site	Sample Method	HP No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm ³)	Age	Comments
7/10/2013	George	George inflow	200 (or 400)	EF	1	1	LKTR	132	26.9	1.17	1	
7/10/2013	George	George inflow	200 (or 400)	EF	1	2	SLSC	77	4.1	0.90	1	
7/10/2013	George	George inflow	200 (or 400)	EF	1	3	SLSC	62	2	0.84	1	
7/10/2013	George	George inflow	200 (or 400)	EF	1	4	ARGR	29	0.3	1.23	-	
7/10/2013	George	George inflow	200 (or 400)	EF	1	5	ARGR	29	0.3	1.23	-	
7/10/2013	George	George inflow	200 (or 400)	EF	1	6	ARGR	28	0.2	0.91	-	
7/10/2013	George	George inflow	200 (or 400)	EF	1	7	ARGR	31	0.5	1.68	-	photos 534-536; site photos 539-541
8/12/2013	Goose	Goose inflow (haul road crossing)	1201	EF	1	1	NSSB	30	-	-	-	
8/12/2013	Goose	Goose inflow (haul road crossing)	1201	EF	1	2	NSSB	26	-	-	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	1	NSSB	37	0.4	0.79	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	2	NSSB	52	0.8	0.57	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	3	NSSB	56	1	0.57	-	photo 660-663
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	4	NSSB	41	0.3	0.44	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	5	NSSB	54	0.7	0.44	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	6	NSSB	44	0.8	0.94	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	7	NSSB	50	0.9	0.72	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	8	NSSB	43	0.5	0.63	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	9	NSSB	36	0.3	0.64	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	10	NSSB	41	0.7	1.02	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	11	NSSB	45	0.6	0.66	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	12	NSSB	47	0.5	0.48	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	13	NSSB	49	1	0.85	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	14	NSSB	53	0.7	0.47	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	15	ARGR	77	9.1	1.99	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	16	SLSC	50	1.2	0.96	-	
6/19/2013	Goose	Gander Pond outflow	101 (or 702)	EF	1	17	BURB	95	8.1	0.94	-	
6/17/2013	George	Lytle-George	401	EF	1	1	LKTR	191	71	1.02	-	photo 282-284

Species Code:

ARGR = Arctic grayling

BURB = burbot

LKTR = lake trout

NSSB = ninespine stickleback

SLSC = slimy sculpin

EF = electrofishing

Dashes indicate data not available

Appendix 3.3-1

Stream Fish Habitat Data, 2013

Appendix 3.3-1. Stream Fish Habitat Data, 2013



Location: Haul and Access Road

Site: 100

Photo #: 0079

Description: Upstream view of Dry/Int. channel



Location: Haul and Access Road

Site: 100

Photo #: 0080

Description: Downstream view of Dry/Int. Channel



Location: Haul and Access Road

Site: 101

Photo #: 0081

Description: Downstream view of bottom of reach



Location: Haul and Access Road

Site: 101

Photo #: 0082

Description: Upstream view of bottom of reach



Location: Haul and Access Road

Site: 102

Photo #: 0093

Description: Upstream view



Location: Haul and Access Road

Site: 102

Photo #: 0094

Description: Downstream view



Location: Haul and Access Road

Site: 103

Photo #: 0016

Description: Instream cover from vegetation and boulders



Location: Haul and Access Road

Site: 103

Photo #: 0106

Description: Cross-channel view of boulder garden habitat



Location: Haul and Access Road

Site: 105

Photo #: 0139

Description: Downstream view



Location: Haul and Access Road

Site: 105

Photo #: 0141

Description: Upstream view



Location: Giraffe Inflow

Site: 200

Photo #: 0437

Description: Downstream view showing fish barrier (subsurface flow)



Location: Giraffe Inflow

Site: 200

Photo #: 0438

Description: Upstream view showing fish barrier (rock obstacle)



Location: Giraffe Inflow

Site: 201

Photo #: 0443

Description: Upstream view showing fish barrier (rock obstacle)



Location: Giraffe Inflow

Site: 201

Photo #: 0444

Description: Downstream view showing fish barrier (subsurface flow)



Location: Giraffe Inflow

Site: 203

Photo #: 0455

Description: Upstream view of survey site



Location: Giraffe Inflow

Site: 203

Photo #: 0456

Description: Downstream view of survey site



Location: Umwelt Outflow

Site: 205

Photo #: 0474

Description: Dowstream view of bottom of reach



Location: Umwelt Outflow

Site: 205

Photo #: 0480

Description: Fish barrier near bottom of reach



Location: Umwelt Outflow

Site: 206

Photo #: 0481

Description: Downstream view of site



Location: Umwelt Outflow

Site: 206

Photo #: 0483

Description: Upstream view of fish barrier (subsurface flow)



Location: Umwelt Outflow

Site: 207

Photo #: 0488

Description: Downstream view of channel



Location: Umwelt Outflow

Site: 207

Photo #: 0490

Description: Cascade upstream of FHAP survey site



Location: Umwelt Outflow

Site: 208

Photo #: 0491

Description: Upstream view of site



Location: Umwelt Outflow

Site: 208

Photo #: 0492

Description: Downstream view of site



Location: Umwelt Outflow

Site: 209

Photo #: 0504

Description: Downstream view of site and unnamed pond



Location: Umwelt Outflow

Site: 209

Photo #: 0505

Description: Upstream view of channel



Location: Giraffe Inflow

Site: 210

Photo #: 0532

Description: Downstream view of bottom of reach and Giraffe Lake



Location: Giraffe Inflow

Site: 210

Photo #: 0538

Description: Upstream view showing fish barrier (subsurface flow)



Location: Giraffe Inflow

Site: 211

Photo #: 0535

Description: Downstream view of bottom of reach and Giraffe Lake



Location: Giraffe Inflow

Site: 211

Photo #: 0540

Description: Upstream view showing fish barrier (subsurface flow)



Location: Giraffe Inflow

Site: 212

Photo #: 0541

Description: Upstream view of reach



Location: Giraffe Inflow

Site: 212

Photo #: 0542

Description: Downstream view of reach



Location: Giraffe Inflow

Site: 213

Photo #: 0550

Description: Upstream view of fish barrier (subsurface flow)



Location: Giraffe Inflow

Site: 213

Photo #: 0552

Description: Cross-channel view of open water



Location: Wasp Inflow

Site: 214

Photo #: 0558

Description: Cross-channel view of overhanging vegetation



Location: Wasp Inflow

Site: 214

Photo #: 0560

Description: Upstream view of channel



Location: Wasp Inflow

Site: 215

Photo #: 0566

Description: Downstream view of bottom of reach and Wasp Lake



Location: Wasp Inflow

Site: 215

Photo #: 0569

Description: View of substrate



Location: Rascal-Goose

Site: 300

Photo #: 0159

Description: Upstream view of channel



Location: Rascal-Goose

Site: 300

Photo #: 0160

Description: Downstream view of channel



Location: Rascal-Goose

Site: 301

Photo #: 0167

Description: Upstream view of channel



Location: Rascal-Goose

Site: 301

Photo #: 0168

Description: Downstream view of channel



Location: Main Goose Pit Streams

Site: 303

Photo #: 0173

Description: Upstream view of channel



Location: Main Goose Pit Streams

Site: 304

Photo #: 0181

Description: Upstream view of channel braiding



Location: Main Goose Pit Streams

Site: 304

Photo #: 0182

Description: Cross-channel view of substrate



Location: Rascal-Goose

Site: 305

Photo #: 0204

Description: Downstream view of channel



Location: Rascal-Goose

Site: 305

Photo #: 0206

Description: Upstream view of channel



Location: Rascal-Goose

Site: 306

Photo #: 0213

Description: Downstream view of channel



Location: Rascal-Goose

Site: 306

Photo #: 0214

Description: Upstream view of channel



Location: Rascal-Goose

Site: 307

Photo #: 0217

Description: View of cascade



Location: Rascal-Goose

Site: 307

Photo #: 0221

Description: Downstream view of channel



Location: Main Goose Pit Streams

Site: 308

Photo #: 0226

Description: Upstream view of channel



Location: Main Goose Pit Streams

Site: 308

Photo #: 0227

Description: Downstream view of channel



Location: Haul and Access Road

Site: 400

Photo #: 0252

Description: Upstream view of electrofishing efforts



Location: Haul and Access Road

Site: 400

Photo #: 0264

Description: Cross-channel view of deep pool



Location: Haul and Access Road

Site: 401

Photo #: 0289

Description: Downstream view



Location: Haul and Access Road

Site: 401

Photo #: 0290

Description: Upstream view



Location: Haul and Access Road

Site: 402

Photo #: 0304

Description: Cross-channel view of intermittent channelization



Location: Haul and Access Road

Site: 402

Photo #: 0309

Description: Downstream end of the site on the shoreline of Occurrence Lake



Location: Occurrence Outflow

Site: 404

Photo #: 0313

Description: Upstream view of Occurrence Outflow and Occurrence Lake



Location: Occurrence Outflow

Site: 404

Photo #: 0315

Description: Cross-channel view of electrofishing efforts



Location: Haul and Access Road

Site: 405

Photo #: 0333

Description: Fish barrier near inflow to Sleigh Lake



Location: Haul and Access Road

Site: 405

Photo #: 0342

Description: Upstream view of top of the reach, showing lack of channelization



Location: Main Goose Pit Streams

Site: 501

Photo #: 0624

Description: Downstream view of channel



Location: Main Goose Pit Streams

Site: 501

Photo #: 0625

Description: Upstream view of channel



Location: Main Goose Pit Streams

Site: 502

Photo #: 0634

Description: Poor channelization



Location: Main Goose Pit Streams

Site: 503

Photo #: 0641

Description: Upstream view of channel



Location: Main Goose Pit Streams

Site: 503

Photo #: 0642

Description: Downstream view of channel



Location: Llama Outflow

Site: 505

Photo #: 0644

Description: Downstream view of channel and Umwelt Lake



Location: Llama Outflow

Site: 505

Photo #: 0645

Description: Upstream view of channel



Location: Llama Outflow

Site: 506

Photo #: 0648

Description: Upstream view of channel



Location: Llama Outflow

Site: 506

Photo #: 0649

Description: Downstream view of channel



Location: Wasp Inflow

Site: 600

Photo #: 0400

Description: Cross-channel view of substrate



Location: Wasp Inflow

Site: 600

Photo #: 0401

Description: Upstream view of channel



Location: George Inflow 1

Site: 800

Photo #: 0537

Description: Downstream view of channel and George Lake



Location: George Inflow 1

Site: 800

Photo #: 0538

Description: Cross-channel view of non-channelized flow



Location: Gander Pond Stream

Site: 804

Photo #: 0555

Description: Upstream view of channel



Location: Gander Pond Stream

Site: 804

Photo #: 0557

Description: Cross-channel view of substrate



Location: McCoy Outflow

Site: 810

Photo #: 0524

Description: Downstream view of channel



Location: McCoy Outflow

Site: 810

Photo #: 0525

Description: Upstream view of channel and McCoy Lake



Location: Goose Outflow

Site: 814

Photo #: 0036

Description: Cross-channel view of substrate



Location: Goose Outflow

Site: 814

Photo #: 0037

Description: Downstream view of channel



Location: Haul and Access Road

Site: 1201/500

Photo #: 0613

Description: Upstream view



Location: Haul and Access Road

Site: 1201/500

Photo #: 0615

Description: Cross-channel view

Appendix 3.3-1. Stream Fish Habitat Data, 2013

					Location				Water Characteristics				Channel Characteristics								Substrate					Max Pool Depth Crest Height (m)			
					DS Easting	DS Northing	US Easting	US Northing	Temp (°C)	pH	Turbidity	Current Flow	Habitat Number	Habitat Type	Distance From Start (m)	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	% Sand	% Gravel	% Cobble	% Boulder				% Bedrock
Property	Site	Station ID	Survey Date	Survey Crew	DS Easting	DS Northing	US Easting	US Northing	Temp (°C)	pH	Turbidity	Current Flow	Habitat Number	Habitat Type	Distance From Start (m)	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Pool Type	Max Pool Depth (m)	Crest Height (m)
Goose	Rascal - Goose	300	6/16/2013	KW/SL	434393	7269570	-	-	8	7.4	C	H	1	G	0	100	0	0.6	0.35	16.4	15.3	98	0	2	0	0	-	-	-
Goose	Rascal - Goose	301	6/16/2013	KW/SL	434349	7269344	-	-	8	6.9	C	H	1	R	0	100	1	0.2	0.2	2.6	2.6	0	5	70	25	0	-	-	-
Goose	Rascal - Goose	305	6/16/2013	KW/SL	434017	7268963	-	-	10.9	6.95	C	H	1	R	0	100	2	0.25	0.17	5.2	1.2	0	0	75	25	0	-	-	-
Goose	Rascal - Goose	306	6/16/2013	KW/SL	434006	7268580	-	-	10.3	6.9	C	H	1	G	0	100	0	0.35	0.32	13.5	7.1	60	10	20	10	0	-	-	-
Goose	Rascal - Goose	307	6/16/2013	KW/SL	433939	7268202	-	-	8.7	6.97	C	H	1	G	0	32	2	0.27	0.24	5.2	4.8	0	0	10	90	0	-	-	-
Goose	Rascal - Goose	307	6/16/2013	KW/SL	433939	7268202	-	-	8.7	6.97	C	H	2	P	32	45	0	0.83	0.77	16.1	15	10	0	0	80	10	D	1	0.3
Goose	Rascal - Goose	307	6/16/2013	KW/SL	433939	7268202	-	-	8.7	6.97	C	H	3	R	77	25	6	0.23	0.2	6.8	6.6	0	0	0	75	25	-	-	-
Goose	Main Goose Pit streams	308	6/16/2013	KW/SL	433836	7268483	-	-	10.1	6.49	C	H	1	G	0	100	1	0.19	0.19	15.8	15.8	0	0	20	80	0	-	-	-
Goose	Main Goose Pit streams	303	6/16/2013	KW/SL	434262	7269284	-	-	10.5	6.8	C	H	1	R	0	100	1	0.2	0.15	0.22	0.2	0	0	80	20	0	-	-	-
Goose	Main Goose Pit streams	304	6/16/2013	KW/SL	434295	7269237	-	-	11.8	6.6	C	H	1	G	0	38	2	0.17	0.17	0.2	0.2	40	0	40	20	0	-	-	-
Goose	Main Goose Pit streams	304	6/16/2013	KW/SL	434295	7269237	-	-	11.8	6.6	C	H	2	R	38	13	2	0.14	0.14	4.2	4.2	0	0	50	50	0	-	-	-
Goose	Main Goose Pit streams	304	6/16/2013	KW/SL	434295	7269237	-	-	11.8	6.6	C	H	3	G	51	52	1	0.24	0.17	1.7	1.7	0	0	75	25	0	-	-	-
Goose	Gander Pond inflow	804	6/22/2013	KW/KK	433444	7269401	-	-	16.1	6.68		H	1	G	0	50	0.5	0.31	0.25	4.5	1.2	70	5	15	10	0	-	-	-
Goose	Giraffe inflow	200	6/14/2013	KW/KK	431254	7273102	-	-	9	8.3	C	H	1	P	0	100	0	1	2	20	25	5	0	20	40	35	D	1.2	-
Goose	Giraffe inflow	201	6/14/2013	KW/KK	431022	7273172	-	-	9	6.96	C	H	1	P	0	27.3	0	0.47	0.47	12	12	5	5	20	50	20	D	0.68	0.1
Goose	Giraffe inflow	201	6/14/2013	KW/KK	431022	7273172	-	-	9	6.96	C	H	2	G	27.3	39	1	0.15	0.32	2.5	3.1	0	10	50	30	10	-	-	-
Goose	Giraffe inflow	203	6/14/2013	KW/KK	430905	7273225	-	-	10	6.35	C	H	1	R	0	50	2.5	0.2	0.28	1.6	2	0	10	40	40	10	-	-	-
Goose	Umwelt - Goose	205	6/15/2013	KW/KK	430995	7269975	-	-	-	-	C	H	1	G	0	60	0.5	1.5	1.5	35	35	0	2	20	70	8	-	-	-
Goose	Umwelt - Goose	205	6/15/2013	KW/KK	430995	7269975	-	-	-	-	C	H	2	C	60	15	4	0.3	0.4	3	6	0	0	10	70	20	-	-	-
Goose	Umwelt - Goose	206	6/15/2013	KW/KK	430933	7269970	-	-	-	-	C	H	1	R	0	70	2	0.6	0.8	5	10	0	5	15	40	40	-	-	-
Goose	Umwelt - Goose	206	6/15/2013	KW/KK	430933	7269970	-	-	-	-	C	H	2	C	70	30	10	0.4	1	0.8	1.2	0	0	0	30	70	-	-	-
Goose	Umwelt - Goose	207	6/15/2013	KW/KK	430762	7270007	-	-	-	-	C	H	1	R	0	100	2	0.3	0.7	4	6	0	5	45	45	5	-	-	-
Goose	Umwelt - Goose	207	6/15/2013	KW/KK	430762	7270007	-	-	-	-	C	H	2	BG	0	30	0	0.4	0.5	16	25	0	0	0	100	0	-	-	-
Goose	Umwelt - Goose	207	6/15/2013	KW/KK	430762	7270007	-	-	-	-	C	H	3	G	75	6	1	0.7	0.7	3	3	0	0	10	90	0	-	-	-
Goose	Umwelt - Goose	208	6/15/2013	KW/KK	430680	7270124	-	-	8	6.6	C	H	1	P	0	21	0.5	0.62	0.7	9.8	10.4	0	0	0	5	95	D	0.74	0.12
Goose	Umwelt - Goose	208	6/15/2013	KW/KK	430680	7270124	-	-	8	6.6	C	H	2	G	21	12	1	0.3	0.4	3.4	5.3	0	0	0	50	50	-	-	-
Goose	Umwelt - Goose	208	6/15/2013	KW/KK	430680	7270124	-	-	8	6.6	C	H	3	P	33	28	0	0.5	0.53	23.2	29.7	0	0	0	60	40	D	0.62	0.29
Goose	Umwelt - Goose	209	6/15/2013	KW/KK	429456	7270277	-	-	14	6.32	C	H	1	G	0	100	1	0.33	0.33	10.1	2.4	2	3	60	35	0	-	-	-
Goose	Giraffe inflow	210	6/16/2013	KK/TM	431407	7273081	-	-	8.5	6.56	C	H	1	P	0	19	0.5	0.5	0.6	3.6	3.7	0	0	10	90	0	D	1	0.15
Goose	Giraffe inflow	210	6/16/2013	KK/TM	431407	7273081	-	-	8.5	6.56	C	H	2	BF	19	10.5	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Giraffe inflow	211	6/16/2013	KK/TM	431405	7273062	-	-	-	-	C	H	1	R	0	5.8	1	0.22	0.27	3.8	4.6	25	0	0	35	40	-	-	-
Goose	Giraffe inflow	211	6/16/2013	KK/TM	431405	7273062	-	-	-	-	C	H	2	BF	5.8	11.4	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Giraffe inflow	212	6/16/2013	KK/TM	431386	7273053	-	-	-	-	C	H	1	R	0	16.3	1.5	0.17	0.21	3.6	3.9	0	33	33	34	0	-	-	-
Goose	Giraffe inflow	212	6/16/2013	KK/TM	431386	7273053	-	-	-	-	C	H	2	G	16.3	24	0.5	0.44	0.6	8.6	8.6	10	0	5	40	45	-	-	-
Goose	Giraffe inflow	212	6/16/2013	KK/TM	431386	7273053	-	-	-	-	C	H	3	BF	40.3	14.8	0	0.17	0.17	7.3	7.3	0	0	0	100	0	-	-	-
Goose	Giraffe inflow	213	6/16/2013	KK/TM	431334	7273046	-	-	-	-	C	H	1	P	0	33.1	0	0.42	0.42	30	30	0	0	10	90	0	-	-	-
Goose	Wasp Inflow	214	6/16/2013	KK/TM	430417	7274352	-	-	12.3	6.34	C	H	1	R	0	5.8	5	0.9	0.12	0.75	0.8	30	30	20	20	0	-	-	-
Goose	Wasp Inflow	214	6/16/2013	KK/TM	430417	7274352	-	-	12.3	6.34	C	H	2	P	5.8	2.7	0	0.29	0.24	2	2.2	40	10	25	25	0	s	0.35	0.17
Goose	Wasp Inflow	214	6/16/2013	KK/TM	430417	7274352	-	-	12.3	6.34	C	H	3	G	8.5	30.2	0.5	0.15	0.15	1.53	1.6	40	20	30	10	0	-	-	-
Goose	Wasp Inflow	215	6/16/2013	KK/TM	430404	7274652	-	-	12.3	6.26	C	H	1	G	0	7.8	0.5	0.18	0.16	0.85	0.71	10	10	20	60	0	-	-	-
Goose	Wasp Inflow	215	6/16/2013	KK/TM	430404	7274652	-	-	12.3	6.26	C	H	2	P	7.8	5.3	2	0.16	0.4	1.05	1.05	25	25	25	25	0	-	-	-
Goose	Wasp Inflow	215	6/16/2013	KK/TM	430404	7274652	-	-	12.3	6.26	C	H	3	G	13.2	24	1	0.24	0.37	1.9	1.7	60	10	10	20	0	-	-	-
Goose	Wasp Inflow	215	6/16/2013	KK/TM	430404	7274652	-	-	12.3	6.26	C	H	4	G	37														

Appendix 3.3-1. Stream Fish Habitat Data, 2013

										Cover														
																								Left Bank Riparian (%)
Property	Site	Station ID	Survey Date	Barrier Type	Temporary or Permanent	Left Bank Height (m)	Right Bank Height (m)	Left Bank Stability	Right Bank Stability	% Pool	% Boulder	% Instream Vegetation	% Overhanging Vegetation	% Undercut Bank	% LWD			Bankfull Area (m²)	Wetted Area (m²)	Proportional length (%)	Proportional Bankfull Area (%)	Proportional Wetted Area (%)	Photos	Comments
Goose	Rascal - Goose	300	6/16/2013	-	-	0	0	U	U	2	0	2	0	1	0	100.0	100.0	1,530.0	1,640.0	100.0	100.0	100.0	158-159	
Goose	Rascal - Goose	301	6/16/2013	-	-	0	0	U	U	0	3	0	0	2	0	100.0	100.0	260.0	260.0	100.0	100.0	100.0	166.0	
Goose	Rascal - Goose	305	6/16/2013	-	-	0	0	U	U	0	2	1	0	3	0	100.0	100.0	120.0	520.0	100.0	100.0	100.0	204-207	
Goose	Rascal - Goose	306	6/16/2013	-	-	0	0	U	U	0	1	1	0	0	0	100.0	100.0	710.0	1,350.0	100.0	100.0	100.0	213-215	
Goose	Rascal - Goose	307	6/16/2013	-	-	0	0	U	U	0	5	0	0	0	0	100.0	100.0	153.6	166.4	31.4	15.5	15.7	221	
Goose	Rascal - Goose	307	6/16/2013	-	-	0	0	U	U	6	10	0	0	0	0	100.0	100.0	675.0	724.5	44.1	67.9	68.3	220	
Goose	Rascal - Goose	307	6/16/2013	-	-	0	0	U	U	0	2	0	0	0	0	100.0	100.0	165.0	170.0	24.5	16.6	16.0	220	
Goose	Main Goose Pit streams	308	6/16/2013	-	-	0	0	U	U	0	20	0	0	0	0	100.0	100.0	1,580.0	1,580.0	100.0	100.0	100.0	226-227	
Goose	Main Goose Pit streams	303	6/16/2013	-	-	0	0	U	U	0	5	1	0	0	0	100.0	100.0	20.0	22.0	100.0	100.0	100.0	173	
Goose	Main Goose Pit streams	304	6/16/2013	-	-	0	0	U	U	0	2	2	0	3	0	100.0	100.0	7.6	7.6	36.9	5.0	5.0	181	Very highly braided
Goose	Main Goose Pit streams	304	6/16/2013	-	-	0	0	U	U	0	8	1	0	0	0	100.0	100.0	54.6	54.6	12.6	36.3	36.3	182	Very highly braided
Goose	Main Goose Pit streams	304	6/16/2013	-	-	0	0	U	U	0	2	5	0	2	0	100.0	100.0	88.4	88.4	50.5	58.7	58.7	183	Very highly braided
Goose	Gander Pond inflow	804	6/22/2013	-	-	0	0	U	U	0	2	5	0	1	0	100.0	100.0	60.0	225.0	100.0	100.0	100.0	555-557	
Goose	Giraffe inflow	200	6/14/2013	BG	P	1	1	H	H	-	-	-	-	-	-	10.0	5.0	2,500.0	2,000.0	100.0	100.0	100.0	237-439-KK	Calm pool between two areas where stream flows through subsurface boulder garden
Goose	Giraffe inflow	201	6/14/2013	BF	P	0.68	0.68	H	H	-	-	-	-	-	-	5.0	5.0	327.6	327.6	41.2	73.0	77.1	443-445	
Goose	Giraffe inflow	201	6/14/2013	-	-	0.32	0.32	H	H	-	-	-	-	-	-	10.0	15.0	120.9	97.5	58.8	27.0	22.9	446-448	
Goose	Giraffe inflow	203	6/14/2013	-	-	0.18	0.2	H	H	-	-	-	-	-	-	5.0	15.0	100.0	80.0	100.0	100.0	100.0	455-457	
Goose	Umwelt - Goose	205	6/15/2013	-	-	0	0	H	H	-	-	-	-	-	-	2.0	2.0	2,100.0	2,100.0	80.0	95.9	97.9	474-476	Deep, open, slow section immediately US of lake. Upper boundary a cascade that is likely a fish barrier during low water. Observed whitefish and lake trout
Goose	Umwelt - Goose	205	6/15/2013	-	T	0.2	0.2	H	H	-	-	-	-	-	-	2.0	10.0	90.0	45.0	20.0	4.1	2.1	471-473	
Goose	Umwelt - Goose	206	6/15/2013	-	-	0.3	0.3	H	H	-	-	-	-	-	-	10.0	2.0	700.0	350.0	70.0	95.1	93.6	481-483	Cascade and riffle. Majority of flow is subsurface. Likely a fish barrier. Boulder garden above and SHIM reach break
Goose	Umwelt - Goose	206	6/15/2013	-	P	0.5	0.5	H	H	-	-	-	-	-	-	0.0	0.0	36.0	24.0	30.0	4.9	6.4		
Goose	Umwelt - Goose	207	6/15/2013	-	-	0.4	0.5	H	H	-	-	-	-	-	-	10.0	0.0	600.0	400.0	73.5	43.9	44.5	488-490	
Goose	Umwelt - Goose	207	6/15/2013	-	-	0.4	0.5	H	H	-	-	-	-	-	-	0.0	0.0	750.0	480.0	22.1	54.8	53.5		
Goose	Umwelt - Goose	207	6/15/2013	-	-	0.3	0.3	H	H	-	-	-	-	-	-	5.0	2.0	18.0	18.0	4.4	1.3	2.0		
Goose	Umwelt - Goose	208	6/15/2013	-	-	0.1	0.1	H	H	-	-	-	-	-	-	5.0	5.0	218.4	205.8	34.4	19.6	23.0	491-494	Mostly bedrock pools with small glide between. Crevasse from deep river
Goose	Umwelt - Goose	208	6/15/2013	-	-	1	0.8	H	H	-	-	-	-	-	-	2.0	0.0	63.6	40.8	19.7	5.7	4.6	495-496	
Goose	Umwelt - Goose	208	6/15/2013	-	-	0.3	0.4	H	H	-	-	-	-	-	-	8.0	2.0	831.6	649.6	45.9	74.7	72.5		
Goose	Umwelt - Goose	209	6/15/2013	-	-	0	0	U	U	-	-	-	-	-	-	100.0	100.0	240.0	1,010.0	100.0	100.0	100.0	504-506	Small. Channelized stream through grass and herbs
Goose	Giraffe inflow	210	6/16/2013	BF	P	0.1	0.1	S	S	-	-	-	-	-	-	80	60	70.3	68.4	-	-	-	531-533	
Goose	Giraffe inflow	210	6/16/2013	BF, D	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	537-538	Boulder field, big barrier to fish passage
Goose	Giraffe inflow	211	6/16/2013	BF	P	0.05	0.05	S	S	-	-	-	-	-	-	10	50	26.7	22.0	-	-	-	534-536	
Goose	Giraffe inflow	211	6/16/2013	BF,D	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	539-540	Boulder field, big barrier to fish passage
Goose	Giraffe inflow	212	6/16/2013	-	-	0.04	0.04	H	H	-	-	-	-	-	-	10	60	63.6	58.7	30.4	16.8	15.7	541-543	
Goose	Giraffe inflow	212	6/16/2013	BF	P	0.16	0.16	S	H	-	-	-	-	-	-	20	80	206.4	206.4	44.7	54.6	55.3	544-546	
Goose	Giraffe inflow	212	6/16/2013	BF	P	0	0	H	H	-	-	-	-	-	-	10	80	108.0	108.0	27.6	28.6	29.0	547-549	
Goose	Giraffe inflow	213	6/16/2013	-	-	0	0	H	H	-	-	-	-	-	-	10	30	993.0	993.0	100.0	100.0	100.0	550-552	
Goose	Wasp Inflow	214	6/16/2013	-	-	0.03	0.03	S	S	-	-	-	-	-	-	60	95	4.6	4.4	15.0	7.9	7.8	556-558	
Goose	Wasp Inflow	214	6/16/2013	-	-	0.04	0.02	U	U	-	-	-	-	-	-	80	80	5.9	5.4	7.0	10.1	9.7		
Goose	Wasp Inflow	214	6/16/2013	-	-	0.11	0.05	U	U	-	-	-	-	-	-	80	80	48.3	46.2	78.0	82.0	82.6	559-561	
Goose	Wasp Inflow	215	6/16/2013	-	-	0	0	U	U	-	-	-	-	-	-	95	95	5.5	6.6	7.1	1.7	2.1	566-568	
Goose	Wasp Inflow	215	6/16/2013	-	-	0.19	0.15	U	U	-	-	-	-	-	-	95	95	5.6	5.6	4.8	1.7	1.7	569	
Goose	Wasp Inflow	215	6/16/2013	-	-	0.13	0	U	U	-	-	-	-	-	-	95	95	40.8	45.6	21.9	12.4	14.2	570-572	
Goose	Wasp Inflow	215	6/16/2013	-	-	0.01	0.01	U	U	-	-	-	-	-	-	95	70	56.7	54.6	19.2	17.2	17.0	573-575	
Goose	Wasp Inflow	215	6/16/2013	-	-	0.15	0	U	U	-	-	-	-	-	-	95	80	65.7	63.6	19.3	20.0	19.8	576-578	Braided - 2 channels

Appendix 3.3-1. Stream Fish Habitat Data, 2013

					Location				Water Characteristics				Channel Characteristics								Substrate					Max Pool Depth (m) Crest Height (m)			
					DS Easting	DS Northing	US Easting	US Northing	Temp (°C)	pH	Turbidity	Current Flow	Habitat Number	Habitat Type	Distance From Start (m)	Length (m)	Slope (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	% Sand	% Gravel	% Cobble	% Boulder				% Bedrock
Goose	Wasp Inflow	215	6/16/2013	KK/TM	430404	7274652	-	-	12.3	6.26	C	H	6	G	69.4	30.3	1	0.22	0.25	4.8	5.1	80	0	10	10	0	-	-	-
Goose	Wasp Inflow	600	6/19/2013	KW/SL	430424	7274323	-	-	10.4	6.5	C	H	1	G	0	100	1	0.1	0.9	1.2	0.8	20	10	55	15	0	-	-	-
Goose	Main Goose Pit streams	500	6/18/2013	KW/KK	434613	7269574	-	-	11.4	6.96	C	H	1	G	0	300	0	1.1	0.7	3.5	2	80	10	10	0	0	-	-	-
Goose	Main Goose Pit streams	501	6/18/2013	KW/KK	435032	7269302	-	-	10.9	7.1	C	H	1	G	0	18	0	0.33	-	4.5	2.5	10	20	40	30	0	-	-	-
Goose	Main Goose Pit streams	501	6/18/2013	KW/KK	435032	7269302	-	-	-	-	C	H	2	P	18	11.3	0	0.5	0.35	4.1	3.4	60	30	0	10	0	S	0.76	0.29
Goose	Main Goose Pit streams	501	6/18/2013	KW/KK	435032	7269302	-	-	-	-	C	H	3	G	18	17	1.5	0.12	0.1	3.7	2.3	15	75	10	0	0	-	-	-
Goose	Main Goose Pit streams	501	6/18/2013	KW/KK	435032	7269302	-	-	-	-	C	H	4	P	35	2	0	0.38	0.37	5.4	4.9	5	15	70	10	0	D	0.53	0.17
Goose	Main Goose Pit streams	502	6/18/2013	KW/KK	435018	7268998	-	-	-	-	C	H	1	R	0	100	1	0.13	0.05	2.1	0.8	90	5	5	0	0	-	-	-
Goose	Main Goose Pit streams	503	6/18/2013	KW/KK	434613	7269049	-	-	12.6	7.1	C	H	1	G	0	100	0.5	0.21	0.13	0.4	0.3	75	0	25	0	0	-	-	-
Goose	Llama - Umwelt	505	6/18/2013	KW/KK	428819	7271365	-	-	8.3	6.97	C	H	1	G	0	100	1	0.14	0.09	3.1	0.73	0	0	70	30	0	-	-	-
Goose	Llama - Umwelt	506	6/18/2013	KW/KK	428747	7271562	-	-	7.5	7.03	C	H	1	G	0	100	1	0.13	0.13	3.1	2.9	5	10	65	20	0	-	-	-
Goose	Goose - Propeller	814	9/6/2013	SN/SL	434891	7272232	435007	7272015	-	-	C	L	1	G	0	200	2	0.15	0.25	40	60	5	15	55	25	0	-	-	-
George	George Inflow 1	800	6/22/2013	KW/KK	387174	7315797	-	-	14.2	4.47	-	-	1	G	0	100	11	0.14	0.05	0.36	0.08	80	0	0	20	0	S	0.51	0.05
George	McCoy Outflow	810	6/21/2013	KW/KK	385842	7310835	-	-	13.1	7.34	C	M	1	G	0	110	0.5	0.22	0.74	19	22	50	5	5	40	0	-	-	-
George	Occurrence - Sleigh	404	6/17/2013	KW/KK	387709	7312942	-	-	6.8	6.5	C	H	1	G	0	23	1	0.41	0.38	26.2	26	30	0	35	35	0	-	-	-

Dashes indicate not applicable or no data available

NCD = non-classified drainage

Turbidity: C = clear

Habitat Type: P = pool, G = glide, R = riffle, C = cascade, O = other

Pool Type: S = scour, D = dammed

Barrier Type: N = none, BF = boulder field, P = permanent, D = dry, NC = no distinct channel, water drains over land

Bank Stability: S = stable, U = unstable, H = highly stable

Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut bank

Appendix 3.3-1. Stream Fish Habitat Data, 2013

										Cover														
										% Pool		% Boulder	% Instream Vegetation	% Overhanging Vegetation	% Undercut Bank	% LWD	Left Bank Riparian (%)							
Property	Site	Station ID	Survey Date	Barrier Type	Temporary or Permanent	Left Bank Height (m)	Right Bank Height (m)	Left Bank Stability	Right Bank Stability	% Pool	% Boulder	% Instream Vegetation	% Overhanging Vegetation	% Undercut Bank	% LWD	Left Bank Riparian (%)	Right Bank Riparian (%)	Bankfull Area (m ²)	Wetted Area (m ²)	Proportional length (%)	Proportional Bankfull Area (%)	Proportional Wetted Area (%)	Photos	Comments
Goose	Wasp Inflow	215	6/16/2013	-	-	0.03	0.04	U	U	-	-	-	-	-	-	95	80	154.5	145.4	27.6	47.0	45.2	579-581	Braided - 2 channels; After habitat unit 5, both channels have some sections of subsurface and overland flow (NDC), but observed 1 fish (150 mm approx length) upstream of NDC section
Goose	Wasp Inflow	600	6/19/2013	-	-	0	0	U	U	0	2	3	0	0	0	100.0	100.0	80.0	120.0	100.0	100.0	100.0	401	
Goose	Main Goose Pit streams	500	6/18/2013	-	-	0.23	0.28	U	U	-	-	-	-	-	-	100.0	100.0	600.0	1,050.0	100.0	100.0	100.0	613-615	
Goose	Main Goose Pit streams	501	6/18/2013	-	-	0.06	0	U	U	0	0	5	0	5	0	100.0	100.0	45.0	81.0	37.3	34.0	40.3	618-620	
Goose	Main Goose Pit streams	501	6/18/2013	-	-	0	0	U	U	10	0	5	0	0	0	100.0	100.0	38.4	46.3	23.4	29.0	23.0	621-623	
Goose	Main Goose Pit streams	501	6/18/2013	-	-	0	0.02	U	U	0	0	1	0	1	0	100.0	100.0	39.1	62.9	35.2	29.5	31.3	624-626	
Goose	Main Goose Pit streams	501	6/18/2013	-	-	0.1	0.03	U	U	0	1	5	0	5	0	100.0	100.0	9.8	10.8	4.1	7.4	5.4	625	
Goose	Main Goose Pit streams	502	6/18/2013	-	-	0	0	U	U	0	0	40	10	0	0	100.0	100.0	80.0	210.0	100.0	100.0	100.0	634	
Goose	Main Goose Pit streams	503	6/18/2013	-	-	0.07	0.1	U	U	0	0	30	0	5	0	100.0	100.0	30.0	40.0	100.0	100.0	100.0	641-643	
Goose	Llama - Umwelt	505	6/18/2013	-	-	0.05	0.05	S	S	0	4	7	0	0	0	100.0	100.0	73.0	310.0	100.0	100.0	100.0	644-647	Highly braided
Goose	Llama - Umwelt	506	6/18/2013	-	-	0	0	U	U	0	5	2	0	1	0	100.0	100.0	290.0	310.0	100.0	100.0	100.0	648-650	
Goose	Goose - Propeller	814	9/6/2013	-	-	0.15	0.15	S	S	0	5	1	1	0	0	50.0	50.0	12,000.0	8,000.0	100.0	100.0	100.0	685-687	Riparian cover only during bankfull times.
George	George Inflow 1	800	6/22/2013	-	-	0	0	-	-	0	2	5	0	2	0	100.0	100.0	8.0	36.0	100.0	100.0	100.0	536-538	
George	McCoy Outflow	810	6/21/2013	-	-	0	0	S	S	0	5	1	0	1	0	100.0	100.0	2,420.0	2,090.0	100.0	100.0	100.0	524-526	
George	Occurrence - Sleigh	404	6/17/2013	-	-	0	0	U	U	0	2	2	0	0	0	100.0	50.0	598.0	602.6	100.0	100.0	100.0	312-314	Not really a stream. A slight constriction in a single lake

Dashes indicate not applicable or no data available
NCD = non-classified drainage
Turbidity: C = clear
Habitat Type: P = pool, G = glide, R = riffle, C = cascade, O = other
Pool Type: S = scour, D = dammed
Barrier Type: N = none, BF = boulder field, P = permanent, D = dry, NC = no distinct channel, water drains over land
Bank Stability: S = stable, U = unstable, H = highly stable
Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut bank

Appendix 3.3-2

Detailed Stream Fish Habitat Data, 2013

Appendix 3.3-2. Detailed Stream Fish Habitat, 2013

SHIM Habitat Data

PropertyStreamSiteDateCrew					LocationEastingNorthing		Reach Details					Channel Characteristics									
							Reach Length (m)	Current Flow	Photo No.	Segment No.	Secondary Characteristics	Morphology	Secondary Morphology	Gradient	Sand Bars	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	Channel Comments	% Riffle
Goose	Main Goose Pit streams	Main Goose Pit Reach 7	6/18/2013	KW, KK	434625	7269027.9	145	H	-	2	Braided	Run	-	0.5	None	0.60	0.15	0.10	0.70	-	0
Goose	Main Goose Pit streams	Main Goose Pit Reach 7 continued	6/18/2013	KW, KK	434516	7269219.2	349	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Gander Pond Inflow	Gander Stream Reach 3	6/22/2013	KW, KK	433686	7269145.2	254	H	549-550	0		no channel just overland flow	-	0.0		0.00	0.00	0.00	0.00	-	0
Goose	Gander Pond Inflow	Gander Stream Reach 2	6/22/2013	KW, KK	433432	7269397.5	385	H	558 559	2	Non-channelized	Run	-	1.0	None	4.50	1.20	0.31	0.15	-	5
Goose	Gander Pond Outflow	Gander Stream Reach 1	6/22/2013	KW, KK	432864	7269970.5	474	H	-	0	Braided	Run	-	2.0	None	1.10	0.70	0.20	0.15	-	10
George	George NE Inflow	George Inflow 1	6/21/2013	KW, KK	387129	7315821.5	697	M	-	1	Non-channelized	Run	-	5.0	None	0.30	0.25	0.15	0.05	-	0
George	George NE Inflow	George Inflow 1 continued	6/21/2013	KW, KK	387282	7315604.4	70	M	-	1	Non-channelized	Run	-	5.0	None	0.30	0.25	0.15	0.05	-	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 2	6/14/2013	KW, KK	431189	7273118	184	-	437 to 439	1	Side channel	Pool	-	0.0	None	15.00	9.00	1.00	0.80	-	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 2, continued	6/14/2013	KW, KK	431068	7273108.2	203	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Giraffe Inflow	Giraffe Inflow Reach 4	6/14/2013	KW, KK	430924	7273198	104	H	-	3	Intermittent	Riffle/Pool	riffle-pool complex w many incoming seeps	1.0	None	8.00	10.00	0.31	0.35	-	40
Goose	Giraffe Inflow	Giraffe Inflow Reach 4	6/14/2013	KW, KK	430575	7273025.1	664	M	-	1	Intermittent	Boulder Garden	-	1.0	None	0.95	0.95	0.15	0.15	-	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 3	6/19/2013	KW, SL	430595	7273220.3	180	M	-	1	Intermittent	Boulder Garden	-	1.0	None	0.95	0.95	0.15	0.15	-	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 3 continued	6/19/2013	KW, SL	430438	7272803.2	605	M	-	1	Intermittent	Boulder Garden	-	1.0	None	0.95	0.95	0.15	0.15	-	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 3 continued	6/19/2013	KW, SL	431025	7273163.2	89	H	-	3	Intermittent	Riffle/Pool	riffle-pool complex w many incoming seeps	1.0	None	8.00	10.00	0.31	0.35	-	40
Goose	Giraffe Inflow	Giraffe Inflow Reach 5	6/14/2013	KW, KK	430806	7273309.8	229	H	-	3	Braided	Riffle	-	2.5	None	9.00	10.00	0.30	0.35	-	50
Goose	Giraffe Inflow	Giraffe Inflow Reach 5 continued	6/14/2013	KW, KK	430839	7273335	174	H	-	3	Braided	Riffle	-	2.5	None	9.00	10.00	0.30	0.35	-	50
Goose	Giraffe Inflow	Giraffe Inflow Reach 5 continued	6/14/2013	KW, KK	430874	7273268.9	119	H	-	3	Braided	Riffle	-	2.5	None	9.00	10.00	0.30	0.35	-	50
Goose	Goose - Propeller	Goose-Propeller Reach 1	6/20/2013	KW, KK	435008	7271537.1	378	M	-	1	-	Run	-	1.0	None	40.00	40.00	0.22	0.22	-	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 4	6/18/2013	KW, KK	434622	7269531.7	131	H	607-612	1	Non-channelized	Run	-	1.0	None	3.50	2.00	1.10	0.70	-	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	KW, KK	435062	7269259.2	364	H	-	2	Braided	Run	-	1.5	None	3.70	2.30	0.12	0.10	-	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 5	6/18/2013	KW, KK	435018	7268997.8	250	H	631-633	3	Non-channelized	Run	-	1.0	None	2.10	0.70	0.13	0.08	-	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	KW, KK	434689	7269668.3	84	H	607-612	1	Non-channelized	Run	-	1.0	None	3.50	2.00	1.10	0.70	-	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	KW, KK	434735	7269685.4	30	H	607-612	1	Non-channelized	Run	-	1.0	None	3.50	2.00	1.10	0.70	-	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	KW, KK	434730	7269700.5	19	H	607-612	1	Non-channelized	Run	-	1.0	None	3.50	2.00	1.10	0.70	-	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	KW, KK	434633	7269616	121	H	607-612	1	Non-channelized	Run	-	1.0	None	3.50	2.00	1.10	0.70	-	0
Goose	Goose - Propeller Offchannel area	Goose - Propeller Offchannel area	6/19/2013	KW, SL	435299	7271197.4	1262	-	446,448	0	-	-	meandering, intermittent	-	-	-	-	-	-	-	-
Goose	Llama Outflow	Llama Outflow Reach 1	6/18/2013	KW, KK	428807	7271305.9	18	H	644 - 647	1	Braided	Run	-	1.0	Medial	3.10	0.73	0.14	0.09	-	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	KW, KK	428814	7271317.9	11	H	644 - 647	1	Braided	Run	-	1.0	Medial	3.10	0.73	0.14	0.09	-	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	KW, KK	428819	7271309.9	67	H	644 - 647	1	Braided	Run	-	1.0	Medial	3.10	0.73	0.14	0.09	-	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	KW, KK	428857	7271368.5	144	H	644 - 647	1	Braided	Run	-	1.0	Medial	3.10	0.73	0.14	0.09	-	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	KW, KK	428830	7271447.1	161	H	644 - 647	1	Braided	Run	-	1.0	Medial	3.10	0.73	0.14	0.09	-	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	KW, KK	428853	7271423.1	26	H	644 - 647	1	Braided	Run	-	1.0	Medial	3.10	0.73	0.14	0.09	-	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	KW, KK	428851	7271404.1	63	H	644 - 647	1	Braided	Run	-	1.0	Medial	3.10	0.73	0.14	0.09	-	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	KW, KK	428848	7271434.4	23	H	644 - 647	1	Braided	Run	-	1.0	Medial	3.10	0.73	0.14	0.09	-	0
Goose	Llama Outflow	Llama Outflow Reach 2	6/18/2013	KW, KK	428744	7271607.7	276	H	648 - 650	2	Braided	Run	-	1.0	None	3.10	2.90	0.13	0.13	-	0
Goose	Llama Outflow	Llama Outflow Reach 2, continued	6/18/2013	KW, KK	428812	7271486	90	H	648 - 650	2	Braided	Run	-	1.0	None	3.10	2.90	0.13	0.13	-	0
Goose	Llama Outflow	Llama Outflow Reach 2, continued	6/18/2013	KW, KK	428786	7271525.1	15	H	648 - 650	2	Braided	Run	-	1.0	None	3.10	2.90	0.13	0.13	-	0
Goose	Rascal - Goose	Rascal Goose Reach 7	6/16/2013	KW, SL	433780	7268564.4	741	H	225-227	7	Braided	Boulder Garden	boulder garden with braid	1.0	None	17.40	17.00	0.19	0.19	-	10
Goose	Rascal - Goose	Rascal Goose Reach 1	6/16/2013	KW, SL	434335	7269819.1	167	H	153-156	1	Braided	Run	-	1.0	None	2.00	1.50	0.35	0.35	-	20
Goose	Rascal - Goose	Rascal Goose Reach 1, continued	6/16/2013	KW, SL	434333	7269776.2	90	H	153-156	1	Braided	Run	-	1.0	None	2.00	1.50	0.35	0.35	-	20
Goose	Rascal - Goose	Rascal Goose Reach 2	6/16/2013	KW, SL	434401	7269564	180	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Rascal - Goose	Rascal Goose Reach 2 continued	6/16/2013	KW, SL	434461	7269471.7	78	H	158-161	2	Non-channelized	Run	-	0.0	None	20.00	18.00	0.60	0.35	-	80
Goose	Rascal - Goose	Rascal Goose Reach 5, continued	6/16/2013	KW, SL	433957	7268389.2	199	H	-	0	-		-	0.0		0.00	0.00	0.00	0.00	-	0
Goose	Rascal - Goose	Rascal Goose Reach 6	6/16/2013	KW, SL	433939	7268202.4	314	H	217-221	6	-	Riffle	-	4.0	None	10.00	8.00	0.25	0.20	-	75
Goose	Rascal - Goose	Rascal Goose Reach 1, continued	6/16/2013	KW, SL	434378	7269703	168	-	-	0	-	-	-	-	-	-	-	-	-	-	-
Goose	Rascal - Goose	Rascal Goose Reach 3	6/16/2013	KW, SL	434472	7269421.4	47	H	-	3	-	-	-	-	-	-	-	-	-	-	-
Goose	Rascal - Goose	Rascal Goose Reach 3, continued	6/16/2013	KW, SL	434336	7269286.5	490	H	162 166-68	3	Other	Riffle	Zary hab - off channel micro ponds/glides	1.0	None	2.50	2.50	0.20	0.20	-	90
Goose	Rascal - Goose	Rascal Goose Reach 4	6/16/2013	KW, SL	433995	7268933	806	H	198-210	4	Braided	Riffle	semi braided riffle	1.0	None	5.10	3.70	0.30	0.25	-	80

Appendix 3.3-2. Detailed Stream Fish Habitat, 2013

SHIM Habitat Data

PropertyStreamSiteDate				Channel Characteristics (cont'd)				Habitat Quality				Substrate							Bank Characteristics			
				% Pool	% Run	% Casade	% Boulder Garden	Spawning Habitat	Overwintering Habitat	Rearing Habitat	Overall Habitat	% Organics	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Compaction	RipClass	Stage2	Bank Stability	Bank Matter
Goose	Main Goose Pit streams	Main Goose Pit Reach 7	6/18/2013	20	80	0	0	None	None	Poor	Marginal	100	0	0	0	0	0	High	Herbs/grasses	low shrubs <2m	Stable - no undercut	Fines
Goose	Main Goose Pit streams	Main Goose Pit Reach 7 continued	6/18/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Gander Pond Inflow	Gander Stream Reach 3	6/22/2013	0	0	0	0	-	-	-	-	0	0	0	0	0	0	-	-	-	-	-
Goose	Gander Pond Inflow	Gander Stream Reach 2	6/22/2013	20	75	0	0	Poor	None	Fair	Marginal	0	50	5	20	25	0	Medium	Herbs/grasses	low shrubs <2m	Stable - undercut	Fines
Goose	Gander Pond Outflow	Gander Stream Reach 1	6/22/2013	20	65	5	0	Fair	None	Good	Important	25	5	10	40	20	0	Medium	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
George	George NE Inflow	George Inflow 1	6/21/2013	5	95	0	0	None	None	Poor	Marginal	95	0	0	0	5	0	High	Herbs/grasses	low shrubs <2m	Eroding	Fines
George	George NE Inflow	George Inflow 1 continued	6/21/2013	5	95	0	0	None	None	Poor	Marginal	95	0	0	0	5	0	High	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Giraffe Inflow	Giraffe Inflow Reach 2	6/14/2013	100	0	0	0	None	None	Fair	Marginal	5	0	0	20	40	35	Low	Herbs/grasses	low shrubs <2m	Stable - no undercut	Bed_Rock
Goose	Giraffe Inflow	Giraffe Inflow Reach 2, continued	6/14/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Goose	Giraffe Inflow	Giraffe Inflow Reach 4	6/14/2013	50	0	0	10	Poor	None	Fair	Marginal	5	0	0	10	50	35	Low	Herbs/grasses	low shrubs <2m	Stable - no undercut	Boulder
Goose	Giraffe Inflow	Giraffe Inflow Reach 4	6/14/2013	45	10	0	45	None	None	Poor	Marginal	0	1	0	30	40	19	Low	Herbs/grasses	-	Stable - no undercut	Boulder
Goose	Giraffe Inflow	Giraffe Inflow Reach 3	6/19/2013	45	10	0	45	None	None	Poor	Marginal	0	1	0	30	40	19	Low	Herbs/grasses	-	Stable - no undercut	Boulder
Goose	Giraffe Inflow	Giraffe Inflow Reach 3 continued	6/19/2013	45	10	0	45	None	None	Poor	Marginal	0	1	0	30	40	19	Low	Herbs/grasses	-	Stable - no undercut	Boulder
Goose	Giraffe Inflow	Giraffe Inflow Reach 3 continued	6/19/2013	50	0	0	10	Poor	None	Fair	Marginal	5	0	0	10	50	35	Low	Herbs/grasses	low shrubs <2m	Stable - no undercut	Boulder
Goose	Giraffe Inflow	Giraffe Inflow Reach 5	6/14/2013	20	15	0	10	Poor	Poor	Good	Marginal	0	0	2	35	35	28	Low	Shrubs	low shrubs <2m	Stable - no undercut	Bed_Rock
Goose	Giraffe Inflow	Giraffe Inflow Reach 5 continued	6/14/2013	20	15	0	10	Poor	Poor	Good	Marginal	0	0	2	35	35	28	Low	Shrubs	low shrubs <2m	Stable - no undercut	Bed_Rock
Goose	Giraffe Inflow	Giraffe Inflow Reach 5 continued	6/14/2013	20	15	0	10	Poor	Poor	Good	Marginal	0	0	2	35	35	28	Low	Shrubs	low shrubs <2m	Stable - no undercut	Bed_Rock
Goose	Goose - Propeller	Goose-Propeller Reach 1	6/20/2013	0	100	0	0	Fair	None	Good	Important	0	0	5	85	10	0	Low	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
Goose	Main Goose Pit streams	Main Goose Pit Stream 4	6/18/2013	50	50	0	0	Poor	None	Good	Important	90	0	0	10	0	0	High	Herbs/grasses	low shrubs <2m	Stable - undercut	Fines
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	15	85	0	0	Good	None	Good	Critical	75	0	0	15	10	0	High	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Main Goose Pit streams	Main Goose Pit Stream 5	6/18/2013	10	90	0	0	None	None	Poor	Marginal	0	90	5	5	0	0	High	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	50	50	0	0	Poor	None	Good	Important	90	0	0	10	0	0	High	Herbs/grasses	low shrubs <2m	Stable - undercut	Fines
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	50	50	0	0	Poor	None	Good	Important	90	0	0	10	0	0	High	Herbs/grasses	low shrubs <2m	Stable - undercut	Fines
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	50	50	0	0	Poor	None	Good	Important	90	0	0	10	0	0	High	Herbs/grasses	low shrubs <2m	Stable - undercut	Fines
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	50	50	0	0	Poor	None	Good	Important	90	0	0	10	0	0	High	Herbs/grasses	low shrubs <2m	Stable - undercut	Fines
Goose	Goose - Propeller Offchannel area	Goose - Propeller Offchannel area	6/19/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Goose	Llama Outflow	Llama Outflow Reach 1	6/18/2013	10	90	0	0	Good	None	Good	Important	0	0	15	55	30	0	Medium	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	10	90	0	0	Good	None	Good	Important	0	0	15	55	30	0	Medium	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	10	90	0	0	Good	None	Good	Important	0	0	15	55	30	0	Medium	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	10	90	0	0	Good	None	Good	Important	0	0	15	55	30	0	Medium	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	10	90	0	0	Good	None	Good	Important	0	0	15	55	30	0	Medium	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	10	90	0	0	Good	None	Good	Important	0	0	15	55	30	0	Medium	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	10	90	0	0	Good	None	Good	Important	0	0	15	55	30	0	Medium	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
Goose	Llama Outflow	Llama Outflow Reach 2	6/18/2013	0	100	0	0	Good	None	Good	Critical	0	5	10	65	20	0	Medium	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
Goose	Llama Outflow	Llama Outflow Reach 2, continued	6/18/2013	0	100	0	0	Good	None	Good	Critical	0	5	10	65	20	0	Medium	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
Goose	Llama Outflow	Llama Outflow Reach 2, continued	6/18/2013	0	100	0	0	Good	None	Good	Critical	0	5	10	65	20	0	Medium	Herbs/grasses	low shrubs <2m	Stable - no undercut	Cobble
Goose	Rascal - Goose	Rascal Goose Reach 7	6/16/2013	0	20	0	70	Fair	None	Good	Important	0	5	5	20	70	0	Medium	-	-	-	-
Goose	Rascal - Goose	Rascal Goose Reach 1	6/16/2013	5	75	0	0	Good	None	Good	Important	5	0	30	40	25	0	Medium	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Rascal - Goose	Rascal Goose Reach 1, continued	6/16/2013	5	75	0	0	Good	None	Good	Important	5	0	30	40	25	0	Medium	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Rascal - Goose	Rascal Goose Reach 2	6/16/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Goose	Rascal - Goose	Rascal Goose Reach 2 continued	6/16/2013	20	0	0	0	None	None	Poor	Marginal	65	0	5	20	10	0	Low	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Rascal - Goose	Rascal Goose Reach 5, continued	6/16/2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	High	Rock	low shrubs <2m	Stable - no undercut	Boulder
Goose	Rascal - Goose	Rascal Goose Reach 1, continued	6/16/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Goose	Rascal - Goose	Rascal Goose Reach 3	6/16/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Goose	Rascal - Goose	Rascal Goose Reach 3, continued	6/16/2013	5	5	0	0	Poor	None	Fair	Important	0	0	5	70	25	0	Low	Herbs/grasses	low shrubs <2m	-	Fines
Goose	Rascal - Goose	Rascal Goose Reach 4	6/16/2013	0	20	0	0	Fair	None	Fair	Important	0	0	10	60	30	0	Medium	Herbs/grasses	low shrubs <2m	Eroding	

Appendix 3.3-2. Detailed Stream Fish Habitat, 2013

SHIM Habitat Data

Property	Stream	Site	Date	Cover					
				% Total Cover	% Boulder	% Deep Pool	% Instream Vegetation	% Overhanging Vegetation	% Undercut Banks
Goose	Main Goose Pit streams	Main Goose Pit Reach 7	6/18/2013	0	0	0	70	0	0
Goose	Main Goose Pit streams	Main Goose Pit Reach 7 continued	6/18/2013	-	-	-	-	-	-
Goose	Gander Pond Inflow	Gander Stream Reach 3	6/22/2013	0	0	0	0	0	0
Goose	Gander Pond Inflow	Gander Stream Reach 2	6/22/2013	10	3	0	5	0	2
Goose	Gander Pond Outflow	Gander Stream Reach 1	6/22/2013	35	10	5	5	15	0
George	George NE Inflow	George Inflow 1	6/21/2013	5	1	2	2	0	0
George	George NE Inflow	George Inflow 1 continued	6/21/2013	5	1	2	2	0	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 2	6/14/2013	10	75	15	10	0	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 2, continued	6/14/2013	-	-	-	-	-	-
Goose	Giraffe Inflow	Giraffe Inflow Reach 4	6/14/2013	20	85	5	5	5	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 4	6/14/2013	20	20	0	0	0	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 3	6/19/2013	20	20	0	0	0	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 3 continued	6/19/2013	20	20	0	0	0	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 3 continued	6/19/2013	20	85	5	5	5	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 5	6/14/2013	25	60	0	0	40	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 5 continued	6/14/2013	25	60	0	0	40	0
Goose	Giraffe Inflow	Giraffe Inflow Reach 5 continued	6/14/2013	25	60	0	0	40	0
Goose	Goose - Propeller	Goose-Propeller Reach 1	6/20/2013	7	5	0	2	0	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 4	6/18/2013	10	0	2	5	0	3
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	25	0	0	18	0	7
Goose	Main Goose Pit streams	Main Goose Pit Stream 5	6/18/2013	50	0	0	40	10	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	10	0	2	5	0	3
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	10	0	2	5	0	3
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	10	0	2	5	0	3
Goose	Main Goose Pit streams	Main Goose Pit Stream 4, continued	6/18/2013	10	0	2	5	0	3
Goose	Goose - Propeller Offchannel area	Goose - Propeller Offchannel area	6/19/2013	-	-	-	-	-	-
Goose	Llama Outflow	Llama Outflow Reach 1	6/18/2013	11	4	0	7	0	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	11	4	0	7	0	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	11	4	0	7	0	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	11	4	0	7	0	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	11	4	0	7	0	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	11	4	0	7	0	0
Goose	Llama Outflow	Llama Outflow Reach 1, continued	6/18/2013	11	4	0	7	0	0
Goose	Llama Outflow	Llama Outflow Reach 2	6/18/2013	8	5	0	2	0	1
Goose	Llama Outflow	Llama Outflow Reach 2, continued	6/18/2013	8	5	0	2	0	1
Goose	Llama Outflow	Llama Outflow Reach 2, continued	6/18/2013	8	5	0	2	0	1
Goose	Rascal - Goose	Rascal Goose Reach 7	6/16/2013	30	90	0	5	5	0
Goose	Rascal - Goose	Rascal Goose Reach 1	6/16/2013	8	70	5	25	0	0
Goose	Rascal - Goose	Rascal Goose Reach 1, continued	6/16/2013	8	70	5	25	0	0
Goose	Rascal - Goose	Rascal Goose Reach 2	6/16/2013	-	-	-	-	-	-
Goose	Rascal - Goose	Rascal Goose Reach 2 continued	6/16/2013	14	1	8	3	0	2
Goose	Rascal - Goose	Rascal Goose Reach 5, continued	6/16/2013	0	0	0	0	0	0
Goose	Rascal - Goose	Rascal Goose Reach 6	6/16/2013	20	90	10	0	0	0
Goose	Rascal - Goose	Rascal Goose Reach 1, continued	6/16/2013	-	-	-	-	-	-
Goose	Rascal - Goose	Rascal Goose Reach 3	6/16/2013	-	-	-	-	-	-
Goose	Rascal - Goose	Rascal Goose Reach 3, continued	6/16/2013	10	50	50	0	0	0
Goose	Rascal - Goose	Rascal Goose Reach 4	6/16/2013	10	70	0	10	0	20

Appendix 3.3-2. Detailed Stream Fish Habitat, 2013

SHIM Habitat Data

PropertyStreamSiteDateCrew					LocationEastingNorthing		Reach Details					Channel Characteristics									
							Reach Length (m)	Current Flow	Photo No.	Segment No.	Secondary Characteristics	Morphology	Secondary Morphology	Gradient	Sand Bars	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	Channel Comments	% Riffle
Goose	Rascal - Goose	Rascal Goose Reach 5	6/16/2013	KW, SL	434013	7268622.4	231	H	-	5	-	Run	-	0.0	None	13.50	7.10	0.35	0.32	-	0
Goose	Umwelt Outflow	Umwelt Outflow 4	6/15/2013	KW, KK	430865	7269994	248	H	-	3	-	Riffle	-	2.0	None	4.00	6.00	0.50	0.55	-	70
Goose	Umwelt Outflow	Umwelt Outflow 3	6/15/2013	KW, KK	430617	7270146.4	582	H	491-494	4	-	Run	run pool alternating units	0.5	None	15.00	18.00	0.51	0.55	-	0
Goose	Umwelt Outflow	Umwelt Outflow 5	6/15/2013	KW, KK	430048	7270521.4	87	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Umwelt Outflow	Umwelt Outflow 6	6/15/2013	KW, KK	429371	7270349.5	472	H	504-506	6	Braided	Run	highly braided	2.0	None	12.10	4.00	0.31	0.28	flooded	0
Goose	Umwelt Outflow	Umwelt Outflow 6, continued	6/15/2013	KW, KK	429442	7270279	256	H	504-506	6	Braided	Run	highly braided	2.0	None	12.10	4.00	0.31	0.28	flooded	0
Goose	Umwelt Outflow	Umwelt Outflow 7	6/15/2013	KW, KK	429182	7270628.7	79	H	-	2	Other	Run	flooded	0.0	Medial	15.00	12.00	0.14	0.14	-	0
Goose	Umwelt Outflow	Umwelt Outflow 1	6/15/2013	KW, KK	431026	7269950.5	156	H	474-476	1	-	Run	-	0.5	-	35.00	35.00	1.50	1.50	-	0
Goose	Umwelt Outflow	Umwelt Outflow 2	6/15/2013	KW, KK	430971	7269975.5	177	-	481-483	2	-	Cascade	alternating cascade - riffle	6.0	None	6.00	8.00	0.25	0.30	-	30
Goose	Wasp Inflow	Wasp Outflow 1	6/19/2013	KW, SL	430414	7274344	456	H	-	1	Braided	Boulder Garden	-	2.0	None	1.20	1.00	0.10	0.80	-	-
Goose	Wasp Inflow	Wasp Outflow 1, continued	6/19/2013	KW, SL	430423	7274525.3	153	H	-	1	Braided	Boulder Garden	-	2.0	None	1.20	1.00	0.10	0.80	-	-
Goose	Wasp Inflow	Wasp Outflow 2	6/19/2013	KW, SL	430107	7274095.6	1111	H	409-422	2	Intermittent	Standing	run/standing with intermittent flow	1.0	None	0.50	0.50	0.10	0.10	-	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 1	6/16/2013	KW, SL	434434	7269342.1	163	H	163-165	1	Intermittent	Run	very small temporary flow	0.0	None	0.20	0.10	0.07	0.04	-	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 2	6/16/2013	KW, SL	434294	7269324.3	224	H	169-174	1	-	Riffle	-	1.0	None	2.50	2.50	0.22	0.20	-	80
Goose	Main Goose Pit streams	Main Goose Pit Stream 2, continued	6/16/2013	KW, SL	434235	7269254.5	243	H	169-174	1	-	Riffle	-	1.0	None	2.50	2.50	0.22	0.20	-	80
Goose	Main Goose Pit streams	Main Goose Pit Stream 3	6/16/2013	KW, SL	434035	7269036.8	518	H	179-189	1	Braided	Run	-	2.0	None	5.00	5.00	0.30	0.31	-	45
Goose	Main Goose Pit streams	Main Goose Pit Stream 3, continued	6/16/2013	KW, SL	434262	7269203.5	177	H	179-189	1	Braided	Run	-	2.0	None	5.00	5.00	0.30	0.31	-	45

Dashes indicate not applicable or no data available

Current flow: H = high, M = moderate

Habitat Type: P = pool, G = glide, R = riffle, C = cascade, O = other

Pool Type: S = scour, D = dammed

Barrier Type: N = none, BF = boulder field, P = permanent, D = dry, NC = no distinct channel, water drains over land

Bank Stability: S = stable, U = unstable, H = highly stable

Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut bank

Appendix 3.3-2. Detailed Stream Fish Habitat, 2013

SHIM Habitat Data

PropertyStreamSiteDate				Channel Characteristics (cont'd)				Habitat Quality				Substrate							Bank Characteristics			
				% Pool	% Run	% Casade	% Boulder Garden	Spawning Habitat	Overwinter ing Habitat	Rearing Habitat	Overall Habitat	% Organics	% Sand	% Gravel	% Cobble	% Boulder	% Bedrock	Compaction	RipClass	Stage2	Bank Stability	Bank Matter
Goose	Rascal - Goose	Rascal Goose Reach 5	6/16/2013	0	100	0	0	None	None	Poor	Marginal	60	0	10	20	10	0	Medium	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Umwelt Outflow	Umwelt Outflow 4	6/15/2013	0	10	0	20	Poor	None	Good	Marginal	0	0	5	30	60	5	Low	Herbs/grasses	low shrubs <2m	Stable - no undercut	Boulder
Goose	Umwelt Outflow	Umwelt Outflow 3	6/15/2013	70	30	0	0	None	None	Fair	Marginal	0	0	0	0	40	60	Low	Rock	low shrubs <2m	Stable - no undercut	Bed_Rock
Goose	Umwelt Outflow	Umwelt Outflow 5	6/15/2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Umwelt Outflow	Umwelt Outflow 6	6/15/2013	0	100	0	0	Good	None	Good	Important	0	5	15	60	20	0	Medium	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Umwelt Outflow	Umwelt Outflow 6, continued	6/15/2013	0	100	0	0	Good	None	Good	Important	0	5	15	60	20	0	Medium	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Umwelt Outflow	Umwelt Outflow 7	6/15/2013	0	100	0	0	Fair	None	Good	Important	35	35	20	10	0	0	High	Herbs/grasses	low shrubs <2m	Stable - undercut	Fines
Goose	Umwelt Outflow	Umwelt Outflow 1	6/15/2013	0	95	5	0	None	Fair	Good	Important	0	0	2	20	70	8	Low	Rock	low shrubs <2m	Stable - no undercut	Bed_Rock
Goose	Umwelt Outflow	Umwelt Outflow 2	6/15/2013	0	0	40	30	Poor	None	Fair		0	0	5	30	35	30	Low	Rock	low shrubs <2m	Stable - no undercut	Bed_Rock
Goose	Wasp Inflow	Wasp Outflow 1	6/19/2013	-	-	-	-	Poor	None	Fair	Marginal	30	0	0	15	55	10	High	Herbs/grasses	low shrubs <2m	Stable - no undercut	Boulder
Goose	Wasp Inflow	Wasp Outflow 1, continued	6/19/2013	-	-	-	-	Poor	None	Fair	Marginal	30	0	0	15	55	10	High	Herbs/grasses	low shrubs <2m	Stable - no undercut	Boulder
Goose	Wasp Inflow	Wasp Outflow 2	6/19/2013	15	45	0	40	None	None	Poor	Marginal	70	0	0	0	30	0	High	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Main Goose Pit streams	Main Goose Pit Stream 1	6/16/2013	10	90	0	0	None	None	Poor	Marginal	100	0	0	0	0	0	Medium	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Main Goose Pit streams	Main Goose Pit Stream 2	6/16/2013	0	20	0	0	Good	None	Good	Critical	0	0	10	70	20	0	Medium	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Main Goose Pit streams	Main Goose Pit Stream 2, continued	6/16/2013	0	20	0	0	Good	None	Good	Critical	0	0	10	70	20	0	Medium	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Main Goose Pit streams	Main Goose Pit Stream 3	6/16/2013	5	50	0	0	Fair	None	Good	Important	0	0	5	50	45	0	Low	Herbs/grasses	low shrubs <2m	Eroding	Fines
Goose	Main Goose Pit streams	Main Goose Pit Stream 3, continued	6/16/2013	5	50	0	0	Fair	None	Good	Important	0	0	5	50	45	0	Low	Herbs/grasses	low shrubs <2m	Eroding	Fines

Dashes indicate not applicable or no data available

Current flow: H = high, M = moderate

Habitat Type: P = pool, G = glide, R = riffle, C = cascade, O = other

Pool Type: S = scour, D = dammed

Barrier Type: N = none, BF = boulder field, P = permanent, D = dry, NC = no distinct channel, water drains over land

Bank Stability: S = stable, U = unstable, H = highly stable

Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut bank

Appendix 3.3-2. Detailed Stream Fish Habitat, 2013

SHIM Habitat Data				Cover					
				% Total Cover	% Boulder	% Deep Pool	% Instream Vegetation	% Overhanging Vegetation	% Undercut Banks
Property	Stream	Site	Date						
Goose	Rascal - Goose	Rascal Goose Reach 5	6/16/2013	2	50	0	50	0	0
Goose	Umwelt Outflow	Umwelt Outflow 4	6/15/2013	40	100	0	0	0	0
Goose	Umwelt Outflow	Umwelt Outflow 3	6/15/2013	20	80	15	0	5	0
Goose	Umwelt Outflow	Umwelt Outflow 5	6/15/2013	-	-	-	-	-	-
Goose	Umwelt Outflow	Umwelt Outflow 6	6/15/2013	10	65	0	15	5	5
Goose	Umwelt Outflow	Umwelt Outflow 6, continued	6/15/2013	10	65	0	15	5	5
Goose	Umwelt Outflow	Umwelt Outflow 7	6/15/2013	10	10	0	60	30	0
Goose	Umwelt Outflow	Umwelt Outflow 1	6/15/2013	30	100	0	0	0	0
Goose	Umwelt Outflow	Umwelt Outflow 2	6/15/2013	10	100	0	0	0	0
Goose	Wasp Inflow	Wasp Outflow 1	6/19/2013	30	30	0	0	0	0
Goose	Wasp Inflow	Wasp Outflow 1, continued	6/19/2013	30	30	0	0	0	0
Goose	Wasp Inflow	Wasp Outflow 2	6/19/2013	30	20	0	10	0	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 1	6/16/2013	70	0	0	100	0	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 2	6/16/2013	10	90	0	5	0	5
Goose	Main Goose Pit streams	Main Goose Pit Stream 2, continued	6/16/2013	10	90	0	5	0	5
Goose	Main Goose Pit streams	Main Goose Pit Stream 3	6/16/2013	10	75	20	10	0	0
Goose	Main Goose Pit streams	Main Goose Pit Stream 3, continued	6/16/2013	10	75	20	10	0	0

Dashes indicate not applicable or no data available
Current flow: H = high, M = moderate
Habitat Type: P = pool, G = glide, R = riffle, C = cascade, O = other
Pool Type: S = scour, D = dammed
Barrier Type: N = none, BF = boulder field, P = permanent, D = dry, NC = no distinct channel, water drains over land
Bank Stability: S = stable, U = unstable, H = highly stable
Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut bank

Appendix 3.3-2. Detailed Stream Fish Habitat, 2013

Additional SHIM Data

Waterbodies

Property	Stream	Waterbody Type	Date	Crew	Easting	Northing	Bank	Length (m)	Reach	Width (m)	Depth (m)	Comments	Photo No.
Goose	Giraffe Inflow	Pond	6/19/2013	KW, SL	430590	7273125.7	Right	26	2	27	0.600000024	small pond shallow	384
Goose	Giraffe Inflow	Pond	6/19/2013	KW, SL	430360	7272665.4	Instream	35	0	35	0	-	393
Goose	Goose - Propeller Offchannel area	Pond	6/19/2013	KW, SL	435545	7270852.7	-	0	0	0	0	lake	-
Goose	Goose - Propeller Offchannel area	Pond	6/19/2013	KW, SL	435415	7271104.1	-	40	0	5	0.400000006	cobble substrate	462-463
Goose	Goose - Propeller Offchannel area	Pond	6/19/2013	KW, SL	435339	7271121.1	-	20	0	17	0.5	shallow temporary	466

Ponds

Property	Stream	Site	Date	Crew	Easting	Northing	Mean Depth (m)	Mean Length (m)	Dominant Substrate	Total Cover	Boulders	Deep Pool	Vegetation	Value	Habitat Use	Fish Bearing (Y/N)	Comments
Goose	Rascal - Goose	Rascal Goose Reach 4	6/16/2013	KW, SL	433926	7268875.6	0.300000012	15	Cobble	5	75	0	25	Marginal	Rearing	Yes	undercut banks
Goose	Wasp Inflow	Wasp Inflow 1	6/19/2013	KW, SL	430209	7274271.1	0	50	Organic	10	0	9	1	Marginal	Rearing	Unknown	photo 414-415

Obstructions

Property	Stream	Type of Obstruction	Date	Crew	Easting	Northing	Barrier	Length	Depth	Height	Slope	PhotoNum	Comments
Goose	Gander Pond Inflow	Cascade	6/22/2013	KW, KK	432865	7269960	Potential	1.5	0	0.5	0		possible obstruction at low flow only
Goose	Gander Pond Inflow	Falls	6/22/2013	KW, KK	432855	7270034.4	Potential	0.4	0.079999998	0.6	0	560	potential seasonal barrier
George	George NE Inflow	Cascade	6/21/2013	KW, KK	387054	7315881.1	Yes	1.5	0	1.1	16	539-541	
Goose	Giraffe Inflow	Rock	6/14/2013	KW, KK	431267	7273084.5	Yes	50	0	0.0	0		subsurface boulder garden
Goose	Giraffe Inflow	Boulder Garden	6/14/2013	KW, KK	431069	7273108.2	Yes	30	0	0.0	1	440-442	boulder garden seasonal flow
Goose	Giraffe Inflow	Boulder Garden	6/14/2013	KW, KK	430925	7273209.4	Yes	18	0	0.0	1	454	
Goose	Giraffe Inflow	Cascade	6/19/2013	KW, SL	430577	7273258.4	Yes	1.5	0	1.5	60	380	
Goose	Giraffe Inflow	Cascade	6/19/2013	KW, SL	430598	7273220.7	Yes	15	0	3.0	21	381	
Goose	Giraffe Inflow	Cascade	6/19/2013	KW, SL	430637	7273178.5	Yes	14	0.029999999	4.0	24	383	
Goose	Giraffe Inflow	Boulder Garden	6/19/2013	KW, SL	430581	7273050.5	Potential	20	0	1.0	0	385	
Goose	Giraffe Inflow	Rock	6/19/2013	KW, SL	430542	7272990.7	Yes	6	0.079999998	0.0	2	386	
Goose	Giraffe Inflow	Underground Flow	6/19/2013	KW, SL	430533	7272976.1	Yes	20	0	0.0	2	387	
Goose	Giraffe Inflow	Cascade	6/19/2013	KW, SL	430540	7272930.3	Yes	14	0.119999997	2.0	24	388	
Goose	Giraffe Inflow	Rock	6/19/2013	KW, SL	430539	7272921	Yes	2.3	0	0.0	1	389	
Goose	Giraffe Inflow	Cascade	6/19/2013	KW, SL	430537	7272903.5	Potential	17	0.029999999	1.1	4		
Goose	Giraffe Inflow	Underground Flow	6/19/2013	KW, SL	430549	7272927.7	Yes	13	0	0.0	6	390	
Goose	Giraffe Inflow	Underground Flow	6/19/2013	KW, SL	430523	7272850.3	Yes	35	0	0.0	2		
Goose	Giraffe Inflow	Boulder Garden	6/19/2013	KW, SL	430446	7272799.4	Yes	10	0	0.0	1	391	
Goose	Giraffe Inflow	Underground Flow	6/19/2013	KW, SL	430392	7272740.5	Yes	8	0	0.0	1		
Goose	Giraffe Inflow	Underground Flow	6/19/2013	KW, SL	430406	7272675.1	Yes	26	0	0.0	0		
Goose	Rascal - Goose	Boulder Garden	6/16/2013	KW, SL	433896	7268964.9	Potential	50	0	0.0	0	186-188	
Goose	Umwelt Outflow	Cascade	6/15/2013	KW, KK	431016	7269952.8	Potential	15	0.300000012	1.5	4	471-473	cascade, potential seasonal barrier
Goose	Umwelt Outflow	Falls	6/15/2013	KW, KK	430973	7269978.5	Yes	6	0.050000001	2.3	50	477-480	falls, lots of subsurface flow in margins, barrier to us movement mnt
Goose	Umwelt Outflow	Underground Flow	6/15/2013	KW, KK	430270	7270471.5	Yes	500	0	0.0	0		subsurface flow for all water no channel
Goose	Umwelt Outflow	Underground Flow	6/15/2013	KW, KK	430019	7270511.7	Yes	0	0	0.0	0		
Goose	Wasp Inflow	Boulder Garden	6/19/2013	KW, SL	430421	7274402.6	Potential	30	0.100000001	0.0	0	398	
Goose	Wasp Inflow	Cascade	6/19/2013	KW, SL	430428	7274350.5	Yes	16	0.050000001	2.6	14	399-400	
Goose	Wasp Inflow	Boulder Garden	6/19/2013	KW, SL	430403	7274289.4	Potential	0	0	0.0	0	402	
Goose	Wasp Inflow	Cascade	6/19/2013	KW, SL	430383	7274202.3	unknown	8	0.129999995	0.0	16	403-404	
Goose	Wasp Inflow	Underground Flow	6/19/2013	KW, SL	430169	7274103.2	unknown	10	0.200000003	0.0	1	416	
Goose	Wasp Inflow	Underground Flow	6/19/2013	KW, SL	429865	7274373	Yes	3	0	0.0	0	422	

Appendix 3.3-2. Detailed Stream Fish Habitat, 2013

Areas								
Property	Stream	Type of Area	Date	Crew	Easting	Northing	Length (m)	Comments
Goose	-	Echo Lake	6/20/2013	KW, KK	432410	-	797	
Goose	-	Echo Pond	6/20/2013	KW, KK	432837	-	383	
Goose	Gander Inflow	Pond	6/22/2013	KW, KK	433560	-	588	Shallow pond, boulder substrate
George	George NE Inflow	Mud flats	6/21/2013	KW, KK	386752	-	1552	Depth = 0.04 m, no habitat
Goose	Giraffe Inflow	Pond	6/19/2013	KW, SL	430567	-	102	Depth = 0.25 m, 90% boulder substrate
Goose	Main Goose Pit streams	Pond	6/18/2013	KW, KK	434835	-	1100	Max depth = 0.6 m, fines substrate, shallow
Goose	Main Goose Pit streams	Pond	6/18/2013	KW, KK	434598	-	36	Max depth = 1 m, Crest = 0.1 m, small, deep
Goose	Llama Outflow	Boulder Field	6/18/2013	KW, KK	428760	-	292	Braided, 40 percent wetted
Goose	Rascal - Goose	Overland flow	6/16/2013	KW, SL	434343	-	555	overland flow , temporarily wet
Goose	Umwelt Outflow	Boulder Garden	6/15/2013	KW, KK	430952	-	267	boulder garden left bank
Goose	Umwelt Outflow	Overland flow	6/15/2013	KW, KK	430376	-	1415	large wetted area with boulder islands
Goose	Umwelt Outflow	Overland flow	6/15/2013	KW, KK	429678	-	558	no channel - 50% water 50% land
Goose	Umwelt Outflow	Pond	6/15/2013	KW, KK	429240	-	279	Shallow pond, organic substrate
Goose	Wasp Inflow	Pond	6/19/2013	KW, SL	430337	-	435	Depth = 0.4 m, no flow, organic substrate
Goose	Goose - Propeller Offchannel area	Overland flow	6/19/2013	KW, SL	435470	7270879.699	-	Ephemeral, wetted width = 4 m, depth = 0.1 m
Goose	Goose - Propeller Offchannel area	Overland flow	6/19/2013	KW, SL	435443	7270927.171	-	Wide wetland, photo 451
Goose	Goose - Propeller Offchannel area	Braided channel	6/19/2013	KW, SL	435435	7270955.945	-	Semipermanent braided channel
Goose	Goose - Propeller Offchannel area	-	6/19/2013	KW, SL	435435	7270956.48	-	Wetted width = 1.2 m, depth = 0.18 m
Goose	Goose - Propeller Offchannel area	Overland flow	6/19/2013	KW, SL	435410	7271004.688	-	Wetted width = 10 m
Goose	Goose - Propeller Offchannel area	Overland flow	6/19/2013	KW, SL	435368	7271139.026	-	Wetted width = 2.5 m, depth = 0.13 m
Goose	Goose - Propeller Offchannel area	-	6/19/2013	KW, SL	435297	7271120.054	-	very little water
Goose	Goose - Propeller Offchannel area	Overland flow	6/19/2013	KW, SL	435297	7271120.133	-	Water seeps overland 50 x 35 m area
Goose	Goose - Propeller Offchannel area	Channel	6/19/2013	KW, SL	435296	7271175.22	-	Wide shallow channel, may be permanent
Goose	Goose - Propeller Offchannel area	-	6/19/2013	KW, SL	435297	7271180.148	-	Wetted width = 7 m, depth = 0.37 m
Goose	Goose - Propeller Offchannel area	Channel split	6/19/2013	KW, SL	435265	7271237.197	-	Splits - 1 channel and overland flow
Goose	Goose - Propeller Offchannel area	-	6/19/2013	KW, SL	435257	7271243.587	-	Semipermanent, wetted width = 6 m, depth = 0.3 m
Goose	Goose - Propeller Offchannel area	-	6/19/2013	KW, SL	435190	7271278.582	-	Semipermanent, wetted width = 1.2 m, depth = 0.2 m
Goose	Goose - Propeller Offchannel area	-	6/19/2013	KW, SL	435180	7271285.754	-	Boulder cobble substrate
Goose	Goose - Propeller Offchannel area	Permanent flow	6/19/2013	KW, SL	435167	7271329.234	-	Wetted width = 2 m, depth = 0.2 m, cobble substrate
Goose	Goose - Propeller Offchannel area	Overland flow	6/19/2013	KW, SL	435153	7271360.825	-	Wetted width = 2.5 m, depth = 0.14 m
Goose	Goose - Propeller Offchannel area	Overland flow	6/19/2013	KW, SL	435124	7271404.647	-	No channel, water everywhere, 30 m
Goose	Goose - Propeller Offchannel area	-	6/19/2013	KW, SL	435110	7271495.85	-	30 x 60 area, depth = 0.35 m, boulder substrate
Goose	Goose - Propeller Offchannel area	Temporary flow	6/19/2013	KW, SL	435117	7271505.6	-	Depth = 0.22 m
Goose	Goose - Propeller Offchannel area	Permanent flow	6/19/2013	KW, SL	435116	7271515.249	-	Wetted width = 6 m, depth = 0.45 m

Location Point										
Property	Stream	Type of Location Point	Date	Crew	Easting	Northing	Distance	Gradient	Comments	Photo No.
Goose	Rascal - Goose	Island	6/16/2013	KW, SL	434271	7269133.991	0	0	Mid-channel	167
Goose	Rascal - Goose	Cascade	6/16/2013	KW, SL	433970	7268144.904	4	24		217

Appendix 3.3-3

Potential Development Area Stream Sampling Effort and
Species Summary, 2013

Appendix 3.3-3. Potential Development Area Stream Sampling Effort and Species Summary, 2013

Property	Local Name	Site #	Date (m/d/y)	Crew	Zone	Easting	Northing	Sampling Method	Method Number	Temperature (°C)	Conductivity (µS/cm)	Turbidity	Haul or Pass	EF Seconds	Length (m)	Width (m)	Enclosure	Voltage	Frequency
Goose	Giraffe inflow (TIA)	210-213	6/16/2013	KK, TM	13	431386	7273053	EF	1	-	-	-	1	196	100	5.4	N	575	30
Goose	Giraffe inflow (TIA)	210-213	6/16/2013	KK, TM	13	431081	7273107	EF	1	-	-	-	1	272	110	2	N	535	30
Goose	Giraffe inflow (TIA)	700	6/19/2013	KK, AB	13	431403	7273082	EF	1	-	-	-	1	533	306	3.5	N	500	30
Goose	Giraffe inflow (TIA)	700	6/19/2013	KK, AB	13	431403	7273082	VO	1	-	-	-	-	-	-	-	-	-	-
Goose	Giraffe inflow (TIA)	701	6/19/2013	KK, AB	13	431081	7273107	EF	1	-	-	-	1	383	150	3	N	500	30
Goose	Wasp Lake Inflow	214	6/16/2013	KK, TM	13	430417	7274352	EF	1	-	-	-	1	102	39	1.4	N	825	30
Goose	Wasp Lake Inflow	215	6/16/2013	KK, TM	13	430404	7274652	EF	1	-	-	-	1	376	-	-	N	815	30
Goose	Wasp Lake Inflow	215	6/16/2013	KK, TM	13	430404	7274652	EF	1	-	-	-	1	376	-	-	N	815	30
Goose	Wasp Lake Inflow	215	6/16/2013	KK, TM	13	430404	7274652	VO	1	-	-	-	-	-	-	-	-	-	-
Goose	Umwelt Outflow	216	6/16/2013	KK, TM	13	430375	7270302	EF	1	-	-	-	1	79	20	20	N	500	30
Goose	Umwelt Outflow	217	6/16/2013	KK, TM	13	430523	7270198	EF	1	-	-	-	1	160	50	-	N	470	30
Goose	Umwelt Outflow	218	6/16/2013	KK, TM	13	430814	7269973	EF	1	-	-	-	1	167	60	8	N	335	30
Goose	Umwelt Outflow	219	6/16/2013	KK, TM	13	429556	7270256	EF	1	-	-	-	1	282	50	15	N	410	30
Goose	Llama Outflow	-	6/18/2013	SL, AB	13	428849	7271316	EF	1	-	-	-	1	895	200	3	N	390	30
Goose	Llama Outflow	-	6/18/2013	SL, AB	13	428849	7271316	EF	1	-	-	-	1	895	200	3	N	390	30
Goose	Llama Outflow	-	6/18/2013	SL, AB	13	428849	7271316	EF	1	-	-	-	1	895	200	3	N	390	30
Goose	Main Goose Pit streams	1001	8/11/2013	KK,LT	13	434361	7269745	EF	1	-	-	-	1	310	90	4.5	N	580	40
Goose	Main Goose Pit streams	1001	8/11/2013	KK,LT	13	434361	7269745	EF	1	-	-	-	1	310	90	4.5	N	580	40
Goose	Main Goose Pit streams	1001	8/11/2013	KK,LT	13	434361	7269745	EF	1	-	-	-	1	310	90	4.5	N	580	40
Goose	Main Goose Pit streams	1001	8/11/2013	KK,LT	13	434361	7269745	EF	1	-	-	-	1	310	90	4.5	N	580	40
Goose	Main Goose Pit streams (N airstrip crossing)	1101	8/11/2013	KK, LT	13	434041	7269033	EF	1	-	-	-	1	322	107	5	N	800	40
Goose	Main Goose Pit streams (N airstrip crossing)	1101	8/11/2013	KK, LT	13	434041	7269033	EF	1	-	-	-	1	322	107	5	N	800	40
Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	8/11/2013	KK, LT	13	434066	7268964	EF	1	-	-	-	1	203	100	3	N	800	40
Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	8/11/2013	KK, LT	13	434066	7268964	EF	1	-	-	-	1	203	100	3	N	800	40
Goose	Main Goose Pit streams	1006	8/11/2013	KK, LT	13	433924	7268309	EF	1	-	-	-	1	124	72	4	N	835	40
Goose	Main Goose Pit streams	1006	8/11/2013	KK, LT	13	433924	7268309	EF	1	-	-	-	1	124	72	4	N	835	40
George	Occurrence Outflow	404	6/17/2013	SL, TM	13	387729	7312942	EF	1	-	-	-	1	351	50	2	N	400	30
Goose	Pond A inflow	-	6/20/2013	KW, KK	13	429292	7273569	EF	1	-	-	-	1	104	60	1.5	N	650	30

Species Code
ARGR = Arctic Grayling
NSSB = Ninespine Stickleback
RDWH = Round Whitefish
SLSC = Slimy Sculpin
NFC = no fish caught

Stage
IM = immature
M = mature

EF = electrofishing
VO = visual observation

Dashes indicate data not available

Appendix 3.3-3. Receiving Environment Stream Sampling Effort and Species Summary, 2013

Property	Local Name	Site #	Date (m/d/y)	Pulse	Make	Model	Species Code	Stage	Total Number	Min. Length (mm)	Max. Length (mm)	Comments
Goose	Giraffe inflow (TIA)	210-213	6/16/2013	12	Smithroot	LR-24	NFC	-	0	-	-	FHAP site 210
Goose	Giraffe inflow (TIA)	210-213	6/16/2013	12	Smithroot	LR-24	NFC	-	0	-	-	At Giraffe hydrostation
Goose	Giraffe inflow (TIA)	700	6/19/2013	12	Smithroot	LR-24	NFC	-	0	-	-	1 SLSC observed in Giraffe Lake but no fish caught or observed upstream of reach 700 (210)
Goose	Giraffe inflow (TIA)	700	6/19/2013	-	-	-	SLSC	-	1	-	-	1 SLSC observed in Giraffe Lake but no fish caught or observed upstream of reach 700 (210)
Goose	Giraffe inflow (TIA)	701	6/19/2013	12	Smithroot	LR-24	NFC	-	0	-	-	-
Goose	Wasp Lake Inflow	214	6/16/2013	12	Smithroot	LR-24	NFC	-	0	-	-	-
Goose	Wasp Lake Inflow	215	6/16/2013	12	Smithroot	LR-24	ARGR	IM	1	78	78	For habitat details see FHAP Site 215
Goose	Wasp Lake Inflow	215	6/16/2013	12	Smithroot	LR-24	SLSC	-	1	72	72	-
Goose	Wasp Lake Inflow	215	6/16/2013	-	-	-	SLSC	-	2	-	-	-
Goose	Umwelt Outflow	216	6/16/2013	12	Smithroot	LR-24	NFC	-	0	-	-	-
Goose	Umwelt Outflow	217	6/16/2013	12	Smithroot	LR-24	NFC	-	0	-	-	-
Goose	Umwelt Outflow	218	6/16/2013	12	Smithroot	LR-24	NFC	-	0	-	-	-
Goose	Umwelt Outflow	219	6/16/2013	12	Smithroot	LR-24	NFC	-	0	-	-	-
Goose	Llama Outflow	-	6/18/2013	12	Smithroot	LR-24	NSSB	-	2	47	50	-
Goose	Llama Outflow	-	6/18/2013	12	Smithroot	LR-24	SLSC	-	2	61	64	-
Goose	Llama Outflow	-	6/18/2013	12	Smithroot	LR-24	ARGR	IM	2	80	108	-
Goose	Main Goose Pit streams	1001	8/11/2013	12	Smithroot	LR-24	ARGR	-	4			-
Goose	Main Goose Pit streams	1001	8/11/2013	12	Smithroot	LR-24	SLSC	-	5			-
Goose	Main Goose Pit streams	1001	8/11/2013	12	Smithroot	LR-24	NSSB	-	2			-
Goose	Main Goose Pit streams	1001	8/11/2013	12	Smithroot	LR-24	RDWH	-	1			-
Goose	Main Goose Pit streams (N airstrip crossing)	1101	8/11/2013	12	Smithroot	LR-24	ARGR	-	8			-
Goose	Main Goose Pit streams (N airstrip crossing)	1101	8/11/2013	12	Smithroot	LR-24	SLSC	-	7			-
Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	8/11/2013	12	Smithroot	LR-24	SLSC	-	4			-
Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	8/11/2013	12	Smithroot	LR-24	ARGR	-	7			-
Goose	Main Goose Pit streams	1006	8/11/2013	12	Smithroot	LR-24	ARGR	-	12			-
Goose	Main Goose Pit streams	1006	8/11/2013	12	Smithroot	LR-24	SLSC	-	2			-
George	Occurrence Outflow	404	6/17/2013	12	Smithroot	LR-24	NFC	-	0	-	-	-
Goose	Pond A inflow	-	6/20/2013	12	Smithroot	LR-24	NFC	-	0	-	-	-

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Appendix 3.3-4

Individual Fish Data — Potential Development Area
Streams, 2013

Appendix 3.3-4. Individual Fish Data - Potential Development Area Streams, 2013

Date (m/d/y)	Property	Waterbody	Site	Sample Method	HP No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm ³)	Age	Comments
6/16/2013	Goose	Wasp Lake Inflow	215	EF	1	1	ARGR	78	5.3	1.12	-	-
6/16/2013	Goose	Wasp Lake Inflow	215	EF	1	2	SLSC	72	4	1.07	-	-
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	1	ARGR	120	19.8	1.15	-	-
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	2	SLSC	58	2.09	1.07	-	-
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	3	ARGR	115	16.1	1.06	-	photo 1115
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	4	SLSC	67	3.3	1.10	-	-
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	5	SLSC	63	3.2	1.28	-	-
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	6	RDWH	53	1.2	0.81	-	photo 1116-1117
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	7	SLSC	75	4.4	1.04	-	-
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	8	ARGR	37	0.55	1.09	-	-
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	9	ARGR	45	1.21	1.33	-	photo 1120
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	10	SLSC	43	0.9	1.13	-	-
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	11	NSSB	24	0.1	0.72	-	-
8/11/2013	Goose	Main Goose Pit streams	1001	EF	1	12	NSSB	22	0.1	0.94	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	1	ARGR	39	0.6	1.01	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	2	ARGR	47	1.2	1.16	-	Mortality
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	3	SLSC	75	4.7	1.11	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	4	ARGR	43	0.6	0.75	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	5	SLSC	72	3.4	0.91	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	6	SLSC	63	3.5	1.40	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	7	SLSC	104	14.3	1.27	-	Mortality
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	8	ARGR	53	2.4	1.61	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	9	ARGR	43	1.4	1.76	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	10	ARGR	42	0.8	1.08	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	11	ARGR	45	1.2	1.32	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	12	SLSC	66	2.9	1.01	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	13	ARGR	49	1.1	0.93	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	14	SLSC	61	2.3	1.01	-	-
8/11/2013	Goose	Main Goose Pit streams (N airstrip crossing)	1101	EF	1	15	SLSC	63	2.6	1.04	-	-
8/11/2013	Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	EF	1	1	SLSC	76	4.3	0.98	-	-
8/11/2013	Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	EF	1	2	ARGR	56	1.8	1.02	-	-
8/11/2013	Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	EF	1	3	SLSC	55	1.8	1.08	-	-
8/11/2013	Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	EF	1	4	ARGR	43	0.9	1.13	-	-
8/11/2013	Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	EF	1	5	ARGR	53	1.3	0.87	-	-
8/11/2013	Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	EF	1	6	ARGR	49	1.2	1.02	-	-
8/11/2013	Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	EF	1	7	ARGR	43	0.8	1.01	-	-
8/11/2013	Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	EF	1	8	ARGR	58	2.2	1.13	-	-
8/11/2013	Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	EF	1	9	SLSC	60	1.8	0.83	-	-
8/11/2013	Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	EF	1	10	SLSC	57	1.3	0.70	-	-
8/11/2013	Goose	Main Goose Pit streams (Middle airstrip crossing)	1004	EF	1	11	ARGR	55	1.1	0.66	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	1	ARGR	46	1	1.03	-	-

Appendix 3.3-4. Individual Fish Data - Potential Development Area Streams, 2013

Date (m/d/y)	Property	Waterbody	Site	Sample Method	HP No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm ³)	Age	Comments
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	2	SLSC	66	2.8	0.97	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	3	ARGR	56	1.6	0.91	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	4	ARGR	45	0.8	0.88	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	5	ARGR	51	1.2	0.90	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	6	ARGR	45	-		-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	7	ARGR	54	1.6	1.02	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	8	ARGR	40	0.5	0.78	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	9	ARGR	41	0.5	0.73	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	10	SLSC	60	1.8	0.83	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	11	ARGR	40	0.8	1.25	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	12	ARGR	45	1.2	1.32	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	13	ARGR	40	0.76	1.19	-	-
8/11/2013	Goose	Main Goose Pit streams	1006	EF	1	14	ARGR	45	0.8	0.88	-	-
6/18/2013	Goose	Llama Outflow	-	EF	1	1	NSSB	50	2.5	2.00	-	-
6/18/2013	Goose	Llama Outflow	-	EF	1	2	NSSB	47	2	1.93	-	-
6/18/2013	Goose	Llama Outflow	-	EF	1	3	SLSC	64	3.2	1.22	-	-
6/18/2013	Goose	Llama Outflow	-	EF	1	4	SLSC	61	2	0.88	-	-
6/18/2013	Goose	Llama Outflow	-	EF	1	5	ARGR	80	5.1	1.00	-	Immature
6/18/2013	Goose	Llama Outflow	-	EF	1	6	ARGR	108	15.5	1.23	-	Immature

Species Code

ARGR = Arctic Grayling

BURB = Burbot

RDWH = Round Whitefish

NSSB = Ninespine Stickleback

SLSC = Slimy Sculpin

EF = electrofishing

Dashes indicate data not available

Appendix 3.3-5

Arctic Grayling Spawning Survey Observations, 2013

Appendix 3.3-5. Arctic Grayling Spawning Survey Observations, 2013

Date (m/d/y)	Site	Crew	Turbidity	Weather	Zone	Easting	Northing	Species	Count	Stage	Habitat unit	Depth (m)	Substrate	Total Cover (%)	Cover Type (% of total)	Comments
6/17/2013	George inflow (site 401)	KK, TM	Clear	Overcast	13W	388325	7315192	-	-	-	-	-	-	-	-	Start of survey
6/17/2013	George inflow (site 401)	KK, TM	Clear	Overcast	13W	386293	7315225	ARGR	6	Adult	Glide	0.4	50% CO, 50% BO	40	90% UCB, 10% OV	Holding in glide below adjacent pool
6/17/2013	George inflow (site 401)	KK, TM	Clear	Overcast	13W	386286	7315251	ARGR	2	Juvenile	Pool	0.3	100% FI	25	50% IV, 50% OV	
6/17/2013	George inflow (site 401)	KK, TM	Clear	Overcast	13W	386287	7315253	ARGR	2	Adult	Pool	0.8	80% FI, 20% BO	35	90% UCB, 10% OV	
6/17/2013	George inflow (site 401)	KK, TM	Clear	Overcast	13W	386282	7315260	ARGR	2	Adult	Riffle	0.35	-	40	50% UCB, 50% IV	
6/17/2013	George inflow (site 401)	KK, TM	Clear	Overcast	13W	386266	7315275	ARGR	1	Juvenile	Glide	0.2	100% FI	30	60%IV, 40% OV	
6/17/2013	George inflow (site 401)	KK, TM	Clear	Overcast	13W	386269	7315286	ARGR	7	Adult	Pool	1.2	100% FI	20	60% DP, 40% UCB	
6/17/2013	George inflow (site 401)	KK, TM	Clear	Overcast	13W	386243	7315311	ARGR	2	Juvenile	Glide	0.45	35% FI, 15% GR, 25% CO, 25% BO	20	80% UCB, 20% OV	
6/17/2013	George inflow (site 401)	KK, TM	Clear	Overcast	13W	386218	7315346	ARGR	1	Juvenile	Glide	0.5	100% FI	10	80% UCB, 20%OV	
6/17/2013	George inflow (site 401)	KK, TM	Clear	Overcast	13W	386217	7315342	-	-	-	-	-	-	-	-	End of survey
6/19/2013	Goose - Propeller Offchannel	KW, SL	Clear	Sunny	13W	435466	7270890	NSSB	1		-	-	-	-	-	
6/19/2013	Goose - Propeller Offchannel	KW, SL	Clear	Sunny	13W	435161	7271348	NSSB	1		-	-	-	-	-	
6/19/2013	Goose - Propeller Offchannel	KW, SL	Clear	Sunny	13W	435118	7271485	ARGR	1	Adult	-	-	-	-	-	
6/19/2013	Goose - Propeller Offchannel	KW, SL	Clear	Sunny	13W	435085	7271617	UNK	1		-	-	-	-	-	
6/19/2013	Goose - Propeller Offchannel	KW, SL	Clear	Sunny	13W	435065	7271633	ARGR	4	Juvenile	-	-	-	-	-	
6/19/2013	Goose - Propeller Offchannel	KW, SL	Clear	Sunny	13W	435005	7271534	UNK	1		-	-	-	-	-	
6/19/2013	Goose - Propeller Offchannel	KW, SL	Clear	Sunny	13W	435010	7271540	ARGR	1	Large Juvenile	-	-	-	-	-	
6/19/2013	Goose - Propeller Offchannel	KW, SL	Clear	Sunny	13W	435041	7271603	ARGR	2	Large Juvenile	-	-	-	-	-	
6/18/2013	Main Goose Pit streams	KK, KW	Clear	Overcast	13W	434725	7269694	ARGR	1	Juvenile	-	-	-	-	-	
6/18/2013	Main Goose Pit streams	KK, KW	Clear	Overcast	13W	434628	7269609	ARGR	2	Juvenile	-	-	-	-	-	
6/18/2013	Main Goose Pit streams	KK, KW	Clear	Overcast	13W	434611	7269571	ARGR	1	Juvenile	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434322	7269745	UNK	7	Small	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434352	7269759	ARGR	4	Juvenile	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434379	7269708	SLSC	1	Small	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434369	7269644	ARGR	1	Large Juvenile	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434453	7269409	UNK	5	Small	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434451	7269410	UNK	5	Small	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434445	7269394	UNK	1	Small	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434470	7269424	UNK	2	Small	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434410	7269387	UNK	3	Small	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434301	7269356	ARGR	1	Adult or large subadult	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434285	7269332	ARGR	4	Adult	-	-	-	-	-	Spawners in group over gravel. Photos 172-173
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434235	7269255	ARGR	2	Adult	Riffle	-	-	-	-	Spawners over cobble/boulder riffle
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434225	7269236	UNK	1	Small	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434222	7269201	ARGR	1	Large Juvenile	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434312	7269258	ARGR	1	Juvenile	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434121	7269062	ARGR	1	Large Juvenile	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434086	7269053	ARGR	1	Large Juvenile	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	434080	7268964	ARGR	2	Adult	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	433994	7268099	SLSC	1	Small	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	433886	7268374	ARGR	2	Large Juvenile	-	-	-	-	-	
6/16/2013	Main Goose Pit streams	KW, SL	Clear	Sunny	13W	433882	7268395	ARGR	1	Large Juvenile	-	-	-	-	-	
6/18/2013	Llama Lake Outflow	KK, KW	Clear	Overcast	13W	428858	7271368.2	SLSC	1	-	-	-	-	-	-	
6/18/2013	Llama Lake Outflow	KK, KW	Clear	Overcast	13W	428745	7271703.2	ARGR	1	Juvenile	-	-	-	-	-	

Dashes indicate data not available

Substrate

CO = cobble

BO = boulder

FI = fines

GR = gravel

Cover Type

UCB = undercut bank

IV = instream vegetation

OV = overhead vegetation

DP = deep pool

Appendix 3.3-6

Arctic Grayling Fry Survey Observations, 2013

Appendix 3.3-6. Arctic Grayling Fry Survey Observations, 2013

Date (m/d/y)	Site	Crew	Turbidity	Weather	Zone	Easting	Northing	Species	Count	Stage	Habitat type	Substrate (Dom/Sub Dom)	Comments	Photos
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434335	7269803	ARGR	1	Fry	glide	CO/BO	Start at Goose Lake	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434335	7269803	NSSB	3	-	glide	CO/BO	Start at Goose Lake	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434335	7269803	SLSC	2	-	glide	CO/BO	Start at Goose Lake	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434347	7269777	ARGR	5	Fry	glide	CO/GR	w/ UCB	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434351	7269752	ARGR	6	Fry	-	BO/CO	braided section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434351	7269752	NSSB	1	-	-	BO/CO	braided section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434361	7269745	ARGR	6	Fry	-	CO/FI	UCB on most edges, braided section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434361	7269745	ARGR	3	Large juvenile	-	CO/FI	UCB on most edges, braided section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434361	7269745	SLSC	1	-	-	CO/FI	UCB on most edges, braided section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434354	7269820	ARGR	6	Fry	-	CO/BO	-	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434370	7269696	ARGR	1	Fry	riffle	GR/CO	faster flowing section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434370	7269696	UNK	2	-	riffle	GR/CO	faster flowing section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434365	7269632	ARGR	25	Fry	glide	BO/FI	slow water	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434365	7269632	NSSB	3	-	glide	BO/FI	slow water	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434450	7269477	ARGR	100	Fry	pool	FI	pond section	1121
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434450	7269477	NSSB	40	-	pool	FI	pond section	1121
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434467	7269438	ARGR	56	Fry	pool	FI/BO	pond section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434467	7269438	ARGR	1	Juvenile	pool	FI/BO	pond section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434467	7269438	ARGR	1	Large juvenile	pool	FI/BO	pond section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434467	7269438	NSSB	15	-	pool	FI/BO	pond section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434446	7269409	ARGR	23	Fry	glide	CO/BO	-	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434446	7269409	ARGR	1	Juvenile	glide	CO/BO	-	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434446	7269409	NSSB	11	-	glide	CO/BO	-	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434359	7269356	ARGR	12	Fry	riffle	BO/CO	slight UCB used for cover by juv. ARGR	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434359	7269356	ARGR	1	Juvenile	riffle	BO/CO	slight UCB used for cover by juv. ARGR	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434359	7269356	SLSC	2	-	riffle	BO/CO	slight UCB used for cover by juv. ARGR	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434348	7269349	ARGR	1	Fry	glide-pool	CO/BO	slight UCB used for cover by juv. ARGR	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434348	7269349	ARGR	1	Juvenile	glide-pool	CO/BO	slight UCB used for cover by juv. ARGR	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434332	7269286	ARGR	22	Fry	riffle-pool	CO/BO	slight UCB used for cover by juv. ARGR, Stream confluence	1122 d/s 1123 u/s
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434332	7269286	NSSB	1	-	riffle-pool	CO/BO	slight UCB used for cover by juv. ARGR, Stream confluence	1122 d/s 1123 u/s
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434302	7269203	ARGR	28	Fry	glide-pool	CO/BO	slight UCB used for cover by juv. ARGR	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434302	7269203	SLSC	1	-	glide-pool	CO/BO	slight UCB used for cover by juv. ARGR	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434257	7269117	ARGR	20	Fry	BG w/ pools	BO/CO	seepage between boulders	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434257	7269117	NSSB	2	-	BG w/ pools	BO/CO	seepage between boulders	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434243	7269023	ARGR	26	Fry	BG w/ pools	BO/CO	seepage between boulders, UCB	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434243	7269023	UNK	2	-	BG w/ pools	BO/CO	seepage between boulders, UCB	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434066	7268964	ARGR	84	Fry	glide-pool	BO/CO	some sections BG with only seepage between	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433972	7268916	ARGR	45	Fry	BG w/ pools	BO/CO	some willow as OV cover	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433924	7268859	ARGR	64	Fry	BG w/ pools	BO/CO	some willow as OV cover	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433924	7268859	ARGR	2	Juvenile	BG w/ pools	BO/CO	some willow as OV cover	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433924	7268859	SLSC	1	-	BG w/ pools	BO/CO	some willow as OV cover	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433940	7268767	ARGR	59	Fry	glide-pool	BO/CO	some BG areas, lower water than d/s	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433940	7268767	ARGR	1	Juvenile	glide-pool	BO/CO	some BG areas, lower water than d/s	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433937	7268677	ARGR	29	Fry	glide-pool	BO/CO	braided section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434016	7268611	ARGR	80	Fry	glide-pool	BO/CO	some BG areas	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433995	7268532	ARGR	106	Fry	-	BO/CO	Pond at end of section	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	434014	7268453	-	-	-	-	-	Pond - not surveyed	-
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433948	7268386	ARGR	108	Fry	glide-pool	BO/CO	BG @ Wpt 395 possible barrier at time of survey (low water)	1127 d/s, 1128 u/s
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433924	7268309	ARGR	129	Fry	glide-pool	BO/CO	BG u/s of 396	1130 and 1129
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433933	7268222	ARGR	80	Fry	BG w/ pools	BO/CO	bigger pool below Rascal Lake, some subsurface flow in this section	1132 - isolated pool habitat, 1132 subsurface flow
8/11/2013	Rascal - Goose	KK, LT	Clear	Sunny, calm	13W	433933	7268222	ARGR	3	Large juvenile	BG w/ pools	BO/CO	bigger pool below Rascal Lake, some subsurface flow in this section	1132 - isolated pool habitat, 1132 subsurface flow
8/11/2013	Gander Pond Outflow	FR, LO	Clear	Sunny, calm	13W	432845	7270079	-	-	-	-	-	Isolated pond, no flow d/s of here. Small dry waterfall at d/s end	3818, 3819
8/11/2013	Gander Pond Outflow	FR, LO	Clear	Sunny, calm	13W	432852	7270064	-	-	-	Riffle	-	Small riffle with flow	3821
8/11/2013	Gander Pond Outflow	FR, LO	Clear	Sunny, calm	13W	432865	7270000	-	-	-	-	-	Dry creek bed	3827-3829
8/11/2013	Gander Pond Outflow	FR, LO	Clear	Sunny, calm	13W	432869	7269956	-	-	-	Pond	-	-	3832
8/11/2013	Gander Pond Outflow	FR, LO	Clear	Sunny, calm	13W	432869	7269952	-	-	-	-	-	-	3833
8/11/2013	Gander Pond Outflow	FR, LO	Clear	Sunny, calm	13W	432890	7269916	-	-	-	-	-	Hydrology station	3835
8/11/2013	Gander Pond Outflow	FR, LO	Clear	Sunny, calm	13W	432890	7269903	-	-	-	-	-	-	3836-3837
8/11/2013	Gander Pond Outflow	FR, LO	Clear	Sunny, calm	13W	432901	7269889	-	-	-	-	-	-	3838
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433284	7269479	-	-	-	-	-	-	3847-3849
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433357	7269440	-	-	-	-	-	-	3860
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433429	7269397	ARGR	4	Fry	-	-	-	3865-3866
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433447	7269374	ARGR	12	Fry	-	-	-	3877

Appendix 3.3-6. Arctic Grayling Fry Survey Observations, 2013

Date (m/d/y)	Site	Crew	Turbidity	Weather	Zone	Easting	Northing	Species	Count	Stage	Habitat type	Substrate (Dom/Sub Dom)	Comments	Photos
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433483	7269378	-	-	-	-	-	-	3886
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433539	7269339	ARGR	2	Fry	-	-	-	3892
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433541	7269331	ARGR	11	Fry	-	-	-	-
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433565	7269272	ARGR	8	Fry	-	-	-	3902-3905
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433543	7269180	ARGR	6	Fry	-	-	-	3915
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433626	7269134	ARGR	25	Fry	-	-	-	-
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433626	7269134	ARGR	10	Small fry (50 mm)	-	-	-	-
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433631	7269142	ARGR	8		-	-	-	3922-3923
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433643	7269155	ARGR	4	Fry	-	-	-	3924
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433672	7269157	ARGR	2	Fry	-	-	-	-
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433681	7269154	ARGR	1	Fry	-	-	-	-
8/11/2013	Gander Pond Inflow	FR, LO	Clear	Sunny, calm	13W	433758	7268998	ARGR	6	Fry	-	-	Pond edge	3942
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433846	7268920	ARGR	5	Fry	-	-	-	3947
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433847	7268920	ARGR	2	Small fry (50 mm)	-	-	-	3950
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433866	7268943	ARGR	1		-	-	-	3951
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433876	7268961	ARGR	1	Fry	-	-	-	3952-3953
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433869	7268975	ARGR	4	Fry	-	-	-	3954
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433892	7268981	ARGR	4	Fry	-	-	-	3955-3956
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433899	7268985	ARGR	4	Fry	-	-	-	3957
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433912	7268994	ARGR	4	Fry	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433912	7268990	ARGR	10	Fry	-	-	-	3958
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433920	7268996	ARGR	35	Fry	-	-	-	3959, 3962
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433922	7268992	ARGR	19	Fry	-	-	-	3963
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433934	7269006	ARGR	24	Fry	-	-	-	3964
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433934	7269001	ARGR	3	Fry	-	-	-	3965
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433937	7268998	ARGR	5	Fry	-	-	-	3966
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433942	7269011	ARGR	4	Fry	-	-	-	3967
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433944	7269003	ARGR	3	Fry	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433958	7269018	ARGR	10	Fry	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433971	7269028	ARGR	15	Fry	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433967	7269018	ARGR	3	Fry	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433976	7269020	ARGR	4	Fry	-	-	-	3969
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433991	7269030	ARGR	12	Fry	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433994	7269029	ARGR	1	Large juvenile	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433994	7269029	ARGR	6		-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434007	7269042	ARGR	35	Fry	-	-	in 5 pools	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434023	7269044	ARGR	10	Fry	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434037	7269036	ARGR	24	Fry	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434037	7269037	-	-	-	-	-	Start of braided section	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434117	7269064	-	-	-	-	-	End	3972
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434118	7269064	-	-	-	-	-	-	3973
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434216	7269149	ARGR	46	Fry	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434216	7269149	ARGR	3	Large juvenile	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434218	7269188	ARGR	63		-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434218	7269188	ARGR	4	Large juvenile	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434345	7269350	-	-		-	-	End	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434930	7268328	NSSB	6	-	-	-	2 alive, 4 dead	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434926	7268333	NSSB	33	-	-	-	All dead (20-35mm)	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434919	7268336	NSSB	28	-	-	-	Most still alive	4012
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434908	7268351	NSSB	50	-	-	-	-	4016
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434901	7268361	NSSB	2	-	-	-	-	4017
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434898	7268370	NSSB	6	-	-	-	1 large dead, 5 small	4018
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434896	7268374	NSSB	30	-	-	-	-	4019
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434889	7268407	NSSB	5	-	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434857	7268475	-	-	-	-	-	No fish in a couple pools	4027
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434813	7268614	-	-	-	-	-	Isolated pools	4033
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434754	7268710	-	-	-	-	-	No fish	4036
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434654	7268972	-	-	-	-	-	Outflow	4043
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434611	7269061	NSSB	1	-	-	-	14.3 C, 95 cm max depth	4051
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434473	7269424	-	-	-	-	-	End	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434635	7269475	-	-	-	-	-	Start	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434623	7269524	-	-	-	-	-	-	4083
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	-	-	-	-	-	-	-	-	No fish	4085

Appendix 3.3-6. Arctic Grayling Fry Survey Observations, 2013

Date (m/d/y)	Site	Crew	Turbidity	Weather	Zone	Easting	Northing	Species	Count	Stage	Habitat type	Substrate (Dom/Sub Dom)	Comments	Photos
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434621	7269623	-	-	-	-	-	isolated pool	4093-4094
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434675	7269636	-	-	-	-	-	Hydro station	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434731	7269694	-	-	-	-	-	Barrier	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434738	7269701	-	-	-	-	-	End	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434012	7269047	-	-	-	-	-	Start Airstrip Trib	4120-4121
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	434001	7269050	ARGR	12	Fry	-	-	-	4122
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433982	7269046	ARGR	8	Fry	-	-	-	4123
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433961	7269044	ARGR	4	Fry	-	-	-	4124
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433936	7269061	ARGR	8	Fry	-	-	-	4125-4126
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433936	7269063	ARGR	8	Fry	-	-	-	-
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433921	7269073	ARGR	28	Fry	-	-	-	4129
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433910	7269097	ARGR	51	Fry	-	-	-	4130
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433896	7269106	ARGR	14	Fry	-	-	-	4132
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433873	7269110	ARGR	12	Fry	-	-	-	4133
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433857	7269099	ARGR	27	Fry	-	-	-	4135
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433855	7269083	ARGR	6	Fry	-	-	-	4035
8/11/2013	Main Goose Pit streams	FR, LO	Clear	Sunny, calm	13W	433856	7269078	-	-	-	-	-	End of survey	4036-4039

*Rascal - Goose was considered a part of the Main Goose Pit streams

UCB = undercut bank

OV = overhead vegetation

BG = boulder garden

d/s = downstream

u/s = upstream

Dashes indicate data not available

Fry = < 70 mm

Juvenile = < 70 mm

Large Juvenile = < 100 mm

Appendix 3.4-1

Lake Substrate Zone Data, 2013

Appendix 3.4-1. Lake Substrate Zone Data, 2013

Lake	Date (m/d/y)	Crew	Weather	Water Temp	Habitat Unit	Fines	Gravel	Cobble	Boulder	Bedrock	Vegetation Abundance	Vegetation Type	Start Easting	Start Northing	End Easting	End Northing
McCoy	7/8/2013	LT, CC, CM	-	-	A	80	5	5	10	0	s	m	-	-	-	-
McCoy	7/8/2013	LT, CC, CM	-	-	B	10	10	20	60	0	s	m	-	-	-	-
McCoy	7/8/2013	LT, CC, CM	-	-	C	10	5	20	65	0	n	n	-	-	-	-
McCoy	7/8/2013	LT, CC, CM	-	-	D	30	15	30	25	0	s	m	-	-	-	-
McCoy	7/8/2013	LT, CC, CM	-	-	E	5	30	40	25	0	n	n	-	-	-	-
McCoy	7/8/2013	LT, CC, CM	-	-	F	20	10	20	50	0	n	n	-	-	-	-
McCoy	7/8/2013	LT, CC, CM	-	-	G	50	10	10	20	10	n	n	-	-	-	-
McCoy	7/8/2013	LT, CC, CM	-	-	H	0	20	20	40	20	n	n	-	-	-	-
McCoy	7/8/2013	LT, CC, CM	-	-	I	50	10	20	20	0	n	n	-	-	-	-
Reference Q	7/7/2013	LT, CC, RD	-	-	A	10	20	20	50	0	a	m/s	-	-	-	-
Reference Q	7/7/2013	LT, CC, RD	-	-	B	20	20	20	40	0	a	m/v	-	-	-	-
Reference Q	7/7/2013	LT, CC, RD	-	-	C	0	40	40	20	0	n	n	-	-	-	-
Reference Q	7/7/2013	LT, CC, RD	-	-	D	0	30	30	40	0	n	n	-	-	-	-
Reference Q	7/7/2013	LT, CC, RD	-	-	E	0	10	50	40	0	n	n	-	-	-	-
Reference Q	7/7/2013	LT, CC, RD	-	-	F	0	5	20	15	60	n	n	-	-	-	-
Reference Q	7/7/2013	LT, CC, RD	-	-	G	30	10	40	20	0	n	n	-	-	-	-
Reference Q	7/7/2013	LT, CC, RD	-	-	H	60	20	20	0	0	n	n	-	-	-	-
Bob	7/10/2013	SL, KG	Clear, sun	14.9	A	90	6	2	2	0	s	s	-	-	-	-
Bob	7/10/2013	SL, KG	Clear, sun	14.9	B	0	5	90	5	0	n	n	-	-	-	-
Bob	7/10/2013	SL, KG	Clear, sun	14.9	C	0	0	50	50	0	n	n	-	-	-	-
Bob	7/10/2013	SL, KG	Clear, sun	14.9	D	0	0	0	100	0	n	n	-	-	-	-
Bob	7/10/2013	SL, KG	Clear, sun	14.9	E	20	0	0	80	0	n	n	-	-	-	-
Bob	7/10/2013	SL, KG	Clear, sun	14.9	F	50	25	25	0	0	n	n	-	-	-	-
Bob	7/10/2013	SL, KG	Clear, sun	14.9	G	10	20	70	0	0	n	n	-	-	-	-
Giraffe	7/13/2013	LT, KK, CM, RD	-	-	A	60	5	25	10	0	n	n	-	-	-	-
Giraffe	7/13/2013	LT, KK, CM, RD	-	-	B	65	5	10	20	0	n	n	-	-	-	-
Giraffe	7/13/2013	LT, KK, CM, RD	-	-	C	20	10	30	40	0	n	n	-	-	-	-
Giraffe	7/13/2013	LT, KK, CM, RD	-	-	D	70	10	10	10	0	n	n	-	-	-	-
Giraffe	7/13/2013	LT, KK, CM, RD	-	-	E	5	15	60	20	0	n	n	-	-	-	-
Giraffe	7/13/2013	LT, KK, CM, RD	-	-	F	0	10	10	20	60	n	n	-	-	-	-
Giraffe	7/13/2013	LT, KK, CM, RD	-	-	G	65	20	5	10	0	n	n	-	-	-	-
Giraffe	7/13/2013	LT, KK, CM, RD	-	-	H	0	20	20	60	0	n	n	-	-	-	-
Giraffe	7/13/2013	LT, KK, CM, RD	-	-	I	30	30	20	20	0	n	n	-	-	-	-
Giraffe	7/13/2013	LT, KK, CM, RD	-	-	J	65	30	20	5	0	n	n	-	-	-	-
Propeller Lake	8/2/2013	LT, KK	-	-	L	60	25	10	5	0	n	n	-	-	-	-
Propeller Lake	8/2/2013	LT, KK	-	-	M	80	10	5	5	0	n	n	-	-	-	-
Propeller Lake	8/2/2013	LT, KK	-	-	N	5	15	30	50	0	n	n	-	-	-	-
Propeller Lake	8/2/2013	LT, KK	-	-	O	10	25	40	25	0	n	n	-	-	-	-
Propeller Lake	8/2/2013	LT, KK	-	-	P	30	10	30	30	0	n	n	-	-	-	-
Propeller Lake	8/2/2013	LT, KK	-	-	Q	5	5	30	40	20	n	n	-	-	-	-
Propeller Lake	8/2/2013	LT, KK	-	-	R	5	5	20	20	50	n	n	-	-	-	-
Propeller Lake	8/2/2013	LT, KK	-	-	S	25	25	25	25	0	n	n	-	-	-	-
Propeller Lake	8/2/2013	LT, KK	-	-	T	20	30	40	10	0	n	n	-	-	-	-

Appendix 3.4-1. Lake Substrate Zone Data, 2013

Lake	Date (m/d/y)	Crew	Weather	Water Temp	Habitat Unit	Fines	Gravel	Cobble	Boulder	Bedrock	Vegetation Abundance	Vegetation Type	Start Easting	Start Northing	End Easting	End Northing
Wasp Lake	8/4/2013	FR	Clear, sun	14	A	5	15	30	40	10	s	s	429892	7277326	430338	7276352
Wasp Lake	8/4/2013	FR	Clear, sun	14	B	40	20	20	20	0	a	s	430338	7276352	430365	7276039
Wasp Lake	8/4/2013	FR	Clear, sun	14	C	0	10	10	60	20	n	n	430365	7276039	430400	7275485
Wasp Lake	8/4/2013	FR	Clear, sun	14	D	0	10	10	40	40	n	n	430400	7275485	430684	7274793
Wasp Lake	8/4/2013	FR	Clear, sun	14	E	0	10	10	60	20	n	n	430684	7274793	430361	7274852
Wasp Lake	8/4/2013	FR	Clear, sun	14	F	0	10	10	40	40	n	n	430361	7274852	430317	7275044
Wasp Lake	8/4/2013	FR	Clear, sun	14	G	5	15	30	40	10	n	n	430317	7275044	430459	7275233
Wasp Lake	8/4/2013	FR	Clear, sun	14	H	0	0	0	10	90	n	n	430459	7275233	430433	7275318
Wasp Lake	8/4/2013	FR	Clear, sun	14	I	0	10	10	40	40	n	n	430433	7275318	430254	7275843
Wasp Lake	8/4/2013	FR	Clear, sun	14	J	0	10	10	60	20	n	n	430254	7275843	430051	7276570
Wasp Lake	8/4/2013	FR	Clear, sun	14	K	30	0	10	40	20	n	n	430051	7276570	430038	7276941
Wasp Lake	8/4/2013	FR	Clear, sun	14	L	0	10	10	40	40	n	n	430038	7276941	429892	7277326
Canyon Lake 1	8/7/2013	LT, KK	-	-	F	5	15	20	60	0	n	n	-	-	-	-
Canyon Lake 1	8/7/2013	LT, KK	-	-	G	75	10	5	10	0	n	n	-	-	-	-
Canyon Lake 1	8/7/2013	LT, KK	-	-	I	20	20	35	25	0	n	n	-	-	-	-
Canyon Lake 1	8/7/2013	LT, KK	-	-	J	5	15	30	40	0	n	n	-	-	-	-
Canyon Lake 1	8/7/2013	LT, KK	-	-	K	0	10	10	40	40	n	n	-	-	-	-
Canyon Lake 2	8/8/2013	LT, KK	-	-	H	0	0	50	50	0	n	n	-	-	-	-
Canyon Lake 2	8/8/2013	LT, KK	-	-	I	0	10	50	40	0	n	n	-	-	-	-
Canyon Lake 2	8/8/2013	LT, KK	-	-	J	5	10	80	5	0	n	n	-	-	-	-
Canyon Lake 2	8/8/2013	LT, KK	-	-	K	30	15	30	15	0	n	n	-	-	-	-
Canyon Lake 2	8/8/2013	LT, KK	-	-	L	35	40	20	5	0	n	n	-	-	-	-
Canyon Lake 3	8/10/2013	LT, KK	-	-	A	10	10	30	50	0	n	n	-	-	-	-
Canyon Lake 3	8/10/2013	LT, KK	-	-	B	50	10	15	10	5	n	n	-	-	-	-
Canyon Lake 3	8/10/2013	LT, KK	-	-	C	10	10	55	25	0	n	n	-	-	-	-
Canyon Lake 3	8/10/2013	LT, KK	-	-	D	10	10	35	40	5	n	n	-	-	-	-

Vegetation Abundance

n = none

s = sparse

a = abundant

Vegetation Type

n = none

m = moss

v = vascular

s = sedge

Appendix 3.4-2a

Potential Development Area Lake Sampling Effort and
Species Summary, 2013 – Gillnets

Appendix 3.4-2a. Potential Development Area Lake Sampling Effort and Species Summary - Gillnets, 2013

Date (m/d/y)	Property	Lake	Crew	Method	Net/Trap No.	Time In	Time Out	Effort (h)	Effort (Decimal h)	Depth 1	Zone	Easting 1	Northing 1	Depth 2	Easting 2	Northing 2	ARGR	LKTR	RDWH	Total	ARGR CPUE	LKTR CPUE	RDWH CPUE	Total CPUE (# Fish/100 m ² /h)
7/5/2013	George	George Lake	KW, RD, CC, CM	FGN	1	10:10	11:10	1:00	1.00	-	13W	388309	7313591	-	388214	7313534	-	-	-	0	0.00	0.00	0.00	0.00
7/5/2013	George	George Lake	LT, SL, GT	SGN	1	10:05	11:07	1:02	1.03	-	13W	388296	7313587	-	388373	7313446	-	-	-	0	0.00	0.00	0.00	0.00
7/5/2013	George	George Lake	LT, SL, GT	SGN	2	11:20	12:48	1:28	1.47	-	13W	387780	7313926	-	387816	7313836	-	-	-	0	0.00	0.00	0.00	0.00
7/5/2013	George	George Lake	LT, SL, GT	SGN	3	12:54	14:55	2:01	2.02	-	13W	387793	7314275	-	387884	7314236	-	1	-	1	0.00	0.23	0.00	0.23
7/5/2013	George	George Lake	LT, SL, GT	FGN	2	11:30	13:08	1:38	1.63	-	13W	387989	7313960	-	388046	7313996	-	-	-	0	0.00	0.00	0.00	0.00
7/5/2013	George	George Lake	LT, SL, GT	FGN	3	13:15	15:15	2:00	2.00	-	13W	387813	7314837	-	387748	7314756	-	2	-	2	0.00	0.46	0.00	0.46
7/5/2013	George	George Lake	LT, SL, GT	SGN	4	15:00	16:20	1:20	1.33	-	13W	387699	7314440	-	387725	7314530	-	3	-	3	0.00	1.03	0.00	1.03
7/5/2013	George	George Lake	LT, SL, GT	FGN	4	15:20	16:35	1:15	1.25	-	13W	387721	7314950	-	387642	7314885	-	-	-	0	0.00	0.00	0.00	0.00
7/6/2013	George	George Lake	LT, CM, GT	SGN	5	9:04	10:10	1:06	1.10	-	13W	387658	7314477	-	387744	7314562	-	2	-	2	0.00	0.83	0.00	0.83
7/7/2013	George	Reference Q Lake	RD, CC, LT	FGN	1	10:38	12:05	1:27	1.45	-	13W	384267	7306848	-	384335	7306780	-	1	3	4	0.00	0.32	0.95	1.26
7/7/2013	George	Reference Q Lake	RD, CC, LT	SGN	1	10:47	11:47	1:00	1.00	-	13W	384481	7306324	-	384529	7306242	-	-	-	0	0.00	0.00	0.00	0.00
7/7/2013	George	Reference Q Lake	RD, CC, LT	SGN	2	11:53	13:20	1:27	1.45	-	13W	384398	7306747	-	384447	7306668	-	1	-	1	0.00	0.32	0.00	0.32
7/7/2013	George	Reference Q Lake	RD, CC, LT	FGN	2	12:15	13:40	1:25	1.42	-	13W	384618	7306314	-	384640	7306211	-	-	3	3	0.00	0.00	0.97	0.97
7/7/2013	George	Reference Q Lake	RD, CC, LT	FGN	3	13:51	15:15	1:24	1.40	-	13W	384647	7306192	-	384565	7306152	-	-	-	0	0.00	0.00	0.00	0.00
7/7/2013	George	Reference Q Lake	RD, CC, LT	SGN	3	14:07	15:20	1:13	1.22	-	13W	384771	7306110	-	384864	7306090	-	2	-	2	0.00	0.75	0.00	0.75
7/7/2013	George	Reference Q Lake	RD, CC, LT	FGN	4	15:48	16:40	0:52	0.87	-	13W	385095	7305676	-	385132	7305585	-	-	-	0	0.00	0.00	0.00	0.00
7/7/2013	George	Reference Q Lake	RD, CC, LT	SGN	4	15:30	17:00	1:30	1.50	-	13W	385054	7305378	-	385177	7305299	-	1	-	1	0.00	0.30	0.00	0.30
7/8/2013	George	Komatic Lake	SL, TA	FGN	1	9:30	10:15	0:45	0.75	-	13W	391421	7308790	-	391350	7308726	-	4	-	4	0.00	2.44	0.00	2.44
7/8/2013	George	Komatic Lake	SL, TA	SGN	1	10:00	10:50	0:50	0.83	-	13W	391558	7308715	-	391491	7308640	-	3	-	3	0.00	1.64	0.00	1.64
7/8/2013	George	Komatic Lake	SL, TA	SGN	2	11:10	12:10	1:00	1.00	-	13W	391680	7308567	-	391625	7308472	-	3	-	3	0.00	1.37	0.00	1.37
7/9/2013	George	McCoy Lake	LT, CM	SGN	1	9:45	11:10	1:25	1.42	-	13W	386656	7311781	-	386568	7311806	-	2	-	2	0.00	0.64	0.00	0.64
7/9/2013	George	McCoy Lake	LT, CM	FGN	1	9:50	11:20	1:30	1.50	-	13W	386764	7311967	-	386685	7312025	-	2	1	3	0.00	0.61	0.30	0.91
7/9/2013	George	McCoy Lake	LT, CM	SGN	2	11:15	12:35	1:20	1.33	-	13W	386696	7311802	-	386610	7311826	-	2	-	2	0.00	0.69	0.00	0.69
7/9/2013	George	McCoy Lake	LT, CM	FGN	2	11:30	12:45	1:15	1.25	-	13W	386755	7312046	-	386709	7311967	-	-	-	0	0.00	0.00	0.00	0.00
7/9/2013	George	McCoy Lake	LT, CM	SGN	3	12:40	14:30	1:50	1.83	-	13W	386697	7311586	-	386630	7311652	-	1	1	2	0.00	0.25	0.25	0.50
7/9/2013	George	McCoy Lake	LT, CM	FGN	3	13:30	14:20	0:50	0.83	-	13W	386481	7311713	-	386484	7311621	-	1	-	1	0.00	0.55	0.00	0.55
7/9/2013	George	McCoy Lake	LT, CM	FGN	4	14:30	15:45	1:15	1.25	-	13W	386514	7311367	-	386598	7311357	-	-	-	0	0.00	0.00	0.00	0.00
7/9/2013	George	McCoy Lake	LT, CM	SGN	4	14:35	15:50	1:15	1.25	-	13W	386713	7311230	-	386618	7311202	-	1	-	1	0.00	0.37	0.00	0.37
7/10/2013	George	Occurrence Lake	SL, KG	FGN	1	8:45	9:29	0:44	0.73	-	13W	387521	7313355	-	387440	7313264	-	-	-	0	0.00	0.00	0.00	0.00
7/10/2013	George	Occurrence Lake	SL, KG	SGN	1	9:10	9:55	0:45	0.75	-	13W	387587	7313261	-	387497	7313182	-	-	-	0	0.00	0.00	0.00	0.00
7/10/2013	George	Occurrence Lake	SL, KG	FGN	2	9:40	10:25	0:45	0.75	-	13W	387597	7313196	-	387522	7313132	1	-	-	1	0.61	0.00	0.00	0.61
7/10/2013	George	Bob Lake	SL, KG	SGN	1	13:20	14:05	0:45	0.75	-	13W	387203	7314546	-	387202	7314436	-	4	-	4	0.00	2.44	0.00	2.44
7/10/2013	George	Bob Lake	SL, KG	FGN	1	13:45	15:03	1:18	1.30	-	13W	387210	7314426	-	387291	7314348	-	-	-	0	0.00	0.00	0.00	0.00
7/10/2013	George	Bob Lake	SL, KG	SGN	2	14:30	15:30	1:00	1.00	-	13W	387311	7314339	-	387313	7314231	-	2	-	2	0.00	0.91	0.00	0.91
7/10/2013	George	Bob Lake	SL, KG	FGN	2	15:15	16:00	0:45	0.75	-	13W	387325	7314224	-	387419	7314178	-	-	-	0	0.00	0.00	0.00	0.00
7/12/2013	Goose	Reference B Lake	LT, KK	SGN	1	10:03	11:05	1:02	1.03	-	13W	442024	7258498	-	441930	7258473	-	1	1	2	0.00	0.44	0.44	0.88
7/12/2013	Goose	Reference B Lake	LT, KK	FGN	1	10:10	11:20	1:10	1.17	-	13W	442021	7258681	-	441877	7258663	-	-	-	0	0.00	0.00	0.00	0.00
7/12/2013	Goose	Reference B Lake	LT, KK	SGN	2	11:08	13:00	1:52	1.87	-	13W	442038	7258378	-	441925	7258387	-	-	4	4	0.00	0.00	0.98	0.98
7/12/2013	Goose	Reference B Lake	LT, KK	FGN	2	11:30	13:30	2:00	2.00	-	13W	441889	7258858	-	441809	7258773	-	3	-	3	0.00	0.69	0.00	0.69
7/13/2013	Goose	Giraffe Lake	LT, KK, RD, CM	SGN	1	9:12	10:15	1:03	1.05	-	13W	432039	7273048	-	432135	7273007	-	-	-	0	0.00	0.00	0.00	0.00
7/13/2013	Goose	Giraffe Lake	LT, KK, RD, CM	FGN	1	9:20	10:39	1:19	1.32	-	13W	431894	7272887	-	431998	7272844	-	2	-	2	0.00	0.69	0.00	0.69
7/13/2013	Goose	Giraffe Lake	LT, KK, RD, CM	SGN	2	10:32	12:15	1:43	1.72	-	13W	432251	7272691	-	432345	7272668	-	7	2	9	0.00	1.86	0.53	2.40
7/13/2013	Goose	Giraffe Lake	LT, KK, RD, CM	FGN	2	10:55	12:50	1:55	1.92	-	13W	431856	7273026	-	431929	7272954	-	-	-	0	0.00	0.00	0.00	0.00
7/15/2013	Goose	Goose Lake	LT, KK, KG	SGN	1	9:50	10:45	0:55	0.92	-	13W	433441	7270943	-	433501	7270829	-	-	-	0	0.00	0.00	0.00	0.00
7/15/2013	Goose	Goose Lake	LT, KK, KG	FGN	1	10:00	11:10	1:10	1.17	-	13W	433038	7271061	-	432970	7271003	-	-	-	0	0.00	0.00	0.00	0.00
7/15/2013	Goose	Goose Lake	LT, KK, KG	SGN	2	11:00	12:00	1:00	1.00	-	13W	433491	7271292	-	433532	7271189	-	3	-	3	0.00	1.37	0.00	1.37
7/15/2013	Goose	Goose Lake	LT, KK, KG	FGN	2	11:17	12:22	1:05	1.08	-	13W	433163	7271537	-	433280	7271536	-	-	-	0	0.00	0.00	0.00	0.00
8/2/2013	Goose	Propellor Lake	FR, LO	FGN	1	11:00	11:50	0:50	0.83	-	13W	436142	7275473	-	436097	7275567	-	-	-	0	0.00	0.00	0.00	0.00
8/2/2013	Goose	Propellor Lake	FR, LO	SGN	1	11:07	12:09	1:02	1.03	-	13W	436121	7275769	-	436090	7275659	-	-	-	0	0.00	0.00	0.00	0.00
8/2/2013	Goose	Propellor Lake	FR, LO	FGN	2	12:04	13:00	0:56	0.93	-	13W	435588	7275196	-	435500	7275232	-	-	-	0	0.00	0.00	0.00	0.00
8/2/2013	Goose	Propellor Lake	FR, LO	SGN	2	12:23	13:26	1:03	1.05	-	13W	436165	7276320	-	436252	7276379	-	-	-	0	0.00	0.00	0.00	0.00
8/2/2013	Goose	Propellor Lake	FR, LO	FGN	3	13:18	13:55	0:37	0.62	-	13W	435475	7276857	-	435446	7276756	-	-	-	0	0.00	0.00	0.00	0.00
8/2/2013	Goose	Propellor Lake	FR, LO	SGN	3	13:45	14:49	1:04	1.07	-	13W	435546	7276192	-	435497	7276009	-	-	-	0	0.00	0.00	0.00	0.00
8/2/2013	Goose	Propellor Lake	FR, LO	FGN	4	14:15	15:36	1:21	1.35	-	13W	435131	7277493	-	435105	7277398	-	-	1	1	0.00	0.00	0.34	0.34
8/2/2013	Goose	Propellor Lake	FR, LO	SGN	4	15:18	16:18	1:00	1.00	-	13W	434533	7276401	-	434580	7276523	-	-	-	0	0.00	0.00	0.00	0.00
8/3/2013	Goose	Propellor Lake	FR, LO	SGN	5	8:56	10:03	1:07	1.12	-	13W	435463	7273925	-	435437	7274037	-	1	-	1	0.00	0.41	0.00	0.41
8/3/2013	Goose	Propellor Lake	FR, LO	FGN	5	9:03	10:18	1:15	1.25	-	13W	435279	7274198	-	435356	7274269	-</							

Appendix 3.4-2a. Potential Development Area Lake Sampling Effort and Species Summary - Gillnets, 2013

Date (m/d/y)	Property	Lake	Crew	Method	Net/Trap No.	Time In	Time Out	Effort (h)	Effort (Decimal h)	Depth 1	Zone	Easting 1	Northing 1	Depth 2	Easting 2	Northing 2	ARGR	LKTR	RDWH	Total	ARGR CPUE	LKTR CPUE	RDWH CPUE	Total CPUE
																								(# Fish/100 m ² /h)
8/4/2013	Goose	Wasp Lake	FR, LO	FGN	1	11:33	12:30	0:57	0.95	-	13W	430172	7276600	-	430132	7276717	-	-	-	0	0.00	0.00	0.00	0.00
8/4/2013	Goose	Wasp Lake	FR, LO	SGN	1	11:48	12:48	1:00	1.00	-	13W	430298	7276354	-	430264	7276448	-	2	1	3	0.00	0.91	0.46	1.37
8/4/2013	Goose	Wasp Lake	FR, LO	FGN	2	12:45	13:34	0:49	0.82	-	13W	430214	7276667	-	430117	7276649	-	1	-	1	0.00	0.56	0.00	0.56
8/4/2013	Goose	Wasp Lake	FR, LO	SGN	2	13:20	14:10	0:50	0.83	-	13W	429964	7277180	-	429922	7277271	-	4	4	8	0.00	2.19	2.19	4.39
8/4/2013	Goose	Wasp Lake	FR, LO	FGN	3	14:05	15:00	0:55	0.92	-	13W	430054	7276736	-	430101	7276840	-	-	-	0	0.00	0.00	0.00	0.00
8/5/2013	Goose	Wasp Lake	FR, LO	SGN	3	10:32	11:26	0:54	0.90	-	13W	430669	7274606	-	430622	7274705	1	2	3	6	0.51	1.02	1.52	3.05
8/5/2013	Goose	Wasp Lake	FR, LO	FGN	4	10:40	11:53	1:13	1.22	-	13W	430658	7274859	-	430555	7274876	-	2	-	2	0.00	0.75	0.00	0.75
8/5/2013	Goose	Wasp Lake	FR, LO	FGN	5	12:46	13:30	0:44	0.73	-	13W	430630	7275116	-	430513	7275156	-	-	-	0	0.00	0.00	0.00	0.00
8/5/2013	Goose	Wasp Lake	FR, LO	SGN	4	13:08	14:00	0:52	0.87	-	13W	430532	7275020	-	430398	7275020	-	1	-	1	0.00	0.53	0.00	0.53

FGN = floating gillnet
SGN = sinking gillnet
ARGR = Arctic grayling
LKTR = lake trout
RDWH = round whitefish
CPUE = catch-per-unit-effort
Dashes indicate data not available

Appendix 3.4-2b

Potential Development Area Lake Sampling Effort and
Species Summary, 2013 – Angling

Appendix 3.4-2b. Potential Development Area Lake Sampling Effort and Species Summary, 2013 - Angling

Date (m/d/y)	Property	Site	Crew	Method	Gear	Time In	Time Out	Time (h)	Time (decimal h)	Depth 1	Zone	Easting 1	Northing 1	Depth 2	Easting 2	Northing 2	ARGR	LKTR	Total
7/12/2013	Goose	Reference B Lake	LT, KK	ANG	-	13:30	15:00	1:30	1.50	-	-	-	-	-	-	-	0	6	6
7/13/2013	Goose	Giraffe Lake	LT, KK	ANG	-	9:15	10:50	1:35	1.58	-	13W	432054	7273119	-	432025	7272678	0	4	4
8/14/2013	Goose	Giraffe Lake	FR, KK	ANG	-	-	-	-	-	-	-	-	-	-	-	-	0	8	8
7/14/2013	Goose	Propeller Lake	LT, KK	ANG	-	-	-	-	-	-	-	-	-	-	-	-	0	10	10
8/2/2013	Goose	Propeller Lake	FR	ANG	Blue Fox	-	15:00	-	-	-	13W	434533	7276401	-	-	-	0	2	2
8/3/2013	Goose	Propeller Lake	FR	ANG	5 of Diamonds	-	9:35	-	-	-	13W	435247	7274498	-	-	-	0	1	1
8/3/2013	Goose	Propeller Lake	FR	ANG	5 of Diamonds	13:20	13:24	0:04	0.07	-	13W	434184	7275973	-	-	-	0	1	1
8/3/2013	Goose	Propeller Lake	FR	ANG	5 of Diamonds	-	13:33	-	-	-	13W	434158	7275986	-	-	-	0	1	1
8/4/2013	Goose	Wasp Lake	FR	ANG	-	-	10:28	-	-	-	13W	430039	7276110	-	-	-	0	1	1
8/4/2013	Goose	Wasp Lake	FR	ANG	-	-	10:47	-	-	-	13W	430025	7276475	-	-	-	0	1	1
8/4/2013	Goose	Wasp Lake	FR	ANG	-	-	11:11	-	-	-	13W	429991	7277029	-	-	-	0	1	1
8/4/2013	Goose	Wasp Lake	FR	ANG	-	-	11:11	-	-	-	13W	429990	7277029	-	-	-	0	1	1
8/4/2013	Goose	Wasp Lake	FR	ANG	-	11:50	11:59	0:09	0.15	-	13W	430352	7275887	-	-	-	0	1	1
8/4/2013	Goose	Wasp Lake	FR	ANG	-	12:06	12:09	0:03	0.05	-	13W	430371	7275679	-	-	-	0	1	1
8/4/2013	Goose	Wasp Lake	FR	ANG	-	12:34	12:36	0:02	0.03	-	13W	430134	7276725	-	-	-	0	1	1
8/4/2013	Goose	Wasp Lake	FR	ANG	-	13:27	13:28	0:01	0.02	-	13W	430085	7276765	-	-	-	0	1	1
8/4/2013	Goose	Wasp Lake	FR	ANG	-	15:47	15:50	0:03	0.05	-	13W	430279	7275881	-	-	-	0	1	1
8/4/2013	Goose	Wasp Lake	FR	ANG	-	15:55	16:04	0:09	0.15	-	13W	430348	7275536	-	-	-	0	1	1
8/4/2013	Goose	Wasp Lake	FR	ANG	-	16:08	16:16	0:08	0.13	-	13W	430252	7276151	-	-	-	0	1	1
8/5/2013	Goose	Wasp Lake	FR	ANG	-	13:35	13:45	0:10	0.17	-	13W	430566	7274855	-	-	-	0	1	1

ANG = angling
ARGR = Arctic grayling
LKTR = lake trout
Dashes indicate data not available

Appendix 3.4-2c

Potential Development Area Lake Sampling Effort and
Species Summary, 2013 – Electrofishing

Appendix 3.4-2c. Potential Development Area Lake Sampling Effort and Species Summary, 2013 - Electrofishing

Property	Local Name	Site #	Date (m/d/y)	Crew	Zone	Easting	Northing	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)	Comments
Goose	Echo Lake	704	6/19/2013	KK, AB	13	432458	7268422	EF	1	-	-	-	1	1047	350	3	N	550-700	30	12	Smithroot	LR-24	NFC	-	0	-	-	Electrofished perimeter of Echo Lake in counter clockwise direction from outflow. Outflow of Echo lake is mostly standing water in grass, small channel not flowing
George	George Lake	1	7/5/2013	SL, CC	13	388058	7313449	EF	1	-	-	-	1	315	50	3	N	535	30	12	Smithroot	LR-24	SLSC	-	1	-	-	-
George	George Lake	B	7/6/2013	SL, RD	13	388700	7313237	EF	1	-	-	-	1	4729	250	4	N	580-550	30	12	Smithroot	LR-24	SLSC	-	18	-	-	-
George	George Lake	B	7/6/2013	SL, RD	13	388700	7313237	EF	1	-	-	-	1	4729	250	4	N	580-550	30	12	Smithroot	LR-24	LKTR	-	2	-	-	Also 1 dead adult - washed up on shore
George	George Lake	B	7/6/2013	SL, RD	13	388700	7313237	EF	1	-	-	-	3	325	50	2	N	550	30	12	Smithroot	LR-24	SLSC	-	2	-	-	-
George	George Lake	B	7/6/2013	KW, CC	13	388700	7313237	EF	1	-	-	-	2	415	75	2	N	550	30	12	Smithroot	LR-24	SLSC	-	5	-	-	-
George	George Lake	C	7/6/2013	SL, RD	13	387648	7314419	EF	1	-	-	-	1	1360	150	1	N	470	30	12	Smithroot	LR-24	SLSC	-	2	-	-	-
George	George Lake	D	7/6/2013	SL, RD	13	387894	7314775	EF	1	-	-	-	1	621	100	1	N	385-450	30	12	Smithroot	LR-24	NFC	-	0	-	-	-
George	George Lake	3	7/6/2013	KW, CC	13	-	-	EF	1	-	-	-	1	2611	100	3	N	650	45	12	Smithroot	LR-24	SLSC	-	1	-	-	-
George	George Lake	3	7/6/2013	KW, CC	13	-	-	EF	1	-	-	-	1	2611	100	3	N	650	45	12	Smithroot	LR-24	LKTR	IM	2	-	-	-
George	George Lake	3	7/6/2013	KW, CC	13	-	-	EF	1	-	-	-	1	2611	100	3	N	650	45	12	Smithroot	LR-24	ARGR	-	12	-	-	-
George	Reference Q Lake	1	7/7/2013	SL, CM	13	384319	7306370	EF	1	-	-	-	1	3162	500	2	N	525	30	12	Smithroot	LR-24	SLSC	-	28	-	-	Good area for future MMER sculpin
George	Reference Q Lake	2	7/7/2013	SL, CM	13	384202	7306882	EF	1	-	-	-	1	592	100	2	N	550	30	12	Smithroot	LR-24	SLSC	-	4	-	-	-
George	Komatic Lake	1	7/7/2013	KW, GT	13	391781	7308033	EF	1	-	-	-	1	2800	1000	5	N	600	35	12	Smithroot	LR-24	SLSC	-	11	-	-	-
George	Komatic Lake	1	7/8/2013	KW, GT	13	391781	7308033	EF	1	-	-	-	2	2100	150	50	N	650	35	12	Smithroot	LR-24	SLSC	-	23	-	-	-
George	Komatic Lake	1	7/8/2013	KW, GT	13	391781	7308033	EF	1	-	-	-	2	2100	150	50	N	650	35	12	Smithroot	LR-24	LKTR	IM	6	-	-	-
George	McCoy Lake	1	7/8/2013	LT, CC	13	386899	7311555	EF	1	-	-	-	1	3327	1170	1	N	700	40	12	Smithroot	LR-24	LKTR	IM	2	-	-	-
George	McCoy Lake	1	7/8/2013	LT, CC	13	386899	7311555	EF	1	-	-	-	1	3327	1170	1	N	700	40	12	Smithroot	LR-24	BURB	-	2	-	-	-
George	McCoy Lake	1	7/8/2013	LT, CC	13	386899	7311555	EF	1	-	-	-	1	3327	1170	1	N	700	40	12	Smithroot	LR-24	SLSC	-	24	-	-	-
George	McCoy Lake	2	7/9/2013	RD, CC	13	386056	7310780	EF	1	-	-	-	1	2100	400	12	N	750	40	12	Smithroot	LR-24	SLSC	-	12	-	-	-
George	Lytle Lake	1	7/9/2013	CC, RD	13	387000	7313800	EF	1	17.1	66.6	-	1	1217	400	5	N	750	40	12	Smithroot	LR-24	NFC	-	0	-	-	pH = 7.25
George	Occurrence Lake	1	7/9/2013	SL, KG	13	387412	7313493	EF	1	-	-	-	1	112	10	4	N	425	30	12	Smithroot	LR-24	NFC	-	0	-	-	-
George	Occurrence Lake	2	7/9/2013	SL, KG	13	387192	7313470	EF	1	-	-	-	1	213	25	3	N	450	30	12	Smithroot	LR-24	NFC	-	0	-	-	-
George	Occurrence Lake	3	7/9/2013	SL, KG	13	387373	7313057	EF	1	-	-	-	1	544	100	3	N	445-550	30	12	Smithroot	LR-24	NFC	-	0	-	-	-
George	Occurrence Lake	4	7/9/2013	SL, KG	13	387781	7313019	EF	1	-	-	-	1	240	40	4	N	450	30	12	Smithroot	LR-24	NFC	-	0	-	-	-
George	Occurrence Lake	-	7/9/2013	SL, KG	13	387232	7313341	VO	1	-	-	-	1	-	-	-	N	-	-	-	-	-	UNK	-	2	-	-	Juvenile lake trout or arctic grayling seen
George	Bob Lake	1	7/9/2013	SL, KG	13	387628	7313759	EF	1	-	-	-	1	140	30	1.5	N	635	30	12	Smithroot	LR-24	NFC	-	0	-	-	-
George	Bob Lake	2	7/9/2013	SL, KG	13	387267	7314210	EF	1	-	-	-	1	254	25	2	N	470-550	30	12	Smithroot	LR-24	NFC	-	0	-	-	-
George	Bob Lake	3	7/9/2013	SL, KG	13	387185	7314374	EF	1	-	-	-	1	367	10	5	N	450	30	12	Smithroot	LR-24	NFC	-	0	-	-	-
George	Bob Lake	-	7/9/2013	SL, KG	13	387185	7314374	VO	-	-	-	-	-	-	-	-	N	-	-	-	-	-	LKTR	IM	1	-	-	-
George	Bob Lake	4	7/9/2013	SL, KG	13	387139	7314536	EF	1	-	-	-	1	335	20	2	N	500	30	12	Smithroot	LR-24	LKTR	IM	1	-	-	-
Goose	Reference B Lake	300	7/12/2013	KW, CM	13	441804	7259239	EF	1	-	-	-	1	5622	1500	5	N	500	45	12	Smithroot	LR-24	BURB	IM	2	-	-	-
Goose	Reference B Lake	300	7/12/2013	KW, CM	13	441804	7259239	EF	1	-	-	-	1	5622	1500	5	N	500	45	12	Smithroot	LR-24	NSSB	M	4	-	-	-
Goose	Reference B Lake	300	7/12/2013	KW, CM	13	441804	7259239	EF	1	-	-	-	1	5622	1500	5	N	500	45	12	Smithroot	LR-24	SLSC	M	11	-	-	-
Goose	Reference B Lake	300	7/12/2013	KW, CM	13	441804	7259239	EF	1	-	-	-	1	5622	1500	5	N	500	45	12	Smithroot	LR-24	LKTR	IM	1	-	-	-
Goose	Reference B Lake	1	7/12/2013	KG, CC	13	442204	7258526	EF	1	-	-	-	1	4427	1000	10	N	635	30	12	Smithroot	LR-24	SLSC	-	9	-	-	-
Goose	Reference B Lake	2	8/12/2013	KK, LT	13	441962	7258951	EF	1	-	-	-	1	2300	1430	5	N	675	45	12	Smithroot	LR-24	SLSC	-	13	-	-	-
Goose	Reference B Lake	2	8/12/2013	KK, LT	13	441962	7258951	EF	1	-	-	-	1	2300	1430	5	N	675	45	12	Smithroot	LR-24	LKTR	IM	1	-	-	-
Goose	Reference B Lake	2	8/12/2013	KK, LT	13	441962	7258951	EF	1	-	-	-	1	2300	1430	5	N	675	45	12	Smithroot	LR-24	BURB	-	2	-	-	-
Goose	Reference B Lake	2	8/12/2013	KK, LT	13	441962	7258951	EF	1	-	-	-	1	2300	1430	5	N	675	45	12	Smithroot	LR-24	NSSB	-	9	-	-	-
Goose	Giraffe Lake	301	7/13/2013	KW	13	432520	7272528	EF	1	-	-	-	1	3429	200	4	N	635	30	12	Smithroot	LR-24	SLSC	-	39	-	-	-
Goose	Giraffe Lake	301	7/13/2013	KW	13	432520	7272528	EF	1	-	-	-	1	3429	200	4	N	635	30	12	Smithroot	LR-24	NSSB	-	3	-	-	-
Goose	Giraffe Lake	301	7/13/2013	KW	13	432520	7272528	EF	1	-	-	-	1	3429	200	4	N	635	30	12	Smithroot	LR-24	BURB	IM	1	-	-	-
Goose	Propeller Lake	A	8/2/2013	LT, KK	13	435596	7277023	EF	1	-	-	-	1	1021	300	20	N	990	30	12	Smithroot	LR-24	NSSB	-	2	-	-	-
Goose	Propeller Lake	A	8/2/2013	LT, KK	13	435596	7277023	EF	1	-	-	-	1	1021	300	20	N	990	30	12	Smithroot	LR-24	BURB	-	1	-	-	-
Goose	Propeller Lake	A	8/2/2013	LT, KK	13	435596	7277023	EF	1	-	-	-	1	1021	300	20	N	990	30	12	Smithroot	LR-24	SLSC	-	11	-	-	-
Goose	Propeller Lake	B	8/2/2013	LT, KK	13	435398	7277260	EF	1	-	-	-	2	387	263	20	N	990	30	12	Smithroot	LR-24	ARGR	-	1	-	-	-
Goose	Propeller Lake	B	8/2/2013	LT, KK	13	435398	7277260	EF	1	-	-	-	2	387	263	20	N	990	30	12	Smithroot	LR-24	SLSC	-	4	-	-	-
Goose	Propeller Lake	C	8/2/2013	LT, KK	13	435301	7277505	EF	1	-	-	-	3	101	69	20	N	990	30	12	Smithroot	LR-24	SLSC	-	1	-	-	-
Goose	Propeller Lake	D	8/2/2013	LT, KK	13	435273	7277566	EF	1	-	-	-	4	207	60	20	N	990	30	12	Smithroot	LR-24	NSSB	-	1	-	-	-
Goose	Propeller Lake	D	8/2/2013	LT, KK	13	435273	7277566	EF	1	-	-	-	4	207	60	20	N	990	30	12	Smithroot	LR-24	SLSC	-	2	-	-	-
Goose	Propeller Lake	E	8/2/2013	LT, KK	13	435281	7277620	EF	1	-	-	-	5	435	200	20	N	990	30	12	Smithroot	LR-24	SLSC	-	4	-	-	-
Goose	Propeller Lake	F	8/3/2013	LT, KK	13	435155	7277654	EF	1	-	-	-	6	263	110	20	N	990	30	12	Smithroot	LR-24	NSSB	-	1	-	-	-
Goose	Propeller Lake	F	8/3/2013	LT, KK	13	435155	7277654	EF	1	-	-	-	6	263	110	20	N	990	30	12	Smithroot	LR-24	SLSC	-	4	-	-	-
Goose	Propeller Lake	G	8/3/2013	LT, KK	13	435135	7277547	EF	1	-	-	-	7	359	160	20	N	990	30	12	Smithroot	LR-24	SLSC	-	2	-	-	-

Appendix 3.4-2c. Potential Development Area Lake Sampling Effort and Species Summary, 2013 - Electrofishing

Property	Local Name	Site #	Date (m/d/y)	Crew	Zone	Easting	Northing	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)	Comments
Goose	Propeller Lake	G	8/3/2013	LT, KK	13	435135	7277547	VO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	BURB	-	1	-	-	-
Goose	Propeller Lake	G	8/3/2013	LT, KK	13	435135	7277547	VO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ARGR	-	1	-	-	-
Goose	Propeller Lake	H	8/3/2013	LT, KK	13	435026	7277637	EF	1	-	-	-	8	549	275	20	N	990	30	12	Smithroot	LR-24	SLSC	-	1	-	-	-
Goose	Propeller Lake	H	8/3/2013	LT, KK	13	435026	7277637	VO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SLSC	-	2	-	-	-
Goose	Propeller Lake	H	8/3/2013	LT, KK	13	435026	7277637	VO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NSSB	-	1	-	-	-
Goose	Propeller Lake	I	8/3/2013	LT, KK	13	434937	7278331	EF	1	-	-	-	9	285	130	20	N	990	30	12	Smithroot	LR-24	SLSC	-	2	-	-	-
Goose	Propeller Lake	I	8/3/2013	LT, KK	13	434937	7278331	VO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SLSC	-	2	-	-	-
Goose	Propeller Lake	J	8/3/2013	LT, KK	13	434974	7278452	EF	1	-	-	-	10	217	-	20	N	990	30	12	Smithroot	LR-24	NSSB	-	1	-	-	-
Goose	Propeller Lake	J	8/3/2013	LT, KK	13	434974	7278452	EF	1	-	-	-	10	217	-	20	N	990	30	12	Smithroot	LR-24	SLSC	-	1	-	-	-
Goose	Propeller Lake	K	8/3/2013	LT, KK	13	434939	7278477	EF	1	-	-	-	11	345	120	20	N	990	30	12	Smithroot	LR-24	NSSB	-	1	-	-	-
Goose	Propeller Lake	K	8/3/2013	LT, KK	13	434939	7278477	EF	1	-	-	-	11	345	120	20	N	990	30	12	Smithroot	LR-24	BURB	-	1	-	-	-
Goose	Propeller Lake	K	8/3/2013	LT, KK	13	434939	7278477	EF	1	-	-	-	11	345	120	20	N	990	30	12	Smithroot	LR-24	SLSC	-	4	-	-	-
Goose	Goose Lake	A	8/4/2013	LT, KK	13	433315	7270858	EF	1	-	-	-	1	60	50	20	N	580	30	12	Smithroot	LR-24	BURB	-	1	-	-	-
Goose	Goose Lake	B	8/4/2013	LT, KK	13	432783	7271218	EF	2	-	-	-	1	566	200	20	N	650	30	12	Smithroot	LR-24	BURB	-	1	-	-	-
Goose	Goose Lake	B	8/4/2013	LT, KK	13	432783	7271218	EF	2	-	-	-	1	566	200	20	N	650	30	12	Smithroot	LR-24	NSSB	-	2	-	-	-
Goose	Goose Lake	B	8/4/2013	LT, KK	13	432783	7271218	EF	2	-	-	-	1	566	200	20	N	650	30	12	Smithroot	LR-24	SLSC	-	6	-	-	-
Goose	Goose Lake	B	8/4/2013	LT, KK	13	432783	7271218	VO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SLSC	-	3	-	-	-
Goose	Goose Lake	C	8/4/2013	LT, KK	13	434020	7272309	EF	3	-	-	-	1	401	390	20	N	650	30	12	Smithroot	LR-24	NSSB	-	2	-	-	-
Goose	Goose Lake	C	8/4/2013	LT, KK	13	434020	7272309	EF	3	-	-	-	1	401	390	20	N	650	30	12	Smithroot	LR-24	BURB	-	1	-	-	-
Goose	Goose Lake	C	8/4/2013	LT, KK	13	434020	7272309	EF	3	-	-	-	1	401	390	20	N	650	30	12	Smithroot	LR-24	SLSC	-	2	-	-	-
Goose	Goose Lake	D	8/4/2013	LT, KK	13	434755	7271236	EF	4	-	-	-	1	592	320	20	N	500	30	12	Smithroot	LR-24	SLSC	-	2	-	-	-
Goose	Goose Lake	D	8/4/2013	LT, KK	13	434755	7271236	EF	4	-	-	-	1	592	320	20	N	500	30	12	Smithroot	LR-24	NSSB	-	3	-	-	-
Goose	Goose Lake	J	8/6/2013	FR, KK	13	433063	7270502	EF	11	-	-	-	1	1290	386	8	N	500	40	12	Smithroot	LR-24	NSSB	-	2	-	-	-
Goose	Goose Lake	J	8/6/2013	FR, KK	13	433063	7270502	EF	11	-	-	-	1	1290	386	8	N	500	40	12	Smithroot	LR-24	SLSC	-	16	-	-	-
Goose	Goose Lake	E	8/5/2013	LT, KK	13	434947	7271288	EF	5	-	-	-	1	593	260	20	N	650	50	12	Smithroot	LR-24	NSSB	-	3	-	-	-
Goose	Goose Lake	F	8/5/2013	LT, KK	13	434945	7271214	EF	6	-	-	-	1	257	73	20	N	650	50	12	Smithroot	LR-24	NSSB	-	2	-	-	-
Goose	Goose Lake	F	8/5/2013	LT, KK	13	434945	7271214	EF	6	-	-	-	1	257	73	20	N	650	50	12	Smithroot	LR-24	ARGR	-	1	-	-	-
Goose	Goose Lake	F	8/5/2013	LT, KK	13	434945	7271214	EF	6	-	-	-	1	257	73	20	N	650	50	12	Smithroot	LR-24	SLSC	-	1	-	-	-
Goose	Goose Lake	F	8/5/2013	LT, KK	13	434945	7271214	VO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ARGR	-	1	-	-	-
Goose	Goose Lake	G	8/5/2013	LT, KK	13	434800	7271483	EF	7	-	-	-	1	1047	140	20	N	650	50	12	Smithroot	LR-24	SLSC	-	3	-	-	-
Goose	Goose Lake	G	8/5/2013	LT, KK	13	434800	7271483	EF	7	-	-	-	1	1047	140	20	N	650	50	12	Smithroot	LR-24	NSSB	-	3	-	-	-
Goose	Goose Lake	B	8/5/2013	LT, KK	13	432783	7271218	EF	8	-	-	-	2	597	120	20	N	650	50	12	Smithroot	LR-24	SLSC	-	7	-	-	-
Goose	Goose Lake	B	8/5/2013	LT, KK	13	432783	7271218	EF	8	-	-	-	2	597	120	20	N	650	50	12	Smithroot	LR-24	NSSB	-	2	-	-	-
Goose	Goose Lake	H	8/5/2013	LT, KK	13	432838	7271329	EF	9	-	-	-	1	229	35	20	N	650	50	12	Smithroot	LR-24	SLSC	-	1	-	-	-
Goose	Goose Lake	H	8/5/2013	LT, KK	13	432838	7271329	EF	9	-	-	-	1	229	35	20	N	650	50	12	Smithroot	LR-24	NSSB	-	1	-	-	-
Goose	Goose Lake	I	8/5/2013	LT, KK	13	432857	7271357	EF	10	-	-	-	1	321	260	20	N	650	50	12	Smithroot	LR-24	SLSC	-	3	-	-	-
Goose	Goose Lake	I	8/5/2013	LT, KK	13	432857	7271357	VO	-	-	-	-	-	-	-	-	-	-	-	-	-	-	SLSC	-	3	-	-	-

Species Code

ARGR = Arctic grayling

BURB = burbot

LKTR = lake trout

NSSB = ninespine stickleback

SLSC = slimy sculpin

UNK = Unknown spp.

NFC = no fish caught

Stage

IM = immature

M = mature

EF = electrofishing

VO = visual observation

N = no

Appendix 3.4-2d

Potential Development Area Lake Sampling Effort and
Species Summary, 2013 – Minnow Traps

Appendix 3.4-2d. Potential Development Area Lake Sampling Effort and Species Summary, 2013 - Minnow Traps

Property	Lake	Crew	Method	Trap No.	Date In	Time In	Date Out	Time Out	Effort (h)	Effort (decimal h)	Depth	Zone	Easting	Northing	SLSC	NSSB	BURB	Total	SLSC CPUE	NSSB CPUE	BURB CPUE	Total CPUE (# Fish/24 h)
Goose	Goose Lake	LT	MT	1	8/6/2013	9:10	8/6/2013	16:05	6:55	6.92	0.6	13	432921	7271457	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	2	8/6/2013	9:14	8/6/2013	16:07	6:53	6.88	0.4	13	432932	7271481	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	3	8/6/2013	9:16	8/6/2013	16:10	6:54	6.90	0.45	13	432937	7271492	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	4	8/6/2013	9:18	8/6/2013	16:13	6:55	6.92	0.33	13	432942	7271498	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	5	8/6/2013	9:22	8/6/2013	16:15	6:53	6.88	0.3	13	432961	7271501	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	6	8/6/2013	9:26	8/6/2013	16:18	6:52	6.87	0.25	13	433001	7271516	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	7	8/6/2013	9:30	8/6/2013	16:20	6:50	6.83	0.6	13	433027	7271534	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	8	8/6/2013	10:01	8/6/2013	16:24	6:23	6.38	0.55	13	433949	7271578	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	9	8/6/2013	10:05	8/6/2013	16:27	6:22	6.37	0.6	13	433953	7271559	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	10	8/6/2013	10:07	8/6/2013	16:29	6:22	6.37	0.5	13	433966	7271551	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	11	8/6/2013	10:12	8/6/2013	16:31	6:19	6.32	0.5	13	433980	7271537	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	12	8/6/2013	10:16	8/6/2013	16:34	6:18	6.30	0.45	13	434016	7271501	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	13	8/6/2013	10:19	8/6/2013	16:37	6:18	6.30	0.55	13	434036	7271473	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	14	8/6/2013	10:46	8/6/2013	16:42	5:56	5.93	0.4	13	434505	7271074	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	15	8/6/2013	10:49	8/6/2013	16:45	5:56	5.93	0.25	13	434501	7271107	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	16	8/6/2013	10:51	8/6/2013	16:47	5:56	5.93	0.4	13	434494	7271123	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	17	8/6/2013	10:54	8/6/2013	16:49	5:55	5.92	0.45	13	434482	7271155	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	18	8/6/2013	10:58	8/6/2013	16:52	5:54	5.90	0.8	13	434475	7271174	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	19	8/6/2013	11:00	8/6/2013	16:55	5:55	5.92	0.5	13	434459	7271197	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Goose Lake	LT	MT	20	8/6/2013	11:03	8/6/2013	16:57	5:54	5.90	0.45	13	434449	7271214	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	1	8/2/2013	9:53	8/3/2013	11:45	1:52	25.87	-	13	435830	7273888	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	2	8/2/2013	10:07	8/3/2013	11:44	1:37	25.62	-	13	435810	7273876	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	3	8/2/2013	10:07	8/3/2013	11:43	1:36	25.60	-	13	435799	7273873	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	4	8/2/2013	10:08	8/3/2013	11:42	1:34	25.57	-	13	435784	7273861	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	5	8/2/2013	10:08	8/3/2013	11:41	1:33	25.55	-	13	435773	7273849	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	6	8/2/2013	10:09	8/3/2013	11:40	1:31	25.52	-	13	435752	7273853	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	7	8/2/2013	10:09	8/3/2013	11:38	1:29	25.48	-	13	435729	7273856	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	8	8/2/2013	10:10	8/3/2013	11:36	1:26	25.43	-	13	435703	7273843	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	9	8/2/2013	10:10	8/3/2013	11:34	1:24	25.40	-	13	435677	7273836	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	10	8/2/2013	10:11	8/3/2013	11:32	1:21	25.35	-	13	435642	7273835	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	11	8/2/2013	10:36	8/3/2013	11:30	0:54	24.90	-	13	436378	7274407	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	12	8/2/2013	10:39	8/3/2013	11:28	0:49	24.82	-	13	436305	7274517	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	13	8/2/2013	10:41	8/3/2013	11:26	0:45	24.75	-	13	436314	7274563	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	14	8/2/2013	10:42	8/3/2013	11:25	0:43	24.72	-	13	436332	7274635	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	15	8/2/2013	10:44	8/3/2013	11:21	0:37	24.62	-	13	436368	7274722	1	0	0	1	0.97	0.00	0.00	0.97
Goose	Propellor Lake	FR	MT	16	8/2/2013	10:45	8/3/2013	11:18	0:33	24.55	-	13	436354	7274786	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	17	8/2/2013	10:47	8/3/2013	11:16	0:29	24.48	-	13	436392	7274833	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	18	8/2/2013	10:49	8/3/2013	11:14	0:25	24.42	-	13	436428	7274912	1	0	0	1	0.98	0.00	0.00	0.98
Goose	Propellor Lake	FR	MT	19	8/2/2013	10:49	8/3/2013	11:10	0:21	24.35	-	13	436457	7274943	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Propellor Lake	FR	MT	20	8/2/2013	10:50	8/3/2013	11:07	0:17	24.28	-	13	436513	7274965	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	1	8/4/2013	9:09	8/5/2013	9:32	0:23	24.38	-	13	430434	7276056	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	2	8/4/2013	9:10	8/5/2013	9:33	0:23	24.38	-	13	430424	7276085	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	3	8/4/2013	9:10	8/5/2013	9:35	0:25	24.42	-	13	430415	7276110	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	4	8/4/2013	9:11	8/5/2013	9:37	0:26	24.43	-	13	430406	7276132	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	5	8/4/2013	9:11	8/5/2013	9:39	0:28	24.47	-	13	430394	7276154	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	6	8/4/2013	9:11	8/5/2013	9:40	0:29	24.48	-	13	430396	7276184	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	7	8/4/2013	9:12	8/5/2013	9:42	0:30	24.50	-	13	430393	7276213	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	8	8/4/2013	9:12	8/5/2013	9:44	0:32	24.53	-	13	430390	7276233	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	9	8/4/2013	9:13	8/5/2013	9:45	0:32	24.53	-	13	430383	7276259	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	10	8/4/2013	9:43	8/5/2013	10:50	1:07	25.12	-	13	430556	7274637	0	0	0	0	0.00	0.00	0.00	0.00

Appendix 3.4-2d. Potential Development Area Lake Sampling Effort and Species Summary, 2013 - Minnow Traps

Property	Lake	Crew	Method	Trap No.	Date In	Time In	Date Out	Time Out	Effort (h)	Effort (decimal h)	Depth	Zone	Easting	Northing	SLSC	NSSB	BURB	Total	SLSC CPUE	NSSB CPUE	BURB CPUE	Total CPUE (# Fish/24 h)
Goose	Wasp Lake	FR	MT	11	8/4/2013	9:44	8/5/2013	10:52	1:08	25.13	-	13	430597	7274597	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	12	8/4/2013	9:46	8/5/2013	10:54	1:08	25.13	-	13	430629	7274586	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	13	8/4/2013	9:47	8/5/2013	10:56	1:09	25.15	-	13	430681	7274613	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	14	8/4/2013	10:08	8/5/2013	10:58	0:50	24.83	-	13	430653	7274912	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	15	8/4/2013	10:08	8/5/2013	11:00	0:52	24.87	-	13	430636	7274952	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	16	8/4/2013	10:09	8/5/2013	11:01	0:52	24.87	-	13	430631	7275011	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	17	8/4/2013	10:35	8/5/2013	11:07	0:32	24.53	-	13	429991	7276067	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	18	8/4/2013	10:35	8/5/2013	11:08	0:33	24.55	-	13	430000	7276034	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	19	8/4/2013	10:36	8/5/2013	11:09	0:33	24.55	-	13	430025	7276002	0	0	0	0	0.00	0.00	0.00	0.00
Goose	Wasp Lake	FR	MT	20	8/4/2013	10:37	8/5/2013	11:11	0:34	24.57	-	13	430047	7275968	0	0	0	0	0.00	0.00	0.00	0.00

MT = minnow trap

SLSC = slimy sculpin

NSSB = ninespine stickleback

BURB = burbot

CPUE = catch-per-unit-effort

Dashes indicate data not available

Appendix 3.4-2e

Potential Development Area Lake Sampling Effort and
Species Summary, 2013 – Beach Seining

Appendix 3.4-2e. Potential Development Area Lake Sampling Effort and Species Summary, 2013 - Beach Seining

Date (m/d/y)	Property	Lake	Crew	Method	Net/Trap No.	HP No.	Time	Easting	Northing	Mesh size (mm)	Net area (m ²)	Seined Area (m ²)	ARGR	LKTR	SLSC	Total #	CPUE (# Fish/100 m ²)
7/5/2013	George	George Lake	KW, RD, CC, CM, SL	BS	1	1	12:30	387848	7313647	6.35	16	55	-	-	1	1	1.82
7/5/2013	George	George Lake	KW, RD, CC, CM, SL	BS	1	2	13:10	387848	7313647	6.35	16	55	-	-	-	0	0.00
7/5/2013	George	George Lake	KW, RD, CC, CM, SL	BS	1	3	14:10	387848	7313647	6.35	16	55	-	-	-	0	0.00
7/5/2013	George	George Lake	KW, RD, CC, CM, SL	BS	1	4	14:16	387848	7313647	6.35	16	75	-	-	1	1	1.33
7/5/2013	George	George Lake	LT, SL, GT	BS	5	1	14:20	387995	7313533	6.35	16	45	-	-	-	0	0.00
7/5/2013	George	George Lake	LT, SL, GT	BS	6	1	14:25	387980	7313551	6.35	16	45	-	-	-	0	0.00
7/6/2013	George	George Lake	LT, GT, CM	BS	7	1	9:28	387602	7314329	6.35	16	55	-	-	-	0	0.00
7/6/2013	George	George Lake	LT, GT, CM	BS	8	1	9:35	387580	7314311	6.35	16	55	-	-	-	0	0.00
7/6/2013	George	George Lake	LT, GT, CM	BS	9	1	9:50	387548	7314282	6.35	16	55	-	-	3	3	5.45
7/6/2013	George	George Lake	LT, GT, CM	BS	10	1	13:40	387550	7314240	6.35	16	55	-	-	-	0	0.00
7/6/2013	George	George Lake	LT, GT, CM	BS	11	1	13:47	387555	7314220	6.35	16	55	-	-	-	0	0.00
7/6/2013	George	George Lake	LT, GT, CM	BS	12	1	13:55	387560	7314210	6.35	16	55	-	-	-	0	0.00
7/6/2013	George	George Lake	LT, GT, CM	BS	13	1	14:35	386870	7314950	6.35	16	55	-	-	-	0	0.00
7/6/2013	George	George Lake	LT, GT, CM	BS	14	1	14:45	386880	7314950	6.35	16	55	-	-	-	0	0.00
7/6/2013	George	George Lake	LT, GT, CM	BS	15	1	15:15	386580	7314840	6.35	16	55	-	-	1	1	1.82
7/6/2013	George	George Lake	LT, GT, CM	BS	16	1	15:30	386580	7314830	6.35	16	55	-	-	-	0	0.00

BS = beach seine
ARGR = Arctic grayling
LTKR = lake trout
SLSC = slimy sculpin
CPUE = catch-per-unit-effort

Appendix 3.4-3

Individual Fish Data — Potential Development Area Lakes,
2013

Appendix 3.4-3. Individual Fish Data - Potential Development Area Lakes, 2013

Date (m/d/y)	Property	Waterbody	Site	Sample Method	Haul/ Pass No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm3)	True weight (without parasite weight)	True Condition (without parasite weight)	Mortality (Y/N)	Sex (F/M/U)	Repr. Status (IM/MTC/M)	Age Taken (S/F/O)	Age	Metals (Y/N)	Liver Weight (g)	Dry Liver Weight	Liver Moisture Content (%)	Gonad Weight (g)	Dry Gonad Weight	Gonad Moisture Content (%)	Tissue Weight (g)	Stomach Sampled (Y/N)	Stomach Weight (g)	Parasites (Y/N)	# of Parasites	Parasite Weight (g)	Proportion of parasite weight to body weight	Comments		
7/13/2013	Goose	Giraffe Lake		ANG	-	-	LKTR	<300	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Fish got away	
7/13/2013	Goose	Giraffe Lake		ANG	-	-	LKTR	<400	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(Assume this fish got away too)		
7/13/2013	Goose	Giraffe Lake		ANG	-	1	LKTR	530	1350	0.91	1350	0.91	N	-	-	F	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7/13/2013	Goose	Giraffe Lake		FGN	1	3	LKTR	535	1550	1.01	1550	1.01	N	-	-	F	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		ANG	-	2	LKTR	390	652	1.10	652	1.10	N	-	-	F	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		FGN	1	4	LKTR	450	998	1.10	998	1.10	N	-	-	F	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		SGN	2	5	LKTR	421	855	1.15	855	1.15	N	-	-	F	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		SGN	2	6	LKTR	362	530	1.12	530	1.12	N	-	-	F	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		SGN	2	7	LKTR	364	507	1.05	507	1.05	N	-	-	F	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		SGN	2	8	LKTR	405	690	1.04	690	1.04	N	-	-	F	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		SGN	2	9	LKTR	424	768	1.01	768	1.01	N	-	-	F	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		SGN	2	10	LKTR	460	960	0.99	960	0.99	N	-	-	F	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		SGN	2	11	LKTR	446	975	1.10	975	1.10	N	-	-	F	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		SGN	2	12	RDWH	381	590	1.07	590	1.07	N	-	-	S/F	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		SGN	2	13	RDWH	418	714	0.98	714	0.98	N	-	-	S/F	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/13/2013	Goose	Giraffe Lake		EF		1	SLSC	62	2.3	0.97	2.04	0.86	-	U	IM	F/O	4	-	0.0045	0.0010	77.7	Too small	-	82.5		Y		Y	2	0.26	11.30434783			
7/13/2013	Goose	Giraffe Lake		EF		2	SLSC	52	1.1	0.78	1.1	0.78	-	U	IM	F/O	1	Y	0.0090	0.0020	77.7	Too small	-	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		3	SLSC	56	1.5	0.85	1.1	0.63	-	U	IM	F/O	2	Y	0.0090	0.0020	77.7	Too small	-	82.5		Y		Y	2	0.4	26.66666667			
7/13/2013	Goose	Giraffe Lake		EF		4	SLSC	52	1.2	0.85	1.2	0.85	-	U	IM	F/O	2	Y	0.0224	0.0050	77.7	Too small	-	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		5	SLSC	37	0.4	0.79	0.4	0.79	-	U	IM	F/O	1	-	0.0090	0.0020	77.7	Too small	-	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		6	SLSC	61	2.3	1.01	1.7	0.75	-	F	IM	F/O	2	-	0.0224	0.0050	77.7	0.0114	0.0020	82.5		Y		Y	1	0.6	26.08695652			
7/13/2013	Goose	Giraffe Lake		EF		7	SLSC	54	1.7	1.08	1	0.64	-	U	IM	F/O	2	-	0.0045	0.0010	77.7	Too small	-	82.5		Y		Y	7	0.7	41.17647059			
7/13/2013	Goose	Giraffe Lake		EF		8	SLSC	69	2.3	0.70	2.3	0.70	-	M	IM	F/O	1	-	0.0179	0.0040	77.7	0.0057	0.0010	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		9	SLSC	56	1.8	1.02	1.4	0.80	-	U	MTC	F/O	2	Y	0.0045	0.0010	77.7	Too small	-	82.5		Y		Y	2	0.4	22.22222222			
7/13/2013	Goose	Giraffe Lake		EF		10	SLSC	61	2.4	1.06	1.9	0.84	-	U	IM	F/O	2	-	0.0314	0.0070	77.7	0.0114	0.0020	82.5		Y		Y	2	0.5	20.83333333			
7/13/2013	Goose	Giraffe Lake		EF		11	SLSC	60	2	0.93	2	0.93	-	M	IM	F/O	3	-	0.0538	0.0120	77.7	0.0057	0.0010	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		12	SLSC	66	2	0.70	1.5	0.52	-	U	IM	F/O	3	-	0.0224	0.0050	77.7	Too small	-	82.5		Y		Y	4	0.5	25			
7/13/2013	Goose	Giraffe Lake		EF		13	SLSC	58	1.8	0.92	1.6	0.82	-	F	IM	F/O	2	-	0.0269	0.0060	77.7	0.0114	0.0020	82.5		Y		Y	1	0.2	11.11111111			
7/13/2013	Goose	Giraffe Lake		EF		14	SLSC	53	1.1	0.74	1.1	0.74	-	U	IM	F/O	2	Y	0.0179	0.0040	77.7	Too small	-	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		15	SLSC	61	2.2	0.97	1.9	0.84	-	F	IM	F/O	2	-	0.0404	0.0090	77.7	0.0057	0.0010	82.5		Y		Y	1	0.3	13.63636364			
7/13/2013	Goose	Giraffe Lake		EF		16	SLSC	30	0.2	0.74	0.2	0.74	-	U	IM	F/O	1	-	0.0179	0.0040	77.7	Too small	-	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		17	SLSC	77	4.3	0.94	3.8	0.83	-	M	MTC	F/O	2	-	0.0179	0.0040	77.7	0.0057	0.0010	82.5		Y		Y	1	0.5	11.62790698			
7/13/2013	Goose	Giraffe Lake		EF		18	SLSC	48	0.86	0.78	0.83	0.75	-	U	IM	F/O	2	-	0.0045	0.0010	77.7	Too small	-	82.5		Y		Y	1	0.03	3.488372093			
7/13/2013	Goose	Giraffe Lake		EF		19	SLSC	58	1.8	0.92	1.5	0.77	-	U	IM	F/O	2	Y	0.0224	0.0050	77.7	Too small	-	82.5		Y		Y	1	0.3	16.66666667			
7/13/2013	Goose	Giraffe Lake		EF		20	SLSC	55	1.54	0.93	1.17	0.70	-	U	IM	F/O	2	Y	-	-	77.7	Too small	-	82.5		Y		Y	2	0.37	24.02597403			
7/13/2013	Goose	Giraffe Lake		EF		21	SLSC	37	0.4	0.79	0.4	0.79	-	U	IM	F/O	1	-	0.0179	0.0040	77.7	Too small	-	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		22	SLSC	35	0.39	0.91	0.39	0.91	-	U	IM	F/O	1	-	0.0045	0.0010	77.7	Too small	-	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		23	SLSC	42	0.5	0.67	0.5	0.67	-	U	IM	F/O	2	-	0.0135	0.0030	77.7	Too small	-	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		24	SLSC	62	2.3	0.97	1.59	0.67	-	U	IM	F/O	2	-	0.0224	0.0050	77.7	Too small	-	82.5		Y		Y	4	0.71	30.86956522			
7/13/2013	Goose	Giraffe Lake		EF		25	SLSC	49	1.1	0.93	1	0.85	-	F	IM	F/O	2	-	0.0179	0.0040	77.7	0.0114	0.0020	82.5		Y		Y	1	0.1	9.090909091			
7/13/2013	Goose	Giraffe Lake		EF		26	SLSC	55	1.93	1.16	1.57	0.94	-	F	MTC	F/O	2	-	0.0135	0.0030	77.7	0.0057	0.0010	82.5		Y		Y	1	0.36	18.65284974			
7/13/2013	Goose	Giraffe Lake		EF		27	SLSC	62	2.3	0.97	1.9	0.80	-	M	IM	F/O	2	-	0.0269	0.0060	77.7	0.0171	0.0030	82.5		Y		Y	3	0.4	17.39130435			
7/13/2013	Goose	Giraffe Lake		EF		28	SLSC	70	3.77	1.10	3.32	0.97	-	M	IM	F/O	3	-	0.0583	0.0130	77.7	Too small	-	82.5		Y		Y	1	0.45	11.93633952			
7/13/2013	Goose	Giraffe Lake		EF		29	SLSC	65	2.5	0.91	2.5	0.91	-	M	MTC	F/O	3	-	0.0224	0.0050	77.7	0.0171	0.0030	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		30	SLSC	50	0.92	0.74	0.92	0.74	-	F	IM	F/O	1	-	0.0135	0.0030	77.7	0.0114	0.0020	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		31	SLSC	73	2.6	0.67	2.6	0.67	-	M	MTC	F/O	3	-	0.0359	0.0080	77.7	0.0229	0.0040	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		32	SLSC	56	1.9	1.08	1.38	0.79	-	U	IM	F/O	2	-	0.0224	0.0050	77.7	Too small	-	82.5		Y		Y	4	0.52	27.36842105			
7/13/2013	Goose	Giraffe Lake		EF		33	SLSC	64	2	0.76	1.2	0.46	-	M	IM	F/O	2	-	0.0224	0.0050	77.7	0.0171	0.0030	82.5		Y		Y	3	0.8	40			
7/13/2013	Goose	Giraffe Lake		EF		34	SLSC	54	1.42	0.90	1.08	0.69	-	M	IM	F/O	2	Y	0.0090	0.0020	77.7	-	-	82.5		Y		Y	2	0.34	23.94366197			
7/13/2013	Goose	Giraffe Lake		EF		35	SLSC	69	2.8	0.85	2.8	0.85	-	M	MTC	F/O	5	-	0.0090	0.0020	77.7	0.0114	0.0020	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		36	SLSC	62	2.15	0.90	2.15	0.90	-	M	IM	F/O	2	-	0.0493	0.0110	77.7	0.0114	0.0020	82.5		Y		N			0			
7/13/2013	Goose	Giraffe Lake		EF		37	SLSC	47	0.9</																									

Appendix 3.4-3. Individual Fish Data - Potential Development Area Lakes, 2013

Date (m/d/y)	Property	Waterbody	Site	Sample Method	Haul/ Pass No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm3)	True weight (without parasite weight)	True Condition (without parasite weight)	Mortality (Y/N)	Sex (F/M/U)	Repr. Status (IM/MTC/M)	Age Taken (S/F/O)	Age	Metals (Y/N)	Liver Weight (g)	Dry Liver Weight	Liver Moisture Content (%)	Gonad Weight (g)	Dry Gonad Weight	Gonad Moisture Content (%)	Tissue Weight (g)	Stomach Sampled (Y/N)	Stomach Weight (g)	Parasites (Y/N)	# of Parasites	Parasite Weight (g)	Proportion of parasite weight to body weight	Comments		
7/15/2013	Goose	Goose Lake		SGN	2	1	LKTR	458	890	0.93	890	0.93	N	-	-	F	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7/15/2013	Goose	Goose Lake		SGN	2	2	LKTR	410	698	1.01	698	1.01	N	-	-	F	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7/15/2013	Goose	Goose Lake		SGN	2	3	LKTR	437	876	1.05	876	1.05	N	-	-	F	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/4/2013	Goose	Goose Lake	A	EF	1		BURB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/4/2013	Goose	Goose Lake	B	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/4/2013	Goose	Goose Lake	B	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/4/2013	Goose	Goose Lake	B	EF	1		BURB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/4/2013	Goose	Goose Lake	C	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/4/2013	Goose	Goose Lake	C	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/4/2013	Goose	Goose Lake	C	EF	1		BURB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/4/2013	Goose	Goose Lake	D	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/4/2013	Goose	Goose Lake	D	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/4/2013	Goose	Goose Lake	D	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/6/2013	Goose	Goose Lake	J	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/6/2013	Goose	Goose Lake	J	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/6/2013	Goose	Goose Lake	E	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/6/2013	Goose	Goose Lake	E	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/6/2013	Goose	Goose Lake	E	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/6/2013	Goose	Goose Lake	E	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/6/2013	Goose	Goose Lake	F	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/6/2013	Goose	Goose Lake	F	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/6/2013	Goose	Goose Lake	F	EF	1		ARGR	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8/6/2013	Goose	Goose Lake	G	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/6/2013	Goose	Goose Lake	G	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/6/2013	Goose	Goose Lake	G	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/6/2013	Goose	Goose Lake	B	EF	2		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/6/2013	Goose	Goose Lake	B	EF	2		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/6/2013	Goose	Goose Lake	H	EF	1		NSSB	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Goose Lake	B	EF	1	1	SLSC	48	0.98	0.89	0.91	0.82	-	U	IM	F/O	2	-	0.0250	0.0030	88.00	Too small	-	82.5		Y	0.074	Y	2	0.07	7.142857143			
8/4/2013	Goose	Goose Lake	B	EF	1	2	SLSC	37	0.38	0.75	0.38	0.75	-	U	IM	F/O	0	-	0.0090	0.0030	66.67	Too small	-	82.5		Y	0.032	N			0			
8/4/2013	Goose	Goose Lake	B	EF	1	3	SLSC	39	0.53	0.89	0.53	0.89	-	U	MTC	-	-	-	0.0100	-	-	0.0010	0.0002	82.5		Y	0.052	N			0			
8/4/2013	Goose	Goose Lake	B	EF	1	4	SLSC	35	0.38	0.89	0.38	0.89	-	U	IM	F/O	2	-	0.0100	0.0040	60.00	Too small	-	82.5		Y	0.029	N			0			
8/4/2013	Goose	Goose Lake	B	EF	1	5	SLSC	75	3.46	0.82	3.43	0.81	-	U	IM	-	-	-	0.0860	0.0090	89.53	0.0160	0.0028	82.5		Y	0.283	Y	1	0.03	0.867052023			
8/4/2013	Goose	Goose Lake	B	EF	1	6	SLSC	45	0.78	0.86	0.78	0.86	-	U	IM	-	-	-	0.0310	0.0070	77.42	0.0070	0.0012	82.5		Y	0.048	N			0			
8/4/2013	Goose	Goose Lake	C	EF	1	7	SLSC	37	0.45	0.89	0.45	0.89	-	U	IM	F/O	2	-	0.0130	0.0050	61.54	Too small	-	82.5		Y	0.03	N			0			
8/4/2013	Goose	Goose Lake	C	EF	1	8	SLSC	60	1.85	0.86	1.85	0.86	-	M	MTC	-	-	-	0.0410	0.0070	82.93	0.0240	0.0042	82.5		Y	0.12	N			0			
8/4/2013	Goose	Goose Lake	D	EF	1	9	SLSC	60	2.1	0.97	1.8	0.83	-	F	MTC	F/O	3	-	0.0310	0.0060	80.65	0.0160	0.0028	82.5		Y	0.122	Y	1	0.3	14.28571429			
8/4/2013	Goose	Goose Lake	D	EF	1	10	SLSC	60	1.92	0.89	1.92	0.89	-	F	MTC	F/O	3	-	0.0800	0.0060	92.50	0.0280	0.0049	82.5		Y	0.101	N			0			
8/5/2013	Goose	Goose Lake	F	EF	1	11	SLSC	69	2.79	0.85	2.79	0.85	-	F	MTC	F/O	3	-	0.0130	77.7342	77.7	0.0440	0.0080	81.82		Y	0.333	N			0			
8/5/2013	Goose	Goose Lake	G	EF	1	12	SLSC	42	0.65	0.88	0.65	0.88	-	U	IM	F/O	2	-	0.0150	0.0033	77.7	Too small	-	-		Y	0.055	N			0			
8/5/2013	Goose	Goose Lake	G	EF	1	13	SLSC	88	6.1	0.90	6.1	0.90	-	F	MTC	F/O	3	-	0.3800	0.0847	77.7	0.0600	0.0120	80.00		Y	0.345	N			0			
8/5/2013	Goose	Goose Lake	G	EF	1	14	SLSC	64	2.99	1.14	2.64	1.01	-	U	IM	F/O	3	-	0.0420	0.0094	77.7	0.0270	0.0010	96.30		Y	0.149	Y	1	0.35	11.70568562			
8/5/2013	Goose	Goose Lake	B	EF	2	15	SLSC	81	4.14	0.78	4.14	0.78	-	M	M	F/O	8	-	0.1550	0.0346	77.7	0.0490	0.0080	83.67		Y	0.391	N			0			
8/5/2013	Goose	Goose Lake	B	EF	2	16	SLSC	46	0.92	0.95	0.92	0.95	-	U	IM	F/O	3	-	0.0150	0.0033	77.7	0.0080	0.0020	75.00		Y	0.062	N			0			
8/5/2013	Goose	Goose Lake	B	EF	2	17	SLSC	69	3.51	1.07	3.12	0.95	-	U	IM	F/O	4	-	0.0820	0.0183	77.7	0.0070	0.0030	57.14		Y	0.183	Y	1	0.39	11.11111111			
8/5/2013	Goose	Goose Lake	B	EF	2	18	SLSC	39	0.48	0.81	0.475	0.80	-	U	IM	F/O	3	-	0.0130	0.0029	77.7	0.0030	-	-		Y	0.032	Y	5	0.005	1.041666667			
8/5/2013	Goose	Goose Lake	B	EF	2	19	SLSC	53	1.34	0.90	1.34	0.90	-	M	MTC	F/O	4	-	0.0290	0.0065	77.7	0.0070	0.0010	85.71		Y	0.149	N			0			
8/5/2013	Goose	Goose Lake	B	EF	2	20	SLSC	67	2.43	0.81	2.43	0.81	-	M	M	-	-	-	0.0380	0.0085	77.7	0.0220	0.0020	90.91		Y	0.147	N			0			
8/5/2013	Goose	Goose Lake	B	EF	2	21	SLSC	62	1.93	0.81	1.93	0.81	-	M	M	F/O	1	-	0.0180	0.0040	77.7	0.0170	0.0020	88.24		Y	0.228	N			0			
8/5/2013	Goose	Goose Lake	H	EF	1	22	SLSC	36	0.38	0.81	0.38	0.81	-	U	IM	F/O	1	-	0.0070	0.0016	77.7	Too small	-	-		Y	0.023	N			0			
8/5/2013	Goose	Goose Lake	I	EF	1	23	SLSC	44	0.89	1.04	0.72	0.85	-	F	IM	F/O	2	-	0.0140	0.0031	77.7	0.0070	0.0010	85.71		Y	0.062	Y	1	0.17	19.1011236			
8/5/2013	Goose	Goose Lake	I	EF	1	24	SLSC	55	1.03	0.62	1.03	0.62	-	M	M	F/O	2	-	0.0440	0.0098	77.7	0.0120	0.0020	83.33		Y	0.067	N			0			
8/5/2013	Goose	Goose Lake	I	EF	1	25	SLSC	50	1.47	1.18	1.17	0.94	-	U	IM	F/O	1	-	0.0130	0.0029	77.7	Too small	0.0010	-		Y	0.086	Y	1	0.3	20.40816327			
8/6/2013	Goose	Goose Lake	J	EF	1	26	SLSC	52	1.31	0.93	1.31	0.93	-	U	IM	F/O	2	-	0.0580	0.0129	77.7	0.0050	0.0009	82.5		Y	0.142	N			0			
8/6/2013	Goose	Goose Lake	J	EF	1	27	SLSC	50	1.2	0.96	1.05	0.84	-																					

Appendix 3.4-3. Individual Fish Data - Potential Development Area Lakes, 2013

Date (m/d/y)	Property	Waterbody	Site	Sample Method	Haul/ Pass No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm3)	True weight (without parasite weight)	True Condition (without parasite weight)	Mortality (Y/N)	Sex (F/M/U)	Repr. Status (IM/MTC/M)	Age Taken (S/F/O)	Metals (Y/N)	Liver Weight (g)	Dry Liver Weight	Liver Moisture Content (%)	Gonad Weight (g)	Dry Gonad Weight	Gonad Moisture Content (%)	Tissue Weight (g)	Stomach Sampled (Y/N)	Stomach Weight (g)	Parasites (Y/N)	# of Parasites	Parasite Weight (g)	Proportion of parasite weight to body weight	Comments	
8/6/2013	Goose	Goose Lake	J	EF	1	37	SLSC	65	2.81	1.02	2	0.73	-	U	IM	F/O	3	-	0.0730	0.0163	77.7	0.0200	0.0035	82.5	Y	0.165	Y	4	0.81	28.82562278		
8/6/2013	Goose	Goose Lake	J	EF	1	38	SLSC	69	3.04	0.93	2.56	0.78	-	U	IM	F/O	2	-	0.0550	0.0123	77.7	0.0020	0.0004	82.5	Y	0.218	Y	1	0.48	15.78947368		
8/6/2013	Goose	Goose Lake	J	EF	1	39	SLSC	65	3.03	1.10	2.57	0.94	-	M	IM	F/O	3	Y	0.0540	0.0120	77.7	0.0050	0.0009	82.5	Y	0.204	Y	1	0.46	15.18151815		
8/6/2013	Goose	Goose Lake	J	EF	1	40	SLSC	55	1.59	0.96	1.59	0.96	-	U	IM	F/O	2	Y	0.0400	0.0089	77.7	0.0090	0.0016	82.5	Y	0.075	N			0		
8/6/2013	Goose	Goose Lake	J	EF	1	41	SLSC	55	1.56	0.94	1.56	0.94	-	M	IM	F/O	2	Y	0.0560	0.0125	77.7	0.0110	0.0019	82.5	Y	0.105	N			0		
7/14/2013	Goose	Propeller Lake		ANG	-	1	LKTR	318	326	1.01	326	1.01	N	-	-	F	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/14/2013	Goose	Propeller Lake		ANG	-	2	LKTR	342	389	0.97	389	0.97	N	-	-	F	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/14/2013	Goose	Propeller Lake		ANG	-	3	LKTR	352	503	1.15	503	1.15	N	-	-	F	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/14/2013	Goose	Propeller Lake		ANG	-	4	LKTR	440	889	1.04	889	1.04	N	-	-	F	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/14/2013	Goose	Propeller Lake		ANG	-	5	LKTR	395	608	0.99	608	0.99	N	-	-	F	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/14/2013	Goose	Propeller Lake		ANG	-	6	LKTR	590	2067	1.01	2067	1.01	N	-	-	F	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/14/2013	Goose	Propeller Lake		ANG	-	7	LKTR	380	354	0.65	354	0.65	N	-	-	F	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/14/2013	Goose	Propeller Lake		ANG	-	8	LKTR	674	2193	0.72	2193	0.72	N	-	-	F	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/14/2013	Goose	Propeller Lake		ANG	-	9	LKTR	601	1437	0.66	1437	0.66	N	-	-	F	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/14/2013	Goose	Propeller Lake		ANG	-	10	LKTR	640	2825	1.08	2825	1.08	N	-	-	F	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		ANG		PL1	LKTR	600	2005	0.93	2005	0.93	N	-	-	F/S	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		FGN	4	PL2	RDWH	170	40	0.81	40	0.81	N	-	-	F/S	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		ANG		PL3	LKTR	560	1700	0.97	1700	0.97	N	-	-	F/S	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		ANG		PL4	LKTR	650	2050	0.75	2050	0.75	N	-	-	F/S	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		SGN	5	PL5	LKTR	651	2800	1.01	2800	1.01	N	-	-	F/S	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		FGN	6	PL6	RDWH	320	320	0.98	320	0.98	N	-	-	F/S	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		FGN	6	PL7	RDWH	365	430	0.88	430	0.88	N	-	-	F/S	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		FGN	6	PL8	RDWH	380	505	0.92	505	0.92	N	-	-	F/S	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		FGN	6	PL9	LKTR	430	870	1.09	870	1.09	N	-	-	F/S	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		FGN	6	PL10	LKTR	620	1970	0.83	1970	0.83	N	-	-	F/S	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		ANG		PL11	LKTR	708	2900	0.82	2900	0.82	N	-	-	F/S	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake		ANG		PL12	LKTR	382	680	1.22	680	1.22	N	-	-	F/S	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake	18	MT	1	PL13	SLSC	64	3	1.14	3	1.14	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake	15	MT	1	PL14	SLSC	61	2	0.88	2	0.88	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/2/2013	Goose	Propeller Lake	A	EF	1		NSSB	43	0.84	1.06	0.84	1.06	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/2/2013	Goose	Propeller Lake	A	EF	1		NSSB	47	0.8	0.77	0.8	0.77	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	PHOTO 749
8/2/2013	Goose	Propeller Lake	A	EF	1		BURB	81	3.22	0.61	3.22	0.61	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/2/2013	Goose	Propeller Lake	B	EF	1		ARGR	150	38	1.13	38	1.13	N	-	IM	F/S	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Juvenile; PHOTO 756
8/2/2013	Goose	Propeller Lake	D	EF	1		NSSB	44	0.56	0.66	0.56	0.66	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake	F	EF	1		NSSB	47	0.58	0.56	0.58	0.56	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake	J	EF	1		NSSB	44	0.88	1.03	0.88	1.03	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake	K	EF	1		NSSB	21	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/3/2013	Goose	Propeller Lake	K	EF	1		BURB	120	11.39	0.66	11.39	0.66	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/2/2013	Goose	Propeller Lake	A	EF	1	1	SLSC	60	2.3	1.06	1.99	0.92	-	M	IM	F/O	2	-	0.0730	0.0163	77.7	0.0280	0.0049	82.5	Y	0.214	Y	1	0.31	13.47826087		
8/2/2013	Goose	Propeller Lake	A	EF	1	2	SLSC	60	1.84	0.85	1.76	0.81	-	F	IM	F/O	2	-	0.0500	0.0112	77.7	0.0250	0.0044	82.5	Y	0.145	Y	3	0.08	4.347826087		
8/2/2013	Goose	Propeller Lake	A	EF	1	3	SLSC	39	0.51	0.86	0.51	0.86	-	U	IM	F/O	2	-	0.0180	0.0040	77.7	Too small	-	82.5	Y	0.046	N			0		
8/2/2013	Goose	Propeller Lake	A	EF	1	4	SLSC	38	0.46	0.84	0.46	0.84	-	U	IM	F/O	1	-	0.0110	0.0025	77.7	0.0030	0.0005	82.5	Y	0.032	N			0		
8/2/2013	Goose	Propeller Lake	A	EF	1	5	SLSC	59	1.84	0.90	1.84	0.90	-	M	M	F/O	2	-	0.0640	0.0143	77.7	0.0080	0.0014	82.5	Y	1.16	N			0	PHOTO	
8/2/2013	Goose	Propeller Lake	A	EF	1	6	SLSC	30	0.27	1.00	0.27	1.00	-	U	IM	-	-	0.0070	0.0016	77.7	Too small	-	82.5	Y	0.028	N			0			
8/2/2013	Goose	Propeller Lake	A	EF	1	7	SLSC	49	1.06	0.90	1.01	0.86	-	M	IM	-	-	0.0280	0.0062	77.7	0.0030	0.0005	82.5	Y	0.119	Y	2	0.05	4.716981132			
8/2/2013	Goose	Propeller Lake	A	EF	1	8	SLSC	38	0.46	0.84	0.46	0.84	-	U	IM	F/O	1	-	0.0100	0.0022	77.7	0.0010	0.0002	82.5	Y	0.036	N			0		
8/2/2013	Goose	Propeller Lake	A	EF	1	9	SLSC	58	2.02	1.04	1.7	0.87	-	F	IM	F/O	2	-	0.0680	0.0152	77.7	0.0150	0.0026	82.5	Y	0.164	Y	1	0.32	15.84158416		
8/2/2013	Goose	Propeller Lake	A	EF	1	10	SLSC	93	6.64	0.83	6.64	0.83	-	F	M	F/O	7	-	0.1780	0.0397	77.7	0.1320	0.0231	82.5	Y	0.621	N			0	PHOTO	
8/2/2013	Goose	Propeller Lake	A	EF	1	11	SLSC	60	1.99	0.92	1.99	0.92	-	M	MTC	F/O	2	-	0.0710	0.0158	77.7	0.0100	0.0018	82.5	Y	0.2	N			0		
8/2/2013	Goose	Propeller Lake	B	EF	1	12	SLSC	39	0.53	0.89	0.53	0.89	-	U	IM	F/O	1	-	0.0120	0.0027	77.7	Too small	-	82.5	Y	0.042	N			0		
8/2/2013	Goose	Propeller Lake	B	EF	1	13	SLSC	54	1.41	0.90	1.41	0.90	-	U	U	F/O	3	-	0.0640	0.0143	77.7	Too small	-	82.5	Y	0.088	N			0		
8/2/2013	Goose	Propeller Lake	B	EF	1	14	SLSC	44	0.73	0.86	0.73	0.86	-	U	IM	F/O	3	-	0.0140	0.0031	77.7	Too small	-	82.5	Y	0.066	N			0		
8/2/2013	Goose	Propeller Lake	B	EF	1	15	SLSC	65	1.7	0.62	1.7	0.62	-	M	MTC	F/O	3	-	0.0350	0.0078	77.7	0.0190	0.0033	82.5	Y	0.124	N			0		
8/2/2013	Goose	Propeller Lake	C	EF	1	16	SLSC	36	0.37	0.79	0.37	0.79	-	U	IM	F/O	1	-	0.0100	0.0022	77.7	Too small	-	82.5	Y	0.017	N			0		
8/2/2013	Goose	Propeller Lake	D	EF	1	17	SLSC	35	0.36	0.84	0.36	0.84	-	U	IM	F/O	2	-	0.0110	0.0025	77.											

Appendix 3.4-3. Individual Fish Data - Potential Development Area Lakes, 2013

Date (m/d/y)	Property	Waterbody	Site	Sample Method	Haul/ Pass No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm3)	True weight (without parasite weight)	True Condition (without parasite weight)	Mortality (Y/N)	Sex (F/M/U)	Repr. Status (IM/MTC/M)	Age Taken (S/F/O)	Metals (Y/N)	Liver Weight (g)	Dry Liver Weight	Liver Moisture Content (%)	Gonad Weight (g)	Dry Gonad Weight	Gonad Moisture Content (%)	Tissue Weight (g)	Stomach Sampled (Y/N)	Stomach Weight (g)	Parasites (Y/N)	# of Parasites	Parasite Weight (g)	Proportion of parasite weight to body weight	Comments	
8/3/2013	Goose	Propeller Lake	F	EF	1	26	SLSC	39	0.46	0.78	0.46	0.78	-	U	IM	F/O	1	-	0.0110	0.0025	77.7	Too small	-	82.5	Y	0.037	N			0		
8/3/2013	Goose	Propeller Lake	G	EF	1	27	SLSC	63	2.62	1.05	2.4	0.96	-	M	M	F/O	3	Y	0.1000	0.0223	77.7	0.0280	0.0049	82.5	Y	0.158	Y	1	0.22	8.396946565		
8/3/2013	Goose	Propeller Lake	G	EF	1	28	SLSC	46	0.88	0.90	0.88	0.90	-	U	IM	F/O	2	Y	0.0410	0.0091	77.7	Too small	-	82.5	Y	0.091	Y	1	<0.01	-		
8/3/2013	Goose	Propeller Lake	H	EF	1	29	SLSC	65	2.47	0.90	2.47	0.90	-	M	M	F/O	3	Y	0.1200	0.0268	77.7	0.0310	0.0054	82.5	Y	0.277	N			0		
8/3/2013	Goose	Propeller Lake	I	EF	1	30	SLSC	44	0.72	0.85	0.72	0.85	-	U	IM	F/O	2	Y	0.0230	0.0051	77.7	Too small	-	82.5	Y	0.063	N			0		
8/3/2013	Goose	Propeller Lake	I	EF	1	31	SLSC	37	0.43	0.85	0.43	0.85	-	U	IM	-	-	0.0170	0.0038	77.7	Too small	-	82.5	Y	0.026	N			0			
8/3/2013	Goose	Propeller Lake	J	EF	1	32	SLSC	37	0.4	0.79	0.4	0.79	-	U	IM	F/O	1	-	0.0220	0.0049	77.7	Too small	-	82.5	Y	0.035	N			0		
8/3/2013	Goose	Propeller Lake	K	EF	1	33	SLSC	48	1.51	1.37	1.15	1.04	-	U	IM	F/O	2	Y	0.0250	0.0056	77.7	0.0020	0.0004	82.5	Y	0.125	Y	3	0.36	23.8410596		
8/3/2013	Goose	Propeller Lake	K	EF	1	34	SLSC	35	0.39	0.91	0.39	0.91	-	U	IM	F/O	2	-	0.0190	0.0042	77.7	Too small	-	82.5	Y	0.018	N			0		
8/3/2013	Goose	Propeller Lake	K	EF	1	35	SLSC	51	1.23	0.93	1.23	0.93	-	U	IM	F/O	3	Y	0.0340	0.0076	77.7	Too small	-	82.5	Y	0.126	N			0		
8/3/2013	Goose	Propeller Lake	K	EF	1	36	SLSC	50	1.2	0.96	1.2	0.96	-	M	MTC	F/O	3	Y	0.0250	0.0056	77.7	0.0100	0.0018	82.5	Y	0.118	N			0		
7/12/2013	Goose	Reference B Lake		SGN	1	1	LKTR	413	658	0.93	658	0.93	N	-	-	F	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Windy day - weights are estimates +- 50g
7/12/2013	Goose	Reference B Lake		FGN	2	2	LKTR	444	1000	1.14	1000	1.14	N	-	-	F	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Windy day - weights are estimates +- 50g
7/12/2013	Goose	Reference B Lake		FGN	2	3	LKTR	446	850	0.96	850	0.96	N	-	-	F	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Windy day - weights are estimates +- 50g
7/12/2013	Goose	Reference B Lake		FGN	2	4	LKTR	510	1210	0.91	1210	0.91	N	-	-	F	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Windy day - weights are estimates +- 50g
7/12/2013	Goose	Reference B Lake		ANG	-	5	LKTR	449	850	0.94	850	0.94	N	-	-	F	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Windy day - weights are estimates +- 50g
7/12/2013	Goose	Reference B Lake		ANG	-	6	LKTR	474	876	0.82	876	0.82	N	-	-	F	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Windy day - weights are estimates +- 50g
7/12/2013	Goose	Reference B Lake		ANG	-	7	LKTR	432	820	1.02	820	1.02	N	-	-	F	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Windy day - weights are estimates +- 50g
7/12/2013	Goose	Reference B Lake		ANG	-	8	LKTR	430	820	1.03	820	1.03	N	-	-	F	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Windy day - weights are estimates +- 50g
7/12/2013	Goose	Reference B Lake		SGN	1	9	RDWH	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/12/2013	Goose	Reference B Lake		SGN	2	10	RDWH	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/12/2013	Goose	Reference B Lake		SGN	2	11	RDWH	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/12/2013	Goose	Reference B Lake		SGN	2	12	RDWH	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/12/2013	Goose	Reference B Lake		SGN	2	13	RDWH	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/12/2013	Goose	Reference B Lake		EF	1	1	SLSC	70	3.2	0.93	3.2	0.93	-	F	IM	F	2	-	0.0583	0.0130	77.7	0.0114	0.0020	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	2	SLSC	62	2.2	0.92	2	0.84	-	F	IM	F/O	3	-	0.0448	0.0100	77.7	0.0114	0.0020	82.5	Y		Y	2	0.2	9.090909091		
7/12/2013	Goose	Reference B Lake		EF	1	3	SLSC	65	2.8	1.02	2.8	1.02	-	F	IM	F	2	-	0.0404	0.0090	77.7	0.0057	0.0010	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	4	SLSC	69	2.9	0.88	2.9	0.88	-	M	IM	-	-	0.0359	0.0080	77.7	-	-	82.5	Y		N			0			
7/12/2013	Goose	Reference B Lake		EF	1	5	SLSC	71	3.2	0.89	3.2	0.89	-	M	IM	F/O	3	Y	0.1076	0.0240	77.7	-	-	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	6	SLSC	44	0.7	0.82	0.7	0.82	-	U	IM	-	-	Y	0.0090	0.0020	77.7	-	-	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	7	SLSC	67	3	1.00	2.8	0.93	-	F	IM	F/O	2	-	0.0314	0.0070	77.7	0.0171	0.0030	82.5	Y		Y	1	0.2	6.666666667		
7/12/2013	Goose	Reference B Lake		EF	1	8	SLSC	67	2.7	0.90	2.7	0.90	-	U	IM	F/O	4	Y	0.1031	0.0230	77.7	-	-	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	9	SLSC	66	3.1	1.08	2.8	0.97	-	M	MTC	-	-	0.0762	0.0170	77.7	0.0229	0.0040	82.5	Y		Y	1	0.3	9.677419355			
7/12/2013	Goose	Reference B Lake		EF	1	10	SLSC	58	1.7	0.87	1.7	0.87	-	M	IM	F/O	2	-	0.0673	0.0150	77.7	-	-	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	11	SLSC	58	1.5	0.77	1.5	0.77	-	U	IM	F/O	1	Y	0.0224	0.0050	77.7	Too small	-	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	12	SLSC	65	2.3	0.84	2.3	0.84	-	M	IM	F/O	2	-	0.0538	0.0120	77.7	-	-	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	13	SLSC	61	2.1	0.93	2.1	0.93	-	M	IM	F/O	2	-	0.0673	0.0150	77.7	0.0171	0.0030	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	14	SLSC	81	4.5	0.85	3.8	0.72	-	M	IM	F	2	Y	0.0314	0.0070	77.7	0.0057	0.0010	82.5	Y		Y	1	0.7	15.55555556		
7/12/2013	Goose	Reference B Lake		EF	1	15	SLSC	50	1.2	0.96	1.2	0.96	-	M	IM	F/O	1	-	0.0179	0.0040	77.7	0.0114	0.0020	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	16	SLSC	68	3	0.95	3	0.95	-	M	MTC	F/O	2	-	0.0717	0.0160	77.7	0.0229	0.0040	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	17	SLSC	34	0.4	1.02	0.4	1.02	-	U	IM	F/O	2	Y	0.0090	0.0020	77.7	Too small	-	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	18	SLSC	81	4.2	0.79	4.2	0.79	-	M	MTC	F/O	3	Y	0.1659	0.0370	77.7	-	-	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	19	SLSC	46	0.8	0.82	0.8	0.82	-	U	IM	F	1	Y	-	-	77.7	Too small	-	82.5	Y		N			0		
7/12/2013	Goose	Reference B Lake		EF	1	20	SLSC	59	1.9	0.93	1.6	0.78	-	U	IM	F/O	2	-	0.0224	0.0050	77.7	Too small	-	82.5	Y		Y	1	0.3	15.78947368		
8/12/2013	Goose	Reference B Lake	1	EF	1	21	SLSC	64	2.4	0.92	2.4	0.92	-	F	M	F/O	3	-	0.1010	0.0225	77.7	0.0230	0.0040	82.5	Y	0.159	N			0		
8/12/2013	Goose	Reference B Lake	1	EF	1	22	SLSC	74	3.4	0.84	3.4	0.84	-	M	M	F/O	4	-	0.0780	0.0174	77.7	0.0520	0.0091	82.5	Y	0.205	N			0		
8/12/2013	Goose	Reference B Lake	1	EF	1	23	SLSC	78	4.9	1.03	4.67	0.98	-	U	IM	F/O	4	-	0.1370	0.0306	77.7	0.0080	0.0014	82.5	Y	0.255	Y	2	0.23	4.693877551		
8/12/2013	Goose	Reference B Lake	1	EF	1	24	SLSC	85	5.79	0.94	5.29	0.86	-	U	IM	F/O	5	-	0.0950	0.0212	77.7	0.0140	0.0025	82.5	Y	0.407	Y	1	0.5	8.635578584		
8/12/2013	Goose	Reference B Lake	1	EF	1	25	SLSC	66	2.72	0.95	2.72	0.95	-	M	MTC	F/O	4	-	0.1430	0.0319	77.7	0.0330	0.0058	82.5	Y	0.227	N			0		
8/12/2013	Goose	Reference B Lake	1	EF	1	26	SLSC	61	2.2	0.97	2.2	0.97	-	U	IM	F/O	2	-	0.1010	0.0225	77.7	0.0250	0.0044	82.5	Y	0.123	N			0		
8/12/2013	Goose	Reference B Lake	1	EF	1	27	SLSC	38	0.41	0.75	0.41	0.75	-	U	IM	F/O	1	-	0.0120	0.0027	77.7	Too small	-	82.5	Y	0.04	N			0		
8/12/2013	Goose	Reference B Lake	1	EF	1	28	SLSC	51	1.11	0.84	1.11	0.84	-	U	IM	F/O	3	-	0.0330	0.0074	77.7	Too small	-	82.5	Y	0.087	N			0		
8/12/2013	Goose	Reference B Lake	1	EF	1	29	SLSC	48	0.96	0.87	0.93	0.84	-	U	IM	F/O	3	-	0.0240	0.0054	77.7	0.0020	0.0004									

Appendix 3.4-3. Individual Fish Data - Potential Development Area Lakes, 2013

Date (m/d/y)	Property	Waterbody	Site	Sample Method	Haul/ Pass No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm3)	True weight (without parasite weight)	True Condition (without parasite weight)	Mortality (Y/N)	Sex (F/M/U)	Repr. Status (IM/MTC/M)	Age Taken (S/F/O)	Age	Metals (Y/N)	Liver Weight (g)	Dry Liver Weight	Liver Moisture Content (%)	Gonad Weight (g)	Dry Gonad Weight	Gonad Moisture Content (%)	Tissue Weight (g)	Stomach Sampled (Y/N)	Stomach Weight (g)	Parasites (Y/N)	# of Parasites	Parasite Weight (g)	Proportion of parasite weight to body weight	Comments	
8/12/2013	Goose	Reference B Lake	1	EF	1	32	SLSC	43	0.65	0.82	0.65	0.82	-	U	U	F/O	2	-	0.0160	0.0036	77.7	Too small	-	82.5		Y	0.037	N			0		
8/12/2013	Goose	Reference B Lake	1	EF	1	33	SLSC	45	0.72	0.79	0.72	0.79	-	U	IM	F/O	2	-	0.0210	0.0047	77.7	0.0050	0.0009	82.5		Y	0.057	N			0		
8/4/2013	Goose	Wasp Lake		ANG		WL1	LKTR	362	455	0.96	455	0.96	N	-	-	F/S	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		ANG		WL2	LKTR	468	760	0.74	760	0.74	N	-	-	F/S	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		ANG		WL3	LKTR	385	540	0.95	540	0.95	N	-	-	F/S	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		ANG		WL4	LKTR	360	480	1.03	480	1.03	N	-	-	F/S	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		ANG		WL5	LKTR	503	1230	0.97	1230	0.97	N	-	-	F/S	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		ANG		WL6	LKTR	385	530	0.93	530	0.93	N	-	-	F/S	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		ANG		WL7	LKTR	444	815	0.93	815	0.93	N	-	-	F/S	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		SGN	1	WL8	LKTR	362	430	0.91	430	0.91	N	-	-	F/S	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		SGN	1	WL9	RDWH	341	420	1.06	420	1.06	N	-	-	F/S	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		SGN	1	WL10	LKTR	328	350	0.99	350	0.99	N	-	-	F/S	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		ANG		WL11	LKTR	309	290	0.98	290	0.98	N	-	-	F/S	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		FGN	2	RECAP	LKTR	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	LKTR WL7 Recapture, freshly clipped fin
8/4/2013	Goose	Wasp Lake		SGN	2	WL13	RDWH	333	350	0.95	350	0.95	N	-	-	F/S	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		SGN	2	WL14	RDWH	210	74	0.80	74	0.80	N	-	-	F/S	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		SGN	2	WL15	RDWH	355	445	0.99	445	0.99	N	-	-	F/S	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		SGN	2	WL16	RDWH	362	430	0.91	430	0.91	N	-	-	F/S	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		SGN	2	WL17	LKTR	333	350	0.95	350	0.95	N	-	-	F/S	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		SGN	2	WL18	LKTR	325	316	0.92	316	0.92	N	-	-	F/S	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		SGN	2	WL19	LKTR	416	760	1.06	760	1.06	Y	M	M	F/S/O	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		SGN	2	WL20	LKTR	412	620	0.89	620	0.89	N	-	-	F/S	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		ANG		WL21	LKTR	334	350	0.94	350	0.94	N	-	-	F/S	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		ANG		WL22	LKTR	450	970	1.06	970	1.06	N	-	-	F/S	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/4/2013	Goose	Wasp Lake		ANG		WL23	LKTR	415	602	0.84	602	0.84	N	-	-	F/S	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/5/2013	Goose	Wasp Lake		SGN	3	WL24	ARGR	316	367	1.16	367	1.16	N	-	-	F/S	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/5/2013	Goose	Wasp Lake		SGN	3	WL25	RDWH	388	540	0.92	540	0.92	N	-	-	F/S	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/5/2013	Goose	Wasp Lake		SGN	3	WL26	RDWH	280	233	1.06	233	1.06	N	-	-	F/S	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/5/2013	Goose	Wasp Lake		SGN	3	WL27	RDWH	378	485	0.90	485	0.90	N	-	-	F/S	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/5/2013	Goose	Wasp Lake		SGN	3	WL28	LKTR	517	990	0.72	990	0.72	N	-	-	F/S	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/5/2013	Goose	Wasp Lake		SGN	3	WL29	LKTR	372	475	0.92	475	0.92	Y	-	-	F/S	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/5/2013	Goose	Wasp Lake		FGN	4	WL30	LKTR	361	372	0.79	372	0.79	N	-	-	F/S	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/5/2013	Goose	Wasp Lake		FGN	4	WL31	LKTR	405	480	0.72	480	0.72	Y	-	-	F/S/O	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/5/2013	Goose	Wasp Lake		ANG		WL32	LKTR	386	560	0.97	560	0.97	N	-	-	F/S	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8/5/2013	Goose	Wasp Lake		SGN	4	WL33	LKTR	410	641	0.93	641	0.93	N	-	-	F/S	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/10/2013	George	Bob Lake		SGN	1	1	LKTR	480	992	0.90	992	0.90	N	-	-	F	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/10/2013	George	Bob Lake		SGN	1	2	LKTR	365	544	1.12	544	1.12	N	-	-	F	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/10/2013	George	Bob Lake		SGN	1	3	LKTR	457	639	0.67	639	0.67	N	-	-	F	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/10/2013	George	Bob Lake		SGN	1	4	LKTR	456	753	0.79	753	0.79	Y	-	-	F	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/10/2013	George	Bob Lake		SGN	2	5	LKTR	410	673	0.98	673	0.98	N	-	-	F	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/10/2013	George	Bob Lake		SGN	2	6	LKTR	450	997	1.09	997	1.09	N	-	-	F	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/9/2013	George	Bob Lake	4	EF	1	1	LKTR	75	4.1	0.97	4.1	0.97	N	-	-	F	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/5/2013	George	George Lake		SGN	3	20	LKTR	504	1262	0.99	1262	0.99	Y	-	-	F/O	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/5/2013	George	George Lake		FGN	3	21	LKTR	478	1440	1.32	1440	1.32	N	-	-	F	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/5/2013	George	George Lake		FGN	3	22	LKTR	490	1320	1.12	1320	1.12	N	-	-	F	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/5/2013	George	George Lake		SGN	4	23	LKTR	389	604	1.03	604	1.03	Y	-	-	F/O	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/5/2013	George	George Lake		SGN	4	24	LKTR	515	1625	1.19	1625	1.19	N	-	-	F	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/5/2013	George	George Lake		SGN	4	25	LKTR	404	705	1.07	705	1.07	N	-	-	F	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/6/2013	George	George Lake		SGN	5	58	LKTR	525	1700	1.17	1700	1.17	N	-	-	F	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/6/2013	George	George Lake		SGN	5	59	LKTR	510	1600	1.21	1600	1.21	N	-	-	F	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/5/2013	George	George Lake		BS	1	2	SLSC	56	1.6	0.91	1.4	0.80	-	M	IM	F/O	1	-	0.0583	0.0130	77.7	0.0114	0.0020	82.5		Y		Y	1	0.2	12.5		
7/5/2013	George	George Lake	1	EF		3	SLSC	50	1.1	0.88	1	0.80	-	U	IM	F/O	1	Y	0.0314	0.0070	77.7	-	-	82.5		Y		Y	1	0.1	9.0909091		
7/5/2013	George	George Lake	4	BS		19	SLSC	46	0.9	0.92	0.9	0.92	-	U	IM	F/O	3	-	0.0179	0.0040	77.7	-	-	82.5		Y		Y	1	0	0		
7/6/2013	George	George Lake	3	EF		1	26	SLSC	59	1.5	0.73	1.5	0.73	-	F	MTC	F/O	3	-	0.1345	0.0300	77.7	0.0229	0.0040	82.5		Y		N		0	0	
7/6/2013	George	George Lake	C	EF		1	27	SLSC	55	1.3	0.78	1.3	0.78	-	F	MTC	F/O	2	-	0.0314	0.0070	77.7	0.0114	0.0020	82.5		Y		N		0	0	
7/6/2013	George	George Lake	C	EF		1	28	SLSC	62	2.3	0.97	1.8	0.76	-	M	MTC	F/O	3	-	0.0179	0.0040	77.7	0.0057	0.0010	82.5		Y		Y	1	0.5		

Appendix 3.4-3. Individual Fish Data - Potential Development Area Lakes, 2013

Date (m/d/y)	Property	Waterbody	Site	Sample Method	Haul/ Pass No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm3)	True weight (without parasite weight)	True Condition (without parasite weight)	Mortality (Y/N)	Sex (F/M/U)	Repr. Status (IM/MTC/M)	Age Taken (S/F/O)	Metals (Y/N)	Liver Weight (g)	Dry Liver Weight	Liver Moisture Content (%)	Gonad Weight (g)	Dry Gonad Weight	Gonad Moisture Content (%)	Tissue Weight (g)	Stomach Sampled (Y/N)	Stomach Weight (g)	Parasites (Y/N)	# of Parasites	Parasite Weight (g)	Proportion of parasite weight to body weight	Comments	
7/6/2013	George	George Lake	B	EF	2	35	SLSC	51	1.2	0.90	1.2	0.90	-	M	IM	F/O	2	-	0.0045	0.0010	77.7	-	-	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	2	36	SLSC	58	1.9	0.97	1.9	0.97	-	F	M	F/O	3	-	0.0090	0.0020	77.7	0.0171	0.0030	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	2	37	SLSC	52	1.5	1.07	1.5	1.07	-	F	IM	F/O	2	-	0.0045	0.0010	77.7	0.0171	0.0030	82.5	Y		Y	1	0	0		
7/6/2013	George	George Lake	B	EF	2	38	SLSC	45	0.8	0.88	0.8	0.88	-	U	IM	F/O	2	Y	0.0090	0.0020	77.7	0.0171	0.0030	82.5	Y		Y	1	0	0		
7/6/2013	George	George Lake	B	EF	2	39	SLSC	58	1.6	0.82	1.6	0.82	-	F	M	F/O	3	Y	0.0090	0.0020	77.7	0.0343	0.0060	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	1	40	SLSC	62	2.6	1.09	2.3	0.97	-	M	MTC	F/O	3	-	0.0224	0.0050	77.7	0.0457	0.0080	82.5	Y		Y	1	0.3	11.53846154		
7/6/2013	George	George Lake	B	EF	1	41	SLSC	44	0.8	0.94	0.8	0.94	-	U	IM	F/O	3	-	0.0090	0.0020	77.7	Too small	-	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	1	42	SLSC	56	1.7	0.97	1.7	0.97	-	U	IM	F/O	4	Y	0.0135	0.0030	77.7	0.0286	0.0050	82.5	Y		Y	2	0	0		
7/6/2013	George	George Lake	B	EF	1	43	SLSC	46	0.9	0.92	0.9	0.92	-	U	IM	F/O	3	-	0.0090	0.0020	77.7	Too small	-	82.5	Y		Y	1	0	0		
7/6/2013	George	George Lake	B	EF	1	44	SLSC	61	2.4	1.06	2.4	1.06	-	M	M	F/O	2	-	0.0404	0.0090	77.7	0.0286	0.0050	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	1	45	SLSC	40	0.9	1.41	0.9	1.41	-	U	IM	F/O	1	-	-	-	77.7	Too small	-	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	1	46	SLSC	61	1.8	0.79	1.8	0.79	-	M	IM	F/O	2	-	0.0045	0.0010	77.7	0.0343	0.0060	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	1	47	SLSC	53	1.4	0.94	1.3	0.87	-	F	IM	F/O	2	-	0.0045	0.0010	77.7	0.0229	0.0040	82.5	Y		Y	1	0.1	7.142857143		
7/6/2013	George	George Lake	B	EF	1	48	SLSC	62	1.8	0.76	1.8	0.76	-	F	MTC	F/O	3	-	0.0224	0.0050	77.7	0.0400	0.0070	82.5	Y		Y	2	0	0		
7/6/2013	George	George Lake	B	EF	1	49	SLSC	47	1.1	1.06	1.1	1.06	-	U	IM	F/O	1	-	-	-	77.7	-	-	82.5	Y		Y	2	0	0		
7/6/2013	George	George Lake	B	EF	1	50	SLSC	53	1.5	1.01	1.5	1.01	-	U	IM	F/O	1	Y	0.0135	0.0030	77.7	0.0114	0.0020	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	1	51	SLSC	50	1.1	0.88	1.1	0.88	-	F	M	F/O	2	-	0.0045	0.0010	77.7	0.0229	0.0040	82.5	Y		Y	2	0	0		
7/6/2013	George	George Lake	B	EF	1	52	SLSC	53	1.4	0.94	1.4	0.94	-	U	IM	F/O	2	Y	0.0090	0.0020	77.7	Too small	-	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	1	53	SLSC	47	0.9	0.87	0.9	0.87	-	F	M	F/O	1	-	-	-	77.7	-	-	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	1	54	SLSC	50	1	0.80	1	0.80	-	F	M	F/O	1	-	0.0090	0.0020	77.7	0.0286	0.0050	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	1	55	SLSC	34	0.3	0.76	0.3	0.76	-	U	IM	F/O	1	-	-	-	77.7	-	-	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	1	56	SLSC	46	1	1.03	1	1.03	-	U	IM	F/O	2	-	0.0090	0.0020	77.7	Too small	-	82.5	Y		N			0		
7/6/2013	George	George Lake	B	EF	1	57	SLSC	51	1.1	0.83	1.1	0.83	-	F	MTC	F	1	-	-	-	77.7	0.0286	0.0050	82.5	Y		N			0		
7/6/2013	George	George Lake	3	EF	1	5	ARGR	281	268	1.21	268	1.21	N	-	-	F/S	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	6	ARGR	194	83	1.14	83	1.14	N	-	-	F/S	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	7	ARGR	97	9.5	1.04	9.5	1.04	N	-	-	F/S	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	8	ARGR	89	6.2	0.88	6.2	0.88	N	-	-	F/S	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	9	ARGR	90	6.9	0.95	6.9	0.95	N	-	-	F/S	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	10	ARGR	87	6.5	0.99	6.5	0.99	N	-	-	F/S	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	11	LKTR	110	13.7	1.03	13.7	1.03	N	-	-	F	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	12	ARGR	82	5.8	1.05	5.8	1.05	N	-	-	F/S	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	13	ARGR	93	7.1	0.88	7.1	0.88	N	-	-	F/S	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	14	ARGR	89	6.9	0.98	6.9	0.98	N	-	-	F/S	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	15	ARGR	85	5.9	0.96	5.9	0.96	N	-	-	F/S	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	16	LKTR	65	2.8	1.02	2.8	1.02	N	-	-	F	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	17	ARGR	85	6.5	1.06	6.5	1.06	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/6/2013	George	George Lake	3	EF	1	18	ARGR	83	6.5	1.14	6.5	1.14	N	-	-	F/S	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/8/2013	George	Komatic Lake		FGN	1	2	LKTR	408	757	1.11	757	1.11	Y	-	-	F/O	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/8/2013	George	Komatic Lake		FGN	1	3	LKTR	352	510	1.17	510	1.17	N	-	-	F	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/8/2013	George	Komatic Lake		FGN	1	4	LKTR	384	635	1.12	635	1.12	Y	-	-	F/O	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/8/2013	George	Komatic Lake		SGN	1	5	LKTR	520	1705	1.21	1705	1.21	N	-	-	F	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/8/2013	George	Komatic Lake		SGN	1	6	LKTR	550	1152	0.69	1152	0.69	Y	-	-	F/O	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/8/2013	George	Komatic Lake		SGN	1	7	LKTR	440	944	1.11	944	1.11	N	-	-	F	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/8/2013	George	Komatic Lake		SGN	2	8	LKTR	646	>3000		>3000	-	N	-	-	F	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/8/2013	George	Komatic Lake		SGN	2	9	LKTR	411	828	1.19	828	1.19	Y	-	-	F/O	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/8/2013	George	Komatic Lake		SGN	2	10	LKTR	433	842	1.04	842	1.04	N	-	-	F	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/8/2013	George	Komatic Lake		FGN	1	1	LKTR	286	269	1.15	269	1.15	N	-	-	F	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/7/2013	George	Komatic Lake	1	EF	1	1	SLSC	47	1.1	1.06	1.1	1.06	-	U	IM	F/O	1	-	0.0269	0.0060	77.7	Too small	-	82.5	Y		N			0		
7/7/2013	George	Komatic Lake	1	EF	1	2	SLSC	45	0.8	0.88	0.8	0.88	-	F	IM	F/O	2	-	0.0135	0.0030	77.7	-	-	82.5	Y		N			0		
7/7/2013	George	Komatic Lake	1	EF	1	3	SLSC	60	1.9	0.88	1.9	0.88	-	U	IM	F/O	1	-	0.0404	0.0090	77.7	Too small	-	82.5	Y		N			0		
7/7/2013	George	Komatic Lake	1	EF	1	5	SLSC	39	0.5	0.84	0.5	0.84	-	U	IM	F/O	2	-	-	-	77.7	Too small	-	82.5	Y		N			0		
7/7/2013	George	Komatic Lake	1	EF	1	4	SLSC	50	1.1	0.88	1.1	0.88	-	M	IM	F/O	0	Y	0.0224	0.0050	77.7	-	-	82.5	Y		N			0		
7/7/2013	George	Komatic Lake	1	EF	1	6	SLSC	50	1.1	0.88	1.1	0.88	-	U	IM	F/O	2	Y	0.0135	0.0030	77.7	-	-	82.5	Y		N			0		
7/7/2013	George	Komatic Lake	1	EF	1	7	SLSC	39	0.5	0.84	0.5	0.84	-	U	IM	F/O	1	-	0.0135	0.0030	77.7	Too small	-	82.5	Y		N			0		
7/7/2013	George	Komatic Lake	1	EF	1	8	SLSC	31	0.3	1.01	0.3	1.01	-	U	IM	F/O	1	-	0.0090	0.0020	77.7	Too small	-	82.5	Y		N			0		
7/7/2013	George	Komatic Lake	1	EF	1	9	SLSC	61	2.1	0.93	2.1	0.93	-	U	IM	F/O	2	-	0.01													

Appendix 3.4-3. Individual Fish Data - Potential Development Area Lakes, 2013

Date (m/d/y)		Property	Waterbody	Site	Sample Method	Haul/ Pass No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm3)	True weight (without parasite weight)	True Condition (without parasite weight)	Mortality (Y/N)	Sex (F/M/U)	Repr. Status (IM/MTC/M)	Age Taken (S/F/O)	Age	Metals (Y/N)	Liver Weight (g)	Dry Liver Weight	Liver Moisture Content (%)	Gonad Weight (g)	Dry Gonad Weight	Gonad Moisture Content (%)	Tissue Weight (g)	Stomach Sampled (Y/N)	Stomach Weight (g)	Parasites (Y/N)	# of Parasites	Parasite Weight (g)	Proportion of parasite weight to body weight	Comments
7/8/2013	George	Komatic Lake	1	EF	2	17	SLSC	59	2.4	1.17	2.1	1.02	-	U	IM	F	1	-	0.0135	0.0030	77.7	Too small	-	82.5		Y	Y	1	0.3	12.5			
7/8/2013	George	Komatic Lake	1	EF	2	18	SLSC	50	1.1	0.88	1.1	0.88	-	M	IM	F/O	1	Y	0.0269	0.0060	77.7	0.0057	0.0010	82.5		Y	N			0			
7/8/2013	George	Komatic Lake	1	EF	2	19	SLSC	35	0.5	1.17	0.5	1.17	-	U	IM	F/O	2	-	0.0135	0.0030	77.7	Too small	-	82.5		Y	N			0			
7/8/2013	George	Komatic Lake	1	EF	2	20	SLSC	33	0.4	1.11	0.4	1.11	-	U	IM	F	0	-	0.0224	0.0050	77.7	Too small	-	82.5		Y	N			0			
7/8/2013	George	Komatic Lake	1	EF	2	21	SLSC	38	0.4	0.73	0.4	0.73	-	U	IM	F	0	-	-	-	77.7	Too small	-	82.5		Y	N			0			
7/8/2013	George	Komatic Lake	1	EF	2	22	SLSC	60	2.5	1.16	1.9	0.88	-	U	IM	F/O	2	-	0.0179	0.0040	77.7	Too small	-	82.5		Y	Y	2	0.6	24			
7/8/2013	George	Komatic Lake	1	EF	2	23	SLSC	37	0.6	1.18	0.6	1.18	-	U	IM	F/O	2	-	0.0135	0.0030	77.7	Too small	-	82.5		Y	N			0			
7/8/2013	George	Komatic Lake	1	EF	2	24	SLSC	62	2.2	0.92	1.9	0.80	-	U	IM	F	1	-	0.0314	0.0070	77.7	Too small	-	82.5		Y	Y	1	0.3	13.63636364			
7/8/2013	George	Komatic Lake	1	EF	2	25	SLSC	43	0.9	1.13	0.9	1.13	-	U	IM	F/O	0	-	0.0179	0.0040	77.7	Too small	-	82.5		Y	Y	2	0	0			
7/8/2013	George	Komatic Lake	1	EF	2	26	SLSC	40	0.6	0.94	0.6	0.94	-	U	IM	F	0	-	0.0090	0.0020	77.7	Too small	-	82.5		Y	N			0			
7/8/2013	George	Komatic Lake	1	EF	2	27	SLSC	78	5.6	1.18	5.1	1.07	-	U	IM	F/O	2	Y	0.1659	0.0370	77.7	0.0057	0.0010	82.5		Y	Y	1	0.5	8.928571429			
7/8/2013	George	Komatic Lake	1	EF	2	28	SLSC	62	2.4	1.01	2.1	0.88	-	U	IM	F/O	2	-	0.0359	0.0080	77.7	Too small	-	82.5		Y	Y	1	0.3	12.5			
7/8/2013	George	Komatic Lake	1	EF	2	29	SLSC	60	2.2	1.02	2.2	1.02	-	U	IM	F/O	2	Y	0.0493	0.0110	77.7	Too small	-	82.5		Y	N			0			
7/8/2013	George	Komatic Lake	1	EF	2	30	SLSC	87	7.8	1.18	7.4	1.12	-	M	MTC	F/O	4	Y	0.1883	0.0420	77.7	0.0114	0.0020	82.5		Y	Y	1	0.4	5.128205128			
7/8/2013	George	Komatic Lake	1	EF	2	31	SLSC	71	2.6	0.73	2.6	0.73	-	M	MTC	F/O	3	-	0.0269	0.0060	77.7	0.0171	0.0030	82.5		Y	N			0			
7/8/2013	George	Komatic Lake	1	EF	2	32	SLSC	51	1.09	0.82	1.09	0.82	-	U	IM	F/O	1	Y	0.0135	0.0030	77.7	-	-	82.5		Y	N			0			
7/8/2013	George	Komatic Lake	1	EF	2	33	SLSC	75	4.33	1.03	3.88	0.92	-	F	MTC	F	2	-	0.0583	0.0130	77.7	0.0229	0.0040	82.5		Y	Y	1	0.45	10.3926097			
7/8/2013	George	Komatic Lake	1	EF	2	34	SLSC	74	4.72	1.16	4.72	1.16	-	-	-	-	F/O	3	-	0.0448	0.0100	77.7	-	-	82.5		Y	N			0		
7/9/2013	George	McCoy Lake		SGN	1	1	LKTR	375	571	1.08	571	1.08	N	-	-	-	F	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/9/2013	George	McCoy Lake		SGN	1	2	LKTR	405	637	0.96	637	0.96	N	-	-	-	F	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/9/2013	George	McCoy Lake		FGN	1	3	LKTR	443	927	1.07	927	1.07	N	-	-	-	F	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/9/2013	George	McCoy Lake		FGN	1	4	LKTR	591	2043	0.99	2043	0.99	N	-	-	-	F	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	weight approx.
7/9/2013	George	McCoy Lake		SGN	2	5	LKTR	424	794	1.04	794	1.04	N	-	-	-	F	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/9/2013	George	McCoy Lake		SGN	2	6	LKTR	430	763	0.96	763	0.96	N	-	-	-	F	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/9/2013	George	McCoy Lake		FGN	3	7	LKTR	243	153	1.07	153	1.07	N	-	-	-	F	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/9/2013	George	McCoy Lake		SGN	3	8	LKTR	384	593	1.05	593	1.05	N	-	-	-	F	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/9/2013	George	McCoy Lake		SGN	4	9	LKTR	462	1051	1.07	1051	1.07	N	-	-	-	F	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/9/2013	George	McCoy Lake		SGN	3	10	RDWH	187	59	0.90	59	0.90	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7/9/2013	George	McCoy Lake		FGN	1	11	RDWH	395	535	0.87	535	0.87	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Photo # 396
7/8/2013	George	McCoy Lake		EF	1	1	SLSC	81	4.93	0.93	4.41	0.83	-	F	IM	F/O	2	-	0.0448	0.0100	77.7	0.0343	0.0060	82.5		Y	Y	1	0.52	10.54766734			
7/8/2013	George	McCoy Lake		EF	1	2	SLSC	52	1.53	1.09	1.21	0.86	-	U	IM	F	2	Y	0.0090	0.0020	77.7	Too small	-	82.5		Y	Y	2	0.32	20.91503268			
7/8/2013	George	McCoy Lake		EF	1	3	SLSC	49	1.57	1.33	1.25	1.06	-	U	IM	F/O	2	-	0.0135	0.0030	77.7	Too small	-	82.5		Y	Y	1	0.32	20.38216561			
7/8/2013	George	McCoy Lake		EF	1	4	SLSC	58	2.01	1.03	2.01	1.03	-	U	IM	F	2	-	0.0314	0.0070	77.7	-	-	82.5		Y	N			0			
7/8/2013	George	McCoy Lake		EF	1	5	SLSC	55	1.64	0.99	1.33	0.80	-	U	IM	F/O	2	-	0.0135	0.0030	77.7	0.0114	0.0020	82.5		Y	Y	2	0.31	18.90243902			
7/8/2013	George	McCoy Lake		EF	1	6	SLSC	46	0.8	0.82	0.8	0.82	-	U	IM	F/O	1	-	0.0135	0.0030	77.7	Too small	-	82.5		Y	N			0			
7/8/2013	George	McCoy Lake		EF	1	7	SLSC	55	1.87	1.12	1.87	1.12	-	U	IM	F	2	-	0.0448	0.0100	77.7	Too small	-	82.5		Y	N			0			
7/8/2013	George	McCoy Lake		EF	1	8	SLSC	65	2.95	1.07	2.55	0.93	-	U	IM	F/O	1	Y	0.0987	0.0220	77.7	Too small	-	82.5		Y	Y	1	0.4	13.55932203			
7/8/2013	George	McCoy Lake		EF	1	9	SLSC	41	1.43	2.07	1.34	1.94	-	U	IM	F/O	1	-	0.0090	0.0020	77.7	Too small	-	82.5		Y	Y	1	0.09	6.293706294			
7/8/2013	George	McCoy Lake		EF	1	10	SLSC	45	0.91	1.00	0.76	0.83	-	U	IM	F/O	1	-	0.0179	0.0040	77.7	Too small	-	82.5		Y	Y	1	0.15	16.48351648			
7/8/2013	George	McCoy Lake		EF	1	11	SLSC	47	1.2	1.16	1.12	1.08	-	U	IM	F/O	1	-	0.0179	0.0040	77.7	Too small	-	82.5		Y	Y	3	0.08	6.666666667			
7/8/2013	George	McCoy Lake		EF	1	12	SLSC	61	2.69	1.19	2.26	1.00	-	U	IM	F	1	Y	0.0538	0.0120	77.7	0.0057	0.0010	82.5		Y	Y	1	0.43	15.98513011			
7/8/2013	George	McCoy Lake		EF	1	13	SLSC	-	-	-	-	-	-	U	IM	F/O	1	-	0.0807	0.0180	77.7	Too small	-	82.5		Y	N			-			
7/8/2013	George	McCoy Lake		EF	1	14	SLSC	47	0.97	0.93	0.97	0.93	-	U	IM	F/O	1	-	0.0090	0.0020	77.7	Too small	-	82.5		Y	Y	1	0	0			
7/8/2013	George	McCoy Lake		EF	1	15	SLSC	50	1.05	0.84	1.05	0.84	-	F	IM	F/O	1	-	0.0090	0.0020	77.7	Too small	-	82.5		Y	N			0			
7/8/2013	George	McCoy Lake		EF	1	16	SLSC	49	1.3	1.10	1.3	1.10	-	U	IM	F/O	1	-	0.0090	0.0020	77.7	0.0114	0.0020	82.5		Y	N			0			
7/8/2013	George	McCoy Lake		EF	1	17	SLSC	59	2.35	1.14	1.72	0.84	-	U	IM	F/O	2	-	0.0359	0.0080	77.7	Too small	-	82.5		Y	Y	3	0.63	26.80851064			
7/8/2013	George	McCoy Lake		EF	1	18	SLSC	52	1.2	0.85	1.1	0.78	-	U	M	F/O	1	-	0.0314	0.0070	77.7	-	-	82.5		Y	Y	1	0.1	8.333333333			
7/8/2013	George	McCoy Lake		EF	1	19	SLSC	48	1.26	1.14	0.94	0.85	-	U	IM	F/O	1	-	0.0224	0.0050	77.7	Too small	-	82.5		Y	Y	2	0.32	25.3968254			
7/8/2013	George	McCoy Lake		EF	1	20	SLSC	50	1.2	0.96	1.2	0.96	-	U	IM	F/O	2	Y	0.0583	0.0130	77.7	-	-	82.5		Y	Y	2	0	0			
7/8/2013	George	McCoy Lake		EF	1	21	SLSC	56	2.03	1.16	2.03	1.16	-	U	IM	F/O	2	-	0.0179	0.0040	77.7	Too small	-	82.5		Y	N			0			
7/8/2013	George	McCoy Lake		EF	1	22	SLSC	52	1.3	0.92	1.2	0.85	-	U	IM	F/O	2	Y	0.0224	0.0050	77.7	0.0114	0.0020	82.5		Y	Y	1	0.1	7.692307692			
7/8/2013	George	McCoy Lake		EF	1	23	SLSC	68	3.29	1.05	2.86	0.91	-	M	IM	F/O	3	Y	0.0224	0.0050	77.7	0.0057	0.0010	82.5		N	Y	1	0.43	13.06990881			
7/8/2013	George	McCoy Lake		EF	1	24	SLSC	47	1	0.96	1	0.96	-	M	IM	F/O	2	Y	0.0045														

Appendix 3.4-3. Individual Fish Data - Potential Development Area Lakes, 2013

Date (m/d/y)	Property	Waterbody	Site	Sample Method	Haul/ Pass No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm3)	True weight (without parasite weight)	True Condition (without parasite weight)	Mortality (Y/N)	Sex (F/M/U)	Repr. Status (IM/MTC/M)	Age Taken (S/F/O)	Age	Metals (Y/N)	Liver Weight (g)	Dry Liver Weight	Liver Moisture Content (%)	Gonad Weight (g)	Dry Gonad Weight	Gonad Moisture Content (%)	Tissue Weight (g)	Stomach Sampled (Y/N)	Stomach Weight (g)	Parasites (Y/N)	# of Parasites	Parasite Weight (g)	Proportion of parasite weight to body weight	Comments
7/7/2013	George	Reference Q Lake		FGN	1	8	RDWH	339	428	1.10	428	1.10	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/7/2013	George	Reference Q Lake		FGN	2	9	RDWH	390	695	1.17	695	1.17	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/7/2013	George	Reference Q Lake		FGN	2	10	RDWH	420	760	1.03	760	1.03	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/7/2013	George	Reference Q Lake		FGN	2	11	RDWH	370	530	1.05	530	1.05	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/7/2013	George	Reference Q Lake		SGN	2	2	LKTR	290	200	0.82	200	0.82	N	-	-	F	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/7/2013	George	Reference Q Lake		SGN	3	3	LKTR	439	691	0.82	691	0.82	N	-	-	F	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/7/2013	George	Reference Q Lake		SGN	3	4	LKTR	372	548	1.06	548	1.06	N	-	-	F	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/7/2013	George	Reference Q Lake		SGN	4	5	LKTR	490	1320	1.12	1320	1.12	N	-	-	F	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/7/2013	George	Reference Q Lake		EF	1	1	SLSC	59	2	0.97	1.6	0.78	-	U	IM	F/O	1	Y	0.0179	0.0040	77.7	-	-	82.5		Y		Y	1	0.4	20	
7/7/2013	George	Reference Q Lake		EF	1	2	SLSC	59	2	0.97	1.6	0.78	-	F	IM	F/O	2	-	0.0135	0.0030	77.7	-	-	82.5		Y		Y	2	0.4	20	
7/7/2013	George	Reference Q Lake		EF	1	3	SLSC	56	1.7	0.97	1.2	0.68	-	U	IM	F/O	2	-	0.0135	0.0030	77.7	0.0114	0.0020	82.5		Y		Y	2	0.5	29.41176471	
7/7/2013	George	Reference Q Lake		EF	1	4	SLSC	91	7.7	1.02	6.7	0.89	-	M	M	-	-	-	0.0583	0.0130	77.7	0.0229	0.0040	82.5		Y		Y	2	1	12.98701299	
7/7/2013	George	Reference Q Lake		EF	1	5	SLSC	62	2.7	1.13	2.3	0.97	-	U	IM	F/O	2	Y	0.0493	0.0110	77.7	Too small	-	82.5		Y		Y	2	0.4	14.81481481	
7/7/2013	George	Reference Q Lake		EF	1	6	SLSC	54	1.8	1.14	1.4	0.89	-	M	MTC	F/O	2	-	0.0314	0.0070	77.7	0.0057	0.0010	82.5		Y		Y	2	0.4	22.22222222	
7/7/2013	George	Reference Q Lake		EF	1	7	SLSC	57	1.8	0.97	1.3	0.70	-	M	IM	F/O	2	-	0.0090	0.0020	77.7	0.0114	0.0020	82.5		Y		Y	3	0.5	27.77777778	
7/7/2013	George	Reference Q Lake		EF	1	8	SLSC	56	2.1	1.20	1.7	0.97	-	U	IM	F/O	1	Y	0.0045	0.0010	77.7	Too small	-	82.5		Y		Y	5	0.4	19.04761905	
7/7/2013	George	Reference Q Lake		EF	1	9	SLSC	62	1.9	0.80	1.6	0.67	-	U	IM	F/O	2	Y	0.0224	0.0050	77.7	Too small	-	82.5		Y		Y	1	0.3	15.78947368	
7/7/2013	George	Reference Q Lake		EF	1	10	SLSC	60	2.9	1.34	2.5	1.16	-	U	IM	-	-	-	0.0359	0.0080	77.7	0.0171	0.0030	82.5		Y		Y	1	0.4	13.79310345	
7/7/2013	George	Reference Q Lake		EF	1	11	SLSC	75	3.9	0.92	3.6	0.85	-	U	MTC	F/O	3	-	0.0448	0.0100	77.7	0.0057	0.0010	82.5		Y		Y	1	0.3	7.692307692	
7/7/2013	George	Reference Q Lake		EF	1	12	SLSC	57	1.5	0.81	1.5	0.81	-	U	IM	F/O	3	-	0.0224	0.0050	77.7	-	-	82.5		Y		N			0	
7/7/2013	George	Reference Q Lake		EF	1	13	SLSC	62	3	1.26	2.6	1.09	-	M	IM	F/O	3	Y	0.0269	0.0060	77.7	0.0057	0.0010	82.5		Y		Y	1	0.4	13.33333333	
7/7/2013	George	Reference Q Lake		EF	1	14	SLSC	68	3.1	0.99	3.1	0.99	-	U	IM	F/O	6	Y	0.0404	0.0090	77.7	-	-	82.5		Y		N			0	
7/7/2013	George	Reference Q Lake		EF	1	15	SLSC	36	0.3	0.64	0.3	0.64	-	U	IM	F/O	2	-	0.0045	0.0010	77.7	Too small	-	82.5		Y		N			0	
7/7/2013	George	Reference Q Lake		EF	1	16	SLSC	54	1.4	0.89	1.3	0.83	-	U	MTC	F/O	3	-	0.0090	0.0020	77.7	0.0171	0.0030	82.5		Y		Y	1	0.1	7.142857143	
7/7/2013	George	Reference Q Lake		EF	1	17	SLSC	60	1.9	0.88	1.9	0.88	-	M	MTC	-	-	-	0.0448	0.0100	77.7	0.0114	0.0020	82.5		Y		N			0	
7/7/2013	George	Reference Q Lake		EF	1	18	SLSC	56	1.9	1.08	1.5	0.85	-	U	IM	F/O	3	Y	0.0135	0.0030	77.7	Too small	0.0010	82.5		Y		Y	3	0.4	21.05263158	
7/7/2013	George	Reference Q Lake		EF	1	19	SLSC	55	2	1.20	1.6	0.96	-	U	IM	F/O	2	-	0.0179	0.0040	77.7	-	-	82.5		Y		Y	2	0.4	20	
7/7/2013	George	Reference Q Lake		EF	1	20	SLSC	57	1.9	1.03	1.5	0.81	-	U	IM	F/O	3	-	0.0224	0.0050	77.7	-	-	82.5		Y		Y	5	0.4	21.05263158	
7/7/2013	George	Reference Q Lake		EF	1	21	SLSC	57	2.1	1.13	1.9	1.03	-	M	MTC	F/O	2	-	0.0224	0.0050	77.7	0.0171	0.0030	82.5		Y		Y	2	0.2	9.523809524	
7/7/2013	George	Reference Q Lake		EF	1	22	SLSC	79	5.6	1.14	5	1.01	-	M	M	F/O	4	-	0.0628	0.0140	77.7	0.0343	0.0060	82.5		Y		Y	1	0.6	10.71428571	
7/7/2013	George	Reference Q Lake		EF	1	23	SLSC	53	1.6	1.07	1.3	0.87	-	U	IM	F/O	3	-	0.0090	0.0020	77.7	0.0057	0.0010	82.5		Y		Y	3	0.3	18.75	
7/7/2013	George	Reference Q Lake		EF	1	24	SLSC	65	2.7	0.98	2.2	0.80	-	M	IM	F/O	2	-	0.0314	0.0070	77.7	0.0057	0.0010	82.5		Y		Y	5	0.5	18.51851852	
7/7/2013	George	Reference Q Lake		EF	1	25	SLSC	74	4.3	1.06	4.3	1.06	-	M	M	F/O	5	-	0.0493	0.0110	77.7	0.0114	0.0020	82.5		Y		N			0	
7/7/2013	George	Reference Q Lake		EF	1	26	SLSC	48	1	0.90	1	0.90	-	U	IM	F/O	2	-	0.0135	0.0030	77.7	-	-	82.5		Y		Y	2	0	0	
7/7/2013	George	Reference Q Lake		EF	1	27	SLSC	54	1.3	0.83	1	0.64	-	U	IM	F/O	2	-	0.0045	0.0010	77.7	Too small	-	82.5		Y		Y	2	0.3	23.07692308	
7/7/2013	George	Reference Q Lake		EF	1	28	SLSC	45	0.8	0.88	0.8	0.88	-	U	IM	F/O	2	-	0.0179	0.0040	77.7	Too small	-	82.5		Y		N			0	
7/7/2013	George	Reference Q Lake		EF	1	29	SLSC	59	2.2	1.07	2	0.97	-	U	IM	F/O	2	Y	0.0359	0.0080	77.7	0.0114	0.0020	82.5		Y		Y	1	0.2	9.090909091	
7/7/2013	George	Reference Q Lake		EF	1	30	SLSC	55	1.4	0.84	1.3	0.78	-	U	IM	F/O	2	-	0.0448	0.0100	77.7	-	-	82.5		Y		Y	9	0.1	7.142857143	
7/7/2013	George	Reference Q Lake		EF	1	31	SLSC	56	2.2	1.25	1.9	1.08	-	F	IM	F/O	2	-	0.0359	0.0080	77.7	0.0057	0.0010	82.5		Y		Y	1	0.3	13.63636364	
7/7/2013	George	Reference Q Lake		EF	1	32	SLSC	56	1.6	0.91	1.6	0.91	-	M	IM	F	2	-	0.0224	0.0050	77.7	0.0171	0.0030	82.5		Y		N			0	

Species Code

ARGR = Arctic grayling

BURB = burbot

LKTR = lake trout

NSSB = ninespine stickleback

RDWH = round whitefish

SLSC = slimy sculpin

Sample Method

ANG = angling

BS = beach seine

EF = electrofishing

FGN = floating gillnet

SGN = sinking gillnet

MT = minnow trap

Y = yes, N = no

Dashes indicate data not available

Sex

F = female, M = male, U = unknown

Age structure

S = scale, F = fin ray, O = otolith

Reproductive Status

IM = immature, MTC = maturing, M = mature

Appendix 3.4-4

Lake Trout Spawning Survey Observations - Goose Lake,
2013

Appendix 3.4-4. Lake Trout Spawning Survey Observations - Goose Lake, 2013

Date (m/d/y)	Waterbody	Site	Crew	Turbidity	Weather	Zone	Start Easting	Northing	End Easting	Northing	Species	Count	Stage	Depth (m)	Substrate	Video	Comments
9/5/2013	Goose Lake	1	SL, SN	Clear	Overcast	13W	433547	7270532	433695	7270440	-	-	-	2.7	CO, BO, some FI	1	-
9/7/2013	Goose Lake	2	SL, SN	Clear	Overcast	13W	433830	7270819	-	-	-	-	-	2.5	CO, FI, BO	2	Good spawning habitat; nice clean area of deeper substrate along southern shore at slight point. Drop-off was deeper here and didn't immediately turn to fines/sand.
9/7/2013	Goose Lake	3	SL, SN	Clear	Overcast	13W	433851	7271533	-	-	-	-	-	2.5	CO, FI, BO	3	-
9/7/2013	Goose Lake	4	SL, SN	Clear	Overcast	13W	424228	7271877	-	-	-	-	-	2.5	FI	4	Representative of majority of lake; majority of lake has cobble/boulder shoreline with drop off ending at 1.5-2 m deep where habitat turns into sand/algae.
9/7/2013	Goose Lake	5	SL, SN	Clear	Overcast	13W	432976	7271268	-	-	-	-	-	2.5	CO, BO, algae	5	Fair spawning habitat; small patch of deeper, semi-clean substrate out from small inlet.
9/7/2013	Goose Lake	6	SL, SN	Clear	Overcast	13W	433674	7270796	-	-	-	-	-	3	CO, BO, some FI	6	Excellent spawning habitat; fair bit of wave action, lots of patches of gravel/cobble ~3 m deep. Top of shoal was ~2m deep. N/NE sides were best.
9/7/2013	Goose Lake	6	SL, SN	Clear	Overcast	13W	433674	7270796	-	-	LKTR	5	Adult	3	CO, BO, some FI	6 (2)	Excellent spawning habitat; fair bit of wave action, lots of patches of gravel/cobble ~3 m deep. Top of shoal was ~2m deep. N/NE sides were best.
9/7/2013	Goose Lake	7	SL, SN	Clear	Overcast	13W	434600	7271340	-	-	-	-	-	3	FI, CO	7	-
9/16/2013	Goose Lake	8	KG, KK	-	-	13W	433536.4379	7270522.385	433328.8046	7270414.196	-	-	-	-	-	104504-1	-
9/16/2013	Goose Lake	9	KG, KK	-	-	13W	433429.3075	7270464.701	433658.7388	7270467.407	-	-	-	-	-	105608-1	-
9/16/2013	Goose Lake	10	KG, KK	-	-	13W	433610.1165	7270834.182	433683.2823	7270873.256	-	-	-	-	-	111705-1	-
9/16/2013	Goose Lake	11	KG, KK	-	-	13W	432883.2191	7271314.598	432990.8235	7271305.358	-	-	-	-	-	113645-1	-
9/16/2013	Goose Lake	12	KG, KK	-	-	13W	433656.6512	7270794.057	433758.5499	7270836.644	-	-	-	-	-	144412-1	-

Substrate
CO = cobble
BO = boulder
FI = fines

LKTR = Lake Trout
Dashes incidate not available/applicable

Appendix 3.4-5

Tissue Metal Analysis Data, 2013



RESCAN ENVIRONMENTAL SERVICES

ATTN: Kyla Warren
1111 West Hastings Street
6/Floor
Vancouver BC V6E 2J3

Date Received: 19-AUG-13
Report Date: 15-OCT-13 13:28 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1350361
Project P.O. #: NOT SUBMITTED
Job Reference: 194096-0004
C of C Numbers: 10-240899, 10-240900, 10-240901, 10-240908, 10-240909, 10-240910
Legal Site Desc:

Amber Springer
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-1 TISSUE 03-AUG-13 PROPELLOR SLSC #23	L1350361-2 TISSUE 03-AUG-13 PROPELLOR SLSC #27	L1350361-3 TISSUE 03-AUG-13 PROPELLOR SLSC #29	L1350361-4 TISSUE 03-AUG-13 PROPELLOR SLSC #35	L1350361-5 TISSUE 03-AUG-13 PROPELLOR SLSC #36
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	70.7	68.9	68.8	70.2	72.8
Metals	Aluminum (Al)-Total (mg/kg ww)	3.9	<1.0	1.2	<1.0	<1.0
	Antimony (Sb)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	0.0080	<0.0020
	Arsenic (As)-Total (mg/kg ww)	0.0247	0.0181	0.0152	0.0152	0.0153
	Barium (Ba)-Total (mg/kg ww)	4.65	1.76	4.20	1.78	2.34
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.0112	0.0073	0.0078	0.0049	0.0072
	Calcium (Ca)-Total (mg/kg ww)	8650	3450	10700	3900	5370
	Cesium (Cs)-Total (mg/kg ww)	0.0189	0.0098	0.0136	0.0097	0.0233
	Chromium (Cr)-Total (mg/kg ww)	0.300	0.311	0.723	0.317	0.158
	Cobalt (Co)-Total (mg/kg ww)	0.0913	0.0368	0.0548	0.0417	0.0301
	Copper (Cu)-Total (mg/kg ww)	0.616	0.445	0.617	0.691	0.404
	Iron (Fe)-Total (mg/kg ww)	12.0	7.2	13.9	7.5	7.3
	Lead (Pb)-Total (mg/kg ww)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	394	257	380	327	318
	Manganese (Mn)-Total (mg/kg ww)	5.11	2.42	8.03	3.29	2.24
	Mercury (Hg)-Total (mg/kg ww)	0.0500	0.0413	0.0512	0.0388	0.0343
	Molybdenum (Mo)-Total (mg/kg ww)	0.0195	<0.0080	0.0085	<0.0080	0.0080
	Nickel (Ni)-Total (mg/kg ww)	0.522	0.278	0.455	0.319	0.194
	Phosphorus (P)-Total (mg/kg ww)	6830	3560	7860	4110	4720
	Potassium (K)-Total (mg/kg ww)	3360	2840	3190	3100	3020
	Rubidium (Rb)-Total (mg/kg ww)	4.04	5.33	4.08	3.86	6.56
	Selenium (Se)-Total (mg/kg ww)	0.187	0.293	0.352	0.297	0.221
	Sodium (Na)-Total (mg/kg ww)	795	741	832	644	694
	Strontium (Sr)-Total (mg/kg ww)	16.2	6.91	20.4	8.44	11.0
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.0115	0.00701	0.00881	0.00464	0.00700
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg ww)	0.00276	0.00075	0.00240	0.00080	0.00066
	Vanadium (V)-Total (mg/kg ww)	0.091	<0.020	0.039	<0.020	0.025
	Zinc (Zn)-Total (mg/kg ww)	23.9	19.2	21.2	24.4	20.8
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-6 TISSUE 03-AUG-13 PROPELLOR SLSC #33	L1350361-7 TISSUE 03-AUG-13 PROPELLOR SLSC #30	L1350361-8 TISSUE 03-AUG-13 PROPELLOR SLSC #28	L1350361-9 TISSUE 12-JUL-13 REF B SLSC #5	L1350361-10 TISSUE 12-JUL-13 REF B SLSC #6
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	72.5	71.8	70.3	72.2	70.4
Metals	Aluminum (Al)-Total (mg/kg ww)	1.2	<1.0	8.3	2.7	5.4
	Antimony (Sb)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	0.0034	<0.0020
	Arsenic (As)-Total (mg/kg ww)	0.0251	0.0212	0.0238	0.0161	0.0160
	Barium (Ba)-Total (mg/kg ww)	4.04	1.92	3.51	4.95	5.65
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.0082	0.0065	0.0118	0.0036	0.0036
	Calcium (Ca)-Total (mg/kg ww)	4660	3890	6360	9060	6360
	Cesium (Cs)-Total (mg/kg ww)	0.0195	0.0251	0.0188	0.0148	0.0150
	Chromium (Cr)-Total (mg/kg ww)	1.10	0.055	0.041	0.081	0.175
	Cobalt (Co)-Total (mg/kg ww)	0.0465	0.0285	0.0555	0.0235	0.0203
	Copper (Cu)-Total (mg/kg ww)	0.571	0.472	0.475	0.505	0.436
	Iron (Fe)-Total (mg/kg ww)	11.4	6.2	23.6	30.3	8.0
	Lead (Pb)-Total (mg/kg ww)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	242	298	330	361	362
	Manganese (Mn)-Total (mg/kg ww)	2.73	3.62	4.43	2.23	1.82
	Mercury (Hg)-Total (mg/kg ww)	0.0449	0.0222	0.0409	0.0469	0.0251
	Molybdenum (Mo)-Total (mg/kg ww)	0.0132	0.0136	0.0082	<0.0080	0.0085
	Nickel (Ni)-Total (mg/kg ww)	0.842	0.157	0.261	0.118	0.142
	Phosphorus (P)-Total (mg/kg ww)	4000	3930	5190	7030	5480
	Potassium (K)-Total (mg/kg ww)	2620	3230	3100	3120	3100
	Rubidium (Rb)-Total (mg/kg ww)	4.07	6.70	4.36	3.39	3.26
	Selenium (Se)-Total (mg/kg ww)	0.207	0.200	0.221	0.316	0.219
	Sodium (Na)-Total (mg/kg ww)	830	787	735	786	762
	Strontium (Sr)-Total (mg/kg ww)	14.4	9.23	13.3	18.1	16.5
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.00494	0.00755	0.00627	0.00248	0.00355
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg ww)	0.00152	0.00048	0.00183	0.00341	0.00051
	Vanadium (V)-Total (mg/kg ww)	0.046	<0.020	0.047	0.043	0.021
	Zinc (Zn)-Total (mg/kg ww)	15.8	19.4	18.7	30.4	21.5
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-11 TISSUE 12-JUL-13 REF B SLSC #8	L1350361-12 TISSUE 12-JUL-13 REF B SLSC #11	L1350361-13 TISSUE 04-AUG-13 GOOSE SLSC #28	L1350361-14 TISSUE 05-AUG-13 GOOSE SLSC #39	L1350361-15 TISSUE 05-AUG-13 GOOSE SLSC #40
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	70.5	71.3	68.5	70.7	67.9
Metals	Aluminum (Al)-Total (mg/kg ww)	<1.0	1.7	2.9	1.3	20.8
	Antimony (Sb)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	0.0039	<0.0020
	Arsenic (As)-Total (mg/kg ww)	0.0161	0.0137	0.0414	0.0332	0.0967
	Barium (Ba)-Total (mg/kg ww)	2.94	6.42	5.48	3.64	2.64
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.0034	0.0050	0.0100	0.0131	0.0090
	Calcium (Ca)-Total (mg/kg ww)	5690	8230	9860	7940	8880
	Cesium (Cs)-Total (mg/kg ww)	0.0260	0.0623	0.0144	0.0087	0.0144
	Chromium (Cr)-Total (mg/kg ww)	0.436	0.434	0.089	0.076	0.585
	Cobalt (Co)-Total (mg/kg ww)	0.0213	0.0180	0.0605	0.0522	0.0684
	Copper (Cu)-Total (mg/kg ww)	0.468	0.482	0.517	0.490	0.741
	Iron (Fe)-Total (mg/kg ww)	7.3	16.6	13.9	8.2	88.6
	Lead (Pb)-Total (mg/kg ww)	<0.010	<0.010	<0.010	<0.010	0.016
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	325	377	398	346	379
	Manganese (Mn)-Total (mg/kg ww)	1.31	2.20	2.65	3.08	2.04
	Mercury (Hg)-Total (mg/kg ww)	0.0557	0.0506	0.0796	0.0699	<0.052 ^{DLB}
	Molybdenum (Mo)-Total (mg/kg ww)	0.0082	<0.0080	0.0089	0.0092	0.0125
	Nickel (Ni)-Total (mg/kg ww)	0.286	0.281	0.220	0.251	0.595
	Phosphorus (P)-Total (mg/kg ww)	4920	6460	7340	6080	6690
	Potassium (K)-Total (mg/kg ww)	3240	3060	3470	3040	3500
	Rubidium (Rb)-Total (mg/kg ww)	4.53	4.85	3.13	3.37	3.84
	Selenium (Se)-Total (mg/kg ww)	0.373	0.300	0.271	0.225	0.238
	Sodium (Na)-Total (mg/kg ww)	616	618	791	843	779
	Strontium (Sr)-Total (mg/kg ww)	8.61	17.8	18.9	14.8	19.7
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.00424	0.00538	0.00461	0.00287	0.00413
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg ww)	0.00051	0.00117	0.00142	0.00117	0.00486
	Vanadium (V)-Total (mg/kg ww)	<0.020	0.054	0.050	0.062	0.160
	Zinc (Zn)-Total (mg/kg ww)	21.2	25.3	21.7	23.8	16.5
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-16 TISSUE 05-AUG-13 GOOSE SLSC #41	L1350361-17 TISSUE 05-AUG-13 GOOSE SSC #36	L1350361-18 TISSUE 06-AUG-13 GOOSE SLSC #31	L1350361-19 TISSUE 06-AUG-13 GOOSE SLSC #32	L1350361-20 TISSUE 06-AUG-13 GOOSE SLSC #33
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	69.3	72.4	69.3	73.8	70.1
Metals	Aluminum (Al)-Total (mg/kg wwt)	<1.0	2.4	1.0	2.2	2.6
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg wwt)	0.0310	0.0354	0.0228	0.0313	0.0500
	Barium (Ba)-Total (mg/kg wwt)	2.45	3.21	1.65	4.14	1.41
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.0057	0.0106	0.0130	0.0434	0.0069
	Calcium (Ca)-Total (mg/kg wwt)	6790	10700	6700	10700	4930
	Cesium (Cs)-Total (mg/kg wwt)	0.0121	0.0104	0.0130	0.0268	0.0087
	Chromium (Cr)-Total (mg/kg wwt)	0.063	0.272	0.244	0.314	0.061
	Cobalt (Co)-Total (mg/kg wwt)	0.0437	0.0460	0.0553	0.0875	0.0561
	Copper (Cu)-Total (mg/kg wwt)	0.410	0.575	0.536	0.615	0.457
	Iron (Fe)-Total (mg/kg wwt)	7.5	23.3	11.1	23.9	14.0
	Lead (Pb)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	350	387	336	379	312
	Manganese (Mn)-Total (mg/kg wwt)	2.70	2.87	1.74	4.26	1.07
	Mercury (Hg)-Total (mg/kg wwt)	0.0749	0.128	0.0497	<0.12 ^{DLB}	0.0368
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0080	0.0085	0.0123	0.0106	0.0083
	Nickel (Ni)-Total (mg/kg wwt)	0.198	0.443	0.340	0.527	0.223
	Phosphorus (P)-Total (mg/kg wwt)	5590	7760	5480	7600	4520
	Potassium (K)-Total (mg/kg wwt)	3260	3290	3430	3310	3470
	Rubidium (Rb)-Total (mg/kg wwt)	4.41	4.43	2.83	4.87	2.99
	Selenium (Se)-Total (mg/kg wwt)	0.178	0.274	0.272	0.296	0.268
	Sodium (Na)-Total (mg/kg wwt)	718	930	710	1070	727
	Strontium (Sr)-Total (mg/kg wwt)	14.5	18.0	12.6	21.0	9.18
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00477	0.00571	0.00384	0.00800	0.00330
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.00075	0.00417	0.00145	0.00308	0.00181
	Vanadium (V)-Total (mg/kg wwt)	0.030	0.060	0.028	0.072	0.039
	Zinc (Zn)-Total (mg/kg wwt)	18.7	33.1	17.6	38.4	20.4
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-21 TISSUE 12-JUL-13 REF B SLSC #14	L1350361-22 TISSUE 12-JUL-13 REF B SLSC #17	L1350361-23 TISSUE 12-JUL-13 REF B SLSC #18	L1350361-24 TISSUE 12-JUL-13 REF B SLSC #19	L1350361-25 TISSUE 13-JUL-13 GIRAFFE SLSC #2
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	71.7	68.2	73.1	71.2	72.3
Metals	Aluminum (Al)-Total (mg/kg ww)	5.2	1.7	2.1	<1.0	1.0
	Antimony (Sb)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg ww)	0.0145	0.0163	0.0191	0.0137	0.0188
	Barium (Ba)-Total (mg/kg ww)	7.17	7.91	1.41	3.99	1.05
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.0049	0.0060	0.0025	0.0022	0.0041
	Calcium (Ca)-Total (mg/kg ww)	12500	8290	3180	5820	3260
	Cesium (Cs)-Total (mg/kg ww)	0.0124	0.0353	0.0109	0.0497	0.0194
	Chromium (Cr)-Total (mg/kg ww)	0.193	0.791	0.085	0.196	<0.040
	Cobalt (Co)-Total (mg/kg ww)	0.0381	0.0284	0.0135	0.0221	0.0269
	Copper (Cu)-Total (mg/kg ww)	0.609	0.613	0.383	0.422	0.351
	Iron (Fe)-Total (mg/kg ww)	19.4	18.7	11.8	9.2	7.3
	Lead (Pb)-Total (mg/kg ww)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	370	416	273	379	280
	Manganese (Mn)-Total (mg/kg ww)	2.82	3.49	0.785	2.39	1.03
	Mercury (Hg)-Total (mg/kg ww)	0.0535	<0.045 ^{DLB}	0.0436	0.0420	0.0487
	Molybdenum (Mo)-Total (mg/kg ww)	0.0154	0.0128	<0.0080	<0.0080	<0.0080
	Nickel (Ni)-Total (mg/kg ww)	0.195	0.476	0.100	0.161	0.247
	Phosphorus (P)-Total (mg/kg ww)	8660	6570	3460	5200	3540
	Potassium (K)-Total (mg/kg ww)	3340	3500	3240	3480	3330
	Rubidium (Rb)-Total (mg/kg ww)	3.86	4.38	3.12	3.64	3.66
	Selenium (Se)-Total (mg/kg ww)	0.310	0.272	0.244	0.238	0.338
	Sodium (Na)-Total (mg/kg ww)	943	592	667	439	619
	Strontium (Sr)-Total (mg/kg ww)	20.1	25.0	4.29	11.3	5.60
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.00450	0.00630	0.00152	0.00373	0.00422
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg ww)	0.00154	0.00122	0.00052	0.00066	0.00095
	Vanadium (V)-Total (mg/kg ww)	0.097	0.034	0.034	0.025	0.028
	Zinc (Zn)-Total (mg/kg ww)	28.7	22.6	28.4	20.0	15.7
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-26 TISSUE 13-JUL-13 GIRAFFE SLSC #3	L1350361-27 TISSUE 13-JUL-13 GIRAFFE SLSC #4	L1350361-28 TISSUE 13-JUL-13 GIRAFFE SLSC #9	L1350361-29 TISSUE 13-JUL-13 GIRAFFE SLSC #14	L1350361-30 TISSUE 13-JUL-13 GIRAFFE SLSC #19
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	72.6	70.6	72.5	73.1	72.5
Metals	Aluminum (Al)-Total (mg/kg ww)	5.0	<1.0	1.4	1.8	1.5
	Antimony (Sb)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg ww)	0.0279	0.0191	0.0251	0.0276	0.0255
	Barium (Ba)-Total (mg/kg ww)	2.72	1.90	2.64	1.67	1.28
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.0086	0.0025	0.0113	0.0089	0.0099
	Calcium (Ca)-Total (mg/kg ww)	7350	5600	7630	6110	3720
	Cesium (Cs)-Total (mg/kg ww)	0.0220	0.0208	0.0105	0.0190	0.0111
	Chromium (Cr)-Total (mg/kg ww)	0.095	0.302	0.441	0.551	0.043
	Cobalt (Co)-Total (mg/kg ww)	0.0343	0.0249	0.0210	0.0527	0.0325
	Copper (Cu)-Total (mg/kg ww)	0.485	0.519	0.471	0.497	0.494
	Iron (Fe)-Total (mg/kg ww)	37.1	7.9	12.5	19.3	9.4
	Lead (Pb)-Total (mg/kg ww)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	281	344	305	297	245
	Manganese (Mn)-Total (mg/kg ww)	1.70	1.44	1.50	1.53	1.24
	Mercury (Hg)-Total (mg/kg ww)	0.0936	0.0645	0.0741	0.0761	0.0757
	Molybdenum (Mo)-Total (mg/kg ww)	<0.0080	<0.0080	<0.0080	0.0082	<0.0080
	Nickel (Ni)-Total (mg/kg ww)	0.388	0.364	0.473	0.553	0.323
	Phosphorus (P)-Total (mg/kg ww)	6480	5910	7130	5760	4250
	Potassium (K)-Total (mg/kg ww)	3260	3570	3330	3130	3260
	Rubidium (Rb)-Total (mg/kg ww)	3.79	3.18	2.65	3.25	2.57
	Selenium (Se)-Total (mg/kg ww)	0.318	0.383	0.371	0.365	0.344
	Sodium (Na)-Total (mg/kg ww)	705	570	728	566	652
	Strontium (Sr)-Total (mg/kg ww)	13.7	9.89	13.8	10.9	6.21
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.00453	0.00416	0.00286	0.00623	0.00210
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg ww)	0.00314	0.00079	0.00182	0.00188	0.00128
	Vanadium (V)-Total (mg/kg ww)	0.089	0.026	0.049	0.057	0.028
	Zinc (Zn)-Total (mg/kg ww)	29.3	27.9	27.9	23.0	22.5
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-31 TISSUE 13-JUL-13 GIRAFFE SLSC #20	L1350361-32 TISSUE 13-JUL-13 GIRAFFE SLSC #34	L1350361-33 TISSUE 05-JUL-13 GEORGE SLSC #3	L1350361-34 TISSUE 06-JUL-13 GEORGE SLSC #32	L1350361-35 TISSUE 06-JUL-13 GEORGE SLSC #34
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	74.5	73.5	72.6	73.5	69.4
Metals	Aluminum (Al)-Total (mg/kg ww)	3.4	1.8	4.0	3.0	5.4
	Antimony (Sb)-Total (mg/kg ww)	<0.0020	<0.0020	0.0025	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg ww)	0.0235	0.0282	0.201	0.172	0.278
	Barium (Ba)-Total (mg/kg ww)	2.66	3.86	1.62	1.35	2.34
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.0081	0.0094	0.0126	0.0259	0.0126
	Calcium (Ca)-Total (mg/kg ww)	8200	10400	9020	11600	10300
	Cesium (Cs)-Total (mg/kg ww)	0.0170	0.0286	0.0200	0.114	0.0349
	Chromium (Cr)-Total (mg/kg ww)	0.056	0.159	2.35	0.359	0.157
	Cobalt (Co)-Total (mg/kg ww)	0.0465	0.0412	0.148	0.178	0.0949
	Copper (Cu)-Total (mg/kg ww)	0.568	0.476	0.619	0.654	0.530
	Iron (Fe)-Total (mg/kg ww)	11.2	12.4	24.0	12.7	15.5
	Lead (Pb)-Total (mg/kg ww)	<0.010	<0.010	0.022	0.017	0.013
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	296	350	377	382	358
	Manganese (Mn)-Total (mg/kg ww)	1.66	2.18	7.39	8.38	6.48
	Mercury (Hg)-Total (mg/kg ww)	0.115	0.0881	0.0216	0.0560	0.0201
	Molybdenum (Mo)-Total (mg/kg ww)	0.0084	0.0086	0.0216	0.0159	<0.0080
	Nickel (Ni)-Total (mg/kg ww)	0.311	0.516	0.557	0.398	0.260
	Phosphorus (P)-Total (mg/kg ww)	7240	8780	8060	9320	9040
	Potassium (K)-Total (mg/kg ww)	3320	3450	3280	3050	3180
	Rubidium (Rb)-Total (mg/kg ww)	2.78	3.27	1.16	2.35	3.16
	Selenium (Se)-Total (mg/kg ww)	0.360	0.317	0.344	0.508	0.344
	Sodium (Na)-Total (mg/kg ww)	793	772	752	1080	861
	Strontium (Sr)-Total (mg/kg ww)	13.9	17.7	9.57	12.3	10.4
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.00439	0.00451	0.00558	0.0100	0.00540
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg ww)	0.00253	0.00226	0.00247	0.00262	0.00195
	Vanadium (V)-Total (mg/kg ww)	0.072	0.068	0.035	0.032	0.025
	Zinc (Zn)-Total (mg/kg ww)	28.7	32.6	35.2	48.3	37.8
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-36 TISSUE 06-JUL-13 GEORGE SLSC #38	L1350361-37 TISSUE 06-JUL-13 GEORGE SLSC #39	L1350361-38 TISSUE 06-JUL-13 GEORGE SLSC #42	L1350361-39 TISSUE 06-JUL-13 GEORGE SLSC #50	L1350361-40 TISSUE 06-JUL-13 GEORGE SLSC #52
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	70.6	73.2	67.0	67.7	71.1
Metals	Aluminum (Al)-Total (mg/kg ww)	6.6	4.6	3.0	1.1	2.2
	Antimony (Sb)-Total (mg/kg ww)	0.0051	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg ww)	0.169	0.241	0.213	0.254	0.207
	Barium (Ba)-Total (mg/kg ww)	3.09	1.36	3.03	1.25	1.82
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.0246	0.0235	0.0288	0.0110	0.0247
	Calcium (Ca)-Total (mg/kg ww)	11400	9000	8720	7890	5380
	Cesium (Cs)-Total (mg/kg ww)	0.0285	0.0290	0.0250	0.0307	0.0243
	Chromium (Cr)-Total (mg/kg ww)	1.14	0.115	0.060	0.316	0.197
	Cobalt (Co)-Total (mg/kg ww)	0.184	0.101	0.137	0.101	0.207
	Copper (Cu)-Total (mg/kg ww)	0.681	0.517	0.553	0.730	0.650
	Iron (Fe)-Total (mg/kg ww)	23.1	14.5	12.7	9.0	8.1
	Lead (Pb)-Total (mg/kg ww)	0.020	<0.010	<0.010	<0.010	<0.010
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	428	325	326	353	291
	Manganese (Mn)-Total (mg/kg ww)	8.26	5.71	14.5	5.11	10.2
	Mercury (Hg)-Total (mg/kg ww)	0.0265	0.109	0.0158	0.0234	0.0181
	Molybdenum (Mo)-Total (mg/kg ww)	0.0158	0.0101	0.0124	0.0093	0.0097
	Nickel (Ni)-Total (mg/kg ww)	0.578	0.311	0.551	0.375	0.542
	Phosphorus (P)-Total (mg/kg ww)	9880	7540	8070	7460	5740
	Potassium (K)-Total (mg/kg ww)	3460	2780	3090	3090	2750
	Rubidium (Rb)-Total (mg/kg ww)	1.25	1.84	1.33	2.47	1.13
	Selenium (Se)-Total (mg/kg ww)	0.484	0.445	0.484	0.404	0.431
	Sodium (Na)-Total (mg/kg ww)	864	819	843	928	719
	Strontium (Sr)-Total (mg/kg ww)	12.4	8.54	9.66	7.79	5.46
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.00662	0.00649	0.00776	0.00349	0.00566
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg ww)	0.00259	0.00202	0.00199	0.00127	0.00241
	Vanadium (V)-Total (mg/kg ww)	0.039	0.022	0.024	0.021	<0.020
	Zinc (Zn)-Total (mg/kg ww)	33.6	50.2	41.2	30.9	36.8
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-41 TISSUE 08-JUL-13 MCCOY SLSC #2	L1350361-42 TISSUE 08-JUL-13 MCCOY SLSC #8	L1350361-43 TISSUE 08-JUL-13 MCCOY SLSC #24	L1350361-44 TISSUE 08-JUL-13 MCCOY SLSC #12	L1350361-45 TISSUE 08-JUL-13 MCCOY SLSC #20
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	73.2	72.1	71.0	71.6	72.2
Metals	Aluminum (Al)-Total (mg/kg wwt)	2.3	11.5	1.7	3.2	38.3
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.0025
	Arsenic (As)-Total (mg/kg wwt)	0.111	0.0747	0.0902	0.163	0.172
	Barium (Ba)-Total (mg/kg wwt)	1.32	1.09	0.991	0.513	1.61
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.0250	0.0152	0.0154	0.0154	0.0231
	Calcium (Ca)-Total (mg/kg wwt)	9310	7300	5900	3370	9290
	Cesium (Cs)-Total (mg/kg wwt)	0.0192	0.0219	0.0470	0.0229	0.0162
	Chromium (Cr)-Total (mg/kg wwt)	0.075	0.290	2.06	<0.040	0.201
	Cobalt (Co)-Total (mg/kg wwt)	0.0634	0.0423	0.0825	0.0575	0.271
	Copper (Cu)-Total (mg/kg wwt)	0.655	0.563	0.868	0.647	0.678
	Iron (Fe)-Total (mg/kg wwt)	13.6	20.2	14.9	10.5	90.0
	Lead (Pb)-Total (mg/kg wwt)	<0.010	<0.010	<0.010	<0.010	0.014
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	313	335	288	259	339
	Manganese (Mn)-Total (mg/kg wwt)	3.01	2.00	2.94	1.65	9.53
	Mercury (Hg)-Total (mg/kg wwt)	0.0620	0.0351	0.0452	0.0522	0.0462
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0080	<0.0080	0.0155	<0.0080	0.0095
	Nickel (Ni)-Total (mg/kg wwt)	0.315	0.277	1.31	0.302	0.718
	Phosphorus (P)-Total (mg/kg wwt)	7810	7370	5920	4110	7780
	Potassium (K)-Total (mg/kg wwt)	2460	2970	3430	2610	1870
	Rubidium (Rb)-Total (mg/kg wwt)	3.32	4.73	4.28	3.51	2.93
	Selenium (Se)-Total (mg/kg wwt)	0.459	0.475	0.512	0.329	0.453
	Sodium (Na)-Total (mg/kg wwt)	841	740	911	879	716
	Strontium (Sr)-Total (mg/kg wwt)	10.5	7.96	5.89	3.15	9.83
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00345	0.00340	0.00325	0.00399	0.00292
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.00295	0.00127	0.00211	0.00124	0.00519
	Vanadium (V)-Total (mg/kg wwt)	0.029	0.039	0.029	<0.020	0.113
	Zinc (Zn)-Total (mg/kg wwt)	26.4	26.0	22.6	24.8	31.4
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	0.065

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-46 TISSUE 08-JUL-13 MCCOY SLSC #22	L1350361-47 TISSUE 08-JUL-13 MCCOY SLSC #23	L1350361-48 TISSUE 08-JUL-13 MCCOY SLSC #27	L1350361-49 TISSUE 07-JUL-13 REF Q SLSC #1	L1350361-50 TISSUE 07-JUL-13 REF Q SLSC #5
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	72.2	73.0	72.9	71.8	68.6
Metals	Aluminum (Al)-Total (mg/kg ww)	11.7	5.1	1.2	4.5	1.2
	Antimony (Sb)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg ww)	0.124	0.102	0.127	0.0622	0.0443
	Barium (Ba)-Total (mg/kg ww)	0.858	1.62	1.68	1.05	2.22
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.0097	0.0283	0.0171	0.0109	0.0116
	Calcium (Ca)-Total (mg/kg ww)	5190	7970	9710	10000	12400
	Cesium (Cs)-Total (mg/kg ww)	0.0159	0.0213	0.0213	0.0118	0.0076
	Chromium (Cr)-Total (mg/kg ww)	0.094	0.224	0.181	0.280	0.122
	Cobalt (Co)-Total (mg/kg ww)	0.0712	0.112	0.0949	0.104	0.0536
	Copper (Cu)-Total (mg/kg ww)	0.660	0.770	0.612	0.573	0.485
	Iron (Fe)-Total (mg/kg ww)	27.7	18.6	9.7	10.4	7.9
	Lead (Pb)-Total (mg/kg ww)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	263	304	356	314	399
	Manganese (Mn)-Total (mg/kg ww)	2.07	4.45	1.78	2.76	7.43
	Mercury (Hg)-Total (mg/kg ww)	0.0495	0.0864	0.0311	0.0383	0.0480
	Molybdenum (Mo)-Total (mg/kg ww)	<0.0080	0.0119	0.0090	<0.0080	<0.0080
	Nickel (Ni)-Total (mg/kg ww)	0.277	0.394	0.426	0.902	0.471
	Phosphorus (P)-Total (mg/kg ww)	5300	7210	8820	8430	10100
	Potassium (K)-Total (mg/kg ww)	2950	2380	3380	3120	3120
	Rubidium (Rb)-Total (mg/kg ww)	4.04	3.84	5.29	2.74	3.51
	Selenium (Se)-Total (mg/kg ww)	0.454	0.439	0.482	0.471	0.398
	Sodium (Na)-Total (mg/kg ww)	783	923	1000	902	972
	Strontium (Sr)-Total (mg/kg ww)	5.39	7.40	10.3	9.73	12.1
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.00310	0.00357	0.00331	0.00471	0.00300
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg ww)	0.00186	0.00177	0.00181	0.00302	0.00258
	Vanadium (V)-Total (mg/kg ww)	0.032	0.041	0.029	0.046	0.025
	Zinc (Zn)-Total (mg/kg ww)	30.0	39.4	38.9	45.2	35.4
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-51 TISSUE 07-JUL-13 REF Q SLSC #8	L1350361-52 TISSUE 07-JUL-13 REF Q SLSC #9	L1350361-53 TISSUE 07-JUL-13 REF Q SLSC #13	L1350361-54 TISSUE 07-JUL-13 REF Q SLSC #14	L1350361-55 TISSUE 07-JUL-13 REF Q SLSC #18
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	70.2	73.2	70.0	73.4	72.1
Metals	Aluminum (Al)-Total (mg/kg ww)	<1.0	1.8	4.6	1.9	2.7
	Antimony (Sb)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	0.0020
	Arsenic (As)-Total (mg/kg ww)	0.0431	0.0417	0.0741	0.0457	0.0569
	Barium (Ba)-Total (mg/kg ww)	0.641	1.19	1.73	1.22	1.04
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.0187	0.0353	0.0631	0.0322	0.0131
	Calcium (Ca)-Total (mg/kg ww)	3730	6580	12400	12800	5420
	Cesium (Cs)-Total (mg/kg ww)	0.0076	0.0229	0.0110	0.0146	0.0139
	Chromium (Cr)-Total (mg/kg ww)	0.041	0.070	0.053	0.154	0.837
	Cobalt (Co)-Total (mg/kg ww)	0.0531	0.0994	0.121	0.0815	0.0650
	Copper (Cu)-Total (mg/kg ww)	0.478	0.655	0.758	0.618	0.698
	Iron (Fe)-Total (mg/kg ww)	6.2	7.9	18.1	9.2	13.0
	Lead (Pb)-Total (mg/kg ww)	<0.010	0.011	0.015	0.015	0.011
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	251	309	345	387	329
	Manganese (Mn)-Total (mg/kg ww)	1.08	1.74	3.29	2.88	1.24
	Mercury (Hg)-Total (mg/kg ww)	0.0386	0.0438	0.0475	0.0601	0.0311
	Molybdenum (Mo)-Total (mg/kg ww)	<0.0080	0.0096	0.0091	0.0094	0.0132
	Nickel (Ni)-Total (mg/kg ww)	0.534	0.626	0.669	0.805	0.983
	Phosphorus (P)-Total (mg/kg ww)	4480	6290	9830	8530	4720
	Potassium (K)-Total (mg/kg ww)	2950	2950	2520	2810	3520
	Rubidium (Rb)-Total (mg/kg ww)	2.73	3.00	2.27	2.49	3.73
	Selenium (Se)-Total (mg/kg ww)	0.437	0.495	0.604	0.562	0.371
	Sodium (Na)-Total (mg/kg ww)	813	972	1010	853	956
	Strontium (Sr)-Total (mg/kg ww)	3.62	6.72	12.3	11.0	5.49
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.00257	0.00612	0.00432	0.00524	0.00344
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg ww)	0.00102	0.00140	0.00281	0.00524	0.00145
	Vanadium (V)-Total (mg/kg ww)	<0.020	0.035	0.081	0.099	0.027
	Zinc (Zn)-Total (mg/kg ww)	12.1	20.5	67.8	24.0	14.8
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-56 TISSUE 07-JUL-13 REF Q SLSC #29	L1350361-57 TISSUE 08-JUL-13 KOMATIC SLSC #4	L1350361-58 TISSUE 08-JUL-13 KOMATIC SLSC #6	L1350361-59 TISSUE 08-JUL-13 KOMATIC SLSC #14	L1350361-60 TISSUE 08-JUL-13 KOMATIC SLSC #18
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	71.5	72.9	73.9	74.7	69.1
Metals	Aluminum (Al)-Total (mg/kg ww)	1.6	3.2	1.4	<1.0	<1.0
	Antimony (Sb)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg ww)	0.0284	0.257	0.145	0.130	0.191
	Barium (Ba)-Total (mg/kg ww)	1.03	0.843	0.949	1.36	0.522
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.0152	0.0201	0.0083	0.0204	0.0114
	Calcium (Ca)-Total (mg/kg ww)	6270	8090	5060	8190	4160
	Cesium (Cs)-Total (mg/kg ww)	0.0125	0.0202	0.0363	0.0216	0.0104
	Chromium (Cr)-Total (mg/kg ww)	0.070	0.924	0.056	0.356	0.222
	Cobalt (Co)-Total (mg/kg ww)	0.130	0.139	0.0651	0.205	0.0735
	Copper (Cu)-Total (mg/kg ww)	0.634	0.726	0.481	0.647	0.470
	Iron (Fe)-Total (mg/kg ww)	9.2	25.1	7.9	19.0	10.9
	Lead (Pb)-Total (mg/kg ww)	<0.010	<0.010	<0.010	<0.010	<0.010
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	313	375	329	313	291
	Manganese (Mn)-Total (mg/kg ww)	2.33	7.43	4.41	4.04	2.55
	Mercury (Hg)-Total (mg/kg ww)	0.0285	0.0288	0.0557	0.0594	0.0482
	Molybdenum (Mo)-Total (mg/kg ww)	<0.0080	0.0164	0.0084	0.0125	<0.0080
	Nickel (Ni)-Total (mg/kg ww)	0.731	0.825	0.240	0.466	0.332
	Phosphorus (P)-Total (mg/kg ww)	5260	6450	4680	5920	4070
	Potassium (K)-Total (mg/kg ww)	3210	3740	3590	2490	2970
	Rubidium (Rb)-Total (mg/kg ww)	3.90	3.32	3.08	2.34	2.27
	Selenium (Se)-Total (mg/kg ww)	0.447	0.327	0.287	0.328	0.268
	Sodium (Na)-Total (mg/kg ww)	912	727	716	771	623
	Strontium (Sr)-Total (mg/kg ww)	6.03	9.08	5.91	9.47	4.93
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.00414	0.00398	0.00328	0.00264	0.00286
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.020	<0.020	<0.020	0.040
	Uranium (U)-Total (mg/kg ww)	0.00117	0.00346	0.00107	0.00179	0.00129
	Vanadium (V)-Total (mg/kg ww)	<0.020	0.040	0.021	0.032	<0.020
	Zinc (Zn)-Total (mg/kg ww)	18.6	34.3	29.4	25.9	21.9
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-61 TISSUE KOMATIC SLSC #27	L1350361-62 TISSUE KOMATIC SLSC #29	L1350361-63 TISSUE KOMATIC SLSC #30	L1350361-64 TISSUE KOMATIC SLSC #32	L1350361-65 TISSUE 08-AUG-13 GIRAFFE LKTR #1
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	70.4	72.2	71.6	70.8	70.8
Metals	Aluminum (Al)-Total (mg/kg ww)	1.5	1.5	1.6	1.8	<1.0
	Antimony (Sb)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	0.0021	<0.0020
	Arsenic (As)-Total (mg/kg ww)	0.122	0.214	0.132	0.193	0.0118
	Barium (Ba)-Total (mg/kg ww)	0.929	0.770	1.60	0.774	<0.040 ^{DLIV}
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	0.0259	0.0123	0.0133	0.0116	<0.0020
	Calcium (Ca)-Total (mg/kg ww)	6010	6400	11800	9000	60.5
	Cesium (Cs)-Total (mg/kg ww)	0.0168	0.0153	0.0132	0.0208	0.0672
	Chromium (Cr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	0.055
	Cobalt (Co)-Total (mg/kg ww)	0.156	0.451	0.289	0.102	0.0206
	Copper (Cu)-Total (mg/kg ww)	0.579	0.818	0.668	0.515	0.389
	Iron (Fe)-Total (mg/kg ww)	10.3	18.4	13.9	11.5	3.3
	Lead (Pb)-Total (mg/kg ww)	<0.010	<0.010	<0.010	0.011	<0.010
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	285	328	386	394	318
	Manganese (Mn)-Total (mg/kg ww)	3.92	8.25	11.5	4.12	0.080
	Mercury (Hg)-Total (mg/kg ww)	0.0441	0.0539	0.114	0.0394	0.575
	Molybdenum (Mo)-Total (mg/kg ww)	0.0091	0.0139	0.0148	0.0081	<0.0080
	Nickel (Ni)-Total (mg/kg ww)	0.370	0.823	0.652	0.258	0.049
	Phosphorus (P)-Total (mg/kg ww)	5030	5440	8000	6730	2650
	Potassium (K)-Total (mg/kg ww)	2840	3190	3360	3240	5150
	Rubidium (Rb)-Total (mg/kg ww)	2.81	3.68	3.95	3.47	10.5
	Selenium (Se)-Total (mg/kg ww)	0.287	0.220	0.302	0.280	0.452
	Sodium (Na)-Total (mg/kg ww)	867	892	839	846	271
	Strontium (Sr)-Total (mg/kg ww)	7.10	7.83	13.6	10.5	0.040
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.00213	0.00373	0.00237	0.00274	0.0126
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg ww)	0.00191	0.00179	0.00468	0.00209	<0.00040
	Vanadium (V)-Total (mg/kg ww)	0.034	0.031	0.057	0.044	<0.020
	Zinc (Zn)-Total (mg/kg ww)	24.1	27.9	38.7	23.6	3.62
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-66 TISSUE 08-AUG-13 GIRAFFE LKTR #2	L1350361-67 TISSUE 08-AUG-13 GIRAFFE LKTR #3	L1350361-68 TISSUE 08-AUG-13 GIRAFFE LKTR #4	L1350361-69 TISSUE 08-AUG-13 GIRAFFE LKTR #5	L1350361-70 TISSUE 08-AUG-13 GIRAFFE LKTR #6
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	69.4	68.0 ^{DLIV}	70.7	67.7	74.1
Metals	Aluminum (Al)-Total (mg/kg ww)	<1.0	<2.0 ^{DLIV}	<1.0	<1.0	1.3
	Antimony (Sb)-Total (mg/kg ww)	0.0025	<0.0040 ^{DLIV}	0.0033	<0.0020	<0.0020
	Arsenic (As)-Total (mg/kg ww)	0.0097	0.015 ^{DLIV}	0.0194	0.0074	0.0384
	Barium (Ba)-Total (mg/kg ww)	<0.040 ^{DLIV}	<0.040 ^{DLIV}	0.081	<0.020 ^{DLIV}	0.127
	Beryllium (Be)-Total (mg/kg ww)	<0.0020	<0.0040 ^{DLIV}	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg ww)	<0.0020	<0.0040 ^{DLIV}	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg ww)	<0.20	<0.40 ^{DLIV}	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg ww)	<0.0020	<0.0040 ^{DLIV}	<0.0020	<0.0020	<0.0020
	Calcium (Ca)-Total (mg/kg ww)	112	65.8	213	60.3	399
	Cesium (Cs)-Total (mg/kg ww)	0.0356	0.0369	0.0412	0.0262	0.0541
	Chromium (Cr)-Total (mg/kg ww)	0.049	<0.080 ^{DLIV}	0.183	0.047	<0.040
	Cobalt (Co)-Total (mg/kg ww)	0.0460	0.0599	0.0216	0.0262	0.0336
	Copper (Cu)-Total (mg/kg ww)	0.261	0.248	0.272	0.217	0.192
	Iron (Fe)-Total (mg/kg ww)	3.9	3.5	5.3	2.4	3.5
	Lead (Pb)-Total (mg/kg ww)	<0.010	0.077 ^{DLIV}	0.382	0.020	0.173
	Lithium (Li)-Total (mg/kg ww)	<0.10	<0.20 ^{DLIV}	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg ww)	387	368	312	345	335
	Manganese (Mn)-Total (mg/kg ww)	0.129	0.109	0.135	0.093	0.123
	Mercury (Hg)-Total (mg/kg ww)	0.273	0.305 ^{DLIV}	0.397	0.225	0.789
	Molybdenum (Mo)-Total (mg/kg ww)	<0.0080	<0.016 ^{DLIV}	0.0081	<0.0080	<0.0080
	Nickel (Ni)-Total (mg/kg ww)	0.084	0.090	0.085	<0.040	0.085
	Phosphorus (P)-Total (mg/kg ww)	2850	2620	2210	2580	2660
	Potassium (K)-Total (mg/kg ww)	5620	4900	4260	5170	4850
	Rubidium (Rb)-Total (mg/kg ww)	7.85	6.55	6.79	6.86	7.52
	Selenium (Se)-Total (mg/kg ww)	0.447	0.485	0.512	0.385	0.505
	Sodium (Na)-Total (mg/kg ww)	310	331	244	243	314
	Strontium (Sr)-Total (mg/kg ww)	0.143	0.066 ^{DLIV}	0.360	0.062	0.574
	Tellurium (Te)-Total (mg/kg ww)	<0.0040	<0.0080 ^{DLIV}	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg ww)	0.00882	0.00792 ^{DLIV}	0.00674	0.00969	0.00720
	Tin (Sn)-Total (mg/kg ww)	<0.020	<0.040 ^{DLIV}	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg ww)	<0.00040	<0.00080 ^{DLIV}	<0.00040	<0.00040	<0.00040
	Vanadium (V)-Total (mg/kg ww)	<0.020	<0.040 ^{DLIV}	<0.020	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg ww)	3.76	3.57 ^{DLIV}	3.72	3.17	4.18
	Zirconium (Zr)-Total (mg/kg ww)	<0.040	<0.080 ^{DLIV}	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1350361-71 TISSUE 08-AUG-13 GIRAFFE LKTR #7	L1350361-72 TISSUE 08-AUG-13 GIRAFFE LKTR #8			
Grouping	Analyte					
TISSUE						
Physical Tests	% Moisture (%)	72.6 ^{DLIV}	72.2			
Metals	Aluminum (Al)-Total (mg/kg ww)	<2.0	3.3			
	Antimony (Sb)-Total (mg/kg ww)	0.0075	0.0114			
	Arsenic (As)-Total (mg/kg ww)	0.046	0.014			
	Barium (Ba)-Total (mg/kg ww)	<0.050 ^{DLIV}	0.29			
	Beryllium (Be)-Total (mg/kg ww)	<0.0040 ^{DLIV}	<0.0040 ^{DLIV}			
	Bismuth (Bi)-Total (mg/kg ww)	<0.0040 ^{DLIV}	<0.0040 ^{DLIV}			
	Boron (B)-Total (mg/kg ww)	<0.40 ^{DLIV}	<0.40 ^{DLIV}			
	Cadmium (Cd)-Total (mg/kg ww)	<0.0040 ^{DLIV}	<0.0040 ^{DLIV}			
	Calcium (Ca)-Total (mg/kg ww)	89.7	142			
	Cesium (Cs)-Total (mg/kg ww)	0.126	0.0375			
	Chromium (Cr)-Total (mg/kg ww)	0.172	0.107			
	Cobalt (Co)-Total (mg/kg ww)	0.0390	0.0223			
	Copper (Cu)-Total (mg/kg ww)	0.258	0.295			
	Iron (Fe)-Total (mg/kg ww)	6.4	8.8			
	Lead (Pb)-Total (mg/kg ww)	0.076	0.590			
	Lithium (Li)-Total (mg/kg ww)	<0.20 ^{DLIV}	<0.20 ^{DLIV}			
	Magnesium (Mg)-Total (mg/kg ww)	426	305			
	Manganese (Mn)-Total (mg/kg ww)	0.148	0.172			
	Mercury (Hg)-Total (mg/kg ww)	1.39	0.744			
	Molybdenum (Mo)-Total (mg/kg ww)	<0.016 ^{DLIV}	<0.016 ^{DLIV}			
	Nickel (Ni)-Total (mg/kg ww)	0.242	0.093			
	Phosphorus (P)-Total (mg/kg ww)	2760	1910			
	Potassium (K)-Total (mg/kg ww)	6070	3570			
	Rubidium (Rb)-Total (mg/kg ww)	12.1	6.13			
	Selenium (Se)-Total (mg/kg ww)	0.432	0.495			
	Sodium (Na)-Total (mg/kg ww)	642	322			
	Strontium (Sr)-Total (mg/kg ww)	0.058	0.192			
	Tellurium (Te)-Total (mg/kg ww)	<0.0080 ^{DLIV}	<0.0080 ^{DLIV}			
	Thallium (Tl)-Total (mg/kg ww)	0.0117	0.00515			
	Tin (Sn)-Total (mg/kg ww)	<0.040 ^{DLIV}	<0.040 ^{DLIV}			
	Uranium (U)-Total (mg/kg ww)	<0.00080 ^{DLIV}	<0.00080 ^{DLIV}			
	Vanadium (V)-Total (mg/kg ww)	<0.040 ^{DLIV}	<0.040 ^{DLIV}			
	Zinc (Zn)-Total (mg/kg ww)	4.47	4.61			
	Zirconium (Zr)-Total (mg/kg ww)	<0.080 ^{DLIV}	<0.080 ^{DLIV}			

* 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	Chromium (Cr)-Total	DUP-H	L1350361-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -21, -22, -23, -24, -25, -3, -4, -5, -6, -7, -8, -9
Duplicate	Iron (Fe)-Total	DUP-H	L1350361-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -21, -22, -23, -24, -25, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nickel (Ni)-Total	DUP-H	L1350361-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -21, -22, -23, -24, -25, -3, -4, -5, -6, -7, -8, -9
Duplicate	Aluminum (Al)-Total	DUP-H	L1350361-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -21, -22, -23, -24, -25, -3, -4, -5, -6, -7, -8, -9
Duplicate	Chromium (Cr)-Total	DUP-H	L1350361-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -21, -22, -23, -24, -25, -3, -4, -5, -6, -7, -8, -9
Duplicate	Iron (Fe)-Total	DUP-H	L1350361-1, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -2, -20, -21, -22, -23, -24, -25, -3, -4, -5, -6, -7, -8, -9
Duplicate	Mercury (Hg)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Aluminum (Al)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Arsenic (As)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Barium (Ba)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Cadmium (Cd)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Calcium (Ca)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Magnesium (Mg)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Manganese (Mn)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Phosphorus (P)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Strontium (Sr)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Thallium (Tl)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Uranium (U)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Zinc (Zn)-Total	DUP-H	L1350361-26, -27, -28, -29, -30, -31, -32, -33, -34, -35, -36, -37, -38, -39, -40, -41, -42, -43, -44, -45, -46, -47, -48, -49, -50, -51, -52, -53
Duplicate	Barium (Ba)-Total	DUP-H	L1350361-54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72
Duplicate	Cadmium (Cd)-Total	DUP-H	L1350361-54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72
Duplicate	Calcium (Ca)-Total	DUP-H	L1350361-54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72
Duplicate	Iron (Fe)-Total	DUP-H	L1350361-54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72
Duplicate	Magnesium (Mg)-Total	DUP-H	L1350361-54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72
Duplicate	Manganese (Mn)-Total	DUP-H	L1350361-54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72
Duplicate	Phosphorus (P)-Total	DUP-H	L1350361-54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72

Reference Information

	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Strontium (Sr)-Total	DUP-H	L1350361-54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72
Duplicate	Thallium (Tl)-Total	DUP-H	L1350361-54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72
Duplicate	Uranium (U)-Total	DUP-H	L1350361-54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72
Duplicate	Vanadium (V)-Total	DUP-H	L1350361-54, -55, -56, -57, -58, -59, -60, -61, -62, -63, -64, -65, -66, -67, -68, -69, -70, -71, -72
Method Blank	Mercury (Hg)-Total	MB-LOR	L1350361-15, -19, -22

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection limit was raised due to detection of analyte at comparable level in Method Blank.
DLIV	Detection Limit Adjusted: Lower Initial Volume
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-WET-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (WET)	EPA 200.3, EPA 245.7
This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.			
MET-WET-MICR-HRMS-VA	Tissue	Metals in Tissue by HR-ICPMS Micro (WET)	EPA 200.3/200.8
Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.			
MOISTURE-TISS-VA	Tissue	% Moisture in Tissues	ASTM D2974-00 Method A
This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.			

** 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:

10-240899	10-240900	10-240901	10-240908	10-240909
10-240910				

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.



DRAFT

10- 240901

Chain of Custody / Analytical Request Form
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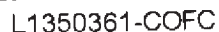
Report To		Report Format / Distribution		Service Request:(Rush subject to availability - Contact ALS to confirm TAT)						
Company: Rescan Environmental Services		Standard: ☒ Other (specify):		☒ Regular (Standard Turnaround Times - Business Days)						
Contact: Kyla Warren		Select: PDF ☒ Excel ☒ Digital Fax		Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT						
Address: 3790 Alfred Ave.		Email 1: kyla.warren@erm.com		Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT						
Smithers BC		Email 2:		Same Day or Weekend Emergency - Contact ALS to confirm TAT						
Phone: 250-877-1838 Fax:				Analysis Request						
Invoice To Same as Report? (circle) ☒ Yes or No (if No, provide details)		Client / Project Information		(Indicate Filtered or Preserved, F/P)						
Copy of Invoice with Report? (circle) ☒ Yes or No		Job #: 194096-0004								
Company:		PO / AFE:								
Contact:		LSD:								
Address:		Quote #:								
Phone:		ALS Amber		Sampler: Kyla Warren						
Lab Wor		Contact: Springer								
Short Holding Time		LI350361								
Rush Processing										
Sample #		Sample Identification (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type				
		Scalpin Propellor SLSC # 23		3-AUG-13		tissue				
		Scalpin Propellor SLSC # 27								
		Scalpin Propellor SLSC # 29								
		Scalpin Propellor SLSC # 35								
		Scalpin Propellor SLSC # 36								
		Scalpin Propellor SLSC # 33								
		Scalpin Propellor SLSC # 30								
		Scalpin Propellor SLSC # 28								
		Ref B SLSC # 5		12-JUL-13						
		Ref B SLSC # 6								
		Ref B SLSC # 8								
		Ref B SLSC # 11								
Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/etc) / Hazardous Details										
Routine ICPMS plus mercury										
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:	
K.Kuchapski	15 AUG 13	8:13	A. Harker	Aug 17, 2013	9pm	-6.6 °C				
									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



Chain of Custody / Analytical Request Form
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10-240900

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Report To			Report Format / Distribution			Service Request: (Rush subject to availability - Contact ALS to confirm TAT)					
Company: Rescan Environmental Services			Standard: [X] Other (specify):			[X] Regular (Standard Turnaround Times - Business Days)					
Contact: Kyla Warren			Select: PDF [X] Excel [X] Digital Fax			Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT					
Address: 379D Alfred Ave. Smithers B.C.			Email 1: kyla.warren@erm.com			Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT					
Phone: 250-877-1838 Fax:			Email 2:			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 (Indicate Filtered or Preserved, F/P)					
Copy of Invoice with Report? (circle) Yes or No			Job #: 194096-0004								
Company:			PO / AFE:								
Contact:			LSD:								
Address:			Quote #:								
Phone: Fax:			ALS Amber Contact: Springer			Sampler: Kyla warren					
Lab Work Order # (lab use only)			Date (dd-mm-yy)			Time (hh:mm)			Sample Type		
Sample Identification (This description will appear on the report)			Date (dd-mm-yy)			Time (hh:mm)			Sample Type		
Scalpin Goose SLSC #28			4-AUG-13			tissue			whole body metals		
Scalpin Goose SLSC #39			5 AUG-13								
Scalpin Goose SLSC #40											
Scalpin Goose SLSC #41											
Scalpin Goose SLSC #36											
Scalpin Goose SLSC #31			6-AUG-13								
Scalpin Goose SLSC #32											
Scalpin Goose SLSC #33											
Ref B SLSC #14			July 12/13								
Ref B SLSC #17											
Ref B SLSC #18											
Ref B SLSC #19											
Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/etc) / Hazardous Details											
Routine ICPMS plus Mercury											
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:
K. Kuchapski		15 AUG 13	8:13	A. Ackoon		Aug 17, 2013	9pm	86°C			
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Company: Pescan Environmental Services			Standard: ☒ Other (specify):			☒ Regular (Standard Turnaround Times - Business Days)														
Contact: Kyla Warren			Select: PDF ☒ Excel ☒ Digital Fax			Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT														
Address: 3790 Alfred Ave Smithers BC			Email 1: kyla.warren@erm.com			Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT														
Phone: 250-877-1838 Fax:			Email 2:			Same Day or Weekend Emergency - Contact ALS to confirm TAT														
Invoice To Same as Report ? (circle) Yes or No (if No, provide details) Copy of Invoice with Report? (circle) Yes or No			Client / Project Information			Analysis Request (Indicate Filtered or Preserved, F/P)														
Company:			Job #: 194096 - 0004																	
Contact:			PO / AFE:																	
Address:			LSD:																	
Phone: Fax:			Quote #:																	
Lab Work Order # (lab use only)			ALS Contact: Amber Springe Sampler: Kyla Warren																	
Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	whole body metals															Number of Containers
	Giraffe SLSC #2	13-JUL-13		tissue	☒															1
	Giraffe SLSC #3				☒															1
	Giraffe SLSC #4				☒															1
	Giraffe SLSC #9				☒															1
	Giraffe SLSC #14				☒															1
	Giraffe SLSC #19				☒															1
	Giraffe SLSC #20				☒															1
	Giraffe SLSC #34				☒															1
	George SLSC #3	5-JUL-13			☒															1
	George SLSC #32	6-JUL-13			☒															1
	George SLSC #34				☒															1
	George SLSC #38				☒															1
Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/etc) / Hazardous Details																				
Routine ICPMS plus Mercury																				
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:										
K.Kuchapski	15 AUG 13	10:13	A. Jackson	Aug 19, 2013	9 pm	8.6 °C				Yes / No ? If Yes add SIF										
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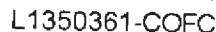
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Appendix 3.4-6

The Number and Taxonomic Identification of Slimy
Sculpin Stomach Contents, 2013

Appendix 3.4-6. The Number and Taxonomic Identification of Slimy Sculpin Stomach Contents, 2013

Taxa	George	Giraffe	Komatic	McCoy	RefB	RefQ	Propellor	Goose	Ref B
Arthropoda									
Arachnida									
<i>Lebertia</i> sp.	1	0	0	0	0	0	0	0	0
Acari	0	0	0	0	0	0	7	1	0
Branchiopoda	0	13	76	1	1	0	0	0	0
Chydoridae	0	0	0	2	12	21	0	0	1
Cladocera	0	0	0	0	0	0	49	18	31
Harpactacoida	0	0	0	0	0	0	3	0	0
Crustacea	0	0	0	0	0	0	2	3	0
Maxilapoda									
Calanoida	0	0	0	0	0	0	3	2	0
Insecta	0	0	0	0	0	0	16	20	23
Coleoptera	0	0	0	0	0	0	0	1	0
Dytiscidae	0	3	5	1	0	10	0	3	0
Colymbetinae	0	0	0	0	1	0	0	0	0
<i>Agabus</i> sp.	0	0	2	0	0	0	0	0	0
Hydroporinae	0	93	13	8	62	34	10	11	0
<i>Hydrocolus</i> sp.	0	0	0	0	0	0	20	26	0
Gyrinidae	0	0	0	0	1	0	0	0	0
Plecoptera	0	0	0	0	0	0	1	0	0
<i>Nemoura</i> sp.	0	0	0	0	0	0	0	1	0
Trichoptera	0	0	0	0	0	0	5	1	1
Leptoceridae	0	0	0	0	0	0	0	1	0
Limnephilidae	0	0	0	0	0	0	1	0	0
Phryganeidae	0	0	0	0	0	0	0	4	5
Diptera	33	51	1	22	0	5	12	7	1
Ceratopogonidae									
<i>Bezzia/Palpomyia</i> sp.	0	0	0	1	0	0	0	3	0
Chironomidae	33	59	0	0	0	4	3	2	2
Chironomini	0	1	1	0	0	0	1	0	2
<i>Chironomus</i> sp.	2	7	1	3	21	6	14	10	5
<i>Cladopelma</i> sp.	0	0	0	0	1	0	0	0	0
<i>Cryptochironomus</i> sp.	1	5	1	8	3	0	5	1	6
<i>Demicryptochironomus</i> sp.	2	0	0	0	0	0	0	1	0
<i>Dicrotendipes fumidus</i>	4	88	2	0	45	10	23	21	36
<i>Dicrotendipes</i> sp.	13	0	96	69	0	0	0	0	0
<i>Endochironomus</i> sp.	0	0	0	0	0	0	0	1	0
<i>Glyptotendipes</i> sp.	1	0	0	0	0	1	0	0	0
<i>Parachironomus</i> sp.	0	0	1	1	0	0	0	0	0
<i>Paracladopelma</i> sp.	8	0	0	0	0	0	0	0	0
<i>Phaenopsectra</i> sp.	0	0	0	0	0	0	16	37	0
<i>Polypedilum</i> sp.	0	0	2	0	0	0	0	0	0
<i>Polypedilum</i> sp.	0	1	0	0	0	0	0	0	0
<i>Polypedilum</i> sp.	0	0	0	1	0	0	0	0	0
<i>Sergentia</i> sp.	1	0	0	0	0	0	0	0	0
<i>Stictochironomus</i> sp.	8	9	4	6	10	2	0	0	0
<i>Tanytarsini</i> sp.	28	14	2	1	14	11	21	13	9
<i>Micropsectra</i> sp.	0	2	0	1	0	0	2	1	2
<i>Paratanytarsus</i> sp.	12	129	210	86	58	131	52	94	49
<i>Rheotanytarsus exiguus</i> gr.	0	0	0	1	0	0	0	0	6
<i>Stempellinella</i> sp.	0	0	3	0	0	0	0	0	0
<i>Tanytarsus</i> sp.	16	11	23	14	8	169	0	0	0
Diamesinae									
<i>Potthastia longimana</i> gr.	6	0	0	2	2	0	0	0	0
Orthoclaadiinae	0	0	10	1	0	2	11	5	0
<i>Acamptocladus</i> sp.	0	2	0	4	0	4	0	0	0
<i>Antillocladius</i> sp.	0	0	0	0	1	0	0	0	0
<i>Chaetocladus</i> sp.	0	0	0	0	0	2	0	3	0
<i>Corynoneura</i> sp.	80	0	2	1	0	1	20	21	1
<i>Cricotopus bicinctus</i> gr.	0	0	1	0	0	0	17	19	11
<i>Cricotopus</i> sp.	101	5	84	263	40	61	0	0	0
<i>Eukiefferiella</i> sp.	0	0	0	0	0	0	2	0	0
<i>Doncricotopus</i> sp.	1	0	10	0	0	0	0	0	0
<i>Heterotrissocladus marcidus</i> gr.	6	0	0	0	2	0	0	0	0

Appendix 3.4-6. The Number and Taxonomic Identification of Slimy Sculpin Stomach Contents, 2013

Taxa	George	Giraffe	Komatic	McCoy	RefB	RefQ	Propellor	Goose	Ref B
<i>Heterotrissocladius subpilosus</i> gr.	0	0	0	0	0	1	0	0	0
<i>Hydrobaenus</i> sp.	0	0	1	0	0	1	0	0	0
<i>Limnophyes</i> sp.	0	0	1	0	0	2	0	0	0
<i>Nanocladius</i> sp.	5	0	8	0	1	1	0	1	0
<i>Orthocladius</i> sp.	4	0	2	14	0	0	0	0	3
<i>Parakiefferiella</i> sp.	22	1	0	0	0	0	0	0	1
<i>Parametriocnemus</i> sp.	0	0	0	0	0	0	0	0	2
<i>Parorthocladius</i> sp.	1	0	0	0	0	0	0	0	0
<i>Psectrocladius</i> sp.	50	21	287	33	40	256	10	21	40
<i>Pseudosmittia</i> sp.	4	0	6	16	0	12	0	0	0
<i>Stilocladius</i> sp.	1	0	0	0	0	0	0	0	0
<i>Synorthocladius</i> sp.	6	0	0	0	0	0	0	0	0
<i>Thienemanniella</i> sp.	0	0	0	0	1	0	0	0	0
<i>Tvetenia</i> sp.	0	0	0	0	0	0	0	1	0
<i>Zalutschia</i> sp.	0	0	0	0	0	29	0	0	0
Podonominae									
<i>Lasiodiamesa</i> sp.	0	0	0	0	0	1	0	0	0
Tanypodinae	0	4	0	0	1	2	18	7	0
<i>Ablabesmyia mallochi</i>	0	1	0	0	0	0	0	0	0
<i>Ablabesmyia</i> sp.	13	0	0	11	0	3	0	0	0
<i>Thienemannimyia</i> gr. sp.	8	5	122	27	53	10	68	2	59
<i>Procladius</i> sp.	5	9	6	0	25	9	3	21	13
Empididae	0	30	1	0	2	1	12	4	4
<i>Trichoclinocera</i> sp.	0	70	6	9	51	0	0	0	0
<i>Clinocera</i> sp.	0	0	0	0	0	0	3	0	0
<i>Metachela/Chelifera</i>	0	0	0	0	0	0	6	0	0
Ephydriidae	0	0	0	0	0	0	1	3	0
<i>Hydrellia</i> sp.	0	0	0	0	0	0	0	1	0
Muscidae	8	8	6	8	1	2	0	1	0
Sciomyzidae	0	0	7	0	0	0	0	0	0
Simuliidae									
<i>Simulium</i> sp.	0	0	0	0	0	2	0	0	0
Tabanidae	0	0	0	0	0	0	0	0	1
Tipulidae	6	8	3	3	6	2	12	35	1
<i>Dicranota</i> sp.	1	0	0	0	0	0	0	0	0
<i>Limnophila</i> sp.	1	0	3	0	0	2	0	0	0
<i>Prionocera</i> sp.	0	0	4	0	0	0	0	0	0
<i>Tipula</i> sp.	0	7	4	1	0	1	0	0	0
Ephemeroptera									
Siphonuridae	0	0	2	0	0	2	0	0	0
Hemiptera	0	0	0	0	0	1	0	0	0
Plecoptera	1	1	0	0	0	0	0	0	0
Nemouridae	0	6	2	0	0	1	0	0	0
Perlodidae									
<i>Diura</i> sp.	0	0	0	1	0	0	0	0	0
Trichoptera	1	2	0	0	0	0	0	0	0
Limnephilidae	4	0	6	0	1	15	0	0	0
<i>Limnephilus</i> sp.	0	0	5	0	0	7	0	0	0
Maxillopoda									
Calanoida	0	13	0	367	1	0	0	0	0
Cyclopoida	0	0	0	0	0	2	0	0	0
Harpacticoida	1	0	0	0	0	0	0	0	0
Ostracoda	10	1	0	2	0	0	0	0	0
Chordata									
Actinopterygii	6	0	0	0	0	0	0	0	0
Nematoda	0	2	0	0	0	0	0	0	0

Appendix 3.5-1

Potential Development Area Pond Sampling Effort and
Species Summary, 2013

Appendix 3.5-1. Potential Development Area Pond Sampling Effort and Species Summary, 2013

Property	Local Name	Site #	Date (m/d/y)	Crew	Zone	Easting	Northing	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)	Comments
Goose	Echo Pond	705	6/19/2013	KK, AB	13	432821	7268725	EF	1	-	-	-	1	629	220	1.5	N	700	30	12	Smithroot	LR-24	NFC	-	0	-	-	
Goose	Pond 1		6/18/2013	SL, AB	13	429188	7271154	EF	1	-	-	Clear	1	1020	250	3	N	265	30	12	Smithroot	LR-24	NFC	-	0	-	-	Windy
Goose	Pond 1		6/18/2013	SL, AB	13	429188	7271154	VO	-	-	-	Clear	-	-	-	-	-	-	-	-	-	-	NSSB	-	4	-	-	All found dead - winterkill?
Goose	Pond 2		6/18/2013	SL, AB	13	429699	7271420	EF	1	-	-	Clear	1	1026	250	3	N	325-425	30	12	Smithroot	LR-24	NFC	-	0	-	-	Windy
Goose	Pond D		6/18/2013	SL, AB	13	429680	7274474	EF	1	-	-	Clear	1	1003	300	2	N	470	30	12	Smithroot	LR-24	NFC	-	0	-	-	Very windy - poor visibility
Goose	Pond A		6/20/2013	KW, KK	13	429440	7273384	EF	1	-	-	-	1	1047	Whole shoreline	1.5	N	650	30	12	Smithroot	LR-24	NFC	-	0	-	-	
Goose	Pond A1		6/20/2013	KW, KK	13	429183	7273702	EF	1	-	-	-	1	501	Whole shoreline	1.5	N	650	30	12	Smithroot	LR-24	NFC	-	0	-	-	
Goose	Pond A2		6/20/2013	KW, KK	13	429400	7273065	EF	1	-	-	-	1	500	Whole shoreline	1.5	N	650	30	12	Smithroot	LR-24	NFC	-	0	-	-	
Goose	Pond A3		6/20/2013	KW, KK	13	429620	7272974	EF	1	-	-	-	1	500	Whole shoreline	1.5	N	650	30	12	Smithroot	LR-24	NFC	-	0	-	-	

Crew

AB = Audla Buchan

KK = Kathryn Kuchapski

KW = Kyla Warren

SL = Sarah Larocque

Species Code

NSSB = ninespine stickleback

NFC = no fish caught

Stage

IM = immature

M = mature

EF = electrofishing

VO = visual observation

Dashes indicate data not available

Appendix 3.6-1a

Offset Area Sampling Effort and Species Summary,
2013 – Electrofishing

Appendix 3.6-1a. Offset Area Sampling Effort and Species Summary, 2013 - Electrofishing

Waterbody Type	Property	Local Name	Site #	Date (m/d/y)	Crew	Zone	Easting	Northing	Sampling Method	Method Number	Temperature (°C)	Conductivity (µS/cm)	Turbidity	Haul or Pass	EF Seconds	Length (m)	Width (m)	Voltage	Frequency	Pulse	Make	Model	Species Code	Stage	Total Number	Min. Length (mm)	Max. Length (mm)	Comments
Stream	Goose	Gander Pond inflow	703	6/19/2013	KK, AB	13	433282	7269476	EF	1	-	-	-	1	504	160	2.1	550-700	30	12	Smithroot	LR-24	NFC	-	0	-	-	Flowing channel with good connectivity. Braided and some flow in narrow channels over grass but with lots of decent cobble-boulder pool habitat. Gander pond: shallow with mud/organic bottom
Stream	Goose	Gander Pond outflow	101 (or 702)	6/19/2013	KK, AB	13	432837	7270080	EF	1	-	-	Clear	1	831	300	1.5	675	30	12	Smithroot	LR-24	NSSB	-	14	36	56	
Stream	Goose	Gander Pond outflow	101 (or 702)	6/19/2013	KK, AB	13	432837	7270080	EF	1	-	-	Clear	1	831	300	1.5	675	30	12	Smithroot	LR-24	ARGR	IM	1	77	77	
Stream	Goose	Gander Pond outflow	101 (or 702)	6/19/2013	KK, AB	13	432837	7270080	EF	1	-	-	Clear	1	831	300	1.5	675	30	12	Smithroot	LR-24	SLSC	-	1	50	50	
Stream	Goose	Gander Pond outflow	101 (or 702)	6/19/2013	KK, AB	13	432837	7270080	EF	1	-	-	Clear	1	831	300	1.5	675	30	12	Smithroot	LR-24	BURB	IM	1	95	95	
Stream	Goose	Goose - Propellor	G-P1	6/20/2013	KK, KW	13	434973	7271458	EF	1	-	-	-	1	593	150	2	700	30	12	Smithroot	LR-24	ARGR	-	4	122	185	
Stream	Goose	Goose - Propellor	G-P1	6/20/2013	KK, KW	13	434973	7271458	VO	-	-	-	-	-	-	-	-	-	-	-	-	-	SLSC	-	1	-	-	
Stream	George	McCoy outflow	810	6/21/2013	KW, KK	13	385842	7310835	EF	1	-	-	-	1	133	200	1.5	650	30	12	Smithroot	LR-24	LKTR	IM	1	155	155	
Stream	George	McCoy outflow	810	6/21/2013	KW, KK	13	385842	7310835	EF	1	-	-	-	1	133	200	1.5	650	30	12	Smithroot	LR-24	SLSC	-	2	49	68	
Stream	George	Long Lake outflow	-	6/23/2013	KW, KK	13	390518	7316862	EF	1	-	-	Clear	1	729	-	-	820	40	12	Smithroot	LR-24	SLSC	-	8	-	-	
Lake	Goose	Canyon Lake 1	1300	8/9/2013	FR, KK, LT	13	439093	7287470	EF	3	-	-	-	1	276	75	20	450	50	12	Smithroot	LR-24	SLSC	-	1	-	-	
Lake	Goose	Canyon Lake 2	1301	8/8/2013	KK, LT	13	438873	7288090	EF	1	16.3	73	-	1	449	175	3	400	50	12	Smithroot	LR-24	SLSC	-	14	35	69	
Lake	Goose	Canyon Lake 2	1301	8/8/2013	KK, LT	13	438873	7288090	VO	-	-	-	-	-	-	-	-	-	-	-	-	-	BURB	-	1	200	-	
Lake	Goose	Canyon Lake 2	1301	8/8/2013	KK, LT	13	438883	7288001	EF	2	16.3	73	-	1	310	100	3	400	50	12	Smithroot	LR-24	SLSC	-	1	53	-	
Lake	Goose	Canyon Lake 3	1302	8/9/2013	LT, LO	13	438449	7289096	EF	1	-	-	-	1	339	150	3	450	50	12	Smithroot	LR-24	SLSC	-	3	-	-	
Lake	Goose	Canyon Lake 3	1302	8/9/2013	LT, LO	13	438654	7289090	EF	2	-	-	-	1	303	100	3	450	50	12	Smithroot	LR-24	SLSC	-	2	-	-	
Lake	Goose	Canyon Lake 3	1302	8/9/2013	LT, LO	13	438654	7289090	EF	2	-	-	-	1	303	100	3	450	50	12	Smithroot	LR-24	BURB	-	1	-	-	
Pond	Goose	Pond E	-	6/18/2013	SL, AB	13	429225	7275046	EF	1	-	-	Clear	1	1000	350	1.5	475	30	12	Smithroot	LR-24	NFC	-	0	-	-	Very windy - poor visibility

Species Code
ARGR = Arctic grayling
BURB = burbot
LKTR = lake trout
NSSB = ninespine stickleback
SLSC = slimy sculpin
NFC = no fish caught
Stage
IM = immature

EF = electrofishing
VO = visual observation
Dashes indicate data not available

Appendix 3.6-1b

Offset Area Sampling Effort and Species Summary,
2013 — Angling

Appendix 3.6-1b. Offset Area Sampling Effort and Species Summary, 2013 - Angling

Date (m/d/y)	Waterbody Type	Property	Site	Crew	Method	Gear	Time In	Time Out	Time (h)	Time (decimal h)	Depth 1	Zone	Easting 1	Northing 1	ARGR	LKTR	Total
6/21/2013	Stream	George	Long Lake inflow	KW, KK	ANG	-	-	-	0:30	0.50	-	13W	439472	7286333	0	1	1
8/9/2013	Lake	Goose	Canyon Lake 3	LT, LO	ANG	-	-	-	-	-	-	-	-	-	1	0	1
8/9/2013	Lake	Goose	Canyon Lake 3	LT, LO	ANG	-	-	-	-	-	-	-	-	-	1	0	1

ANG = angling
ARGR = Arctic grayling
LKTR = lake trout
Dashes indicate data not available

Appendix 3.6-1c

Offset Area Sampling Effort and Species Summary,
2013 – Gillnets

Appendix 3.6-1c. Offset Area Sampling Effort and Species Summary, 2013 - Gillnets

Date (m/d/y)	Property	Lake	Crew	Method	Net/Trap No.	Time In	Time Out	Effort (h)	Effort (decimal h)	Depth 1	Zone	Easting 1	Northing 1	Depth 2	Easting 2	Northing 2	ARGR	LKTR	Total	ARGR CPUE	LKTR CPUE	Total CPUE	Comments
																						(# Fish/100 m ² /h)	
8/7/2013	Goose	Canyon Lake 1	FR, JM	FGN	1	10:42	11:32	0:50	0.83	-	13W	438982	7287820	-	439013	7287731	2	1	3	1.10	0.55	1.64	
8/7/2013	Goose	Canyon Lake 1	FR, JM	SGN	1	10:52	11:48	0:56	0.93	-	13W	439019	7287724	-	439067	7287597	-	-	0	0.00	0.00	0.00	
8/7/2013	Goose	Canyon Lake 1	FR, JM	SGN	2	12:11	13:01	0:50	0.83	-	13W	439107	7287499	-	439052	7287465	3	5	8	1.64	2.74	4.39	
8/7/2013	Goose	Canyon Lake 1	FR, JM	FGN	2	12:51	13:34	0:43	0.72	-	13W	439073	7287633	-	439058	7287553	2	-	2	1.27	0.00	1.27	
8/8/2013	Goose	Canyon Lake 2	FR, JM	FGN	1	12:58	13:38	0:40	0.67	-	13W	438882	7288041	-	438831	7288156	-	-	0	0.00	0.00	0.00	
8/8/2013	Goose	Canyon Lake 2	FR, JM	SGN	1	13:27	14:05	0:38	0.63	-	13W	438825	7288166	-	438789	7288272	3	1	4	2.16	0.72	2.89	
8/8/2013	Goose	Canyon Lake 2	FR, JM	FGN	2	14:41	15:15	0:34	0.57	-	13W	438770	7288313	-	438734	7288421	-	-	0	0.00	0.00	0.00	
8/8/2013	Goose	Canyon Lake 2	FR, JM	SGN	2	15:09	15:54	0:45	0.75	-	13W	438672	7288548	-	438715	7288451	-	-	0	0.00	0.00	0.00	
8/9/2013	Goose	Canyon Lake 3	LT, LO	FGN	1	10:43	11:50	1:07	1.12	-	13W	438449	7289052	-	438488	7288958	4	-	4	1.64	0.00	1.64	
8/9/2013	Goose	Canyon Lake 3	LT, LO	SGN	2	12:40	13:40	1:00	1.00	-	13W	438583	7288749	-	438547	7288831	-	1	1	0.00	0.46	0.46	
8/9/2013	Goose	Canyon Lake 3	LT, LO	FGN	2	12:10	13:10	1:00	1.00	-	13W	438473	7288998	-	438508	7288903	-	-	0	0.00	0.00	0.00	
8/9/2013	Goose	Canyon Lake 3	LT, LO	SGN	1	11:22	12:30	1:08	1.13	-	13W	438524	7288862	-	438568	7288781	-	-	0	0.00	0.00	0.00	

FGN = floating gillnet

SGN = sinking gillnet

ARGR = Arctic grayling

LTKR = lake trout

CPUE = catch-per-unit-effort

Dashes indicate data not available

Appendix 3.6-1d

Offset Area Sampling Effort and Species Summary,
2013 – Minnow Traps

Appendix 3.6-1d. Offset Area Sampling Effort and Species Summary, 2013 - Minnow Traps

Property	Lake	Crew	Method	Trap No.	Date In	Time In	Date Out	Time Out	Effort (h)	Effort (decimal h)	Depth	Zone	Easting	Northing	SLSC	NSSB	BURB	Total	SLSC CPUE	NSSB CPUE	BURB CPUE	Total CPUE (# Fish/24 h)
Goose	Canyon Lake 1	KK, LT, FR	MT	1	8/7/2013	10:05	8/8/2013	10:43	0:38	24.63	-	13	438988	7287763	-	1	-	1	0.00	0.97	0.00	0.97
Goose	Canyon Lake 1	KK, LT, FR	MT	2	8/7/2013	10:05	8/8/2013	10:44	0:39	24.65	-	13	438977	7287791	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	3	8/7/2013	10:06	8/8/2013	10:45	0:39	24.65	-	13	438965	7287821	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	4	8/7/2013	10:07	8/8/2013	10:46	0:39	24.65	-	13	438972	7287826	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	5	8/7/2013	10:08	8/8/2013	10:46	0:38	24.63	-	13	438992	7287813	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	6	8/7/2013	10:09	8/8/2013	10:47	0:38	24.63	-	13	439009	7287762	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	7	8/7/2013	10:10	8/8/2013	10:48	0:38	24.63	-	13	439030	7287711	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	8	8/7/2013	10:10	8/8/2013	10:49	0:39	24.65	-	13	439052	7287680	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	9	8/7/2013	10:11	8/8/2013	10:49	0:38	24.63	-	13	439070	7287643	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	10	8/7/2013	10:12	8/8/2013	10:50	0:38	24.63	-	13	439086	7287609	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	11	8/7/2013	10:13	8/8/2013	10:51	0:38	24.63	-	13	439105	7287526	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	12	8/7/2013	10:13	8/8/2013	10:52	0:39	24.65	-	13	439045	7287472	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	13	8/7/2013	10:14	8/8/2013	10:53	0:39	24.65	-	13	439055	7287472	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	14	8/7/2013	10:15	8/8/2013	10:53	0:38	24.63	-	13	439062	7287537	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	15	8/7/2013	10:16	8/8/2013	10:54	0:38	24.63	-	13	439048	7287571	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	16	8/7/2013	10:17	8/8/2013	10:54	0:37	24.62	-	13	439033	7287607	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	17	8/7/2013	10:18	8/8/2013	10:55	0:37	24.62	-	13	439026	7287652	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	18	8/7/2013	10:19	8/8/2013	10:56	0:37	24.62	-	13	439017	7287690	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 1	KK, LT, FR	MT	19	8/7/2013	10:20	8/8/2013	10:57	0:37	24.62	-	13	439006	7287721	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	1	8/8/2013	12:26	8/9/2013	8:30	20:04	20.07	-	13	438892	7287987	-	1	-	1	0.00	1.20	0.00	1.20
Goose	Canyon Lake 2	KK, LT	MT	2	8/8/2013	12:27	8/9/2013	8:33	20:06	20.10	-	13	438890	7287992	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	3	8/8/2013	12:28	8/9/2013	8:35	20:07	20.12	-	13	438868	7288047	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	4	8/8/2013	12:29	8/9/2013	8:38	20:09	20.15	-	13	438845	7288099	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	5	8/8/2013	12:31	8/9/2013	8:40	20:09	20.15	-	13	438793	7288196	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	6	8/8/2013	12:32	8/9/2013	8:43	20:11	20.18	-	13	438771	7288270	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	7	8/8/2013	12:33	8/9/2013	8:45	20:12	20.20	-	13	438754	7288320	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	8	8/8/2013	12:34	8/9/2013	8:47	20:13	20.22	-	13	438734	7288384	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	9	8/8/2013	12:36	8/9/2013	8:50	20:14	20.23	-	13	438713	7288441	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	10	8/8/2013	12:37	8/9/2013	8:52	20:15	20.25	-	13	438680	7288522	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	11	8/8/2013	12:38	8/9/2013	8:54	20:16	20.27	-	13	438672	7288553	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	12	8/8/2013	12:39	8/9/2013	8:57	20:18	20.30	-	13	438700	7288519	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	13	8/8/2013	12:41	8/9/2013	8:59	20:18	20.30	-	13	438754	7288392	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	14	8/8/2013	12:42	8/9/2013	9:01	20:19	20.32	-	13	438775	7288341	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	15	8/8/2013	12:43	8/9/2013	9:02	20:19	20.32	-	13	438788	7288305	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	16	8/8/2013	12:44	8/9/2013	9:03	20:19	20.32	-	13	438805	7288247	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	17	8/8/2013	12:46	8/9/2013	9:05	20:19	20.32	-	13	438844	7288153	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	18	8/8/2013	12:47	8/9/2013	9:07	20:20	20.33	-	13	438856	7288115	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	19	8/8/2013	12:48	8/9/2013	9:08	20:20	20.33	-	13	438885	7288040	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 2	KK, LT	MT	20	8/8/2013	12:49	8/9/2013	9:10	20:21	20.35	-	13	438902	7288015	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	1	8/9/2013	9:40	8/10/2013	8:30	22:50	22.83	0.3	13	438654	7288624	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	2	8/9/2013	9:45	8/10/2013	8:32	22:47	22.78	1	13	438639	7288629	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	3	8/9/2013	9:47	8/10/2013	8:33	22:46	22.77	0.5	13	438625	7288620	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	4	8/9/2013	9:55	8/10/2013	8:35	22:40	22.67	1.2	13	438595	7288731	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	5	8/9/2013	9:56	8/10/2013	8:39	22:43	22.72	0.5	13	438572	7288746	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	6	8/9/2013	9:59	8/10/2013	8:42	22:43	22.72	0.3	13	438572	7288801	1	-	-	1	1.06	0.00	0.00	1.06
Goose	Canyon Lake 3	KK, LT	MT	7	8/9/2013	10:00	8/10/2013	8:46	22:46	22.77	1.4	13	438547	7288788	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	8	8/9/2013	10:03	8/10/2013	8:47	22:44	22.73	1.8	13	438538	7288869	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	9	8/9/2013	10:04	8/10/2013	8:47	22:43	22.72	1.2	13	438516	7288854	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	10	8/9/2013	10:17	8/10/2013	8:50	22:33	22.55	1.2	13	438479	7288933	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	11	8/9/2013	10:19	8/10/2013	8:51	22:32	22.53	1	13	438515	7288925	-	5	-	5	0.00	5.33	0.00	5.33
Goose	Canyon Lake 3	KK, LT	MT	12	8/9/2013	10:20	8/10/2013	8:53	22:33	22.55	0.8	13	438497	7288974	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	13	8/9/2013	10:23	8/10/2013	8:54	22:31	22.52	1.4	13	438459	7288998	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	14	8/9/2013	10:23	8/10/2013	8:56	22:33	22.55	0.6	13	438457	7289004	-	-	-	0	0.00	0.00	0.00	0.00

Appendix 3.6-1d. Offset Area Sampling Effort and Species Summary, 2013 - Minnow Traps

Property	Lake	Crew	Method	Trap No.	Date In	Time In	Date Out	Time Out	Effort (h)	Effort (decimal h)	Depth	Zone	Easting	Northing	SLSC	NSSB	BURB	Total	SLSC CPUE	NSSB CPUE	BURB CPUE	Total CPUE (# Fish/24 h)
Goose	Canyon Lake 3	KK, LT	MT	15	8/9/2013	10:25	8/10/2013	9:57	23:32	23.53	0.3	13	438468	7289041	-	-	1	1	0.00	0.00	1.02	1.02
Goose	Canyon Lake 3	KK, LT	MT	16	8/9/2013	10:26	8/10/2013	8:57	22:31	22.52	0.3	13	438459	7289058	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	17	8/9/2013	10:28	8/10/2013	8:58	22:30	22.50	0.6	13	438410	7289104	-	1	-	1	0.00	1.07	0.00	1.07
Goose	Canyon Lake 3	KK, LT	MT	18	8/9/2013	10:30	8/10/2013	8:59	22:29	22.48	3	13	438426	7289110	-	-	-	0	0.00	0.00	0.00	0.00
Goose	Canyon Lake 3	KK, LT	MT	19	8/9/2013	10:31	8/10/2013	9:00	22:29	22.48	2	13	438445	7289087	-	-	-	0	0.00	0.00	0.00	0.00

MT = minnow trap
SLSC = slimy sculpin
NSSB = ninespine stickleback
BURB = burbot
CPUE = catch-per-unit-effort
Dashes indicate data not available

Appendix 3.6-2

Individual Fish Data — Offset Areas, 2013

Appendix 3.6-2. Individual Fish Data - Offset Areas, 2013

Date (m/d/y)	Waterbody Type	Property	Waterbody	Site	Sample Method	Haul/Pass No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm ³)	Mortality (Y/N)	Age Taken (S/F/O)	Age	Comments
6/20/2013	Stream	Goose	Goose-Propeller	GP1	EF	1	1	ARGR	143	31	1.06	-	-	-	
6/20/2013	Stream	Goose	Goose-Propeller	GP1	EF	1	2	ARGR	185	62	0.98	-	-	-	
6/20/2013	Stream	Goose	Goose-Propeller	GP1	EF	1	3	ARGR	166	47	1.03	-	-	-	
6/20/2013	Stream	Goose	Goose-Propeller	GP1	EF	1	4	ARGR	122	18	0.99	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	1	NSSB	37	0.4	0.79	-	-	-	PHOTO 660-663
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	2	NSSB	52	0.8	0.57	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	3	NSSB	56	1	0.57	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	4	NSSB	41	0.3	0.44	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	5	NSSB	54	0.7	0.44	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	6	NSSB	44	0.8	0.94	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	7	NSSB	50	0.9	0.72	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	8	NSSB	43	0.5	0.63	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	9	NSSB	36	0.3	0.64	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	10	NSSB	41	0.7	1.02	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	11	NSSB	45	0.6	0.66	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	12	NSSB	47	0.5	0.48	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	13	NSSB	49	1	0.85	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	14	NSSB	53	0.7	0.47	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	15	ARGR	77	9.1	1.99	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	16	SLSC	50	1.2	0.96	-	-	-	
6/19/2013	Stream	Goose	Gander Pond outflow	101 (or 702)	EF	1	17	BURB	95	8.1	0.94	-	-	-	
6/21/2013	Stream	George	McCoy outflow	810	EF	1	1	LKTR	155	42.6	1.14	-	-	-	
6/21/2013	Stream	George	McCoy outflow	810	EF	1	2	SLSC	49	1.2	1.02	-	-	-	
6/21/2013	Stream	George	McCoy outflow	810	EF	1	3	SLSC	68	2.3	0.73	-	-	-	
6/21/2013	Stream	George	Long Lake inflow	-	ANG	1	-	LKTR	-	-	-	-	-	-	PHOTO 586-589
8/8/2013	Lake	Goose	Canyon Lake 1	-	EF	3	1	SLSC	45	1.2	1.32	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 1	-	MT	1	2	NSSB	59	1.05	0.51	-	F	-	
8/7/2013	Lake	Goose	Canyon Lake 1	-	FGN	1	A1	LKTR	427	872	1.12	-	F/S	8	
8/7/2013	Lake	Goose	Canyon Lake 1	-	FGN	1	A2	ARGR	271	232	1.17	-	F/S	5	
8/7/2013	Lake	Goose	Canyon Lake 1	-	FGN	1	A3	ARGR	286	245	1.05	-	F/S	5	
8/7/2013	Lake	Goose	Canyon Lake 1	-	FGN	2	A4	ARGR	318	307	0.95	-	F/S	9	
8/7/2013	Lake	Goose	Canyon Lake 1	-	FGN	2	A5	ARGR	309	297	1.01	-	F/S	6	
8/7/2013	Lake	Goose	Canyon Lake 1	-	SGN	2	A6	LKTR	272	218	1.08	-	F/S	8	
8/7/2013	Lake	Goose	Canyon Lake 1	-	SGN	2	A8	ARGR	203	105	1.26	-	F/S	2	
8/7/2013	Lake	Goose	Canyon Lake 1	-	SGN	2	A9	LKTR	325	401	1.17	-	F/S	6	
8/7/2013	Lake	Goose	Canyon Lake 1	-	SGN	2	A10	ARGR	345	386	0.94	-	F/S	7	
8/7/2013	Lake	Goose	Canyon Lake 1	-	SGN	2	A11	LKTR	195	72	0.97	-	F/S	3	
8/7/2013	Lake	Goose	Canyon Lake 1	-	SGN	2	A12	ARGR	230	121	0.99	-	F/S	3	
8/7/2013	Lake	Goose	Canyon Lake 1	-	SGN	2	A13	LKTR	242	161	1.14	-	F/S	4	
8/7/2013	Lake	Goose	Canyon Lake 1	-	SGN	2	A14	LKTR	205	90	1.04	-	F/S	4	
8/8/2013	Lake	Goose	Canyon Lake 2	-	VO	1	1	BURB	20	-	-	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	1	SLSC	46	1.1	1.13	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	2	SLSC	67	2.6	0.86	-	F	2	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	3	SLSC	60	2.4	1.11	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	4	SLSC	55	1.2	0.72	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	5	SLSC	58	1.5	0.77	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	6	SLSC	69	2.5	0.76	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	7	SLSC	64	3.6	1.37	-	-	-	

Appendix 3.6-2. Individual Fish Data - Offset Areas, 2013

Date (m/d/y)	Waterbody Type	Property	Waterbody	Site	Sample Method	Haul/Pass No.	Sample No.	Species	Fork Length (mm)	Total Weight (g)	Condition (g/mm ³)	Mortality (Y/N)	Age Taken (S/F/O)	Age	Comments
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	8	SLSC	65	2.2	0.80	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	9	SLSC	49	1.4	1.19	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	10	SLSC	42	0.6	0.81	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	11	SLSC	45	0.5	0.55	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	12	SLSC	35	0.2	0.47	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	1	13	SLSC	39	-	-	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	EF	2	14	SLSC	53	2.2	1.48	-	-	-	
8/8/2013	Lake	Goose	Canyon Lake 2	-	MT	1	15	NSSB	46	-	-	Y	-	-	PHOTO 1089
8/8/2013	Lake	Goose	Canyon Lake 2	-	ANG	1	B1	ARGR	266	190	1.01	-	F/S	4	
8/8/2013	Lake	Goose	Canyon Lake 2	-	SGN	1	B2	ARGR	180	67	1.15	-	F/S	2	
8/8/2013	Lake	Goose	Canyon Lake 2	-	SGN	1	B3	ARGR	244	150	1.03	-	F/S	4	
8/8/2013	Lake	Goose	Canyon Lake 2	-	SGN	1	B4	LKTR	245	151	1.03	-	F/S	4	
8/8/2013	Lake	Goose	Canyon Lake 2	-	SGN	1	B5	ARGR	255	178	1.07	-	F/S	4	
8/8/2013	Lake	Goose	Canyon Lake 2	-	ANG	1	B6	LKTR	209	88	0.96	-	F/S	5	
8/8/2013	Lake	Goose	Canyon Lake 2	-	ANG	1	B7	ARGR	281	223	1.01	-	F/S	5	
8/9/2013	Lake	Goose	Canyon Lake 3	-	EF	1	15	SLSC	65	3.01	1.10	-	-	-	
8/9/2013	Lake	Goose	Canyon Lake 3	-	EF	1	16	SLSC	61	2.2	0.97	-	-	-	
8/9/2013	Lake	Goose	Canyon Lake 3	-	EF	1	17	SLSC	40	0.4	0.63	-	-	-	
8/9/2013	Lake	Goose	Canyon Lake 3	-	EF	2	18	BURB	230	-	-	-	-	-	
8/9/2013	Lake	Goose	Canyon Lake 3	-	EF	2	19	SLSC	40	0.55	0.86	-	-	-	
8/9/2013	Lake	Goose	Canyon Lake 3	-	EF	2	20	SLSC	60	1.7	0.79	-	-	-	
8/9/2013	Lake	Goose	Canyon Lake 3	-	ANG	1	1	ARGR	225	135	1.19	-	F/S	3	
8/9/2013	Lake	Goose	Canyon Lake 3	-	FGN	1	2	ARGR	272	213	1.06	-	F/S	5	
8/9/2013	Lake	Goose	Canyon Lake 3	-	FGN	1	3	ARGR	288	255	1.07	-	F/S	5	
8/9/2013	Lake	Goose	Canyon Lake 3	-	FGN	1	4	ARGR	235	152	1.17	-	F/S	3	
8/9/2013	Lake	Goose	Canyon Lake 3	-	FGN	1	5	ARGR	265	198	1.06	Y	F/S/O	4	
8/9/2013	Lake	Goose	Canyon Lake 3	-	SGN	2	6	LKTR	272	219	1.09	-	F/S	4	
8/9/2013	Lake	Goose	Canyon Lake 3	-	ANG	2	7	ARGR	240	163	1.18	-	F/S	4	
8/9/2013	Lake	Goose	Canyon Lake 3	15	MT	1	8	BURB	120	8.6	0.50	-	-	-	PHOTO 1109
8/9/2013	Lake	Goose	Canyon Lake 3	11	MT	1	9	NSSB	55	1.38	0.83	-	-	-	PHOTO 1110
8/9/2013	Lake	Goose	Canyon Lake 3	11	MT	1	10	NSSB	52	0.94	0.67	-	-	-	
8/9/2013	Lake	Goose	Canyon Lake 3	11	MT	1	11	NSSB	51	-	-	Y	-	-	PHOTO 1111
8/9/2013	Lake	Goose	Canyon Lake 3	11	MT	1	12	NSSB	55	0.9	0.54	-	-	-	
8/9/2013	Lake	Goose	Canyon Lake 3	11	MT	1	13	NSSB	58	1.1	0.56	-	-	-	
8/9/2013	Lake	Goose	Canyon Lake 3	6	MT	1	14	SLSC	40	0.5	0.78	-	-	-	PHOTO 1112

Species Code
ARGR = Arctic grayling
BURB = burbot
LKTR = lake trout
NSSB = ninespine stickleback
SLSC = slimy sculpin

Y = yes, N = no
Dashes indicate data not available

Sample Method
ANG = angling
EF = electrofishing
FGN = floating gillnet
SGN = sinking gillnet
MT = minnow trap

Age structure
S = scale, F = fin ray, O = otolith

Appendix V6-6E

**Back River Project: 2014 Fish and Fish Habitat
Assessment of the Tailings Impoundment Area
Alternative Site**

BACK RIVER PROJECT

2014 Fish and Fish Habitat Assessment of the Tailings Impoundment Area Alternative Site



BACK RIVER PROJECT

2014 FISH AND FISH HABITAT ASSESSMENT OF THE TAILINGS IMPOUNDMENT AREA ALTERNATIVE SITE

December 2014
Project #0234411-0011

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Prepared for:



Sabina Gold & Silver Corp.

Prepared by:



Rescan Environmental Services Ltd., an ERM company
Vancouver, British Columbia

Executive Summary

Executive Summary

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold & Silver Corp. (Sabina) located in the West Kitikmeot region of Nunavut. A baseline fish and fish habitat program was completed in 2014 to support freshwater fish and fish habitat assessment at the Tailings Impoundment Area (TIA) Alternative Site at the Goose Property Area.

The objectives of this program were to assess fish presence/absence and fish habitat value in ponds and streams within the footprint and downstream of the proposed TIA Alternative Site. Work included fish habitat assessments in eight ponds and nine stream reaches and fish presence/absence sampling in five ponds and eight stream reaches.

Overall, fish habitat was of marginal value in ponds and stream reaches sampled within the TIA Alternative Site footprint. Downstream and outside of the TIA Alternative Site, two stream reaches had marginal fish habitat value and an additional two stream reaches had fish habitat that was important to at least one fish life history stage. Reaches containing important fish habitat included Main Goose Pit Stream Reaches 7 and 13, which provide the potential for good rearing and migration habitat for Arctic Grayling. These reaches were the nearest to Goose Lake of all sampled reaches and were located 400 m (Main Goose Pit Stream Reach 13) and 1.1 km (Main Goose Pit Stream Reach 7) downstream of the TIA Alternative Site.

Most ponds surveyed within the TIA Alternative Site footprint had only marginally suitable rearing habitat and no overwintering habitat for fish (depths < 2 m), with the exception of Ponds 10 and 13. Although Pond 10 had an estimated maximum depth greater than two meters, potentially providing overwintering habitat, migration into Pond 10 is likely restricted by ephemeral and low flows. Pond 13, which borders the TIA Alternative Site, had sufficient water depth and habitat complexity to provide good habitat potential for rearing and overwintering fish and was classified as important fish habitat.

One season of fisheries sampling in 2014 suggests that the waterbodies located within the footprint of the TIA Alternative Site are not fish-bearing, with the possible exception of Pond 13. No fish were captured at five stream reaches and five ponds within the TIA Alternative Site. Pond 13, located on the southwest margin of the TIA Alternative Site, was not sampled, but is likely to be fish bearing due to its large area, direct and close connection to fish bearing lakes (Rascal and Wolf lakes), and sufficient depth for overwintering. Outside the footprint of the TIA Alternative Site, fish were captured only in the furthest downstream reach (Main Goose Pit Stream Reach 7) of the three sampled reaches connecting the TIA Alternative Site to Goose Lake. Seven young-of-year Arctic Grayling were captured in Main Goose Pit Stream Reach 7, between 1.1 and 1.6 km downstream of the TIA Alternative Site. This confirmed the fish-bearing status reported in 2013, which indicated the presence of Ninespine Stickleback in Main Goose Pit Stream Reach 7 and Reach 8 (located approximately 350 m downstream of the TIA Alternative Site).

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BACK RIVER PROJECT

2014 FISH AND FISH HABITAT ASSESSMENT OF THE TAILINGS IMPOUNDMENT AREA ALTERNATIVE SITE

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Glossary and Abbreviations

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.

AUP	Animal Use Protocol
CPUE	Catch-per-unit-effort
DC	Dry Channel
DFO	Department of Fisheries and Oceans
Dry/Int.	Dry/Intermittent
NCD	Non-classified Drainage
PDA	Potential Development Area
RIC	Resources Inventory Committee of British Columbia
TIA	Tailings Impoundment Area

1. Introduction

1. Introduction

The Back River Project (the Project) is a proposed gold project owned by Sabina Gold & Silver Corp. (Sabina) located in the West Kitikmeot region of Nunavut (Figure 1-1). This report presents the results of the 2014 fish and fish habitat program which was developed to support freshwater fish and fish habitat assessment at the Tailings Impoundment Area (TIA) Alternative Site (Figure 1-2).

The objectives of this program were to:

- complete one season of fish presence/absence sampling in ponds and streams within and near the proposed TIA Alternative Site footprint; and
- assess the fish habitat value of ponds and streams within and near the proposed TIA Alternative Site footprint.

Chapter 2 of this report presents the program methods, Chapter 3 presents results and discussion, and Chapter 4 contains a brief summary. All raw data collected are included as appendices.

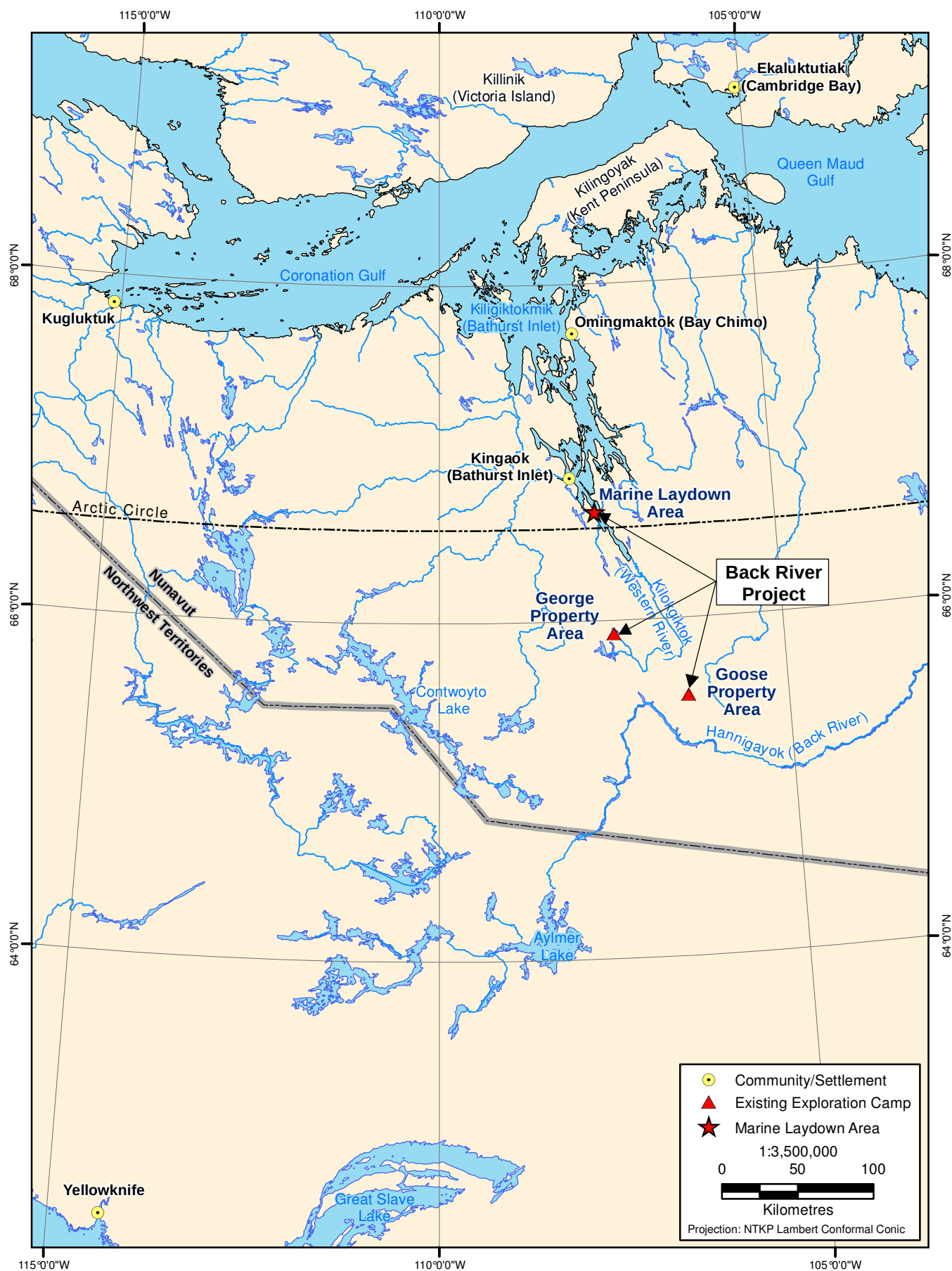
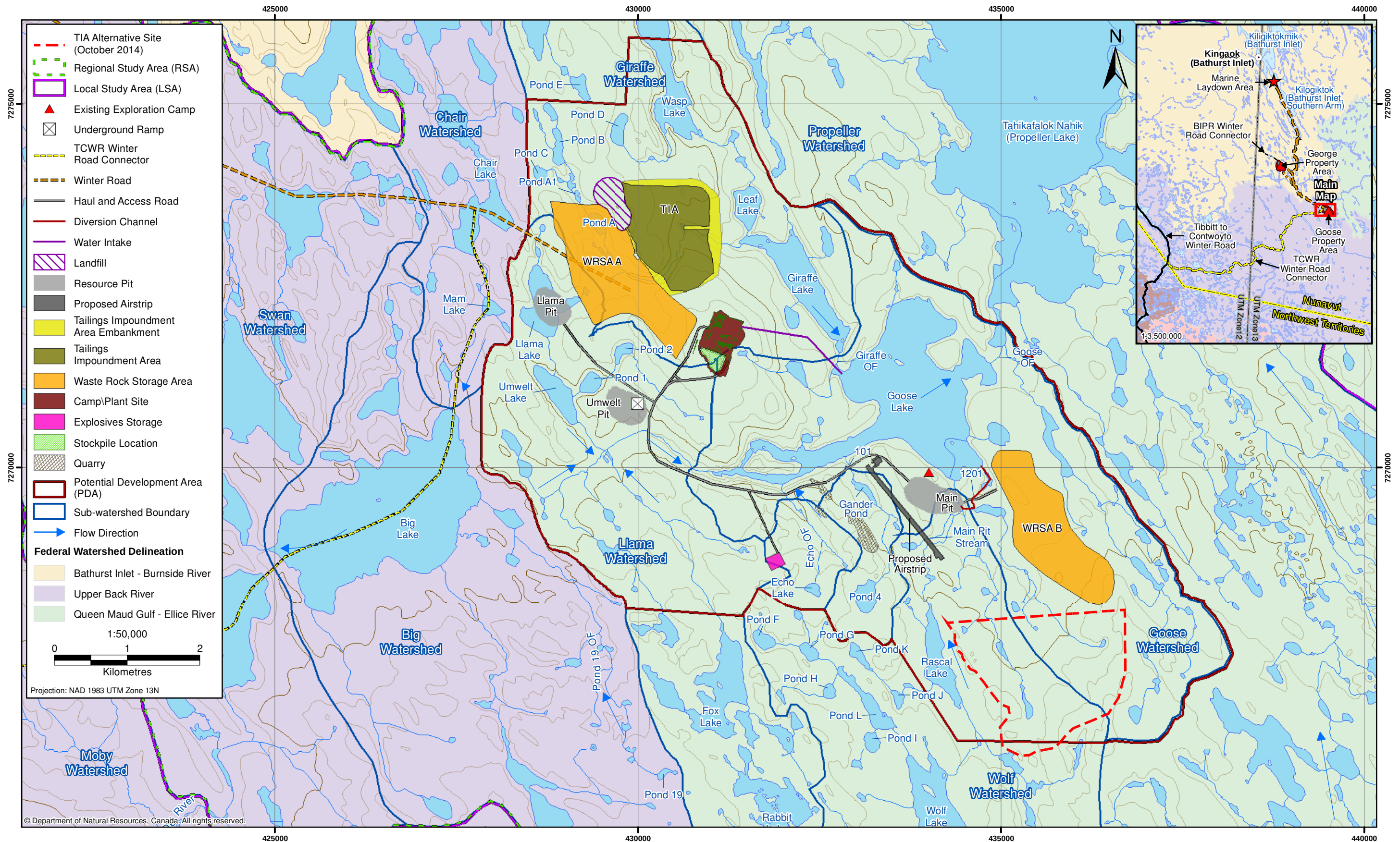


Figure 1-1



2. Methods

2. Methods

2.1 STUDY AREA

The study area for the 2014 fish and fish habitat assessment included pond and stream habitats associated with the TIA Alternative Site at the Goose Property (Figure 1-2 and 2.1-1). The sampled waterbodies are located within the Wolf and Goose watersheds, drain to the north, and enter Goose Lake along its southern and eastern shorelines. In general, the ponds that were sampled are fed by overland flow from the Wolf Watershed and discharge via the sampled streams into Goose Lake. One pond (Pond 13) is located higher in the watershed, is fed by flows from upstream lakes, and ultimately discharges into Goose Lake via Rascal Lake and the Rascal Stream system (Figure 2.1-1).

2.2 FIELDWORK METHODS

Fieldwork was designed to identify fish and fish habitat in ponds and streams potentially affected by the development of a tailings impoundment area at the TIA Alternative Site location. Fieldwork was completed from September 7 to 10, 2014. Fish habitat sampling was completed in all waterbodies (six ponds and five stream reaches) found within or partially within (Pond 13) the TIA Alternative Site footprint and in two ponds and four stream reaches downstream (Figure 2.1-1 and Table 2.2-1). Fish community sampling was completed in five ponds and all stream reaches found exclusively within the TIA alternative footprint and in three additional stream reaches downstream (Figure 2.1-1 and Table 2.1-1).

2.2.1 Fish Habitat

2.2.1.1 Streams

Streams in the TIA Alternative Site were located in the field by performing aerial observations from a helicopter flying at low elevation to determine drainage patterns. The length of each stream was then walked by a field crew in order to identify permanent and ephemeral stream reaches. Where water flowed overland but was not associated with a continuous channel of at least 50 m in length, the site was labeled as a non-classified drainage (NCD). Sites where a channel was identified, but the channel was void of water were labeled Dry Channel (DC). Channels that contained only unconnected pools of water were labeled Dry/Intermittent (Dry/Int.). NCD and DC sites are not considered fish habitat and were not assessed further. Where water flowed through a continuous or intermittent channel, fish habitat surveys were undertaken.

Each stream was divided into reaches delimited by hydrological features (ponds and confluences) and detailed assessments were performed over sections of each reach with relatively homogenous habitat (Figure 2.2-1). The length of habitat assessment sites was dependent on the length of the reach and the homogeneity of habitat within the reach. Fish habitat was assessed by filling out a site card according to the Reconnaissance (1:20,000) Fish and Fish Habitat Inventory (RIC 1999). The site card assessment included the evaluation of channel characteristics, substrate type, physical measurements, habitat characteristics, cover and habitat quality for fish. A complete list of the attributes measured is presented in Table 2.2-2. Physical measurements and habitat characteristics were quantified using a measuring tape, measuring stick or by visual estimation. Conductivity ($\mu\text{S}/\text{cm}$) and pH were recorded using electronic meters. Habitat assessment site locations were referenced with a handheld GPS unit.

Table 2.2-1. Fish and Fish Habitat Sampling Summary for TIA Alternative Site Area, 2014

Location	Site Name	UTM			Fish Habitat	Fish Community	
		Zone	Easting	Northing		Minnow Trapping	Electrofishing
Within TIA Alternative Site Footprint	Pond 6	13	434485	7267770	X	X	X
	Pond 7	13	434992	7267508	X	X	X
	Pond 8	13	435357	7266749	X	X	X
	Pond 9	13	435465	7267793	X	X	X
	Pond 10	13	436395	7267577	X	X	X
	Main Goose Pit Stream Reach 10	13	434771	7267923	X		X
	Main Goose Pit Stream Reach 11	13	434771	7267923	X		X
	Main Goose Pit Stream Reach 12	13	435097	7267352	X		X
	Main Goose Pit Stream Reach 14	13	435421	7268259	X		X
	Main Goose Pit Stream Reach 15	13	435449	7268251	X		X
Partially Within TIA Alternative Site Footprint	Pond 13	13	435120	7266059	X		
Downstream of TIA Alternative Site Footprint	Pond 11	13	434769	7268329	X		
	Pond 12	13	434898	7268210	X		
	Main Goose Pit Stream Reach 7	13	434481	7269394	X		X
	Main Goose Pit Stream Reach 8	13	434770	7268653	X	X	X
	Main Goose Pit Stream Reach 9	13	434880	7268168	X	X	X
	Main Goose Pit Stream Reach 13	13	435358	7268549	X		

Blanks indicate sampling not performed

Stream morphology, channel type, and channel boundary were determined based on habitat features that are often present in Arctic streams but that may not appear in the southern streams for which the Reconnaissance (1:20,000) Fish and Fish Habitat Inventory (RIC 1999) was designed. These characteristics were classified into categories that suitably describe Arctic stream habitats. Categories used for stream morphology classification are described in Table 2.2-3 and categories used for channel type and boundary classification are described in Table 2.2-4.

Assessment of fish habitat quality for spawning, rearing, migration, and overwintering was based on habitat measures and the habitat preferences of life history stages of fish species that are known to use Arctic stream habitats in the Potential Development Area including Ninespine Stickleback (*Pungitius pungitius*), Burbot (*Lota lota*), Slimy Sculpin (*Cottus cognatus*) and Arctic Grayling (*Thymallus arcticus*) (Scott and Crossman 1973, Rescan 2014). Fish habitats were given a ranking of good, fair, poor or none. From these fish habitat qualities, an overall ranking was determined as either critical, important, marginal, or none. Critical habitat provides fish habitat that is necessary but limited in the area. If critical habitat were removed, fish in that area may not be able to access alternative habitat for that life history stage. Important habitat provides fair or good fish habitat for one or more life history stages. Marginal habitat provides poor or no habitat for all life stages, or contains barriers that limit the accessibility of the habitat to fish. If no habitat is provided for any life stage, the area has no overall habitat quality.

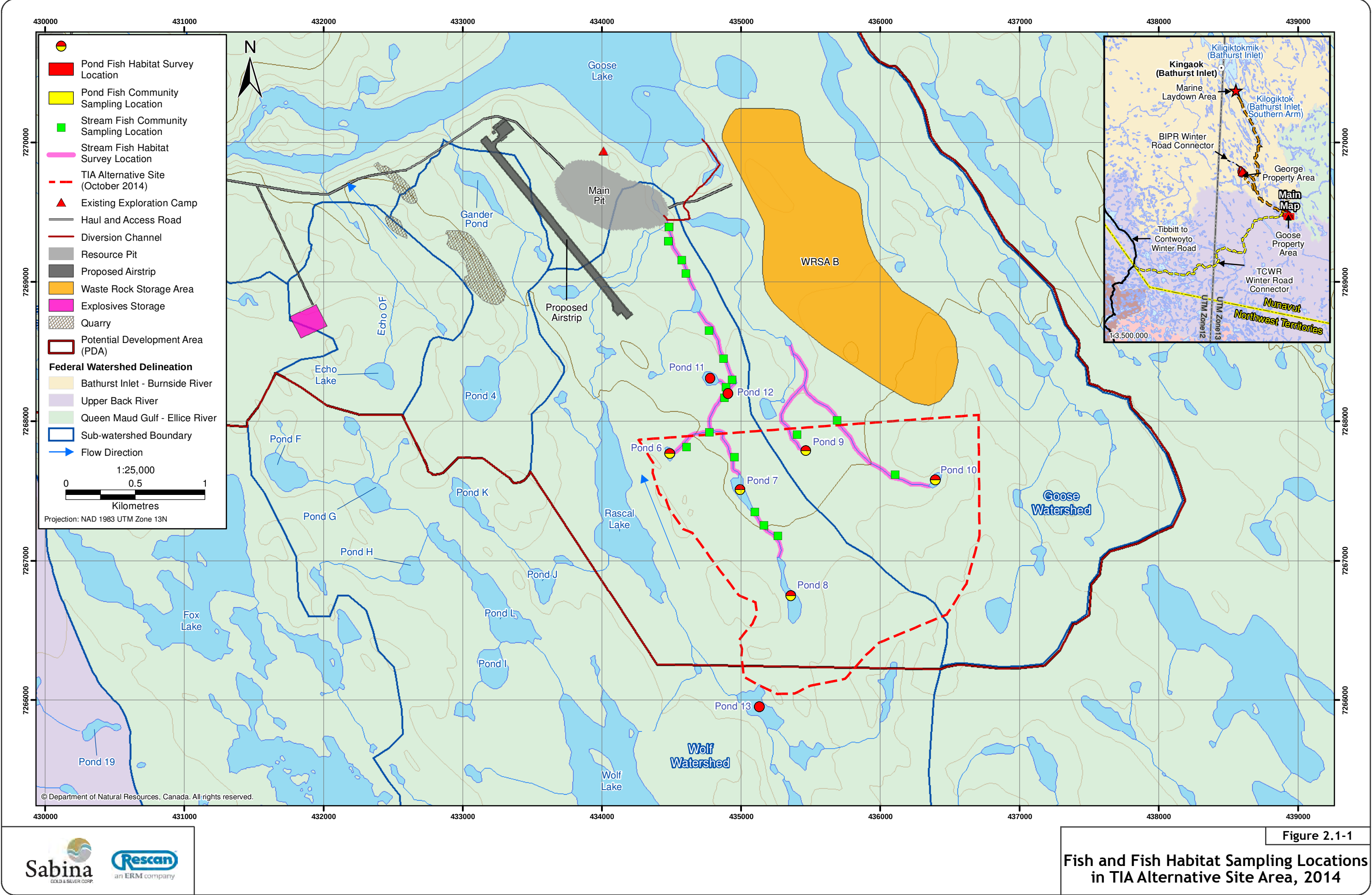


Figure 2.1-1

Fish and Fish Habitat Sampling Locations
in TIA Alternative Site Area, 2014

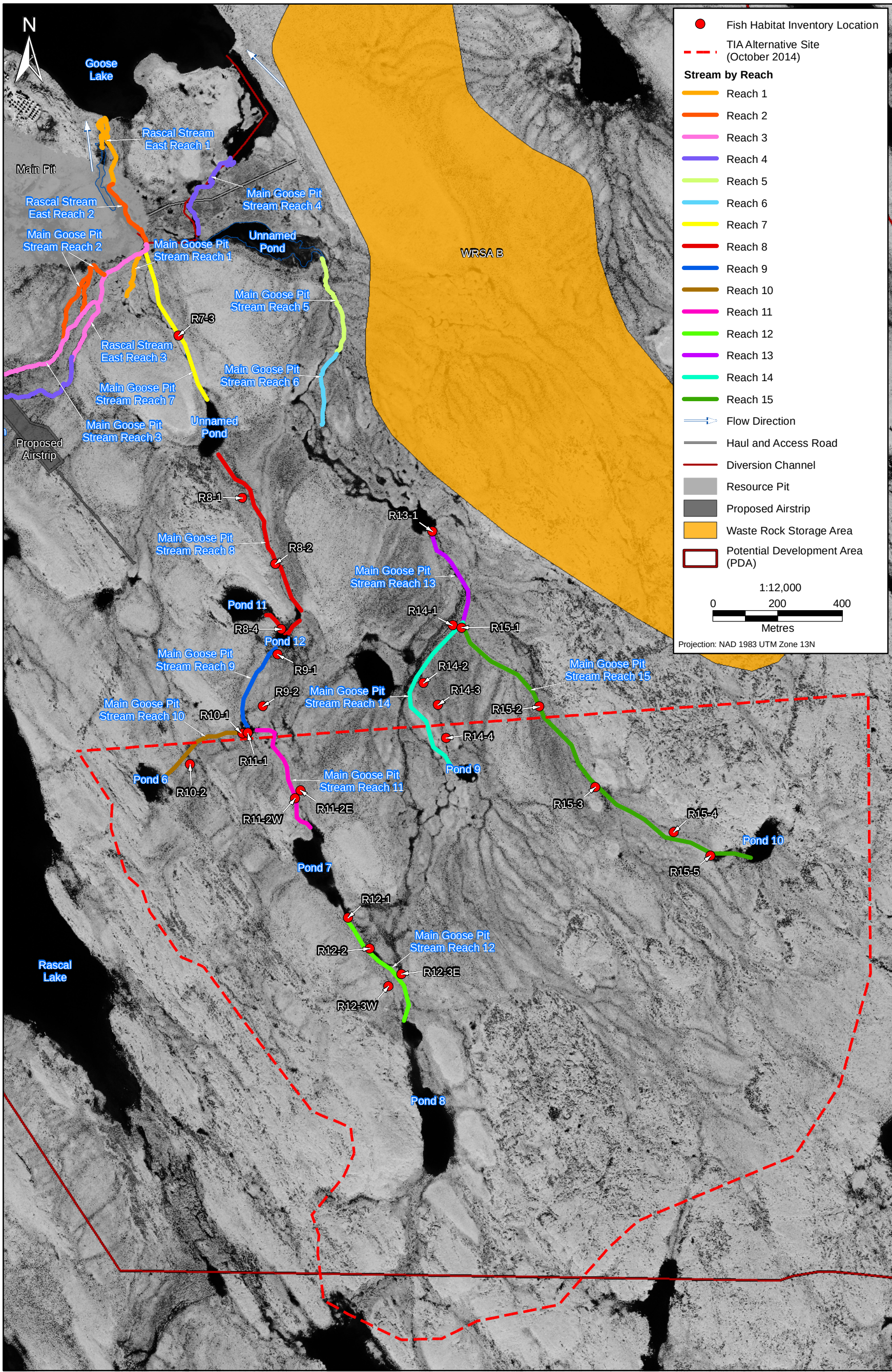


Table 2.2-2. Fish Habitat Inventory Attributes Assessed and Measured at Stream Sites, 2014

Channel Characteristics	Substrate Type	Physical Measurements	Habitat Characteristics	Cover	Habitat Quality
Stream Morphology	Dominant	Length (m)	Pool Type	Deep Pool (%)	Spawning
Channel Type	Subdominant	Wetted Depth (m)	Pool Residual Depth (m)	Boulder (%)	Rearing
Channel Boundary	D95 (cm)	Bankfull Depth (m)	Fish Passage Barriers	Instream Vegetation (%)	Migration
Channel Pattern	D (cm)	Wetted Width (m)	Bank Texture	Overhanging Vegetation (%)	Overwintering
Channel Confinement		Bankfull Width (m)	Bank Shape	Undercut Bank (%)	
		Gradient (%)	Riparian Vegetation Type		
		pH	Instream Vegetation Type		
		Conductivity (µS/cm)	Crown Closure (%)		
		Turbidity	Features		

Substrate Type: D = size of the largest substrate particle that will be moved at channel forming flows , D95 = diameter of the substrate particle that is larger than 95% of substrate particles

Table 2.2-3. Stream Morphology Codes and Descriptions

Type	Code	Description
Boulder Garden	BG	Large boulders, usually only partially submerged, distributed through the stream channel and providing high quality cover for juvenile and small fish. Often associated or in combination with Rf habitat type.
Cascade	Ca	A series of small steps where stream falls over channel obstructions such as boulders and organic debris. Often in series with Run and/or Pool habitat types.
Riffle	Rf	Shallow rapids where the water flows swiftly over completely or partially submerged materials to produce surface agitation. Usually less than 0.2 m in depth, with a gradient of less than 4%.
Glide		Areas of swiftly flowing water, without surface waves, which approximates uniform flow and in which the slope of water surface is roughly parallel to the overall gradient of the stream reach.
	G1	high quality glide habitat; depth greater than 0.75 m.
	G2	intermediate quality habitat; depth 0.3 to 0.75 m.
	G3	poor quality glide habitat; less than 0.3 m in depth.
Flat		Areas of still, often stagnant water. Substrate usually covered in silt or organic matter. Though fish habitat quality is usually poor, deep flats can provide cover for holding fish.
	F1	high quality flat habitat; depth greater than 0.75 m.
	F2	intermediate quality flat habitat; depth 0.3 to 0.75 m.
	F3	poor quality flat habitat; depth less than 0.3 m.
Pool		Portions of the stream with reduced current velocity at low flow and deeper water than surrounding areas. Often associated with Run habitat types.
	P1	high quality pool habitat; depth greater than 0.75 m.
	P2	intermediate quality pool habitat; depth between 0.3 and 0.75 m.
	P3	poor quality pool habitat; depth less than 0.3 m.
Bedrock	BR	Very shallow stream flow over a bedrock outcrop. When combined with steep gradient, forms a fish passage barrier. Poor habitat quality.

Table 2.2-4. Stream Channel Type and Boundary Codes and Descriptions

Type	Code	Description
Channel	C1	single stream channel (no bars, islands, or side channels) throughout the survey section.
	C2	occasional bars, creating areas within the survey section with more than one channel. No more than 50 % of the survey section has multiple channels.
	C3	stream channel is heavily braided. More than 50 % of the survey section consists of multiple channels.
Channel Boundary	D1	stream is confined to a well-defined channel with a distinct boundary at the water's edge.
	D2	up to 50 % of the stream survey section possesses no distinct channel.
	D3	there is no distinct channel. Stream is often dispersed through grasses or other vegetation and/or boulders.

2.2.1.2 Ponds

Fish habitat was assessed in each pond through a visual survey of the shoreline and littoral zone. The shoreline and littoral zone were grouped into units of relatively homogenous habitat. The substrate of each unit 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 (less than 2 mm), gravel (2 to 64 mm), cobble (64 to 256 mm), boulder (256 to 4,000 mm), and bedrock (greater than 4,000 mm). Emergent and submergent vegetation can provide cover for fish, and the presence and type of shoreline vegetation in each habitat unit was recorded.

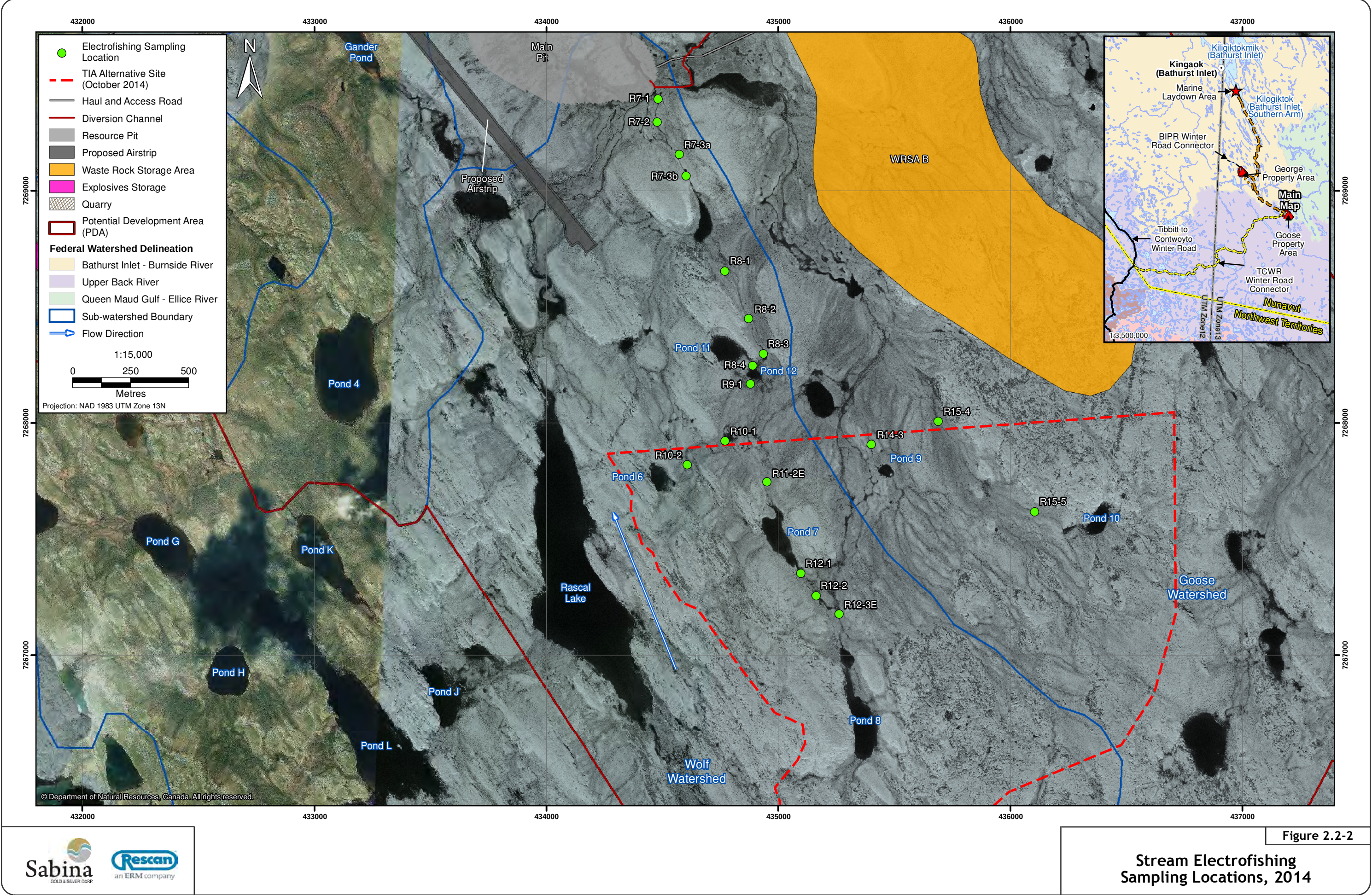
In Ponds 6, 9, 11 and 12, depth and substrate conditions permitted the maximum depth of the pond to be measured by wading to the deepest point and measuring depth with a measuring stick. In Ponds 7, 8, 10 and 13, the deepest point could not be reached by wading and the maximum depth was estimated from aerial surveys. Any inflows and outflows at each pond were identified and photographs were taken of representative habitat types.

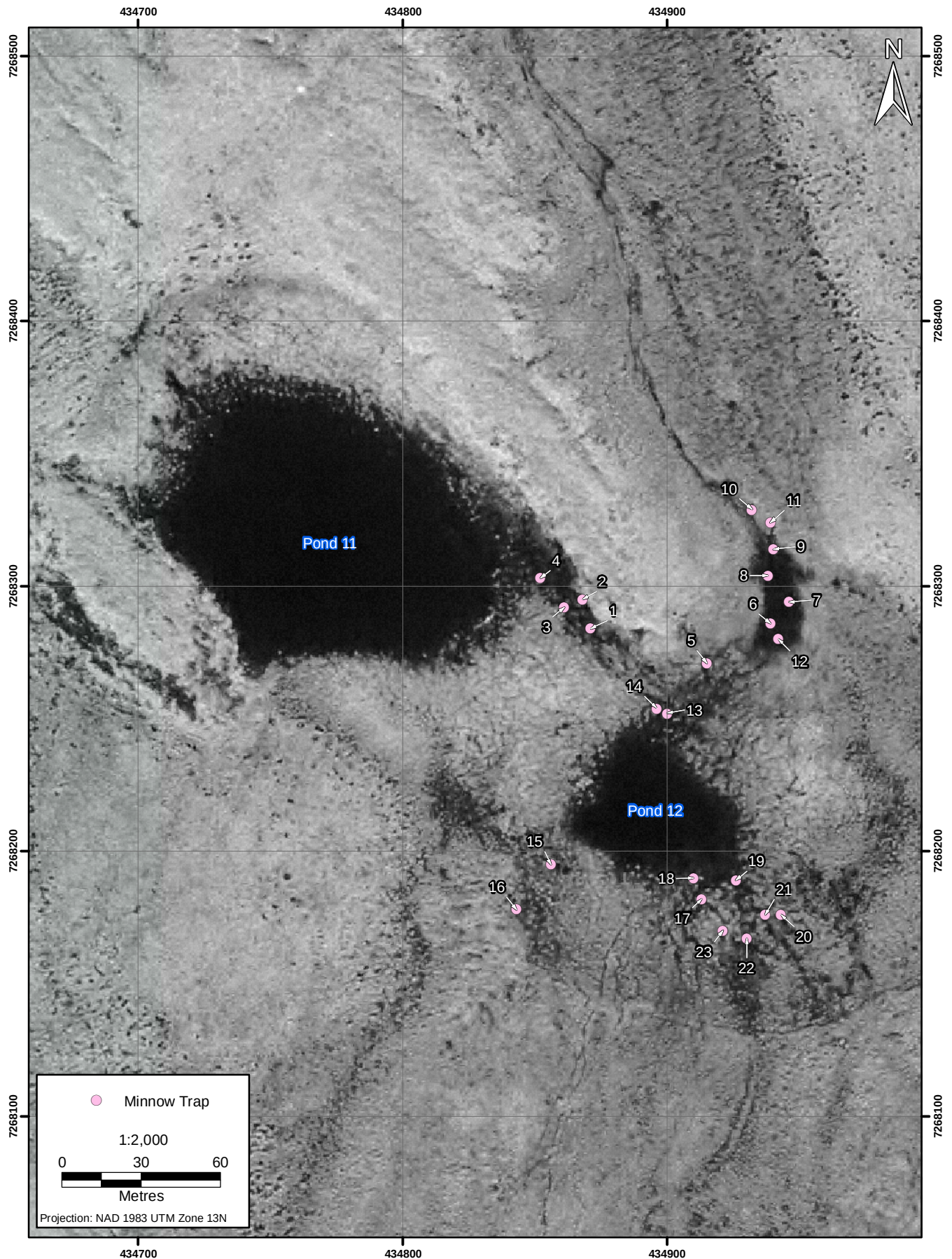
2.2.2 Fish Community

The fish communities of ponds and streams in the TIA Alternative Site Area were sampled to determine fish presence/absence by a combination of backpack electrofishing and minnow trapping according to Department of Fisheries and Oceans (DFO) Licence to Fish for Scientific Purposes #S-14/15-1016-NU and Animal Use Protocol (AUP) #FWI-ACC-2014-043.

2.2.2.1 Streams

The fish communities of streams in the TIA Alternative Site area were surveyed by backpack electrofishing at 18 sites (Figure 2.2-2) and minnow trapping in two stream reaches (Figure 2.2-3). Fish presence and species composition, rather than density, was the primary purpose of sampling, thus single pass electrofishing with no use of stop nets was performed. At each electrofishing site, the length of the stream surveyed was between 53 and 200 m and depended on the presence of a section of homogenous habitat. Sites that were shorter than 100 m were sampled for a minimum of 100 electrofishing seconds while sites that were longer than 100 m were sampled for a minimum of 150 seconds. Sampling was conducted by one crew leader and one dip netter. The anode ring diameter was 28 cm and the dip net was 21 cm in diameter and contained 3.2 mm mesh. A systematic sweep sampling approach was conducted at each site. Electrofishing effort in seconds and the voltage (V), frequency (Hz), and pulse width (ms) settings were recorded for each site.





Minnow traps were placed in the inflow and outflow streams of Ponds 11 and 12 (Main Goose Pit Stream Reaches 8 and 9; Figure 2.2-3). Minnow traps consisted of two cylinders of 6.3 mm galvanized metal mesh measuring 42 cm long and 23 cm in diameter with a 2 cm diameter opening. The cylinders were locked together using a clip attached to a rope and buoy. Minnow traps baited with commercial prawn bait were set at depths of 0.2 to 1.0 m and left to fish overnight. Any fish captured were identified to species, enumerated and released to the stream locations where they were captured.

2.2.2.2 Ponds

The fish communities of Ponds 6, 7, 8, 9 and 10 were sampled by electrofishing and minnow trapping in shallow, littoral areas. Backpack electrofishers were used to sample the shoreline of the ponds by the same methods used for stream sampling. A minimum of 500 electrofishing seconds of effort was expended at small ponds (Pond 9) and a minimum of 1000 electrofishing seconds of effort was expended at larger ponds (Ponds 6, 7, 8, and 10).

Minnow traps were set along the shorelines of ponds by the same methods used for stream sampling. Figures 2.2-4 to 2.2-8 show the locations where minnow traps were set in each sampled pond in the TIA Alternative Site footprint. Any fish captured were identified to species, enumerated and released to the waterbody location where they were captured.

2.3 DATA ANALYSIS

2.3.1 Fish Habitat

Fish habitat data in streams were based on measurements made over representative segments of each reach surveyed. Where applicable, habitat characteristics within a site are reported as the mean of all measurements within that section.

2.3.2 Fish Community

Fish presence/absence and species composition were summarized in sampled ponds and streams. Where applicable, catch-per-unit-effort (CPUE) was calculated to provide an index of relative abundance that can be used to compare fish populations among different areas. CPUE is defined as the number of fish captured per sampling device per unit time (Table 2.3-1).

Table 2.3-1. Catch-Per-Unit Effort Calculations Used in Community Sampling Analysis

Sampling Gear	CPUE Calculation
Minnow trap	$CPUE = \text{number of fish caught per trap} * [(24 \text{ h} / (\text{set time, h}))]$
Electrofisher	$CPUE = \text{number of fish caught} * [100 / (\text{electrofishing effort, s})]$

CPUE = Catch-per-unit-effort

2.4 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance and quality control was implemented to ensure accurate data collection and analysis. Methods and gear types for fish community sampling and habitat assessments were selected to ensure sampling and data collection were being conducted in a standardized manner. Field water quality meters were calibrated prior to the beginning of the field trip. Summary and graphical analyses of the data were completed according to established standards and best practice.

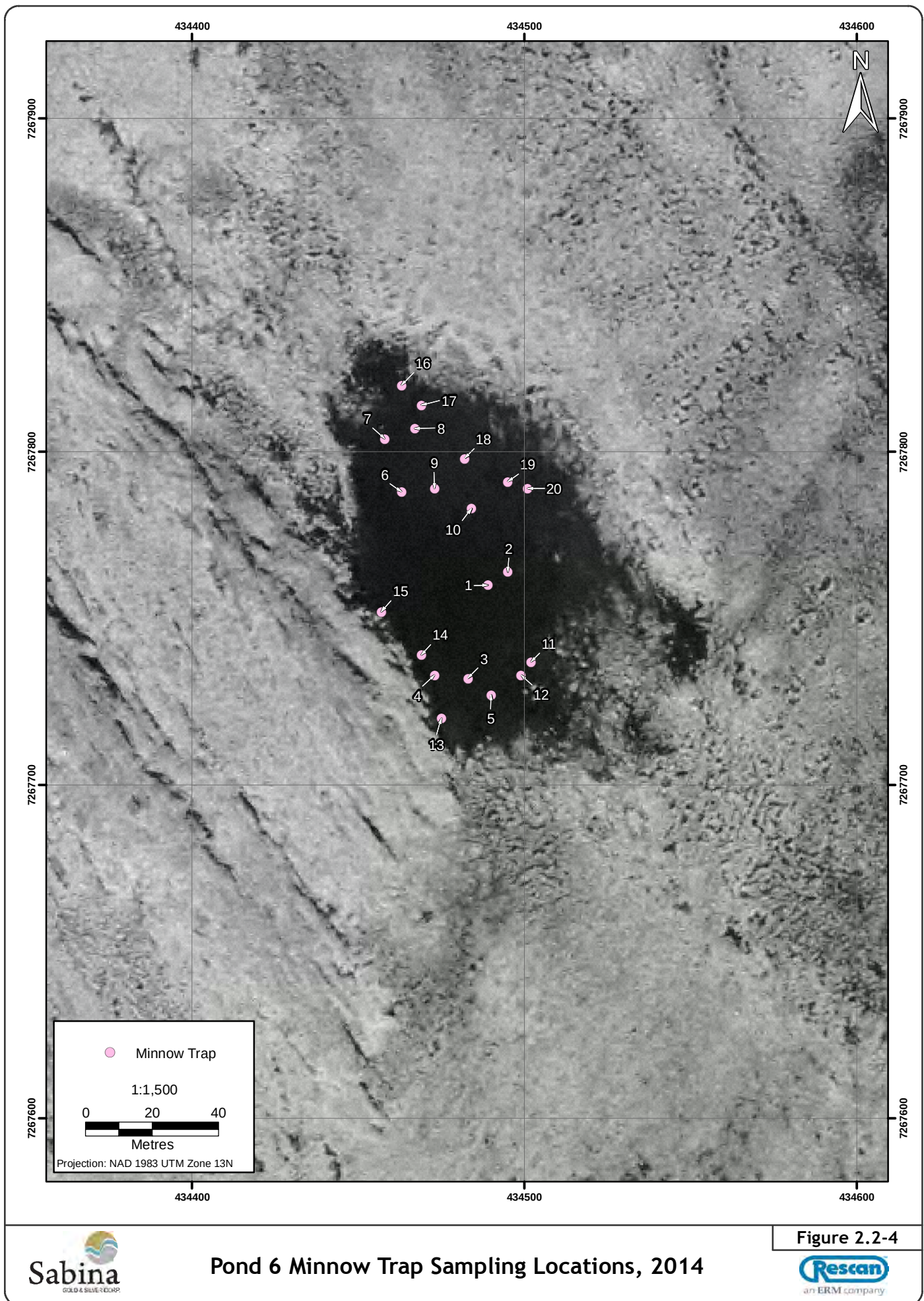
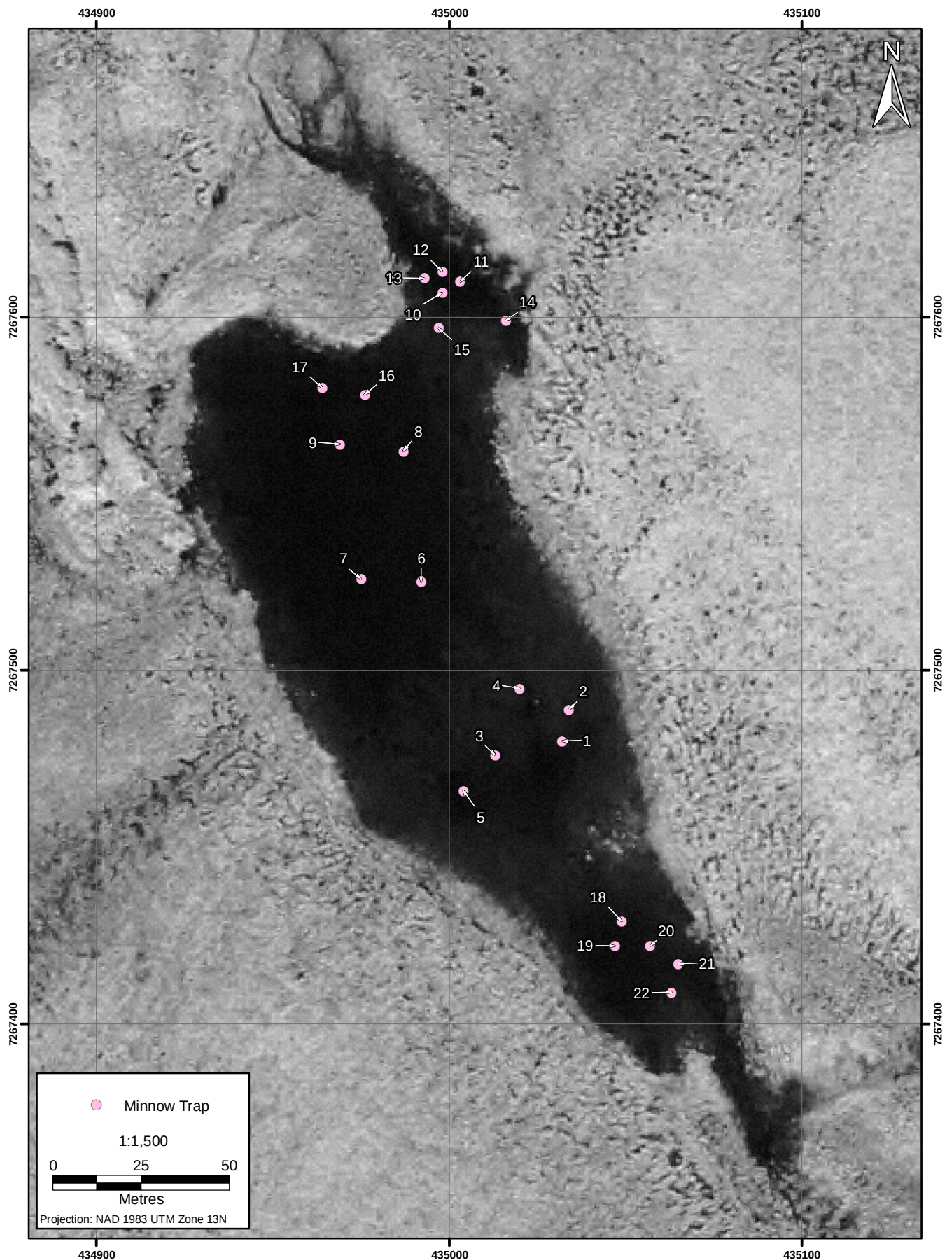
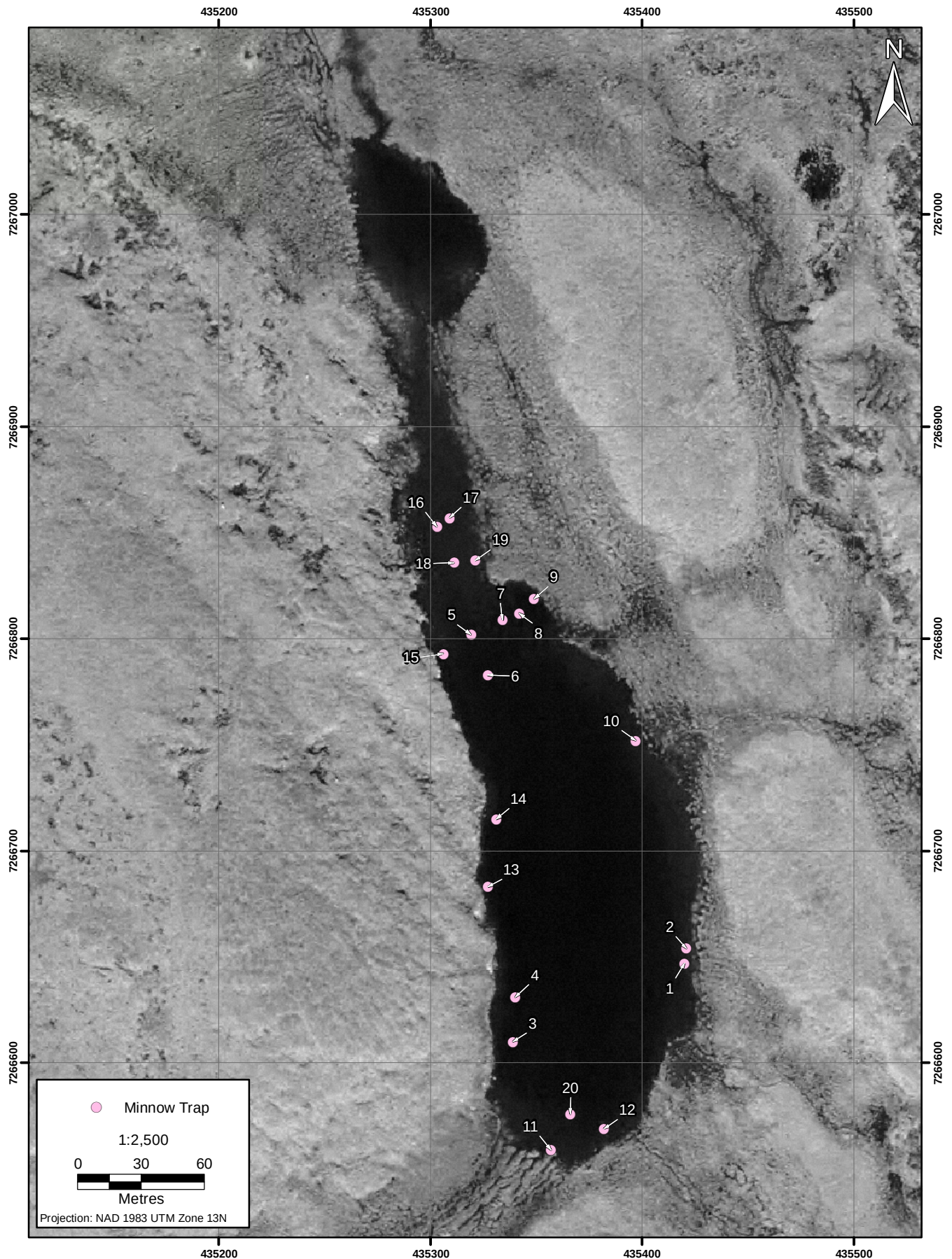


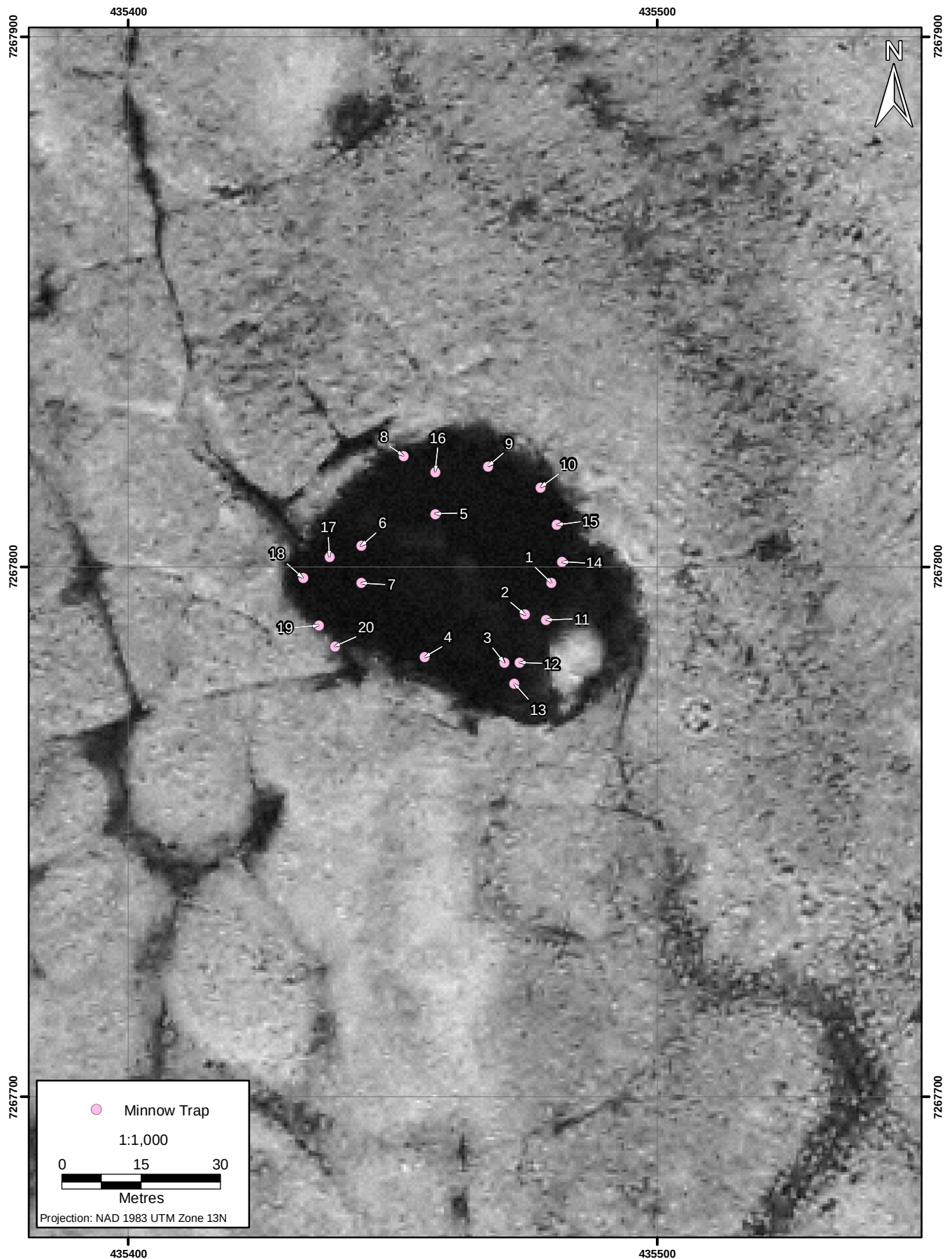
Figure 2.2-4

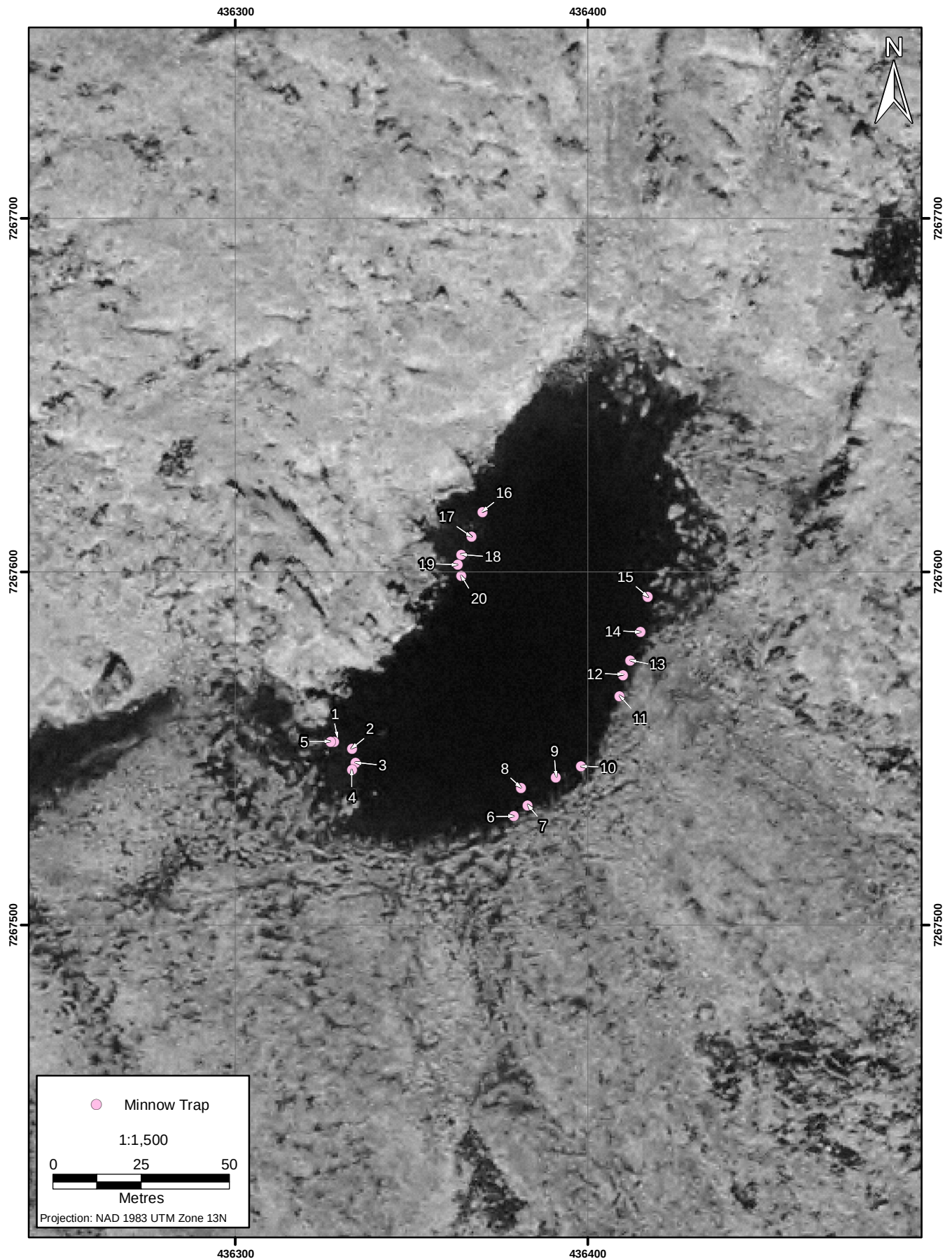




Pond 8 Minnow Trap Sampling Locations, 2014

Figure 2.2-6





3. Results

3. Results

3.1 FISH HABITAT

3.1.1 Streams

Streams that were sampled in the TIA Alternative Site area include eight upper reaches of the Main Goose Pit Streams which are tributaries that flow into Rascal Stream East and Goose Lake within the main pit area of the Goose PDA (Figure 2.2-1). The eight reaches are not consecutive reaches of a single stream, but rather reaches of several streams in close proximity which are grouped together in Project baseline reports (Rescan 2014). Fish habitat value in Reaches 1 to 7 of the Main Goose Pit Streams has been previously described (Rescan 2014). Habitat value in Reaches 7 to 15 was assessed in 2014 at the Fish Habitat Inventory Locations presented in Figure 2.2-1. The TIA Alternative Site footprint contains abundant low lying, wet habitat where the locations of streams and areas of overland flow may change over time. Habitat inventory locations were identified in the field and assessments of fish habitat value reflect conditions on the survey date. Appendix 3.1-1 presents complete fish habitat data for each inventory site.

Reach 7 is downstream and outside of the TIA Alternative Site footprint and connects an unnamed pond with Rascal Stream East Reach 3 (Figure 2.2-1). The reach is comprised of a braided channel of moderate depth (bankfull depth = 0.48 m) with scour pools that create deeper habitats throughout (up to 0.85 m wetted depth; Plate 3.1-1). Fine substrates dominate the reach though pockets of gravel, cobble and boulders are present, particularly in small scour pools (Plate 3.1-2). Overall fish habitat is characterized as important due to good quality rearing habitat in pools with moderate instream vegetation and undercut bank cover (Plate 3.1-2). However, very limited spawning habitat for Arctic Grayling was identified and migration potential is poor to fair, particularly at the downstream end of the reach where the stream is braided and small channels flow through surrounding grasses.

Reach 8 is downstream and outside of the TIA Alternative Site footprint and connects Ponds 11 and 12 with an unnamed pond and Reach 7 downstream (Figure 2.2-1). Downstream of Pond 12, Reach 8 is dominated by fine substrates and has abundant instream and overhanging vegetation cover. The stream morphology is generally shallow glide habitat (mean bankfull depth = 0.31 m) with occasional braiding and sections where the channel possesses no distinct boundaries (Plate 3.1-3). Although abundant vegetation provides cover, shallow areas where the channel is not defined influence stream connectivity and result in the potential for poor rearing and migration habitat. No spawning habitat was identified and the overall habitat potential is marginal.

The portion of Reach 8 that connects Pond 11 and Pond 12 is a wide (bankfull width = 18.5 m) channel where the outflow from Pond 11 pools in a boulder garden (Plate 3.1-4). While boulders may provide cover for rearing fish near Pond 11, at the time of the survey there was a dry channel barrier between Pond 11 and Pond 12, preventing fish passage and resulting in overall marginal potential for fish habitat.

Reach 9 is located downstream and outside of the TIA Alternative Site footprint, upstream of Pond 12 (Figure 2.2-1). The channel enters Pond 12 as very shallow (bankfull depth = 0.17 m) and narrow (bankfull width = 2.3 m) glide habitat. Fine substrates are dominant and there is limited cover in the margins of the channel in the form of instream and overhanging vascular plants (grasses and sedges; Plate 3.1-5). Approximately 170 m upstream of Pond 12, the channel bed was void of water and was designated as dry channel (DC) habitat (Plate 3.1-6). Rearing and migration potential in the lower part of Reach 9 is poor and dry channels are not considered fish habitat therefore, overall fish habitat potential in Reach 9 is marginal.



Plate 3.1-1. An aerial view, facing upstream, of braided channel sections and scour pools in Main Goose Pit Stream Reach 7. September 10, 2014.



Plate 3.1-2. A scour pool in Main Goose Pit Stream Reach 7 with cobble and gravel substrate. September 10, 2014.



Plate 3.1-3. Braided glide habitat in Main Goose Pit Stream Reach 8, downstream of Pond 12. September 10, 2014.



Plate 3.1-4. Boulder garden feature in Main Goose Pit Stream Reach 8, near Pond 11, created a dry channel barrier to fish passage on the survey date. September 9, 2014.



Plate 3.1-5. Shallow, narrow glides provide poor quality rearing habitat for fish in Main Goose Pit Stream Reach 9. September 9, 2014.

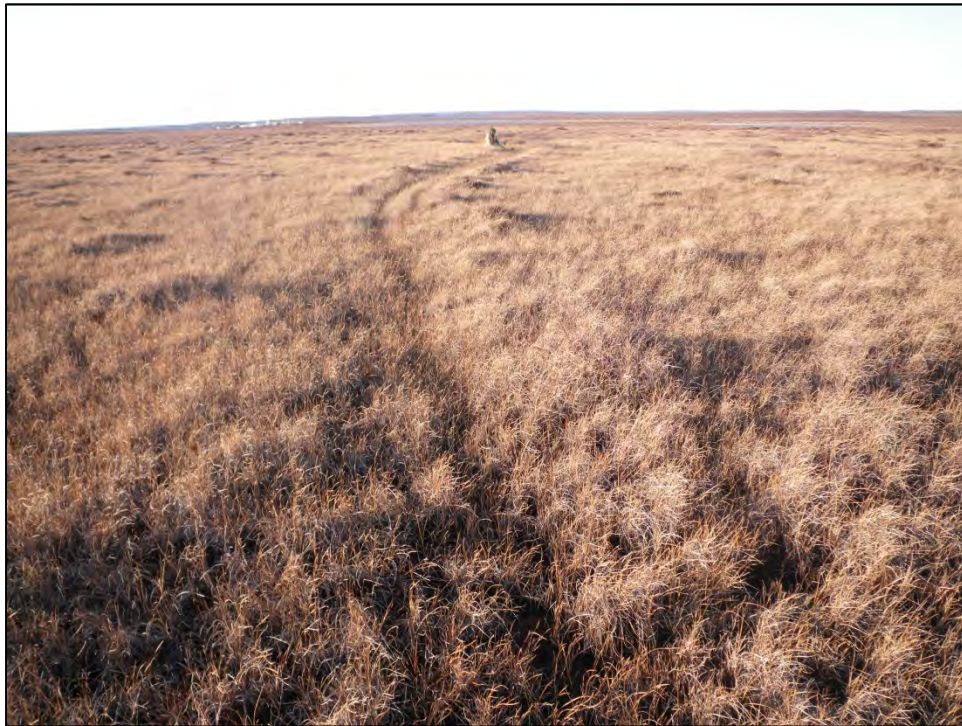


Plate 3.1-6. Dry channel in Main Goose Pit Stream Reach 9. September 9, 2014.

Reach 10 is located within the TIA Alternative Site footprint, directly downstream of Pond 6 (Figure 2.2-1). The stream morphology in the reach is defined by flat habitat where the channel is heavily braided and there are no distinct channel boundaries. In the upper portion of the reach, near Pond 6, boulder garden and overland flow features create temporary barriers to fish passage. In the lower portion of the reach, isolated shallow pools classify the reach as NCD (Plate 3.1-7). Where a channel is present, substrates are comprised of fine materials, except in boulder garden features, and abundant instream and overhanging vegetation (grasses, shrubs and mosses) provide instream cover. Poor connectivity within the reach (NCD section) and with downstream reaches (dry channel section in Reach 9) resulted in no potential fish habitat being identified in Reach 10 on the survey date.



Plate 3.1-7. Overland flow and isolated pools in Main Goose Pit Stream Reach 10. September 9, 2014.

Reach 11 is located within the TIA Alternative Site footprint, downstream of Pond 7 (Figure 2.2-1). There are two separate channels that flow north from Pond 7 with the majority of water flowing through an eastern channel (R11-2E) on the survey date. A western channel (R11-2W) meets the eastern channel approximately 200 m downstream of Pond 7 and stream characteristics downstream of this confluence (R11-1) are similar to those in the eastern channel. The eastern channel is characterized by very shallow (bankfull depth = 0.13 m) and very narrow (bankfull width = 0.3 m) glide habitat with fine substrates, abundant instream and overhanging vegetation cover and several locations where the channel bed was dewatered (Plate 3.1-8). The western channel is wider with rockier substrates (cobble and gravel) but was dry in many locations, creating isolated pools and indicating intermittent flow (Plate 3.1-9). Low flow and poor connectivity strongly limit fish passage into and through Reach 11 and the reach is therefore considered to have marginal fish habitat potential.



Plate 3.1-8. Glide habitat with poor connectivity in the eastern channel of Main Goose Pit Stream Reach 11 (R11-2E). September 9, 2014.



Plate 3.1-9. Isolated pools formed in the intermittent western channel (R11-2W) of Main Goose Pit Stream Reach 11. September 9, 2014.

Reach 12 is located within the TIA Alternative Site footprint, between Pond 7 and Pond 8 (Figure 2.2-1). Reach 12 includes two channels that flow north from Pond 8 (eastern channel = R12-3E, western channel = R12-3W) and converge approximately 180 m downstream in an area of overland flow that was identified as an NCD (R12-2). The eastern channel is comprised of glide and flat habitats with a combination of fine and rocky substrates (cobble and boulders) and moderate instream vegetation and undercut bank cover (Plate 3.1-10). The western channel is characterized by boulder garden and dry channel features (Plate 3.1-11). Although flow and cover conditions provide fair potential rearing and migration habitat for fish in a lower section (R12-1) and in the eastern channel (R12-3E), no fish habitat is present in the western channel (R12-3W) or the NCD section (R12-2). Poor connectivity within the reach and in reaches downstream (Reach 9 and 11) suggests that access to Reach 12 by fish is either not possible or is seasonally limited. Therefore, the overall fish habitat potential is considered marginal.



Plate 3.1-10. Glide habitat with boulder and fine substrates in the eastern channel of Main Goose Pit Stream Reach 12. September 9, 2014.

Reach 13 is located along the eastern edge of the Main Goose Pit Streams area, downstream and outside of the TIA Alternative Site footprint and upstream of Reach 6 (Figure 2.2-1; Rescan 2014). Stream habitat in Reach 13 is comprised mostly of glides with well-defined channel boundaries and occasional braiding. The depth and width of the channel are moderate (bankfull depth = 0.40 m and bankfull width = 13.2 m). The channel bed is composed of cobble, boulders and patches of gravel that are suitable for Arctic Grayling spawning (Plate 3.1-12). Cover is abundant and diverse with substantial amounts of instream and overhanging vegetation, boulder cover and undercut banks (Plate 3.1-13). Fish habitat potential in Reach 13 is considered important due to the presence of fair spawning habitat for Arctic Grayling and good rearing and migration habitat for multiple fish species, as well as good connectivity with critical and important fish habitat downstream in Reaches 4, 5, and 6 (Rescan 2014).



Plate 3.1-11. Boulder garden feature in the western channel of Main Goose Pit Stream Reach 12 (R12-3W). September 9, 2014.



Plate 3.1-12. Gravel substrates provide suitable spawning habitat for Arctic Grayling in Main Goose Pit Stream Reach 13. September 9, 2013.



Plate 3.1-13. Abundant and diverse cover types in Main Goose Pit Stream Reach 13 create good rearing habitat for multiple fish species. September 10, 2014.

Reach 14 is located within the TIA Alternative Site footprint, downstream of Pond 9 (Figure 2.2-1). Diverse habitat characteristics were observed in Reach 14 at multiple habitat inventory sites. The lower section of Reach 14 (R14-1) contains boulder garden and intermediate quality glide habitats with boulder and cobble substrates. The stream depth is moderate (bankfull depth = 0.54 m) and deeper pools have residual depths up to 0.46 m. The channel is heavily braided and boulder cover is abundant, however the quality of habitat potential for rearing and migrating fish is reduced by numerous boulder garden features that could act as seasonal, low flow barriers to fish passage (Plate 3.1-14).

The upper sections of Reach 14 (R14-2 to R14-4) are located upstream of an area of flooded tundra to the east of an unnamed pond (Figure 2.2-1). One of these sections was classified as an NCD while the others contained shallow glide and flat habitat units with fine substrates and vegetation cover where the channel flowed through the surrounding grasses (Plate 3.1-15). These shallow, undefined channel sections do not provide quality rearing or migration habitat potential for fish. Overall, fish habitat potential in Reach 14 is marginal due to seasonally restricted access to good rearing habitat in the lower section and because negligible fish habitat is present in the upper sections.

Reach 15 is located within the TIA Alternative Site footprint where it flows northwest from Pond 10 (Figure 2.2-1). The reach is composed of shallow (mean bankfull depth = 0.24 m) glide and flat habitats. In the majority of the reach the channel is braided and its boundaries are poorly defined. Fine materials are the dominant substrate type though gravels and cobbles are also present in isolated areas. Instream vegetation is the most abundant cover type, particularly in flat areas with substantial overland flow (Plate 3.1-16). There is no spawning habitat for Arctic Grayling in the reach and the potential for poor quality rearing habitat is present in the stream sections nearest Pond 10 (R15-5; Plate 3.1-17) and the confluence with Reach 14. Low flows in the remainder of the reach may seasonally limit access by fish (though no barriers were identified on the survey date), resulting in overall marginal fish habitat potential.



Plate 3.1-14. Boulder features in the lower section of Main Goose Pit Stream Reach 14 (R14-1) create seasonal barriers to fish passage. September 10, 2014.



Plate 3.1-15. Glide habitat and overland flows in Main Goose Pit Stream Reach 14 near Pond 9. September 8, 2014.



Plate 3.1-16. Flat habitat unit in Main Goose Pit Stream Reach 15. September 8, 2014



Plate 3.1-17. Aerial view of flat habitat in Main Goose Pit Stream Reach 15, downstream of Pond 10. September 8, 2014.

3.1.2 Ponds

Shoreline and littoral zone fish habitat was assessed at eight ponds in the TIA Alternative Site area (Figure 2.1-1 and Table 2.2-1). Pond habitat survey data is presented in Appendix 3.1-2.

Pond 6 is located east of Rascal Lake within the TIA Alternative Site footprint (Figure 2.1-1). The majority of shoreline habitat units are dominated by boulders, embedded in fine substrates (Figure 3.1-1) and shoreline vegetation includes algae, sedges and other vascular plants. The western shoreline of the pond is defined by a large bedrock outcrop (Plate 3.1-18). The outflow from Pond 6 (Main Goose Pit Stream Reach 10) was classified as NCD which limits fish passage into the pond and no channelized inflow was identified. The pond has a maximum depth of approximately 1 m which is not sufficient to provide overwintering habitat for fish.



Plate 3.1-18. Bedrock outcrop along the western shoreline of Pond 6. September 8, 2014.

Pond 7 is a shallow pond, east of Pond 6 (Figure 2.1-1), within the TIA Alternative Site footprint. Pond 7 has one inflow stream (Main Goose Pit Stream Reach 12) and one outflow stream (Main Goose Pit Stream Reach 11) each with poor quality migration habitat potential that may restrict fish passage into Pond 7. Shoreline habitat units near the inflow and outflow streams are dominated by fine substrates, sometimes with embedded boulders present (Figure 3.1-2). The eastern and western shorelines are rockier and are generally dominated by cobble substrates (Plate 3.1-19). Algae and sedges were identified in the majority of habitat units. Pond 7 has an estimated maximum depth of less than 1 m which is not sufficient to provide habitat for overwintering fish.

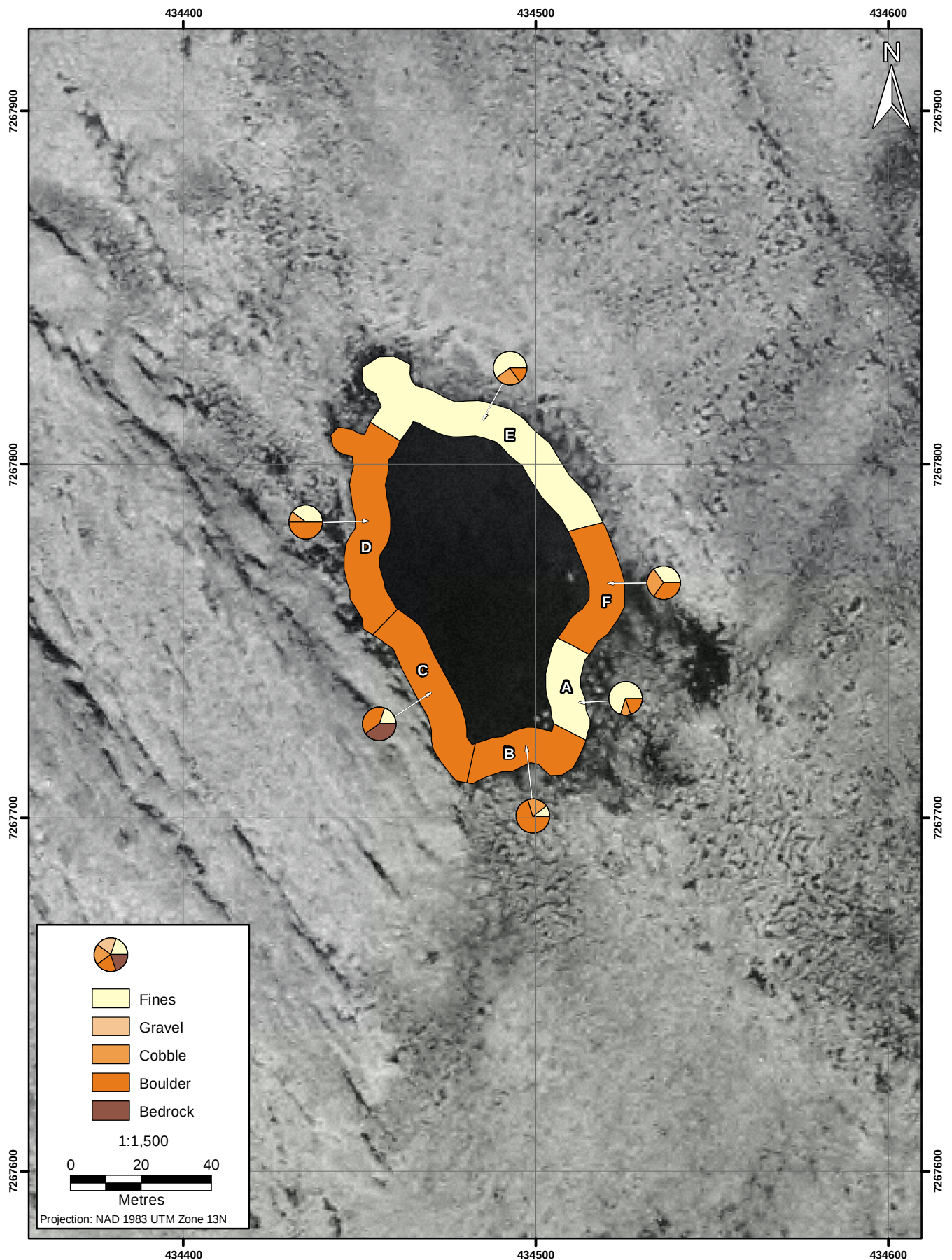


Figure 3.1-1

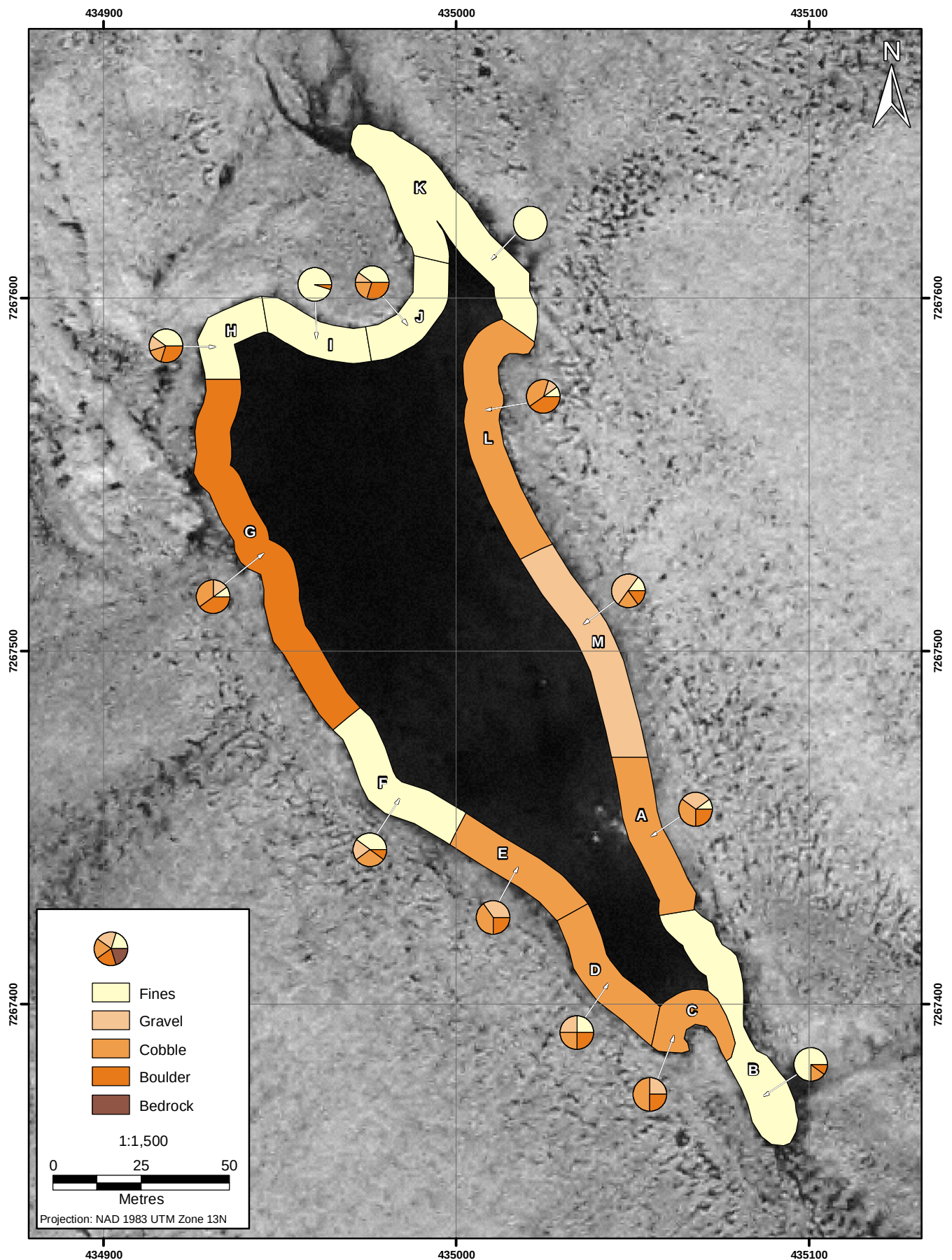


Figure 3.1-2



Plate 3.1-19. Boulder and cobble substrates along the eastern shoreline of Pond 7. September 8, 2014.

Pond 8 is located upstream of Pond 7 within the TIA Alternative Site footprint (Figure 2.1-1). Pond 8 is separated into a northern and southern basin (Figure 3.1-3) by a shallow narrows (Plate 3.1-20). The northern basin is shallow and characterized by fine substrates and shoreline vegetation comprised of algae and sedges. The southern basin is larger and deeper than the northern basin with an estimated maximum depth of 2 m. Habitat units in the southern basin are dominated by boulder and cobble substrates and the shoreline vegetation includes mosses in addition to algae and sedges. A channelized inflow carries overland flow into the southern end of Pond 8 while Main Goose Pit Stream Reach 12 provides marginal downstream connectivity with Pond 7. Pond 8 is unlikely to be of sufficient depth to provide overwintering habitat for fish.

Pond 9 is a small pond located within the TIA Alternative Site footprint. Boulders and cobbles comprise the majority of substrates in Pond 9, except in the southeast corner where fine substrates dominate (Figure 3.1-4) and sedges are the dominant shoreline vegetation type. Satellite imagery suggests that diffuse overland flows enter Pond 9 from the south (Figure 3.1-4). A small outflow channel (Main Goose Pit Stream Reach 14) flows northwest but contains temporary barriers to fish migration that restricted connectivity with downstream reaches of the Main Goose Pit Streams on the survey dates. Pond 9 has a maximum depth of approximately 0.4 m and is therefore not of sufficient depth to provide overwintering habitat for fish.

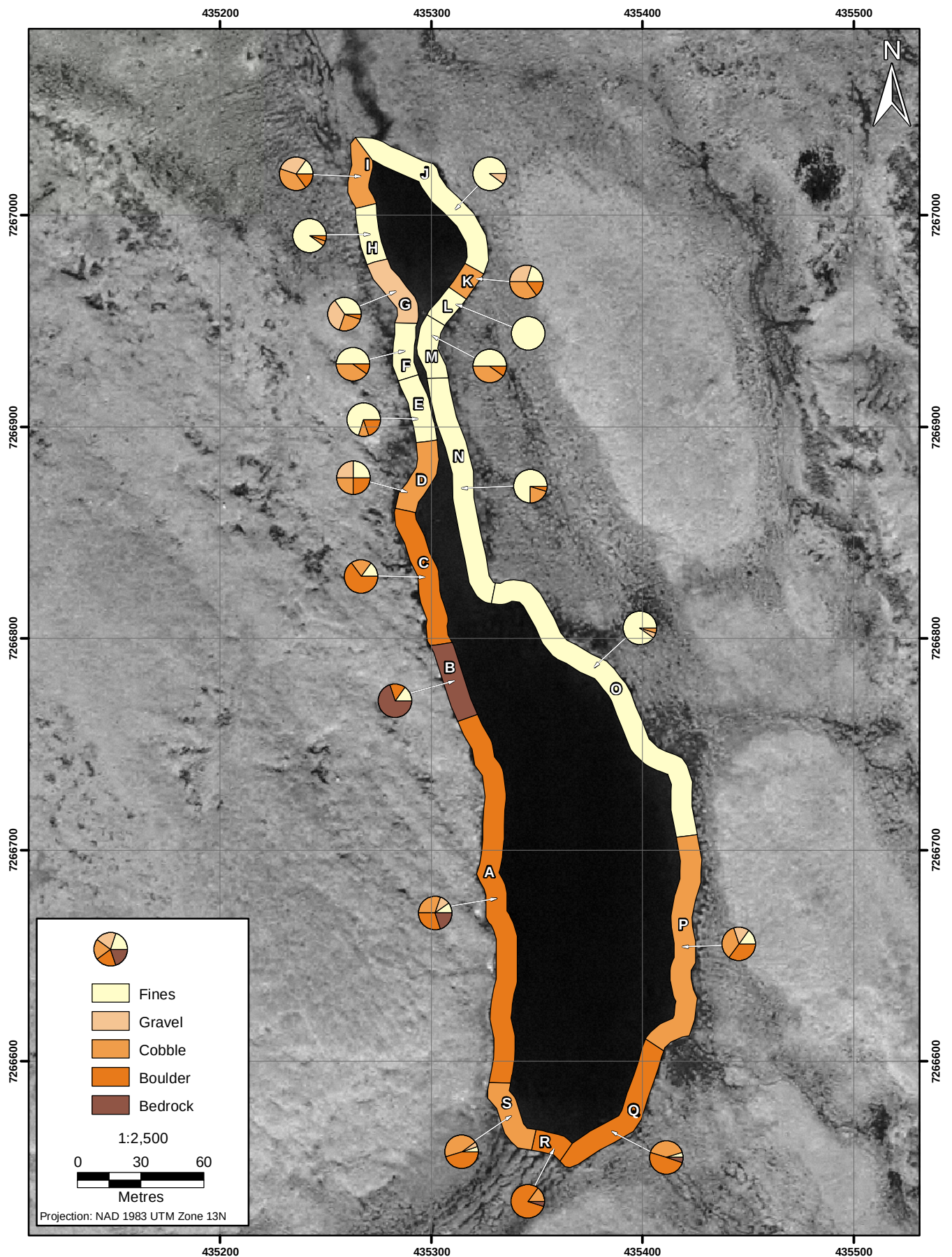


Figure 3.1-3

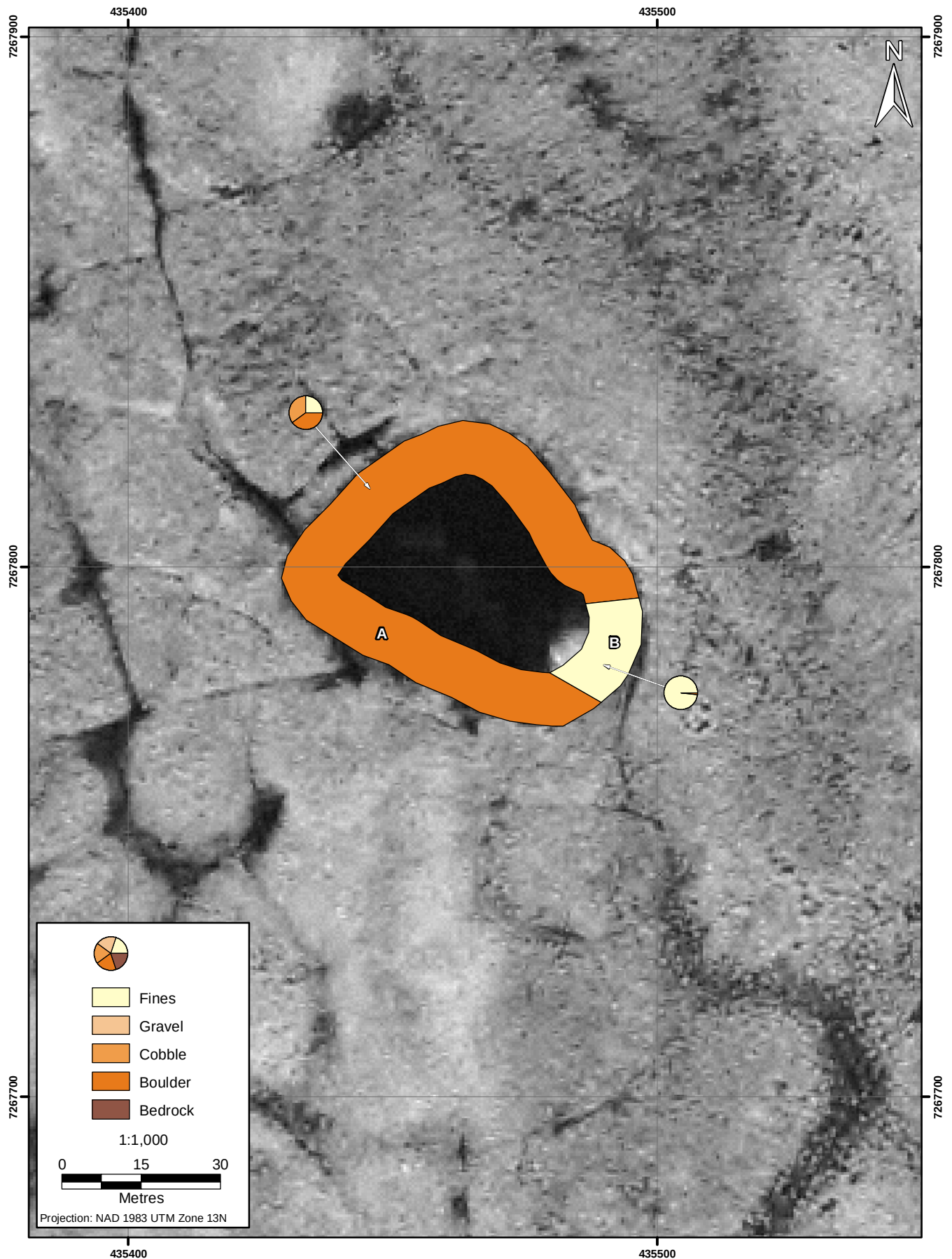
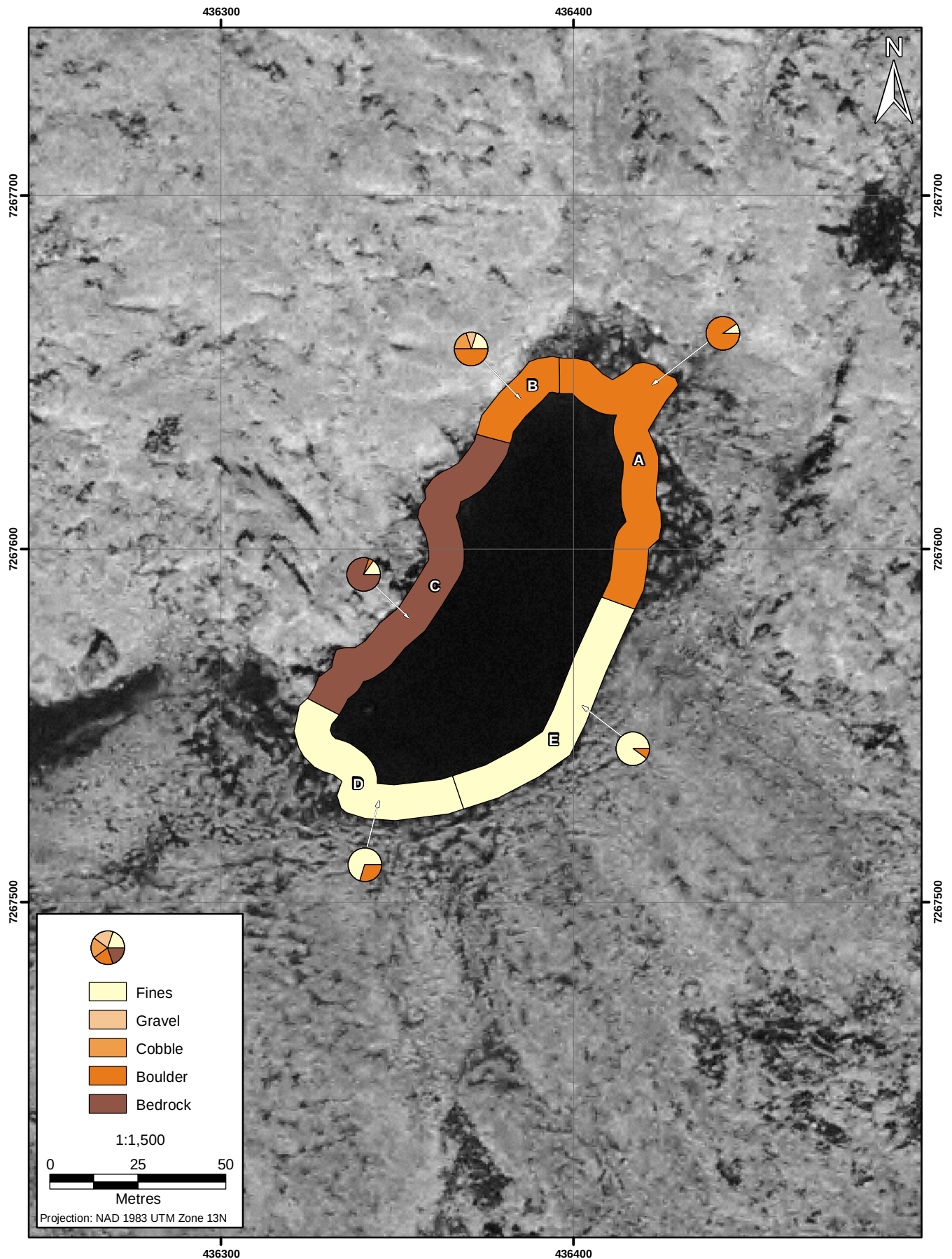




Plate 3.1-20. Shallow narrows between the northern and southern basins of Pond 8. September 9, 2014.

Pond 10 is a headwater pond located on the eastern edge of the Main Goose Pit Streams area (Figure 2.1-1), within the TIA Alternative Site footprint. Habitat assessment of the shoreline and littoral zones of Pond 10 identified fine substrates near an outflow stream (Main Goose Pit Stream Reach 15) on the southwestern edge of the pond (Figure 3.1-5). Algae, mosses and sedges were common in most habitat units except where bedrock or boulders dominated the shoreline. The majority of Pond 10 is shallow (less than 2 m depth) but outcropped bedrock along the northwestern shoreline (Plate 3.1-21) creates areas where the pond's depth was estimated to be greater than 3 m deep, potentially providing important overwintering habitat for fish. However, the outflow channel (Main Goose Pit Stream Reach 15) provides poor quality migration potential between Pond 10 and the Main Goose Pit Streams and a channelized inflow was not identified.

Pond 11 and Pond 12 are small, shallow ponds located between Reaches 8 and 9 of the Main Goose Pit Streams outside of the TIA Alternative Site (Figure 2.1-1). A wide, intermittent outflow channel connects Pond 11 to Pond 12 and the channelized outflow of Pond 12 (Main Goose Pit Streams Reach 8) allows the potential for fish passage between Pond 12 and the lower reaches of the Main Goose Pit Streams and Rascal Stream East (Figure 2.2-1). The shoreline habitat of both ponds is dominated by fine substrates with embedded boulders (Figure 3.1-6; Plate 3.1-22). Shoreline vegetation includes emergent mosses and sedges and submerged algae. The maximum depths of Ponds 11 and 12 are less than 1 m and they do not provide habitat for overwintering fish.



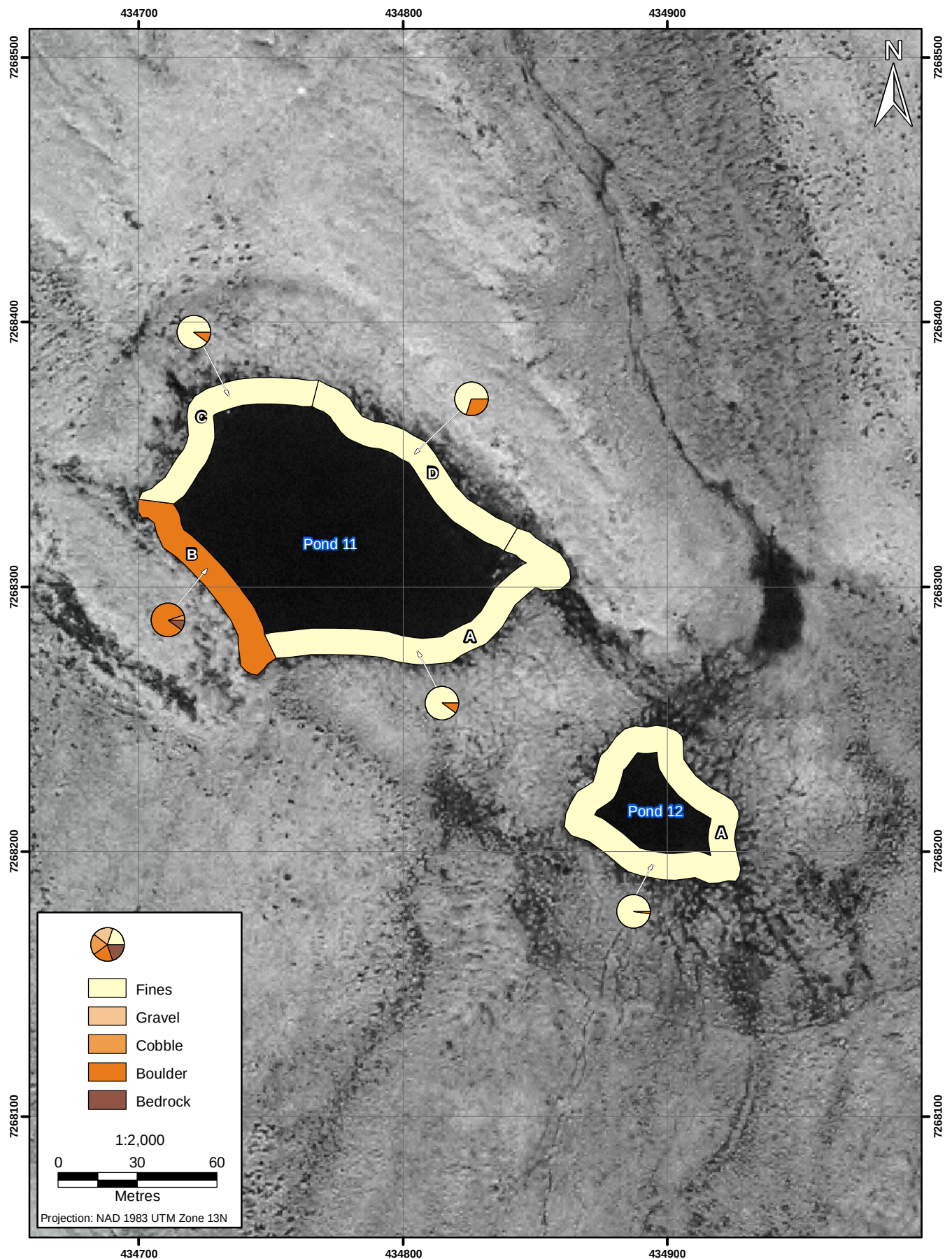


Figure 3.1-6



Plate 3.1-21. Bedrock outcrops along the shoreline of Pond 10. September 8, 2014.



Plate 3.1-22. Boulders embedded in fine substrates and emergent vegetation growth along the shoreline of Pond 11. September 10, 2014.

Pond 13 is a small lake, located on the southwestern margin of the TIA Alternative Site footprint in the Wolf Watershed, upstream of Rascal Lake (Figure 2.1-1). Several braided inflow channels enter the lake at the southern end (Plate 3.1-23) and an outflow channel flows toward Rascal Lake from the northwest corner (Plate 3.1-24). Fine substrates are the dominant substrate type in most shoreline habitat units but units containing boulders and abundant emergent vegetation provide patches of habitat complexity (Figure 3.1-7). Pond 13 likely provides overwintering habitat for fish as the maximum depth was estimated, through an aerial survey, to be greater than 3 m. The majority of the Pond's area was estimated to be greater than 1 m deep (Plate 3.1-24). Overall fish habitat potential in Pond 13 is considered important due to the presence of large substrates and shoreline vegetation that can provide cover for rearing fish and because it is estimated to be of sufficient depth to act as overwintering habitat.



*Plate 3.1-23. Inflow channels at the southern end of Pond 13.
September 9, 2014.*

3.2 FISH COMMUNITY

3.2.1 Species Composition

One fish species, Arctic Grayling, was captured and observed in the study area, outside the TIA Alternative Site footprint during the 2014 fish community sampling. Table 3.2-1 presents the life history periodicity of Arctic Grayling. 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). Spawning occurs in areas with varying depths and current velocities of less than 1.4 m/s (Evans et al. 2002). Newly hatched fry rear over boulder, cobble, silt and sand substrates in water depths between 0.3 and 0.5 m and water velocities less than 0.8 m/s (Evans et al. 2002). Juveniles tend to rear in streams for most or all of the summer and prefer habitats with slow-moving water and depths between 0.20 and 0.80 m (Evans et al. 2002). Adults rear in lakes or larger rivers, to which they return after spawning (Hubert et al. 1985). Both adults and juvenile Arctic Grayling overwinter in larger rivers and lakes downstream of spawning areas (Stewart et al. 2007).

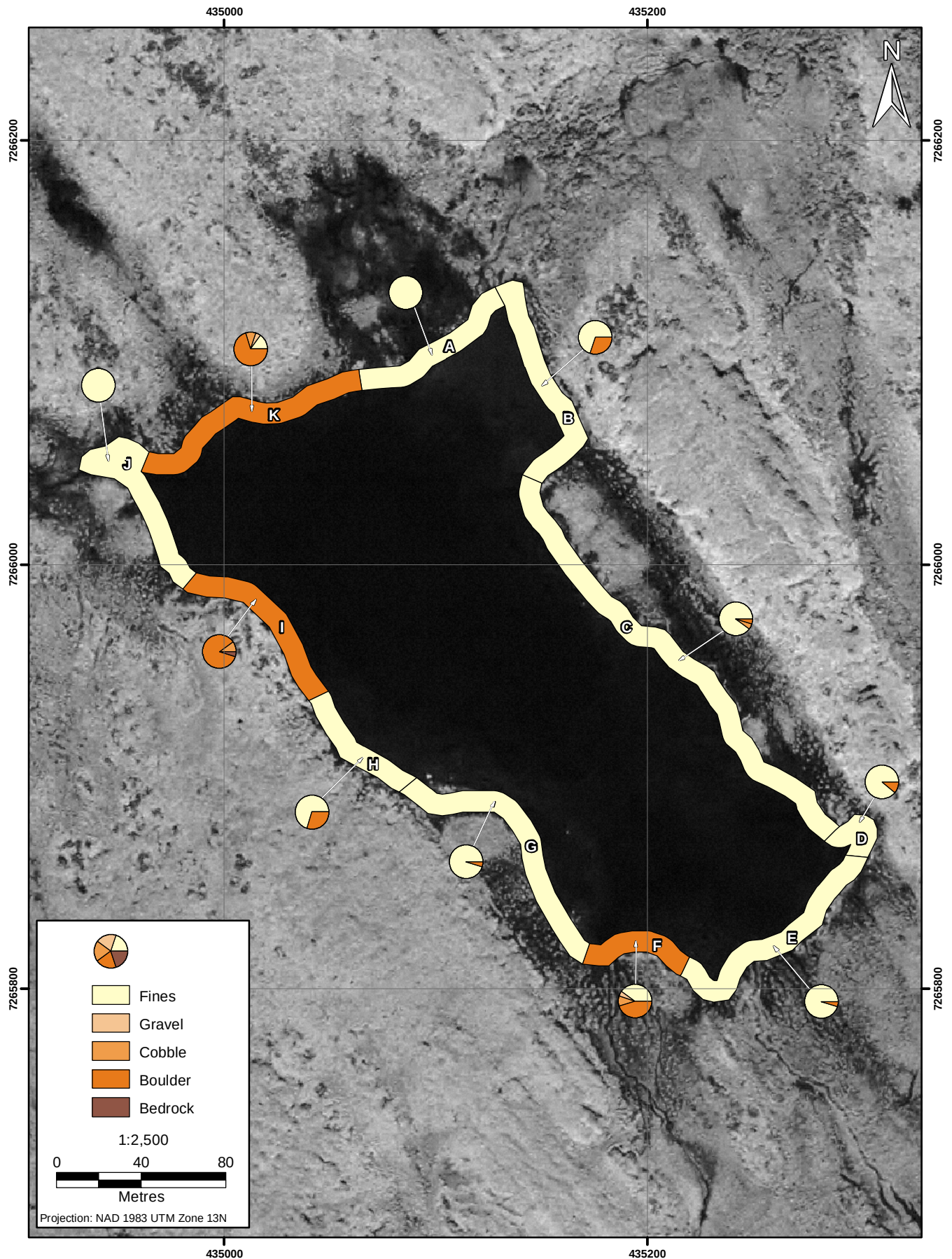




Plate 3.1-24. Aerial view of Pond 13 (facing south). September 9, 2014.

Table 3.2-1. Fish Life History Periodicity Table for Arctic Grayling

Species	Life stage	Habitat	Month											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Arctic Grayling	Spawning	Streams/ Rivers												
	Hatching	Streams/ Rivers												
	Fry rearing/ migration	Streams/ Rivers												
	Rearing/ overwintering	Rivers/ Lakes												
	Adult migration	Streams/ Rivers												

Information compiled from Scott and Crossman (1973) and from field observations.

3.2.2 Streams

No fish were captured in stream reaches sampled by electrofishing within the TIA Alternative Site footprint. Arctic Grayling were captured in one of the three sampled stream reaches downstream and outside of the TIA Alternative Site (Table 3.2-2). In Main Goose Pit Stream Reach 7, seven young-of-year Arctic Grayling were captured in a total of 838 seconds of electrofishing effort expended at four sites along the reach. An additional four young-of-year Arctic Grayling were visually observed, but not captured, during electrofishing and habitat surveys. Among the four sites in Reach 7 where fish were captured, CPUE ranged between 0.70 fish per 100 electrofishing seconds at R7-3b and 2.53 fish per 100 electrofishing seconds at R7-1. R7-1 is the furthest downstream (approximately 1.5 to 1.6 km downstream of the TIA Alternative Site footprint) and nearest to Goose Lake of any of the sampling sites (Figure 2.2-2). No other fish were captured or observed in 3317 seconds of electrofishing effort in the seven other stream reaches that were sampled within and downstream of the TIA Alternative Site footprint (Table 3.2-2).

Table 3.2-2. Summary of Electrofishing CPUE and Visual Observations of Fish in TIA Alternative Site Area Streams, 2014

Location	Site	Station ID	Electrofishing						Visual Observation	
			No. of Fish Captured				Effort (s)	CPUE (Fish/100 s)	Arctic Grayling	Total
			Arctic Grayling	Ninespine Stickleback	Slimy Sculpin	Burbot				
Downstream of TIA Alternative Site Footprint	Main Goose Pit Stream - Reach 7	R7-1	4	0	0	0	158	2.53	3	7
	Main Goose Pit Stream - Reach 7	R7-2	0	0	0	0	318	0.00	1	1
	Main Goose Pit Stream - Reach 7	R7-3b	1	0	0	0	143	0.70	0	1
	Main Goose Pit Stream - Reach 7	R7-3a	2	0	0	0	219	0.91	0	2
	Main Goose Pit Stream - Reach 8	R8-1	0	0	0	0	249	0.00	0	0
	Main Goose Pit Stream - Reach 8	R8-2	0	0	0	0	252	0.00	0	0
	Main Goose Pit Stream - Reach 8	R8-3	0	0	0	0	128	0.00	0	0
	Main Goose Pit Stream - Reach 8	R8-4	0	0	0	0	552	0.00	0	0
	Main Goose Pit Stream - Reach 9	R9-1	0	0	0	0	133	0.00	0	0
Within TIA Alternative Site Footprint	Main Goose Pit Stream - Reach 10	R10-1	0	0	0	0	196	0.00	0	0
	Main Goose Pit Stream - Reach 10	R10-2	0	0	0	0	222	0.00	0	0
	Main Goose Pit Stream - Reach 11	R11-2E	0	0	0	0	142	0.00	0	0
	Main Goose Pit Stream - Reach 12	R12-1	0	0	0	0	226	0.00	0	0
	Main Goose Pit Stream - Reach 12	R12-2	0	0	0	0	220	0.00	0	0
	Main Goose Pit Stream - Reach 12	R12-3E	0	0	0	0	146	0.00	0	0
	Main Goose Pit Stream - Reach 14	R14-3	0	0	0	0	286	0.00	0	0
	Main Goose Pit Stream - Reach 15	R15-4	0	0	0	0	343	0.00	0	0
	Main Goose Pit Stream - Reach 15	R15-5	0	0	0	0	222	0.00	0	0

No fish were captured in 23 minnow traps set for a total of 347.8 trap hours in Reach 8 and Reach 9 (inflow and outflow channels of Ponds 11 and 12; Figure 2.2-3). Appendix 3.2-1 and 3.2-2 present the sampling effort and catch summary for stream electrofishing and minnow trap sampling, respectively.

3.2.3 Ponds

No fish were captured in electrofishing efforts along the shoreline of the five sampled ponds within the TIA Alternative Site footprint (Ponds 6, 7, 8, 9 and 10), resulting in CPUE of zero for all ponds. Between 802 and 1488 seconds of electrofishing effort was expended in each pond and 6227 seconds of electrofishing were performed overall. There were no incidental visual observations of fish in ponds during the electrofishing or habitat surveys. Two overnight sets of twenty minnow traps per pond, where the average effort was 408 trap hours per pond (range = 360.2 - 463.5 trap hours), did not capture any fish. Appendix 3.2-3 and 3.2-4 present the sampling effort and catch summary for pond electrofishing and minnow trap sampling, respectively.

3.3 FISH BEARING STATUS

The fish-bearing status (Figure 3.3-1) of streams and ponds within, and downstream of, the TIA Alternative Site is built upon data collected in 2013 (Rescan 2014) and 2014 (this report). Table 3.3-1 also summarizes fish presence, habitat quality, and the presence of barriers to fish passage identified in 2013 (Rescan 2014) and 2014 field surveys. Although ponds and streams located in the TIA Alternative Site footprint have the potential for marginal to important (Pond 10) fish habitat value, temporary barriers to fish passage and poor migration habitat exists in several downstream reaches. These conditions likely restrict fish access and prohibit fish migration into waterbodies within the TIA Alternative Site footprint, at least on a seasonal basis. Fish community sampling immediately following freshet would be required to identify habitat value and barriers under high flow conditions and would confirm the current map of fish distribution and fish bearing status.

No fish were captured in ponds and streams located within the footprint of the TIA Alternative Site. Fish were captured or observed in 2013 and/or 2014 in two stream reaches downstream and outside of the TIA Alternative Site footprint (Reaches 7 and 8; Table 3.3-1). These reaches are located between 400 and 1,100 m downstream of the TIA Alternative Site and have good connectivity with critical and important fish habitats that were identified in the lower reaches of the Main Goose Pit Streams and Rascal Stream East in 2013 (Rescan 2014). The fish bearing status of Pond 13 (located partially within the TIA Alternative Site) and Main Goose Pit Stream Reach 13 (located downstream and outside of the TIA Alternative Site) cannot be determined as fish community sampling has not been performed in these waterbodies. However, both were assessed as having important fish habitat potential.

Figure 3.3-1 summarizes fish species distribution in the TIA Alternative Site as supported by 2014 sampling results, as well as previous baseline studies conducted outside of the TIA Alternative Site (Rescan 2014). Sampling conducted in September 2014 represented initial baseline sampling in all waterbodies within, and most downstream of, the TIA Alternative Site footprint. In Figure 3.3-1, the *Fish Absence* status of waterbodies sampled only in the fall of 2014 is indicated as *Fish Absent in 2014 Community Survey* to distinguish these waterbodies from those in which sufficient previous baseline sampling has confirmed fish absence.

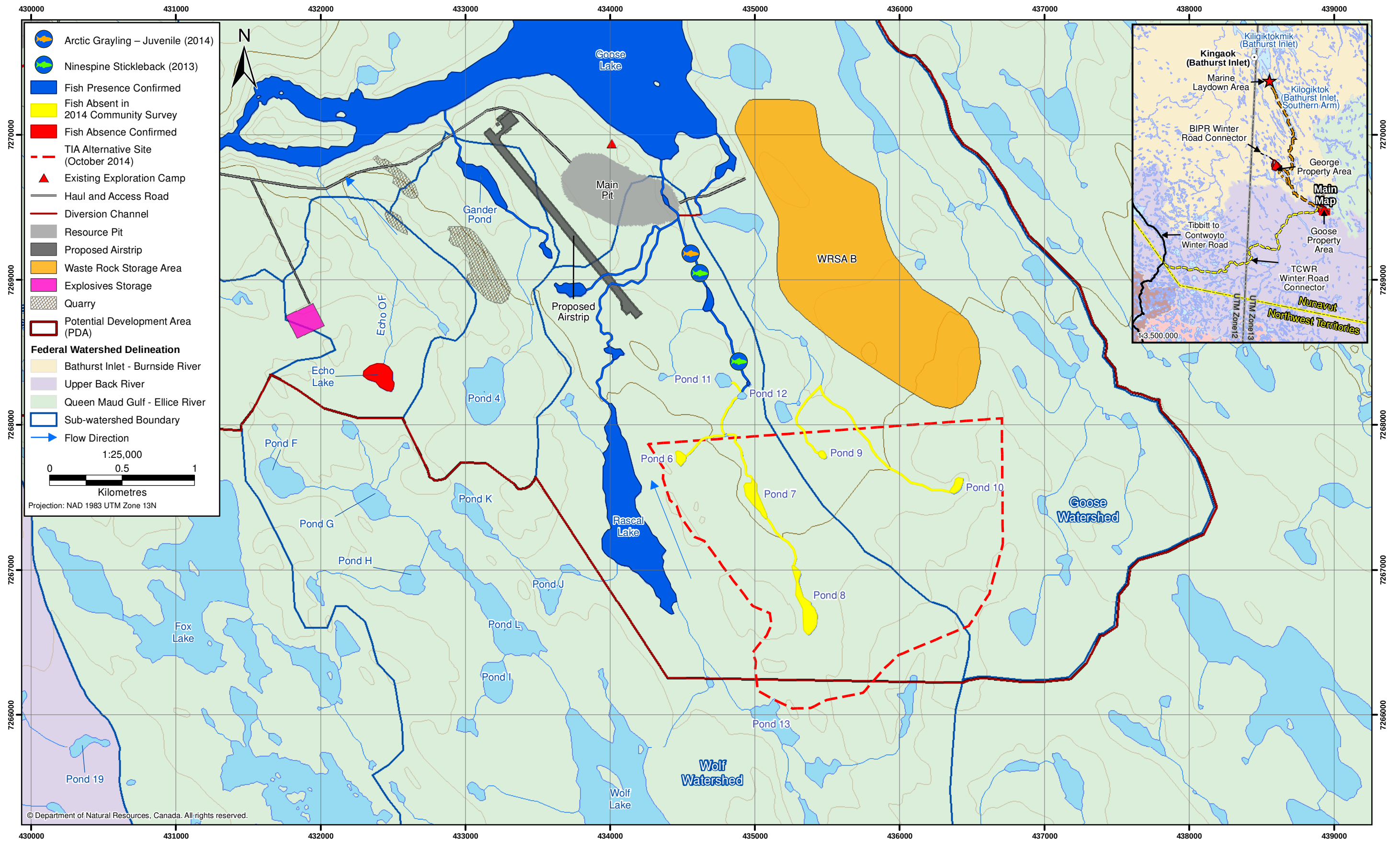


Table 3.3-1. Fish Presence, Habitat Quality and Barriers to Fish Passage in Waterbodies in the TIA Alternative Site Area, 2013 and 2014

Location	Site Name	Fish Presence			Fish Habitat Quality	Potential Fish Passage Barriers Within Site**		Potential Fish Passage Barriers Downstream of Site**	
		Fish Present	Species	Sampling Years		Type	Permanence	Type	Permanence
Within TIA Alternative Site Footprint	Pond 6	N	-	2014	Marginal	-	-	NCD, BG	Temporary (Seasonal)
	Pond 7	N	-	2014	Marginal	-	-	DC, Dry/Int.	Temporary (Seasonal)
	Pond 8	N	-	2014	Marginal	-	-	NCD, BG, DC	Temporary (Seasonal)
	Pond 9	N	-	2014	Marginal	-	-	NCD	Temporary (Seasonal)
	Pond 10	N	-	2014	Important*	-	-	None	-
	Main Goose Pit Stream Reach 10	N	-	2014	None	NCD, BG	Temporary (Seasonal)	DC	Temporary (Seasonal)
	Main Goose Pit Stream Reach 11	N	-	2014	Marginal	Dry/Int.	Temporary (Seasonal)	DC	Temporary (Seasonal)
	Main Goose Pit Stream Reach 12	N	-	2014	Marginal	NCD, BG, DC	Temporary (Seasonal)	DC, Dry/Int.	Temporary (Seasonal)
	Main Goose Pit Stream Reach 14	N	-	2014	Marginal	NCD	Temporary (Seasonal)	None	-
	Main Goose Pit Stream Reach 15	N	-	2014	Marginal	None	-	None	-
Partially Within TIA Alternative Site	Pond 13	Unknown			Important				
Downstream of TIA Alternative Site Footprint	Pond 11	Unknown			Marginal	-	-	BG, DC	Temporary (Seasonal)
	Pond 12	Unknown			Marginal	-	-	None	-
	Main Goose Pit Stream Reach 7	Y	NSSB ^a , ARGR	2013 ^a , 2014	Important	None	-	None	-
	Main Goose Pit Stream Reach 8	N	NSSB ^a	2013 ^a , 2014	Marginal	DC, BG	Temporary (Seasonal)	None	-
	Main Goose Pit Stream Reach 9	N	-	2014	Marginal	DC	Temporary (Seasonal)	DC	Temporary (Seasonal)
	Main Goose Pit Stream Reach 13	Unknown			Important	None	-	None	-

Dashes = not applicable

Blanks = sampling not performed

^a Rescan 2014

* Classified as having the potential for important overwintering habitat though no fish were caught and migration to the pond from fish bearing reaches is limited by poor quality outflow channel habitat (Reach 15)

** Observations of potential barriers have not been conducted during high flows and permanence assessments may change with additional sampling

4. Summary

4. Summary

The Back River Project (the Project) is an exploration gold project owned by Sabina Gold & Silver Corp. (Sabina) located in the West Kitikmeot region of Nunavut. A baseline fish and fish habitat program was completed in 2014 to support freshwater fish and fish habitat assessment at the Tailings Impoundment Area (TIA) Alternative Site at the Goose Property Area.

The objectives of this program were to assess fish presence/absence and fish habitat value in ponds and streams within the footprint and downstream of the proposed TIA Alternative Site. Work included fish habitat assessments in eight ponds and nine stream reaches and fish presence/absence sampling in five ponds and eight stream reaches.

Overall, fish habitat was of marginal value in ponds and stream reaches sampled within the TIA Alternative Site footprint. Downstream and outside of the TIA Alternative Site, two stream reaches had marginal fish habitat value and an additional two stream reaches had fish habitat that was important to at least one fish life history stage. Reaches containing important fish habitat included Main Goose Pit Stream Reaches 7 and 13, which provide the potential for good rearing and migration habitat for Arctic Grayling. These reaches were the nearest to Goose Lake of all sampled reaches and were located 400 m (Main Goose Pit Stream Reach 13) and 1.1 km (Main Goose Pit Stream Reach 7) downstream of the TIA Alternative Site.

Most ponds surveyed within the TIA Alternative Site footprint had only marginally suitable rearing habitat and no overwintering habitat for fish (depths < 2 m), with the exception of Ponds 10 and 13. Although Pond 10 had an estimated maximum depth greater than two meters, potentially providing overwintering habitat, migration into Pond 10 is likely restricted by ephemeral and low flows. Pond 13, which borders the TIA Alternative Site, had sufficient water depth and habitat complexity to provide good habitat potential for rearing and overwintering fish and was classified as important fish habitat.

One season of fisheries sampling in 2014 suggests that the waterbodies located within the footprint of the TIA Alternative Site are not fish-bearing, with the possible exception of Pond 13. No fish were captured at five stream reaches and five ponds within the TIA Alternative Site. Pond 13, located on the southwest margin of the TIA Alternative Site, was not sampled, but is likely to be fish bearing due to its large area, direct and close connection to fish bearing lakes (Rascal and Wolf lakes), and sufficient depth for overwintering. Outside the footprint of the TIA Alternative Site, fish were captured only in the furthest downstream reach (Main Goose Pit Stream Reach 7) of the three sampled reaches connecting the TIA Alternative Site to Goose Lake. Seven young-of-year Arctic Grayling were captured in Main Goose Pit Stream Reach 7, between 1.1 and 1.6 km downstream of the TIA Alternative Site. This confirmed the fish-bearing status reported in 2013, which indicated the presence of Ninespine Stickleback in Main Goose Pit Stream Reach 7 and Reach 8 (located approximately 350 m downstream of the TIA Alternative Site).

References

References

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 Fish Habitat Inventory Data, TIA Alternative Site
Area, Back River Project, 2014**

Appendix 3.1-1. Stream Fish Habitat Inventory Data, TIA Alternative Site Area, Back River Project, 2014

PropertySiteStation IDSurvey DateSurvey Crew					Location				Channel Characteristics					Physical Measurements									
					DS Easting	DS Northing	US Easting	US Northing	Stream Morphology	Channel Type	Channel Boundary	Pattern	Confinement	Length (m)	Gradient (%)	Wetted Depth (m)	Bankfull Depth (m)	Wetted Width (m)	Bankfull Width (m)	pH	Turbidity	Conductivity (µS/cm)	Flow Conditions
Goose	Main Goose Pit Stream - Reach 7	R7-3	9/10/2014	KK/JH	434573	7269156	434650	7268976	G2	C2	D2	IR	OC	200	1	0.44	0.48	3.4	9.6	7.6	C	40	M
Goose	Main Goose Pit Stream - Reach 8	R8-1	9/10/2014	KK/JH	434770	7268653	434873	7268449	G3	C2	D2	IR	OC	249	1.5	0.18	0.27	1.5	15.6	7.7	C	30	M
Goose	Main Goose Pit Stream - Reach 8	R8-2	9/10/2014	KK/JH	434873	7268449	434937	7268323	G2/G3	C2	D2	IR	OC	143	1	0.28	0.34	1.4	8.7	7.3	C	30	M
Goose	Main Goose Pit Stream - Reach 8	R8-4	9/9/2014	KK/JH	434891	7268247	434845	7268310	F3/BG	C3	D2	IR	OC	95	1	0.32	0.29	10.1	18.5	8.2	C	50	M
Goose	Main Goose Pit Stream - Reach 9	R9-1	9/9/2014	KK/JH	434880	7268168	434834	7268008	G3	C1	D2	IR	UN	165	1	0.1	0.17	0.5	2.3	7	C	30	M
Goose	Main Goose Pit Stream - Reach 9	R9-2	9/9/2014	KK/JH	434834	7268008	434844	7267953	DC	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Main Goose Pit Stream - Reach 10	R10-1	9/9/2014	KK/JH	434771	7267923	434719	7267881	F3	C3	D3	IR	UN	85	1.5	-	-	-	14	5.7	C	30	M
Goose	Main Goose Pit Stream - Reach 10	R10-2	9/9/2014	KK/JH	434608	7267827	434559	7267731	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Main Goose Pit Stream - Reach 11	R11-1	9/9/2014	KK/JH	434771	7267923	434934	7267721	G3	C2	D2	SI	UN	260	-	0.04	0.12	0.3	0.4	-	C	-	L
Goose	Main Goose Pit Stream - Reach 11	R11-2W	9/9/2014	KK/JH	434934	7267721	434974	7267640	G3	C2	D2	IR	FC	90	0.5	0.04	0.16	0.7	1.3	6.7	C	40	M
Goose	Main Goose Pit Stream - Reach 11	R11-2E	9/9/2014	KK/JH	434951	7267746	435071	7267587	G3	C2	D2	IR	UN	90	1	0.08	0.13	0.3	0.3	7.7	C	50	M
Goose	Main Goose Pit Stream - Reach 12	R12-1	9/9/2014	KK/JH	435097	7267352	435164	7267256	F3/G3	C2	D1	IR	OC	110	0.5	0.17	0.17	1.1	17.8	7.4	C	50	M
Goose	Main Goose Pit Stream - Reach 12	R12-2	9/9/2014	KK/JH	435164	7267256	435263	7267177	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Main Goose Pit Stream - Reach 12	R12-3E	9/9/2014	KK/JH	435263	7267177	435269	7267092	G3	C2	D1	IR	UN	70	0.5	0.22	0.22	0.8	9.3	7.4	C	60	M
Goose	Main Goose Pit Stream - Reach 12	R12-3W	9/9/2014	KK/JH	435222	7267139	435262	7267032	G3/BG	C1	D1	IR	FC	115	0.5	0.07	0.15	1.1	2.4	6.2	C	100	M
Goose	Main Goose Pit Stream - Reach 13	R13-1	9/10/2014	KK/JH/JC/TG	435358	7268549	435459	7268364	G2	C2	D1	IR	FC	210	1	0.34	0.4	3.3	13.2	7.2	C	40	M
Goose	Main Goose Pit Stream - Reach 14	R14-1	9/10/2014	KK/JH/JC/TG	435459	7268364	435333	7268163	BG/G2	C3	D1	IR	FC	166	1	0.44	0.54	9.9	33.2	7.7	C	40	M
Goose	Main Goose Pit Stream - Reach 14	R14-2	9/8/2014	KK/JH	435331	7268080	435375	7268012	NCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goose	Main Goose Pit Stream - Reach 14	R14-3	9/8/2014	KK/JH	435375	7268012	435401	7267908	F3	C3	D3	IR	UN	86	0	0.09	0.16	6.1	12.5	7.6	C	30	L
Goose	Main Goose Pit Stream - Reach 14	R14-4	9/8/2014	KK/JH	435401	7267908	434410	7267828	G3	C1	D1	IR	FC	92	1	0.17	0.33	1.4	3.5	6.3	C	30	M
Goose	Main Goose Pit Stream - Reach 15	R15-1	9/10/2014	KK/JH/JC/TG	435440	7268277	435680	7268026	G3/F3	C3	D3	SI	UN	350	1	0.13	0.22	4.7	16.3	7.6	C	50	M
Goose	Main Goose Pit Stream - Reach 15	R15-2	9/8/2014	KK/JH	435689	7268007	435762	726918	G2	C2	D1	SI	OC	110	0.5	0.13	0.21	1.7	9.6	7.4	C	50	M
Goose	Main Goose Pit Stream - Reach 15	R15-3	9/8/2014	KK/JH	435862	7267756	435931	7267717	F3	C3	D3	IM	UN	80	1	0.12	0.19	6.5	24.5	7.1	C	50	M
Goose	Main Goose Pit Stream - Reach 15	R15-4	9/8/2014	KK/JH	436105	7267617	436191	7267588	G3/F3	C2	D2	ST	UN	115	0.5	0.09	0.24	1	6.8	10	C	70	M
Goose	Main Goose Pit Stream - Reach 15	R15-5	9/7/2014	KK/JH	436219	7267544	436327	7267552	F3	C3	D3	IR	UN	75	0	0.25	0.32	16.2	26.7	10.2	C	60	M

Dashes indicate not applicable or no data available

Stream Morphology: F = flat (areas of still, often stagnat water), G = glide (areas of swiftly flowing water), BG = boulder garden; 1 = high quality habitat with depth > 0.75 m,

2 = intermediate quality with depth 0.3 - 0.75 m, 3 = poor quality with depth < 0.3 m.

Channel Type: C1 = single stream channel, C2 = occasional bars and < 50% of area with multiple channels, C3 = heavily braided and > 50% with multiple channels

Channel Boundary: D1 = stream confined to well defined channel, D2 = < 50% of survey section possessed no distinct channel, D3 = no distinct channel

Pattern: IR = irregular wandering, SI = sinuous, IM = irregular meandering, ST = straight

Confinement: UN = unconfined, OC = occasionally confined, FC = frequently confined

Turbidity: C = clear

Flow Conditions: L = low, M = moderate, H = high

Substrate Type and Bank Texture : FI = fines, GR = gravel, CO = cobble, BO = boulder, RO = bedrock

Substrate Size: D = size of the largest substrate particle that will be moved at channel forming flows , D95 = diameter of the substrate particle that is larger than 95% of substrate particles

Pool Type: S = scour

Feature Type: BG = boulder garden, D/I = dry/intermittent, DW = dewatered, O = overland flow

Bank Shape: S = slopeing, V = vertical, U = undercut

Bank Texture:

Riparian Vegetation Type: G = grass, S = shrub

Instream Vegetation Type: V = vascular plants, M = mosses, A = algae, N = none

Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut bank

Habitat Quality: None = at least one parameter prevents the use of stream as habitat, Poor = may support fish but does not provide habitat for all life stages or is seasonal,

Good = supports fish but lacks at least one life stage use, Excellent = supports all life stages

Appendix 3.1-1. Stream Fish Habitat Inventory Data, TIA Alternative Site Area, Back River Project, 2014

PropertySiteStation IDSurvey Date				Substrate				Habitat Characteristics										% Crown ClosureInstream Vegetation Type	
				DominantSub-dominantD95 (cm)D (cm)				Pool type	Residual Depth (m)	Feature Type	Barrier (Temporary/Permanent)	Left Bank			Right Bank				
												Shape	Texture	Vegetation Type	Shape	Texture	Vegetation Type		
Goose	Main Goose Pit Stream - Reach 7	R7-3	9/10/2014	FI	CO/BO	20	2	S	0.45	-	-	V	FI	G/S	V	FI	G/S	1-20	N
Goose	Main Goose Pit Stream - Reach 8	R8-1	9/10/2014	FI	CO	20	0.6	S	0.22	-	-	S	FI	G/S	S	FI	G/S	1-20	V
Goose	Main Goose Pit Stream - Reach 8	R8-2	9/10/2014	FI	GR/CO	20	0.6	S	0.27	-	-	S	FI	G/S	S	FI	G/S	1-20	V
Goose	Main Goose Pit Stream - Reach 8	R8-4	9/10/2014	FI	BO	25	0.2	-	-	BG, D/I	T	S	FI	G	S	FI	G	1-20	M/V
Goose	Main Goose Pit Stream - Reach 9	R9-1	9/9/2014	FI	GR	4	0.2	-	-	D/I	T	S	FI	G	S	FI	G	1-20	V
Goose	Main Goose Pit Stream - Reach 9	R9-2	9/9/2014	-	-	-	-	-	-	DC	T	-	-	-	-	-	-	-	-
Goose	Main Goose Pit Stream - Reach 10	R10-1	9/9/2014	FI	-	0.2	0.2	-	-	D/I	T	S	FI	G/S	S	FI	G/S	20-40	M/V
Goose	Main Goose Pit Stream - Reach 10	R10-2	9/9/2014	-	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-
Goose	Main Goose Pit Stream - Reach 11	R11-1	9/9/2014	FI	-	0.2	0.2	-	-	D/I	T	S	FI	G/S	S	FI	G/S	1-20	V
Goose	Main Goose Pit Stream - Reach 11	R11-2W	9/9/2014	FI	CO	20	0.2	-	-	D/I	T	V	FI	G/S	V	FI	G/S	1-20	V
Goose	Main Goose Pit Stream - Reach 11	R11-2E	9/9/2014	FI	GR	0.2	0.2	-	-	D/I	T	V	FI	G/S	V	FI	G/S	1-20	V
Goose	Main Goose Pit Stream - Reach 12	R12-1	9/9/2014	FI	CO	25	0.2	-	-	-	-	S	FI	G/S	S	FI	G/S	1-20	V
Goose	Main Goose Pit Stream - Reach 12	R12-2	9/9/2014	-	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-
Goose	Main Goose Pit Stream - Reach 12	R12-3E	9/9/2014	FI	CO/BO	20	2	-	-	-	-	S	FI	G/S	S	FI	G/S	1-20	V
Goose	Main Goose Pit Stream - Reach 12	R12-3W	9/9/2014	CO	BO	25	0.6	-	-	BG, D/I	T	V	FI/RO	G/S	V	FI/RO	G/S	1-20	V
Goose	Main Goose Pit Stream - Reach 13	R13-1	9/10/2014	CO	BO	35	3	S	0.25	-	-	V	FI	G/S	V	FI	G/S	1-20	A/V
Goose	Main Goose Pit Stream - Reach 14	R14-1	9/10/2014	BO	CO	40	4	S	0.46	-	-	V	FI/BO	G/S	S	FI/BO	G/S	1-20	A/M/V
Goose	Main Goose Pit Stream - Reach 14	R14-2	9/8/2014	-	-	-	-	-	-	NCD	-	-	-	-	-	-	-	-	-
Goose	Main Goose Pit Stream - Reach 14	R14-3	9/8/2014	FI	-	0.2	0.2	-	-	O	T	S	FI	G	S	FI	G	20-40	V
Goose	Main Goose Pit Stream - Reach 14	R14-4	9/8/2014	FI	GR	5	0.2	S	0.16	O	T	V	FI	G/S	V	FI	G/S	1-20	V
Goose	Main Goose Pit Stream - Reach 15	R15-1	9/10/2014	FI	GR	2	0.2	S	0.12	-	-	S	FI	B	S	FI	G	1-20	V
Goose	Main Goose Pit Stream - Reach 15	R15-2	9/8/2014	FI	GR	20	0.5	S	0.22	-	-	S	FI	G/S	S	FI	G/S	1-20	V
Goose	Main Goose Pit Stream - Reach 15	R15-3	9/8/2014	FI	CO	15	0.2	-	-	-	-	S	FI	G	S	FI	G	1-20	V
Goose	Main Goose Pit Stream - Reach 15	R15-4	9/8/2014	FI	GR	2	0.2	-	-	-	-	V	FI	G/S	V	FI	G/S	1-20	V
Goose	Main Goose Pit Stream - Reach 15	R15-5	9/7/2014	FI	BO	0.2	0.2	-	-	O	-	S	FI	G	S	FI	G	1-20	V

Dashes indicate not applicable or no data available

Stream Morphology: F = flat (areas of still, often stagnat water), G = glide (areas of swiftly flowing water), BG = boulder garden; 1 = high quality habitat with depth > 0.75 m,

2 = intermediate quality with depth 0.3 - 0.75 m, 3 = poor quality with depth < 0.3 m.

Channel Type: C1 = single stream channel, C2 = occasional bars and < 50% of area with multiple channels, C3 = heavily braided and > 50% with multiple channels

Channel Boundary: D1 = stream confined to well defined channel, D2 = < 50% of survey section possessed no distinct channel, D3 = no distinct channel

Pattern: IR = irregular wandering, SI = sinuous, IM = irregular meandering, ST = straight

Confinement: UN = unconfined, OC = occasionally confined, FC = frequently confined

Turbidity: C = clear

Flow Conditions: L = low, M = moderate, H = high

Substrate Type and Bank Texture : FI = fines, GR = gravel, CO = cobble, BO = boulder, RO = bedrock

Substrate Size: D = size of the largest substrate particle that will be moved at channel forming flows , D95 = diameter of the substrate particle that is larger than 95% of substrate particles

Pool Type: S = scour

Feature Type: BG = boulder garden, D/I = dry/intermittent, DW = dewatered, O = overland flow

Bank Shape: S = slopeing, V = vertical, U = undercut

Bank Texture:

Riparian Vegetation Type: G = grass, S = shrub

Instream Vegetation Type: V = vascular plants, M = mosses, A = algae, N = none

Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut bank

Habitat Quality: None = at least one parameter prevents the use of stream as habitat, Poor = may support fish but does not provide habitat for all life stages or is seasonal,

Good = supports fish but lacks at least one life stage use, Excellent = supports all life stages

Appendix 3.1-1. Stream Fish Habitat Inventory Data, TIA Alternative Site Area, Back River Project, 2014

PropertySiteStation IDSurvey Date				Cover						Habitat Quality					Photos
				% Pool	% Boulder	% Instream Vegetation	% Overhanging Vegetation	% Undercut Bank	% Total	Spawning Habitat	Over-wintering Habitat	Rearing Habitat	Migration Habitat	Overall Habitat	
Goose	Main Goose Pit Stream - Reach 7	R7-3	9/10/2014	5	0	20	5	15	45	Poor	None	Good	Fair	Important	273-279, 284
Goose	Main Goose Pit Stream - Reach 8	R8-1	9/10/2014	0	0	25	10	2	37	None	None	Poor	Poor	Marginal	195-201, 204-206
Goose	Main Goose Pit Stream - Reach 8	R8-2	9/10/2014	0	0	25	10	5	40	Poor	None	Fair	Poor	Marginal	179-192
Goose	Main Goose Pit Stream - Reach 8	R8-4	9/10/2014	0	10	5	10	0	25	None	None	Poor	None	Marginal	155-162
Goose	Main Goose Pit Stream - Reach 9	R9-1	9/9/2014	0	0	10	10	0	20	None	None	Poor	Poor	Marginal	165-169
Goose	Main Goose Pit Stream - Reach 9	R9-2	9/9/2014	-	-	-	-	-	-	None	None	None	None	None	170-172
Goose	Main Goose Pit Stream - Reach 10	R10-1	9/9/2014	0	0	40	40	0	80	None	None	Poor	None	None	75-79, 83
Goose	Main Goose Pit Stream - Reach 10	R10-2	9/9/2014	-	-	-	-	-	-	None	None	None	None	None	61-67, 70-71
Goose	Main Goose Pit Stream - Reach 11	R11-1	9/9/2014	0	2	30	10	0	40	None	None	Poor	None	None	84, 86, 88, 90-91
Goose	Main Goose Pit Stream - Reach 11	R11-2W	9/9/2014	0	5	5	10	10	30	None	None	None	None	None	95-102, 104
Goose	Main Goose Pit Stream - Reach 11	R11-2E	9/9/2014	0	0	20	30	0	50	None	None	Poor	Poor	Marginal	105-108, 111
Goose	Main Goose Pit Stream - Reach 12	R12-1	9/9/2014	0	0	15	5	0	20	None	None	Fair	Poor	Marginal	112-119, 121
Goose	Main Goose Pit Stream - Reach 12	R12-2	9/9/2014	-	-	-	-	-	-	None	None	None	None	None	124-130
Goose	Main Goose Pit Stream - Reach 12	R12-3E	9/9/2014	0	0	15	5	10	30	Poor	None	Fair	Poor	Marginal	132-136, 141
Goose	Main Goose Pit Stream - Reach 12	R12-3W	9/9/2014	0	30	10	5	5	50	None	None	None	None	None	142-149, 151, 154
Goose	Main Goose Pit Stream - Reach 13	R13-1	9/10/2014	0	30	20	10	10	70	Fair	None	Good	Good	Important	244-265
Goose	Main Goose Pit Stream - Reach 14	R14-1	9/10/2014	0	50	5	10	5	70	None	None	Fair	Poor	Marginal	221-231, 239-240
Goose	Main Goose Pit Stream - Reach 14	R14-2	9/8/2014	-	-	-	-	-	-	None	None	None	None	None	41, 44-47
Goose	Main Goose Pit Stream - Reach 14	R14-3	9/8/2014	0	0	50	30	0	80	None	None	None	None	None	48-51
Goose	Main Goose Pit Stream - Reach 14	R14-4	9/8/2014	0	0	15	30	5	50	None	None	Poor	Poor	Marginal	53-55, 59
Goose	Main Goose Pit Stream - Reach 15	R15-1	9/10/2014	0	0	40	10	0	50	None	None	Poor	None	Marginal	208-218, 220
Goose	Main Goose Pit Stream - Reach 15	R15-2	9/8/2014	0	0	20	10	5	35	None	None	None	Poor	Marginal	23-26, 28
Goose	Main Goose Pit Stream - Reach 15	R15-3	9/8/2014	0	0	30	20	0	50	None	None	None	Poor	Marginal	17, 19-22
Goose	Main Goose Pit Stream - Reach 15	R15-4	9/8/2014	0	0	15	15	0	30	None	None	None	Poor	Marginal	11, 13-16
Goose	Main Goose Pit Stream - Reach 15	R15-5	9/7/2014	0	0	50	0	0	50	None	None	Poor	Poor	Marginal	1-4

Dashes indicate not applicable or no data available

Stream Morphology: F = flat (areas of still, often stagnat water), G = glide (areas of swiftly flowing water), BG = boulder garden; 1 = high quality habitat with depth > 0.75 m,

2 = intermediate quality with depth 0.3 - 0.75 m, 3 = poor quality with depth < 0.3 m.

Channel Type: C1 = single stream channel, C2 = occasional bars and < 50% of area with multiple channels, C3 = heavily braided and > 50% with multiple channels

Channel Boundary: D1 = stream confined to well defined channel, D2 = < 50% of survey section possessed no distinct channel, D3 = no distinct channel

Pattern: IR = irregular wandering, SI = sinuous, IM = irregular meandering, ST = straight

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Turbidity: C = clear

Flow Conditions: L = low, M = moderate, H = high

Substrate Type and Bank Texture : FI = fines, GR = gravel, CO = cobble, BO = boulder, RO = bedrock

Substrate Size: D = size of the largest substrate particle that will be moved at channel forming flows , D95 = diameter of the substrate particle that is larger than 95% of substrate particles

Pool Type: S = scour

Feature Type: BG = boulder garden, D/I = dry/intermittent, DW = dewatered, O = overland flow

Bank Shape: S = slopeing, V = vertical, U = undercut

Bank Texture:

Riparian Vegetation Type: G = grass, S = shrub

Instream Vegetation Type: V = vascular plants, M = mosses, A = algae, N = none

Cover: B = boulder; IV = intream veg.; LWD = large woody debris; P = pool; OV = overhanging veg.; SWD = small woody debris; UB = undercut bank

Habitat Quality: None = at least one parameter prevents the use of stream as habitat, Poor = may support fish but does not provide habitat for all life stages or is seasonal,

Good = supports fish but lacks at least one life stage use, Excellent = supports all life stages

Appendix 3.1-2

**Pond Shoreline and Littoral Zone Fish Habitat Data,
TIA Alternative Site Area, Back River Project, 2014**

Appendix 3.1-2. Pond Shoreline and Littoral Zone Fish Habitat Data, TIA Alternative Site Area, Back River Project, 2014

Pond	Date (m/d/y)	Crew	Habitat					Vegetation		Start Easting	Start Northing	End Easting	End Northing
			Unit	Fines	Gravel	Cobble	Boulder	Bedrock	Type				
Pond 6	9/8/2014	TG, JC	A	70	0	10	20	0	a, s, m	434510	7267749	434510	7267724
Pond 6	9/8/2014	TG, JC	B	10	0	20	70	0	a, s, m, v	434510	7267724	434480	7267708
Pond 6	9/8/2014	TG, JC	C	20	0	0	40	40	a	434480	7267708	434452	7267750
Pond 6	9/8/2014	TG, JC	D	40	0	10	50	0	a, s	434452	7267750	434453	7267812
Pond 6	9/8/2014	TG, JC	E	60	0	25	15	0	a, m, s	434453	7267812	434509	7267781
Pond 6	9/8/2014	TG, JC	F	35	0	30	35	0	a, s	434509	7267781	434868	7268295
Pond 7	9/8/2014	TG, JC	A	10	30	35	25	0	a, s	435053	7267470	435068	7267427
Pond 7	9/8/2014	TG, JC	B	75	0	15	10	0	a, s	435068	7267427	435078	7267385
Pond 7	9/8/2014	TG, JC	C	0	25	50	25	0	a	435078	7267385	435056	7267391
Pond 7	9/8/2014	TG, JC	D	25	25	25	25	0	a, s	435056	7267391	435029	7267424
Pond 7	9/8/2014	TG, JC	E	0	35	40	25	0	a	435029	7267424	435000	7267449
Pond 7	9/8/2014	TG, JC	F	40	20	30	10	0	a, s	435000	7267449	434969	7267481
Pond 7	9/8/2014	TG, JC	G	10	15	35	40	0	a, s	434969	7267481	434931	7267577
Pond 7	9/8/2014	TG, JC	H	40	15	15	30	0	a, s	434931	7267577	434945	7267600
Pond 7	9/8/2014	TG, JC	I	95	0	0	5	0	a, s	434945	7267600	434974	7267594
Pond 7	9/8/2014	TG, JC	J	40	10	20	30	0	a, s	434974	7267594	434988	7267612
Pond 7	9/8/2014	TG, JC	K	100	0	0	0	0	a, s, m, v	434988	7267612	435019	7267590
Pond 7	9/8/2014	TG, JC	L	10	10	40	40	0	a, s	435019	7267590	435024	7267529
Pond 7	9/8/2014	TG, JC	M	15	50	20	15	0	a, s	435024	7267529	435053	7267470
Pond 8	9/8/2014	TG, JC	A	10	10	30	30	20	a, s	435329	7266590	435313	7266761
Pond 8	9/8/2014	TG, JC	B	15	0	0	15	70	a	435313	7266761	435302	7266797
Pond 8	9/8/2014	TG, JC	C	15	0	20	65	0	a, m, s	435302	7266797	435290	7266860
Pond 8	9/8/2014	TG, JC	D	25	25	25	25	0	a, s	435290	7266860	435297	7266893
Pond 8	9/8/2014	TG, JC	E	70	0	10	20	0	s	435297	7266893	435293	7266924
Pond 8	9/8/2014	TG, JC	F	50	0	40	10	0	a, s	435293	7266924	435295	7266949
Pond 8	9/8/2014	TG, JC	G	35	35	25	5	0	a	435295	7266949	435273	7266478
Pond 8	9/8/2014	TG, JC	H	90	0	5	5	0	a, s	435273	7266478	435267	7267004
Pond 8	9/8/2014	TG, JC	I	15	30	40	15	0	a	435267	7267004	435264	7267037
Pond 8	9/8/2014	TG, JC	J	90	10	0	0	0	a, s	435264	7267037	435322	7266974
Pond 8	9/8/2014	TG, JC	K	20	30	35	15	0	n	435322	7266974	435316	7266961
Pond 8	9/8/2014	TG, JC	L	100	0	0	0	0	a, s	435316	7266961	435310	7266946
Pond 8	9/8/2014	TG, JC	M	50	0	40	10	0	a, s	435310	7266946	435330	7266825
Pond 8	9/8/2014	TG, JC	N	75	0	20	5	0	a, s	435293	7266924	435295	7266949
Pond 8	9/8/2014	TG, JC	O	90	5	5	0	0	a, m, s	435330	7266825	435423	7266707
Pond 8	9/8/2014	TG, JC	P	15	15	35	35	0	m, s	435423	7266707	435413	7266603
Pond 8	9/8/2014	TG, JC	Q	5	0	40	50	5	a	435413	7266603	435361	7266553
Pond 8	9/8/2014	TG, JC	R	0	0	15	80	5	a, m, s	435361	7266553	435346	7266551
Pond 8	9/8/2014	TG, JC	S	5	5	45	45	0	s	435346	7266551	435329	7266590

Appendix 3.1-2. Pond Shoreline and Littoral Zone Fish Habitat Data, TIA Alternative Site Area, Back River Project, 2014

Pond	Date (m/d/y)	Crew	Habitat					Vegetation		Start Easting	Start Northing	End Easting	End Northing
			Unit	Fines	Gravel	Cobble	Boulder	Bedrock	Type				
Pond 9	9/9/2014	TG, JC	A	25	0	35	40	0	a, s	435486	7267793	435492	7267773
Pond 9	9/9/2014	TG, JC	B	98	0	0	2	0	m, s	435492	7267773	435486	7267793
Pond 10	9/8/2014	TG, JC	A	10	0	0	90	0	a, m, s	430365	7276039	430400	7275485
Pond 10	9/8/2014	TG, JC	B	20	10	20	50	0	a	430400	7275485	430684	7274793
Pond 10	9/8/2014	TG, JC	C	15	0	0	5	80	a	430684	7274793	430361	7274852
Pond 10	9/8/2014	TG, JC	D	70	0	0	30	0	a, m,s	430361	7274852	430317	7275044
Pond 10	9/8/2014	TG, JC	E	90	0	0	10	0	a, m, s	430317	7275044	430459	7275233
Pond 11	9/10/2014	TG, JC	A	90	0	0	10	0	a, m, s	434840	7268317	434752	7268273
Pond 11	9/10/2014	TG, JC	B	0	0	5	85	10	a, s, v	434752	7268273	434700	7268333
Pond 11	9/10/2014	TG, JC	C	90	0	0	10	0	s, m	434700	7268333	434768	7268378
Pond 11	9/10/2014	TG, JC	D	70	0	0	30	0	a, m, s	434768	7268378	434840	7268317
Pond 12	9/10/2014	TG, JC	A	98	0	0	2	0	m, s	434892	7268247	-	-
Pond 13	9/9/2014	TG, JC	A	100	0	0	0	0	a, m,s	435064	7266090	435129	7266129
Pond 13	9/9/2014	TG, JC	B	70	0	0	30	0	a, m, s	435129	7266129	435151	7266038
Pond 13	9/9/2014	TG, JC	C	90	0	5	5	0	a, m, s	435151	7266038	435289	7265875
Pond 13	9/9/2014	TG, JC	D	80	0	0	10	0	a, m, s	435289	7265875	435305	7265862
Pond 13	9/9/2014	TG, JC	E	95	0	0	5	0	a, m, s	435305	7265862	435216	7265807
Pond 13	9/9/2014	TG, JC	F	40	5	10	45	0	s	435216	7265807	435173	7265822
Pond 13	9/9/2014	TG, JC	G	95	0	0	5	0	s	435173	7265822	435083	7265893
Pond 13	9/9/2014	TG, JC	H	70	0	0	30	0	s	435083	7265893	435040	7265936
Pond 13	9/9/2014	TG, JC	I	0	0	10	85	5	s	435040	7265936	434980	7265988
Pond 13	9/9/2014	TG, JC	J	100	0	0	0	0	m, s	434980	7265988	434965	7266054
Pond 13	9/9/2014	TG, JC	K	15	5	10	70	0	a, m, s	434965	7266054	435064	7266090

Vegetation Abundance

n = none

s = sparse

a = abundant

Vegetation Type

n = none

m = moss

v = vascular

s = sedge

a = algae

Appendix 3.2-1

**TIA Alternative Site Area Stream Electrofishing Sampling
Effort and Species Summary, Back River Project, 2014**

Appendix 3.2-1. TIA Alternative Site Area Stream Electrofishing Sampling Effort and Species Summary, Back River Project, 2014

Property	Site	Station ID	Date (m/d/y)	Crew	Zone	Easting	Northing	Sampling Method	Method Number	Temperature (°C)	Conductivity (µS/cm)	Turbidity	Haul or Pass	EF Seconds	Length (m)	Width (m)	Enclosure	Voltage	Frequency	Pulse
Goose	Main Goose Pit Stream - Reach 7	R7-1	9/10/2014	KK, JH	13	434481	7269394	EF	1	-	30	C	1	158	100	0.5	N	350	30	4
Goose	Main Goose Pit Stream - Reach 7	R7-1	9/10/2014	KK, JH	13	434481	7269394	VO	1	-	30	C	1	-	100	0.5	N	-	-	-
Goose	Main Goose Pit Stream - Reach 7	R7-2	9/10/2014	KK, JH	13	434478	7269294	EF	1	-	30	C	1	318	170	1	N	350	30	4
Goose	Main Goose Pit Stream - Reach 7	R7-2	9/10/2014	KK, JH	13	434478	7269294	VO	-	-	30	C	1	-	170	1	N	-	-	-
Goose	Main Goose Pit Stream - Reach 7	R7-3b	9/10/2014	KK, JH	13	434602	7269064	EF	1	-	30	C	1	143	100	1	N	450	30	4
Goose	Main Goose Pit Stream - Reach 7	R7-3a	9/10/2014	KK, JH	13	434573	7269156	EF	1	-	30	C	1	219	100	1	N	350	30	4
Goose	Main Goose Pit Stream - Reach 8	R8-1	9/10/2014	KK, JH	13	434770	7268653	EF	1	-	30	C	1	249	200	1	N	560	30	4
Goose	Main Goose Pit Stream - Reach 8	R8-2	9/10/2014	KK, JH	13	434873	7268449	EF	1	-	30	C	1	252	142	0.5	N	450	30	4
Goose	Main Goose Pit Stream - Reach 8	R8-3	9/10/2014	KK, JH	13	434936	7268297	EF	1	-	30	C	1	128	53	2	N	250	30	4
Goose	Main Goose Pit Stream - Reach 8	R8-4	9/9/2014	KK, JH	13	434891	7268247	EF	1	-	50	C	1	552	95	20	N	480	30	4
Goose	Main Goose Pit Stream - Reach 9	R9-1	9/10/2014	KK, JH	13	434880	7268168	EF	1	-	-	C	1	133	73	0.2	N	250	30	4
Goose	Main Goose Pit Stream - Reach 10	R10-1	9/9/2014	KK, JH	13	434771	7267923	EF	1	-	30	C	1	196	70	0.2	N	560	30	4
Goose	Main Goose Pit Stream - Reach 10	R10-2	9/9/2014	KK, JH	13	434607	7267820	EF	1	-	60	C	1	222	80	0.5	N	495	30	4
Goose	Main Goose Pit Stream - Reach 11	R11-2E	9/9/2014	KK, JH	13	434951	7267746	EF	1	-	50	C	1	142	100	0.3	N	400	30	4
Goose	Main Goose Pit Stream - Reach 12	R12-1	9/9/2014	KK, JH	13	435097	7267352	EF	1	-	50	C	1	226	110	1	N	350	30	4
Goose	Main Goose Pit Stream - Reach 12	R12-2	9/9/2014	KK, JH	13	435164	7267256	EF	1	-	50	C	1	220	130	5	N	400	30	4
Goose	Main Goose Pit Stream - Reach 12	R12-3E	9/9/2014	KK, JH	13	435263	7267177	EF	1	-	60	C	1	146	65	0.5	N	400	30	4
Goose	Main Goose Pit Stream - Reach 14	R14-3	9/8/2014	KK, JH	13	435401	7267908	EF	1	-	30	C	1	286	103	1.6	N	570	30	4
Goose	Main Goose Pit Stream - Reach 15	R15-4	9/8/2014	KK, JH	13	435689	7268007	EF	1	-	50	C	1	343	110	0.8	N	525	30	4
Goose	Main Goose Pit Stream - Reach 15	R15-5	9/8/2014	KK, JH	13	436105	7267617	EF	1	-	70	C	1	222	90	0.5	N	470	30	4

Dashes indicate data not available
Turbidity: C = Clear
Method: EF = Electrofishing, Vo = Visual Observation
Species Code: ARGR = Arctic Grayling, NSSB = Ninespine Stickleback, BURB = Burbot, SLSC = Slimy Sculpin, NFC = No Fish Caught
Statge: YOY = Young-of-year, IM = immature, M = mature
CPUE = Catch-per-unit-effort

Appendix 3.2-1. TIA Alternative Site Area Stream Electrofishing Sampling Effort and Species Summary, Back River Project, 2014

Property	Site	Station ID	Make	Model	Species Code	Stage	Total Number	Min. Length (mm)	Max. Length (mm)	CPUE (# of Fish/100 s)	Comments
Goose	Main Goose Pit Stream - Reach 7	R7-1	Smithroot	LR-24	ARGR	YOY	4	-	-	2.53	-
Goose	Main Goose Pit Stream - Reach 7	R7-1	-	-	ARGR	YOY	3	-	-	-	YOY ARGR observed during EF pass
Goose	Main Goose Pit Stream - Reach 7	R7-2	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Main Goose Pit Stream - Reach 7	R7-2	-	-	ARGR	YOY	1	-	-	-	YOY ARGR observed during EF pass
Goose	Main Goose Pit Stream - Reach 7	R7-3b	Smithroot	LR-24	ARGR	YOY	1	57	57	0.70	-
Goose	Main Goose Pit Stream - Reach 7	R7-3a	Smithroot	LR-24	ARGR	YOY	2	48	68	0.91	-
Goose	Main Goose Pit Stream - Reach 8	R8-1	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Main Goose Pit Stream - Reach 8	R8-2	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Main Goose Pit Stream - Reach 8	R8-3	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Main Goose Pit Stream - Reach 8	R8-4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Main Goose Pit Stream - Reach 9	R9-1	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Main Goose Pit Stream - Reach 10	R10-1	Smithroot	LR-24	NFC	-	0	-	-	0.00	disconnected pool/channel areas where no distinct channel
Goose	Main Goose Pit Stream - Reach 10	R10-2	Smithroot	LR-24	NFC	-	0	-	-	0.00	
Goose	Main Goose Pit Stream - Reach 11	R11-2E	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Main Goose Pit Stream - Reach 12	R12-1	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Main Goose Pit Stream - Reach 12	R12-2	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Main Goose Pit Stream - Reach 12	R12-3E	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Main Goose Pit Stream - Reach 14	R14-3	Smithroot	LR-24	NFC	-	0	-	-	0.00	other reaches of Goose Stream 3 where no distinct channel, overland flow
Goose	Main Goose Pit Stream - Reach 15	R15-4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Main Goose Pit Stream - Reach 15	R15-5	Smithroot	LR-24	NFC	-	0	-	-	0.00	-

Dashes indicate data not available

Turbidity: C = Clear

Method: EF = Electrofishing, Vo = Visual Observation

Species Code: ARGR = Arctic Grayling, NSSB = Ninespine Stickleback, BURB = Burbot, SLSC = Slimy Sculpin, NFC = No Fish Caught

Statge: YOY = Young-of-year, IM = immature, M = mature

CPUE = Catch-per-unit-effort

Appendix 3.2-2

**TIA Alternative Site Area Stream Minnow Trapping
Sampling Effort and Species Summary, Back River
Project, 2014**

Appendix 3.2-2. TIA Alternative Site Area Stream Minnow Trapping Sampling Effort and Species Summary,Back River Project, 2014

Property	Site	Station ID	Crew	Method	Trap No.	Date In	Time In	Date Out	Time Out	Effort (h)	Effort (decimal h)	Depth	Zone	Easting	Northing	SLSC	NSSB	BURB	Total	Total CPUE (# Fish/24 h)
Goose	Main Goose Pit Stream - Reach 8	R8-3	TG, JC	MT	5	9/10/2014	16:55	9/11/2014	7:20	14:25	14.42	0.3	13	434915	7268271	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-3	TG, JC	MT	6	9/10/2014	16:40	9/11/2014	7:20	14:40	14.67	0.2	13	434939	7268286	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-3	TG, JC	MT	7	9/10/2014	16:40	9/11/2014	10:45	18:05	18.08	0.3	13	434946	7268294	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-3	TG, JC	MT	8	9/10/2014	16:40	9/11/2014	7:25	14:45	14.75	0.3	13	434938	7268304	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-3	TG, JC	MT	9	9/10/2014	16:40	9/11/2014	7:25	14:45	14.75	0.45	13	434940	7268314	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-3	TG, JC	MT	10	9/10/2014	16:45	9/11/2014	7:25	14:40	14.67	0.25	13	434932	7268329	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-3	TG, JC	MT	11	9/10/2014	16:45	9/11/2014	7:30	14:45	14.75	0.25	13	434939	7268324	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-3	TG, JC	MT	12	9/10/2014	16:45	9/11/2014	7:30	14:45	14.75	0.25	13	434942	7268280	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-3	TG, JC	MT	13	9/10/2014	16:45	9/11/2014	7:35	14:50	14.83	0.25	13	434900	7268252	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-3	TG, JC	MT	14	9/10/2014	16:50	9/11/2014	8:00	15:10	15.17	0.25	13	434896	7268254	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-4	TG, JC	MT	1	9/10/2014	16:40	9/11/2014	7:20	14:40	14.67	0.3	13	434871	7268284	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-4	TG, JC	MT	2	9/10/2014	16:40	9/11/2014	7:20	14:40	14.67	0.5	13	434868	7268295	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-4	TG, JC	MT	3	9/10/2014	16:40	9/11/2014	7:20	14:40	14.67	0.25	13	434861	7268292	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 8	R8-4	TG, JC	MT	4	9/10/2014	16:40	9/11/2014	7:20	14:40	14.67	0.25	13	434852	7268303	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 9	R9-1	TG, JC	MT	15	9/10/2014	16:55	9/11/2014	8:05	15:10	15.17	0.25	13	434856	7268195	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 9	R9-1	TG, JC	MT	16	9/10/2014	17:00	9/11/2014	8:10	15:10	15.17	0.25	13	434843	7268178	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 9	R9-1	TG, JC	MT	17	9/10/2014	17:05	9/11/2014	8:15	15:10	15.17	0.25	13	434913	7268182	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 9	R9-1	TG, JC	MT	18	9/10/2014	17:10	9/11/2014	8:25	15:15	15.25	0.25	13	434910	7268190	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 9	R9-1	TG, JC	MT	19	9/10/2014	17:15	9/11/2014	8:35	15:20	15.33	0.2	13	434926	7268189	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 9	R9-1	TG, JC	MT	20	9/10/2014	17:20	9/11/2014	8:45	15:25	15.42	0.3	13	434943	7268176	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 9	R9-1	TG, JC	MT	21	9/10/2014	17:25	9/11/2014	8:55	15:30	15.50	0.25	13	434937	7268176	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 9	R9-1	TG, JC	MT	22	9/10/2014	17:30	9/11/2014	9:05	15:35	15.58	0.3	13	434930	7268167	0	0	0	0	0.00
Goose	Main Goose Pit Stream - Reach 9	R9-1	TG, JC	MT	23	9/10/2014	17:30	9/11/2014	9:15	15:45	15.75	0.25	13	434921	7268170	0	0	0	0	0.00

MT = minnow trap

SLSC = slimy sculpin

NSSB = ninespine stickleback

BURB = burbot

CPUE = catch-per-unit-effort

Dashes indicate data not available

Appendix 3.2-3

**TIA Alternative Site Area Pond Electrofishing Sampling
Effort and Species Summary, Back River Project, 2014**

Appendix 3.2-3. TIA Alternative Site Area Pond Electrofishing Sampling Effort and Species Summary, Back River Project, 2014

Property	Pond	Station ID	Date (m/d/y)	Crew	Zone	Easting	Northing	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)	CPUE (# of fish/ 100s)	Comments
Goose	Pond 6	P6-1	9/8/2014	KK, JH	13	434525	7267775	EF	1	-	90	C	1	365	105	8	N	410	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 6	P6-2	9/8/2014	KK, JH	13	434457	7267819	EF	1	-	90	C	1	353	100	2	N	410	40	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 6	P6-3	9/8/2014	KK, JH	13	434486	7267705	EF	1	-	90	C	1	394	80	4	N	600	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 7	P7-1	9/9/2014	KK, JH	13	434959	7267642	EF	1	-	60	C	1	306	110	3	N	300	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 7	P7-2	9/9/2014	KK, JH	13	434927	7267588	EF	1	-	60	C	1	417	131	5	N	300	40	3	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 7	P7-3	9/9/2014	KK, JH	13	434975	7267466	EF	1	-	60	C	1	353	120	4	N	450	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 7	P7-4	9/9/2014	KK, JH	13	435069	7267428	EF	1	-	60	C	1	412	167	3	N	520	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 8	P8-1	9/9/2014	KK, JH	13	435282	7267032	EF	1	-	50	C	1	410	190	3	N	400	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 8	P8-2	9/9/2014	KK, JH	13	435303	7266938	EF	1	-	50	C	1	504	170	3	N	400	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 8	P8-3	9/9/2014	KK, JH	13	435328	7266706	EF	1	-	50	C	1	507	180	3	N	500	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 8	P8-4	9/9/2014	KK, JH	13	435424	7266677	EF	1	-	50	C	1	298	100	3	N	500	40	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 9	P9-1	9/8/2014	KK, JH	13	435456	7267827	EF	1	-	30	C	1	468	95	4	N	395	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 9	P9-2	9/8/2014	KK, JH	13	435480	7267778	EF	1	-	30	C	1	334	60	3	N	500	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 10	P10-1	9/8/2014	KK, JH	13	436322	7267550	EF	1	-	70	C	1	266	78	5	N	250	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 10	P10-2	9/8/2014	KK, JH	13	436340	7267515	EF	1	-	70	C	1	288	90	7	N	500	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 10	P10-3	9/8/2014	KK, JH	13	436418	7267543	EF	1	-	70	C	1	275	50	5	N	500	40	3	Smithroot	LR-24	NFC	-	0	-	-	0.00	-
Goose	Pond 10	P10-4	9/8/2014	KK, JH	13	436408	7267648	EF	1	-	70	C	1	277	70	7	N	750	30	4	Smithroot	LR-24	NFC	-	0	-	-	0.00	-

Dashes indicate data not available

Turbidity: C = Clear

Method: EF = Electrofishing, Vo = Visual Observation

Species Code: ARGR = Arctic Grayling, NSSB = Ninespine Stickleback, BURB = Burbot, SLSC = Slimy Sculpin, NFC = No Fish Caught

Statge: YOY = Young-of-year, IM = immature, M = mature

CPUE = Catch-per-unit-effort

Appendix 3.2-4

**TIA Alternative Site Area Pond Minnow Trapping Sampling
Effort and Species Summary, Back River Project, 2014**

Appendix 3.2-4. TIA Alternative Site Area Pond Minnow Trapping Sampling Effort and Species Summary, Back River Project, 2014

Property	Pond	Crew	Method	Trap No.	Date In	Time In	Date Out	Time Out	Effort (h)	Effort (decimal h)	Depth	Zone	Easting	Northing	SLSC	NSSB	BURB	Total	Total CPUE (# Fish/24 h)
Goose	Pond 6	TG, JC	MT	1	9/7/2014	16:40	9/8/2014	10:20	17:40	17.67	0.6	13	434489	7267760	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	2	9/7/2014	16:45	9/8/2014	10:20	17:35	17.58	0.4	13	434495	7267764	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	3	9/7/2014	16:50	9/8/2014	10:25	17:35	17.58	0.5	13	434483	7267732	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	4	9/7/2014	16:55	9/8/2014	10:25	17:30	17.50	0.6	13	434473	7267733	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	5	9/7/2014	16:40	9/8/2014	10:27	17:47	17.78	0.6	13	434490	7267727	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	6	9/7/2014	16:45	9/8/2014	10:45	18:00	18.00	0.6	13	434463	7267788	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	7	9/7/2014	16:50	9/8/2014	10:45	17:55	17.92	0.4	13	434458	7267804	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	8	9/7/2014	16:55	9/8/2014	10:55	18:00	18.00	0.3	13	434467	7267807	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	9	9/7/2014	16:45	9/8/2014	10:55	18:10	18.17	0.6	13	434473	7267789	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	10	9/7/2014	16:50	9/8/2014	16:29	23:39	23.65	0.4	13	434484	7267783	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	11	9/8/2014	10:30	9/9/2014	8:15	21:45	21.75	0.4	13	434502	7267737	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	12	9/8/2014	10:30	9/9/2014	8:15	21:45	21.75	0.4	13	434499	7267733	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	13	9/8/2014	10:40	9/9/2014	8:20	21:40	21.67	0.5	13	434475	7267720	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	14	9/8/2014	10:40	9/9/2014	8:20	21:40	21.67	0.95	13	434469	7267739	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	15	9/8/2014	10:40	9/9/2014	8:20	21:40	21.67	1	13	434457	7267752	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	16	9/8/2014	10:50	9/9/2014	8:25	21:35	21.58	0.3	13	434463	7267820	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	17	9/8/2014	10:50	9/9/2014	8:25	21:35	21.58	0.3	13	434469	7267814	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	18	9/8/2014	10:50	9/9/2014	8:25	21:35	21.58	0.25	13	434482	7267798	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	19	9/8/2014	10:55	9/9/2014	8:25	21:30	21.50	0.5	13	434495	7267791	0	0	0	0	0.00
Goose	Pond 6	TG, JC	MT	20	9/8/2014	10:55	9/9/2014	8:30	21:35	21.58	0.3	13	434501	7267789	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	1	9/7/2014	17:00	9/8/2014	14:05	21:05	21.08	0.4	13	435032	7267480	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	2	9/7/2014	17:00	9/8/2014	14:05	21:05	21.08	0.3	13	435034	7267489	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	3	9/7/2014	17:00	9/8/2014	14:05	21:05	21.08	0.45	13	435013	7267476	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	4	9/7/2014	17:00	9/8/2014	14:10	21:10	21.17	0.4	13	435020	7267495	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	5	9/7/2014	17:00	9/8/2014	14:10	21:10	21.17	0.5	13	435004	7267466	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	6	9/7/2014	17:00	9/8/2014	14:20	21:20	21.33	0.55	13	434992	7267525	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	7	9/7/2014	17:00	9/8/2014	14:22	21:22	21.37	0.75	13	434975	7267526	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	8	9/7/2014	17:00	9/8/2014	14:25	21:25	21.42	0.55	13	434987	7267562	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	9	9/7/2014	17:00	9/8/2014	14:30	21:30	21.50	0.55	13	434969	7267564	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	10	9/7/2014	17:00	9/8/2014	14:30	21:30	21.50	0.35	13	434998	7267607	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	11	9/7/2014	17:00	9/8/2014	14:30	21:30	21.50	0.4	13	435003	7267610	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	12	9/8/2014	14:20	9/9/2014	11:10	20:50	20.83	0.4	13	434998	7267613	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	13	9/8/2014	14:20	9/9/2014	11:10	20:50	20.83	0.4	13	434993	7267611	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	14	9/8/2014	14:20	9/9/2014	11:10	20:50	20.83	0.3	13	435016	7267599	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	15	9/8/2014	14:20	9/9/2014	11:10	20:50	20.83	0.3	13	434997	7267597	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	16	9/8/2014	14:20	9/9/2014	11:10	20:50	20.83	0.5	13	434976	7267578	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	17	9/8/2014	14:25	9/9/2014	11:15	20:50	20.83	0.3	13	434964	7267580	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	18	9/8/2014	14:25	9/9/2014	11:15	20:50	20.83	0.3	13	435049	7267429	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	19	9/8/2014	14:30	9/9/2014	11:20	20:50	20.83	0.45	13	435047	7267422	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	20	9/8/2014	14:30	9/9/2014	11:20	20:50	20.83	0.35	13	435057	7267422	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	21	9/8/2014	14:30	9/9/2014	11:25	20:55	20.92	0.3	13	435065	7267417	0	0	0	0	0.00
Goose	Pond 7	TG, JC	MT	22	9/8/2014	14:30	9/9/2014	11:25	20:55	20.92	0.3	13	435063	7267409	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	1	9/7/2014	18:00	9/8/2014	17:20	23:20	23.33	0.5	13	435420	7266647	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	2	9/7/2014	18:00	9/8/2014	17:20	23:20	23.33	0.3	13	435421	7266654	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	3	9/7/2014	18:00	9/8/2014	17:25	23:25	23.42	0.8	13	435339	7266610	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	4	9/7/2014	18:00	9/8/2014	17:30	23:30	23.50	0.95	13	435340	7266631	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	5	9/7/2014	18:00	9/8/2014	17:50	23:50	23.83	0.4	13	435319	7266802	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	6	9/7/2014	18:00	9/8/2014	17:50	23:50	23.83	0.8	13	435327	7266783	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	7	9/7/2014	18:00	9/8/2014	17:50	23:50	23.83	0.7	13	435334	7266809	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	8	9/7/2014	18:00	9/8/2014	17:55	23:55	23.92	0.75	13	435342	7266812	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	9	9/7/2014	18:00	9/8/2014	17:55	23:55	23.92	0.6	13	435349	7266819	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	10	9/7/2014	18:00	9/8/2014	18:00	0:00	24.00	-	13	435397	7266752	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	11	9/8/2014	17:30	9/9/2014	12:05	18:35	18.58	0.25	13	435357	7266559	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	12	9/8/2014	17:30	9/9/2014	12:05	18:35	18.58	0.6	13	435382	7266569	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	13	9/8/2014	17:30	9/9/2014	12:15	18:45	18.75	0.4	13	435327	7266683	0	0	0	0	0.00

Appendix 3.2-4. TIA Alternative Site Area Pond Minnow Trapping Sampling Effort and Species Summary, Back River Project, 2014

Property	Pond	Crew	Method	Trap No.	Date In	Time In	Date Out	Time Out	Effort (h)	Effort (decimal h)	Depth	Zone	Easting	Northing	SLSC	NSSB	BURB	Total	Total CPUE (# Fish/24 h)
Goose	Pond 8	TG, JC	MT	14	9/8/2014	17:30	9/9/2014	12:30	19:00	19.00	1	13	435331	7266715	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	15	9/8/2014	17:30	9/9/2014	12:30	19:00	19.00	0.5	13	435306	7266793	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	16	9/8/2014	17:30	9/9/2014	12:35	19:05	19.08	0.3	13	435303	7266853	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	17	9/8/2014	17:30	9/9/2014	12:35	19:05	19.08	0.2	13	435309	7266857	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	18	9/8/2014	17:30	9/9/2014	12:35	19:05	19.08	0.3	13	435311	7266836	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	19	9/8/2014	17:30	9/9/2014	12:40	19:10	19.17	0.2	13	435321	7266837	0	0	0	0	0.00
Goose	Pond 8	TG, JC	MT	20	9/8/2014	17:30	9/9/2014	12:55	19:25	19.42	0.6	13	435366	7266576	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	1	9/7/2014	18:28	9/8/2014	12:45	18:17	18.28	0.3	13	435480	7267797	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	2	9/7/2014	18:28	9/8/2014	12:45	18:17	18.28	0.3	13	435475	7267791	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	3	9/7/2014	19:28	9/8/2014	12:45	17:17	17.28	0.4	13	435471	7267782	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	4	9/7/2014	20:28	9/8/2014	12:50	16:22	16.37	0.4	13	435456	7267783	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	5	9/7/2014	21:28	9/8/2014	12:50	15:22	15.37	0.25	13	435458	7267810	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	6	9/7/2014	22:28	9/8/2014	12:55	14:27	14.45	0.25	13	435444	7267804	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	7	9/7/2014	23:28	9/8/2014	12:55	13:27	13.45	0.25	13	435444	7267797	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	8	9/7/2014	0:28	9/8/2014	12:55	12:27	12.45	0.25	13	435452	7267821	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	9	9/7/2014	1:28	9/8/2014	13:00	11:32	11.53	0.2	13	435468	7267819	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	10	9/7/2014	2:28	9/8/2014	13:00	10:32	10.53	0.3	13	435478	7267815	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	11	9/8/2014	12:50	9/9/2014	12:05	23:15	23.25	0.25	13	435479	7267790	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	12	9/8/2014	12:50	9/9/2014	9:55	21:05	21.08	0.25	13	435474	7267782	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	13	9/8/2014	12:55	9/9/2014	9:55	21:00	21.00	0.25	13	435473	7267778	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	14	9/8/2014	12:55	9/9/2014	9:55	21:00	21.00	0.25	13	435482	7267801	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	15	9/8/2014	12:55	9/9/2014	9:55	21:00	21.00	0.25	13	435481	7267808	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	16	9/8/2014	13:00	9/9/2014	9:55	20:55	20.92	0.25	13	435458	7267818	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	17	9/8/2014	13:00	9/9/2014	10:00	21:00	21.00	0.25	13	435438	7267802	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	18	9/8/2014	13:00	9/9/2014	10:00	21:00	21.00	0.25	13	435433	7267798	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	19	9/8/2014	13:00	9/9/2014	10:00	21:00	21.00	0.25	13	435436	7267789	0	0	0	0	0.00
Goose	Pond 9	TG, JC	MT	20	9/8/2014	13:00	9/9/2014	10:00	21:00	21.00	0.25	13	435439	7267785	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	1	9/7/2014	18:02	9/8/2014	8:44	14:42	14.70	-	13	436328	7267552	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	2	9/7/2014	18:03	9/8/2014	8:44	14:41	14.68	-	13	436333	7267550	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	3	9/7/2014	18:03	9/8/2014	8:44	14:41	14.68	-	13	436334	7267546	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	4	9/7/2014	18:04	9/8/2014	8:45	14:41	14.68	-	13	436333	7267544	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	5	9/7/2014	18:06	9/8/2014	8:45	14:39	14.65	-	13	436327	7267552	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	6	9/7/2014	18:08	9/8/2014	8:43	14:35	14.58	-	13	436379	7267531	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	7	9/7/2014	18:09	9/8/2014	8:49	14:40	14.67	-	13	436383	7267534	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	8	9/7/2014	18:10	9/8/2014	8:49	14:39	14.65	-	13	436381	7267539	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	9	9/7/2014	18:10	9/8/2014	8:49	14:39	14.65	-	13	436391	7267542	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	10	9/7/2014	18:11	9/8/2014	8:50	14:39	14.65	-	13	436398	7267545	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	11	9/8/2014	8:55	9/9/2014	9:10	0:15	24.25	0.65	13	436409	7267565	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	12	9/8/2014	8:55	9/9/2014	9:10	0:15	24.25	0.75	13	436410	7267571	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	13	9/8/2014	8:55	9/9/2014	9:10	0:15	24.25	0.4	13	436412	7267575	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	14	9/8/2014	8:55	9/9/2014	9:10	0:15	24.25	0.7	13	436415	7267583	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	15	9/8/2014	8:55	9/9/2014	9:15	0:20	24.33	0.5	13	436417	7267593	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	16	9/8/2014	8:55	9/9/2014	9:25	0:30	24.50	0.7	13	436370	7267617	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	17	9/8/2014	8:55	9/9/2014	9:25	0:30	24.50	0.75	13	436367	7267610	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	18	9/8/2014	8:55	9/9/2014	9:25	0:30	24.50	0.5	13	436364	7267605	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	19	9/8/2014	8:55	9/9/2014	9:25	0:30	24.50	0.6	13	436363	7267602	0	0	0	0	0.00
Goose	Pond 10	TG, JC	MT	20	9/8/2014	8:55	9/9/2014	9:25	0:30	24.50	-	13	436364	7267599	0	0	0	0	0.00

MT = minnow trap

SLSC = slimy sculpin

NSSB = ninespine stickleback

BURB = burbot

CPUE = catch-per-unit-effort

Dashes indicate data not available